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Vapor Intrusion Mitigation Work Plan

RACER

Former Delphi Harrison Thermal Systems Moraine Plant
Former General Motors Powertrain Group, Moraine Engine Plant
Former General Motors Truck Group, Moraine Assembly Plant

Moraine, Ohio

May 6, 2011
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1. Introduction

The United States Environmental Protection Agency (U.S. EPA) requested, in a letter dated December 3, 2010 "Re: RCRA 3008(h) Unilateral Administrative Order, Docket # V-W-91 R-2 Former Delphi Harrison Thermal Systems (OHD 000 817 577) and Former Moraine Engine Plant (OHD 980 569 388) and Former Moraine Assembly Plant (OHD 041 063 074)" that Motors Liquidation Company (MLC) (as of March 31, 2011, MLC is referred to as Revitalizing Auto Communities Environmental Response Trust [RACER]) provide a draft work plan by December 13, 2010 for sub-slab and indoor air sampling in the neighborhood southwest of the Moraine Site (Site) (U.S. EPA, 2010). A Sub-Slab and Indoor Air Sampling Work Plan (Work Plan) was created to satisfy this request and was submitted to the U.S. EPA on December 13, 2010 (ARCADIS, Inc., 2010a). The Work Plan covered the scope of work for sampling sub-slab soil-gas and indoor air within residential and commercial structures located in the Riverview Plat neighborhood to the southwest of the Site. MLC received comments from the U.S. EPA on this Work Plan in a letter dated February 8, 2011 "Draft Sub-Slab and Indoor Air Sampling Work Plan – Motors Liquidation Company - Former Delphi Harrison Thermal Systems (OHD 000 817 577) and Former Moraine Engine Plant (OHD 980 569 388) and Former Moraine Assembly Plant (OHD 041 063 074)" providing conditional approval contingent upon MLC resolving U.S. EPA comments (U.S. EPA, 2011a). The Revised Sub-Slab and Indoor Air Sampling Work Plan (Revised Work Plan) addressing these comments was submitted to the U.S EPA on March 4, 2011 (ARCADIS, Inc., 2011).

The Revised Work Plan outlined the sub-slab soil-gas, ambient air, and indoor air (basement, first floor, and crawlspace) sampling program to be completed for the residential properties, church, and gas station located in the Riverview Plat neighborhood southwest of the Site. The sampling of all properties where access has been granted in the Riverview Plat neighborhood began on March 7, 2011 and is on-going as of the date of this document. Upon receipt of the final laboratory reports and completion of data validation, the data will be compared to the indoor air and sub-slab Action Levels presented on Table 1 for residential and commercial scenarios and grouped within the categories discussed in Section 2. Based on this comparison and grouping, a decision matrix will be followed to determine what action is required for each property, including "worst-case" confirmatory sampling or resident-specific mitigation based on a meeting to be held with the property owner. The results of the sub-slab soil-gas and indoor air sampling will be summarized in a property-specific letter and submitted to the property owners during the meeting. Template letters to property owners , an access agreement, and a fact sheet are included in Appendix A.

This Vapor Intrusion Mitigation Work Plan (VI Mitigation Work Plan) includes a discussion of the decision matrix (Section 2), a discussion of the VI mitigation system components and design considerations (Sections 3 and 4; Appendices C, D, and G), system sampling (Section 5 and Appendix B), the property-specific work plan template (Section 4 and Appendix E), system operation and maintenance (O&M) (Section 6 and Appendix F), system decommissioning (Section 7), and quality objectives (Section 8). This VI Mitigation Work Plan incorporates comments provided by the U.S. EPA on April 18, 21, and 22, 2011 (U.S. EPA, 2011b, c, and d) to a Draft VI Mitigation Work Plan submitted by RACER on April 8, 2011, conditional approval with comments provided by U.S. EPA in correspondence dated May 23, 2011 to the revised Draft VI Mitigation Work Plan submitted by RACER on May 6, 2011 (U.S. EPA 2011e), and final revised comments to the Vapor Intrusion Mitigation Work Plan submitted by RACER on June 3, 2011 (U.S. EPA 2011f) provided by the U.S. EPA in correspondence (July 14, 2011), conference calls (July 19, 28, and 29, 2011 and August 9, 2011), meetings (August 3, 17, 30, and 31, 2011 and September 1, 2011), and email (July 25, 28, and 29, 2011and August 5, 9, and 13, 2011).

2. Decision Matrix

Following receipt of the final laboratory analytical results and completion of data validation per the Revised Work Plan (ARCADIS, Inc., 2011), a decision analysis will be conducted to evaluate the vapor intrusion potential and recommend additional evaluation, sampling, or mitigation, if necessary. Each building will be evaluated on a case-by-case basis considering the indoor air (first floor, basement, and crawlspace) and sub-slab soil-gas results, applicable Action Levels (Table 1), and the results of the right-of-way groundwater and soil-gas sampling completed in the Riverview Plat. The right-of-way groundwater and soil-gas results and the applicable Action Levels are summarized on Tables 2 and 3, respectively.

Potential future actions may include "worst case" confirmation sampling or mitigation. In cases where "worst case" confirmation sampling is required, sampling will be completed during the heating season which extends from November through March (aiming at high water table conditions). If a mitigation system is required, post-installation proficiency sampling will be conducted to confirm that the mitigation system is operating properly. If post-installation proficiency sampling indicates concentrations of chemicals of concern are above the Action Levels (Table 1), mitigation system modifications may be required. Confirmatory and post-installation proficiency sampling will be completed following the standard operating procedures (SOPs 20, 21, 22) approved in the Revised Work Plan (ARCADIS, Inc., 2011), and included in Appendix B. Information regarding design, installation, sampling, and operation and maintenance of a typical mitigation system is presented in Sections 3 through 6.

The U.S. EPA has provided the following decision matrix for the Site. Categories 1 through 4 are for properties where sub-slab data was available. Categories 5 and 6 are for properties where sub-slab data was not available.

Category 1

Sub-slab and indoor air concentrations are less than the Action Levels (see Table 1).

Category 1A: If the right-of-way sample concentration is less than the Action Levels for groundwater and/or soil-gas (see Tables 2 and 3), proceed to "worst case" confirmatory sampling (below).

Perform "worst case" confirmatory sampling biannually for two consecutive years, beginning during the up-coming heating season. Confirmatory sampling will be

completed during the first quarter of the year (January through March) and the fourth quarter of the year (November through December) to coincide with the "worst case" scenario. Number of samples and sample locations will be based on building construction and previous sampling results. If confirmatory sampling results are less than the Action Levels for indoor air and sub-slab, no further action is required. If confirmatory sampling results are greater than or equal to the Action Levels for indoor air and/or sub-slab, proceed to Category 2, 3, or 4, as appropriate.

Category 1B: If the right-of-way sample concentration is greater than or equal to the Action Levels for groundwater and/or soil-gas (see Tables 2 and 3), proceed to design and install an active mitigation system.

- Design and install an active mitigation system in consultation with the property owner. The active mitigation system will be designed to depressurize the sub-slab region and prevent the entry of soil vapors into the building. Section 3.1 provides additional information for design and installation of active mitigation systems.

- Confirm mitigation system is operating properly (sub-slab region is depressurized/manometer reading).

- Perform post-installation proficiency sampling events for indoor air approximately 30 days, 180 days, and 360 days after system installation. Section 5 provides additional information for post-installation sampling.

- Complete system modifications if necessary based on proficiency sampling results.

- Perform system O&M as necessary (Appendix F).

Category 2

Indoor air concentrations are greater than or equal to the Action Levels and sub-slab concentrations are less than the Action Levels (see Table 1).

Perform additional review of product inventory to determine the potential for background sources to contribute to the indoor air concentrations and evaluate representativeness of sub-slab sample point. If possible, remove any identified background source.

Category 2A: If a potential background source for the detected VOC can be identified, remove the potential source and re-sample indoor air. If the results of the re-sampling indicate that indoor air concentrations are less than the Action Levels, proceed to Category 1. If the results of the re-sampling indicate that indoor air concentrations are greater than or equal to the Action Levels, proceed to Category 2B (below).

Category 2B: If a background source cannot be identified, proceed to install an active mitigation system. In this scenario, an active mitigation system should be installed regardless of the right-of-way sample results.

- Design and install an active mitigation system in consultation with the property owner. The active mitigation system will be designed to depressurize the sub-slab region and prevent the entry of soil vapors into the building. Section 3.1 provides additional information for design and installation of active mitigation systems.

- Confirm mitigation system is operating properly (sub-slab region is depressurized/manometer reading).

- Perform post-installation proficiency sampling events for indoor air approximately 30 days, 180 days, and 360 days after system installation. Section 5 provides additional information for post-installation sampling.

- Complete system modifications if necessary based on proficiency sampling results.

- Perform system O&M as necessary (Appendix F).

Category 3

Indoor air concentrations are less than the Action Levels and sub-slab concentrations are greater than or equal to the Action Levels (see Table 1).

Proceed to design and install of an active mitigation system.

- Design and install an active mitigation system in consultation with the property owner. The active mitigation system will be designed to depressurize the sub-slab region and prevent the entry of soil vapors into the building. Section 3.1 provides additional information for design and installation of active mitigation systems.

- Confirm mitigation system is operating properly (sub-slab region is depressurized/manometer reading).

- Perform post-installation proficiency sampling events for indoor air approximately 30 days, 180 days, and 360 days after system installation. Section 5 provides additional information for post-installation sampling.

- Complete system modifications if necessary based on proficiency sampling results.

- Perform system O&M as necessary (Appendix F).

Category 4

Indoor air concentrations are greater than or equal to the Action Levels and sub-slab concentrations are greater than or equal to the Action Levels (see Table 1).

Proceed to design and install of an active mitigation system.

- Design and install an active mitigation system in consultation with the property owner. The active mitigation system will be designed to depressurize the sub-slab region and prevent the entry of soil vapors into the building. Section 3.1 provides additional information for design and installation of active mitigation systems.

- Confirm mitigation system is operating properly (sub-slab region is depressurized/manometer reading).

- Perform post-installation proficiency sampling events for indoor air approximately 30 days, 180 days, and 360 days after system installation. Section 5 provides additional information for post-installation sampling.

- Complete system modifications if necessary based on proficiency sampling results.

- Perform system O&M as necessary (Appendix F).

Category 5

Indoor air concentrations are greater than or equal to the Action Levels (see Table 1) and sub-slab data is not available.

Proceed to design and install of an active mitigation system.

- Design and install an active mitigation system in consultation with the property owner. The active mitigation system will be designed to depressurize the sub-membrane region and prevent the entry of soil vapors into the building. Section 3.1 provides additional information for design and installation of active mitigation systems.

- Confirm mitigation system is operating properly (manometer reading).

- Perform post-installation proficiency sampling events for indoor air approximately 30 days, 180 days, and 360 days after system installation. Section 5 provides additional information for post-installation sampling.

- Complete system modifications if necessary based on proficiency sampling results.

- Perform system O&M as necessary (Appendix F).

Category 6

Indoor air concentrations are less than the Action Levels (see Table 1) and sub-slab data is not available.

Category 6A: If the right-of-way sample concentration is less than the Action Levels for groundwater and/or soil-gas (see Tables 2 and 3), proceed to "worst case" confirmatory sampling (below).

Perform "worst case" confirmatory sampling biannually for two consecutive years, beginning during the up-coming heating season. Confirmatory sampling will be completed during the first quarter of the year (January through March) and the fourth quarter of the year (November through December) to coincide with the "worst case" scenario. Number of samples and sample locations will be based on building construction and previous sampling results. If confirmatory sampling results are less than the Action Levels for indoor air, no further action is required. If confirmatory sampling results are greater than or equal to the Action Levels for indoor air, proceed to design and install an active mitigation system.

Category 6B: If the right-of-way sample concentration is greater than or equal to the Action Levels for groundwater and/or soil-gas (see Tables 2 and 3), proceed to design and install an active mitigation system.

- Design and install an active mitigation system in consultation with the property owner. The active mitigation system will be designed to depressurize the sub-membrane region and prevent the entry of soil vapors into the building. Section 3.1 provides additional information for design and installation of active mitigation systems.

- Confirm mitigation system is operating properly (manometer reading).

- Perform post-installation proficiency sampling events for indoor air approximately 30 days, 180 days, and 360 days after system installation. Section 5 provides additional information for post-installation sampling.

- Complete system modifications if necessary based on proficiency sampling results.

- Perform system O&M as necessary (Appendix F).

3. VI Mitigation Systems

For the properties that require mitigation (see Section 2), an active mitigation system should be designed to prevent vapors present below the foundation of the structure from entering the indoor air within the structure.

An active mitigation system includes a depressurization system that creates a negative pressure (vacuum) below the foundation of the structure using an electric powered fan. The proposed active mitigation includes either a sub-slab depressurization system (SSDS), a sub-membrane depressurization system (SMDS), or a crawlspace depressurization system (CSDS) as applicable based on structure. The mitigation system works by reversing the pre-existing pressure gradient across the foundation of the structure. The resulting vacuum below the foundation prevents soil vapor from entering the structure.

3.1 Active Mitigation Systems

Active mitigation systems are being considered for installation at structures with three different foundation types: basement, crawlspace, and slab-on-grade, or a combination of these. The active mitigation system will be designed to depressurize the sub-slab region, sub-membrane (crawlspace sealed with reinforced, polyethylene sheeting) region, or inaccessible crawlspaces and prevent the entry of soil vapors into the building. Reinforced sheeting is the same as cross-laminated polyethylene. The active mitigation system design is based on SSDS, SMDS, and CSDS design criteria found in American Society for Testing and Materials (ASTM E2121), Standard Practice for Installing Radon Mitigation Systems in Existing Low-Rise Residential Buildings (ASTM, 2003), U.S. EPA Region 5, Vapor Intrusion Guidebook (U.S. EPA, 2010), U.S. EPA 625, Radon Reduction Techniques for Existing Detached Houses (U.S. EPA, 1993), and the U.S. EPA Indoor Air Vapor Intrusion Mitigation Approaches (U.S. EPA, 2008).

As a component of the mitigation system, the foundation will be sealed to the extent possible to minimize the existing pathways for vapors to enter the building and to minimize short-circuiting. The prevention of short-circuiting will enhance the ability of the active mitigation system to create the necessary negative pressure beneath the entire foundation of the building. Permanent sub-slab sample points will be installed in properties with basement or slab-on-grade foundation types to allow for monitoring of the pressure field extension and ensuring sub-slab depressurization that exceeds negative 0.004 inches of water column (in. w.c.). Sub-slab pressure field extension readings will be collected from the permanent sub-slab sample points during operation

and maintenance inspections. If the results of post-installation proficiency sampling (see Section 5) indicate that indoor air concentrations remain above the Action Levels (see Table 1), appropriate system modifications will be included to help the pressure field extend adequately around the crawlspace or dirt floor.

3.1.1 Basement Foundation

Components of a typical active mitigation system installed within a basement include the following:

- Sealing (see Section 3.3) of the foundation to enable vacuum influence to extend under the entire foundation of the building.
- A suction pit installed through the basement slab. The pit will be created by removing approximately 1 cubic foot of soil from below the slab, inserting the vent piping through the slab, and sealing the slab opening with polyurethane caulk.
- Vent piping (4-inch, Schedule 40 poly-vinyl chloride [PVC]) installed from the suction pit through the sill plate of the building and up the exterior of the building to the rooftop discharge location (see photograph 1, Appendix C).
- An in-line fan installed within the vent piping on the exterior of the building. The fan will be wired through a local disconnect switch to the building's electric panel. The associated breaker on the panel will be labeled to indicate it is connected to the fan. A schematic for a typical fan to be used is included in Appendix D.
- A manometer installed on the vent piping within the basement to confirm on-going system operation within the desired range (see photograph 2, Appendix C). If approved by the homeowner, an audible alarm may also be installed to notify the property owner of system malfunction.
- Roof flashing installed as necessary to seal the penetration of the vent piping through the roof.

An example of a typical active mitigation system installed in a building with a basement foundation is depicted in Figure 1.

3.1.2 Slab-On-Grade Foundation

Components of a typical active mitigation system installed at a building with a slab-on-grade foundation include the following:

- Sealing (see Section 3.3) of the foundation to enable vacuum influence to extend under the entire foundation of the building.
- A suction pit installed through the slab-on-grade foundation. The pit will be created by removing approximately 1 cubic foot of soil from below the slab, inserting the vent piping through the slab, and sealing the slab opening with polyurethane caulk.
- Vent piping (4-inch, Schedule 40 PVC) installed from the suction pit, up through the attic of the building, and through the roof to the rooftop discharge location (see photograph 1, Appendix C).
- An in-line fan installed within the vent piping inside the attic of the building. The fan will be wired through a local disconnect switch to the building's electric panel. The associated breaker on the panel will be labeled to indicate it is connected to the fan. A schematic for a typical fan to be used is included in Appendix D.
- A manometer installed on the vent piping within the building to confirm system operation within the desired range (see photograph 2, Appendix C). If approved by the homeowner, an audible alarm may also be installed to notify the property owner of system malfunction.
- Roof flashing installed to seal the penetration of the vent piping through the roof, if installed through the interior of the building.
- In the event that the vent piping is not able to be installed through the interior of the building, the suction pit may be installed from the exterior of the building through the frost wall. In this case the vent piping would continue up the outside of the building to the discharge location above the roof line. The in-line fan and manometer would be installed in the piping on the exterior of the building.

An example of a typical active mitigation system installed in a building with a slab-on-grade foundation is depicted in Figure 2.

3.1.3 Crawlspace and Other Dirt Floor Type Foundations

Components of a typical active mitigation system installed within a crawlspace include the following:

- Sealing (see Section 3.3) of the foundation with reinforced, polyethylene sheeting to enable vacuum influence to extend under the entire foundation of the building.
- Installation of a suction point under the crawlspace sheeting. The suction point will consist of a tee connected to perforated polyethylene drain tile. The drain tile will

create the necessary collection area and prevent the sheeting from being pulled into the vent pipe. These components are equivalent to a sub-membrane depressurization system.

- Vent piping (4-inch, Schedule 40 PVC) installed from the suction point through the sill plate of the building and up the exterior of the building to the rooftop discharge location (see photograph 1, Appendix C).
- An in-line fan installed within the vent piping on the exterior of the building. The fan will be wired through a local disconnect switch to the building's electric panel. The associated breaker on the panel will be labeled to indicate it is connected to the fan. A schematic for a typical fan to be used is included in Appendix D.
- A manometer installed on the vent piping at an accessible location within the crawlspace to confirm system operation within the desired range (see photograph 2, Appendix C). If approved by the homeowner, an audible alarm may also be installed to notify the property owner of system malfunction.
- Roof flashing installed as necessary to seal the penetration of the vent piping through the roof.

An example of a typical active mitigation system installed in buildings with a crawlspace foundation is depicted in Figure 3.

3.2 Sealing

Sealing openings in the foundation is necessary to eliminate potential pathways for soil vapors to enter the building and to enhance the performance of the mitigation system. A photo log of various sealing procedures is provided in Appendix C (see photographs 3-8).

Sealing will include sealing of all basement floor and wall cracks, basement perimeter joints, cracks in slab-on-grade foundations, crawlspaces, open block wall cores, sump lids, and any other openings leading directly to the soil. Sealing will be conducted utilizing the following methods.

- All surfaces to be sealed will be cleaned prior to applying sealant using a wet/dry vacuum. In some cases a wire brush may be necessary to loosen dirt or debris prior to vacuuming. Surfaces must be clean, dry, and free of all dirt, debris, oil, and grease prior to sealing.

- All cracks greater than 1/2 - inch wide will be filled with closed cell foam backer rod prior to applying sealant. Backer rod should be approximately 25 percent larger than the width of the crack. Backer rods should be installed using a roller or flat sided tool to prevent puncture of the rods during installation.

- Cracks will be sealed with polyurethane caulk by forcing the caulk into the crack and smoothing at or slightly below the floor/wall surface to create a complete seal to each edge of the crack.

- Open block wall cores will typically be sealed by filling the top portion of the cores with expanding foam.

- Sumps will be sealed by installing solid lids with air-tight seals around all protrusions through the lid. Lids will be sealed to the floor using a non-permanent caulking, such as silicone, or through the use of an air-tight gasket and mechanical fasteners to allow the opening of the lid for pump maintenance. A view port may also be included in the lid to enable routine inspection of pump performance without repeated removal of the lid.

- Drains installed through sump lids, through crawlspace liners, or through basement floors (not connected to sewer) will be sealed by installing a drain seal consisting of a trapped drain or a one way valve which allows water to drain, but no air to travel up through them. If a trapped drain is utilized it should be capable of holding a minimum of 6-inches of standing water to minimize the potential for drying out.

- Accessible crawlspaces will be sealed using reinforced, polyethylene sheeting. Adjacent sheets will be overlapped by 1 foot and sealed between with polyurethane caulking and tape. Sheeting will be sealed to the perimeter of the crawlspace and around any protrusions using polyurethane caulking and tape as necessary. Sheeting will be secured to the crawlspace walls using 1-inch by 2-inch wood strips (non-treated) and concrete anchors. Exterior crawlspace walls will be sealed as necessary with polyurethane caulking or by extending the sheeting up the exterior walls and securing at the top. Crawlspace access openings will be covered as necessary to prevent pets or other animals from entering and damaging the sheeting.

- Inaccessible crawlspaces will be sealed by identifying and sealing openings from the crawlspace to the first floor with appropriate materials (e.g., polyurethane caulking, expanding foam, and/or polyethylene sheeting). Cracks within the

crawlspace foundation walls will be sealed with polyurethane caulking. Larger openings in the foundation will be sealed with expanding foam or covered with sheet metal, sealed with polyurethane caulk, and anchored to the foundation with screws. Concrete will be considered to seal dirt floor areas with significant foot traffic (i.e., daily). If the dirt floor is only periodically used (weekly or less) plastic sheeting protected with foam padding and plywood will be considered. Regardless, the condition of the flooring will be inspected twice during the first year after installation and annually thereafter.

- Other openings will be evaluated and sealed using polyethylene sheeting, non-shrink grout, mortar, concrete, or expanding foam.

- Based on specific construction details of each property, other sealing methods may be determined to be appropriate.

4. Design Process

A unique design for each mitigation system will be completed at each property. The process will begin with a visual survey of the structure. After the necessary information has been gathered the system design will be completed and submitted to the U.S. EPA for approval. After the design has been approved the system will be installed and operation verified. It should be noted that small deviations from the approved property-specific work plan may be warranted based on field conditions. These deviations will be noted in the as-built diagram provided to the resident and the U.S. EPA. An Inspection and Mitigation System Design SOP (SOP 23) is included in Appendix B.

4.1 Property Inspection

A visual survey and hand sketch of each building will be conducted to identify the unique characteristics of that building that will need to be considered during the design phase. The items listed below will be identified. The property owner will also be consulted for input on areas that may need sealing and on their preferences for system component location. The following information will be recorded on the Inspection Form included in the Inspection and Mitigation System Design SOP (SOP 23) in Appendix B.

- Identify each separate foundation and its type. Sketch the configuration and note the approximate size of each separate area.

- Include the size and location of crawlspace access doors and the approximate working height within each crawlspace. Note any obstacles that may present a problem for access and if any stored materials will need to be temporarily removed. Note whether padding and plywood or other materials will be needed to protect the sheeting and whether the access door will need to be protected from pets or other small animals.

- For slab-on-grade foundations sketch the floor plan of the first floor, and identify locations such as closets or utility rooms that may be candidates for system installation. If a second floor is present, identify any locations where the system piping could be installed through both floor levels within closets or other acceptable locations. Identify any cracks or other openings in the slab that are accessible for sealing.

- Sketch the basement floor plan (as applicable) including the identification of finished and unfinished areas, sumps, floor drains not connected to sewers,

cracks, wall to floor joints, open block wall cores, plumbing penetrations, and any other areas that may require sealing. Note the presence of stored items that may need to be temporarily relocated to access areas for sealing and system installation. Note any significant degradation in the integrity of the floor and/or walls that would require additional sealing measures beyond the standard caulking procedures.

- If a sump is present, identify the drains that are connected to the sump and the type of sump pump that is present (pedestal or submersible).

- Identify gas fired appliances, such as furnaces and water heaters that may need to be checked for backdrafting. If a backdraft test failure is noted at any time during the mitigation design or installation process, the contractor will be assigned to diagnose the cause of the backdraft test failure. If the backdraft test failure is associated with appliance venting, the mitigation contractor will correct the problem and the appliance will be re-tested. If the backdraft test failure is associated with the appliance malfunctioning, the property owner will be asked to repair or replace the appliance prior to mitigation system operation. Mitigation systems can be installed at homes with backdraft failures; however, the mitigation system will be locked in the off position and should not be operated until the backdraft condition has been remedied.

- On the exterior of the building, identify the number of stories, the type and condition of the roof, and any receptors that may need to be avoided when determining the system discharge location.

4.2 Property Specific Design Specifications

For each property that is identified for mitigation, ARCADIS will complete a design which will identify the location and components of the mitigation system. Specific design factors to be considered for each property will include the following:

- The number of suction points that will be necessary and their location. If multiple foundation types (basement, crawlspace, slab-on-grade) exist or if the building has had additions of the same foundation type, it may be necessary to install a suction point in each of these areas. This determination will be made based on the configuration of these areas.

- Pipe routing to enable installation at the required one percent slope. Where possible, multiple suction points will be plumbed together to a single fan and discharge. The discharge point will be located a minimum of 10 feet from any intakes. The fan will be located either on the exterior of the building or within the attic of the building.

- Determining the fan sizing. Fan sizing will be based on the number of suction points, the tightness of the soils present below the slab, and the background differential pressure across the slab. The fan will be sized to create 1 to 4 in. w.c. vacuum at the suction point and negative 0.004 in. w.c. under the foundation slab. It is anticipated that vacuums nearing 4 in. w.c. will need to be applied to some suction points in order to achieve the required negative 0.004 in. w.c. vacuum across the entire slab. When possible fans sized between 1 and 2.5 in. w.c. will be selected; however, fans sized up to 4 in. w.c. will be selected as necessary to achieve the sub-slab vacuum requirement. The RadonAway™ GP Series of fans represents typical in-line fan sizes that will be chosen. A schematic with fan details is attached in Appendix D.

- Areas to be sealed including crawlspaces, cracks, sumps, perimeter joints, block tops, and any other openings in the foundation.

- Sealing of mitigation system components (i.e. suction pits and sub-slab sample points) that may provide a pathway for water in the unlikely event of a flood.

The location of the components will be reviewed with the property owner.

4.2.1 Property-Specific Work Plan

Property-specific work plans with the following information will be prepared for each property and submitted to the U.S. EPA for approval prior to installation. The property-specific work plans will be submitted to the U.S. EPA within five business days of the completion of the initial visit. It should be noted that small deviations from the approved property-specific work plan may be warranted based on field conditions. These deviations will be noted in the as-built diagram provided to the property owner and the U.S. EPA in the O&M Manual (see Section 4.2.2). The following information will be included in the property-specific work plans:

- A floor plan showing each foundation type, location of suction point(s) and piping, location of sub-slab sample points, and areas to be sealed;

- The fan model to be used and the manufacturers design specifications for the fan;
- The fan location;
- The discharge location; and
- Property owner preferences that are to be incorporated.

A property-specific work plan template is included in Appendix E.

4.2.2 Property-Specific O&M Manual

An O&M Manual (Appendix F) will be supplied to each property owner within 10 business days of mitigation system installation. The following typical items will be included:

- Photos of the mitigation system;
- Copy of the signed access agreement;
- Copy of the sample results letter;
- Copy of confirmation sample results letter;
- Fan warranty information;
- Initial and annual O&M inspection forms; and
- Contact information.

The O&M Manual will be attached to the system piping to enable easy future access. A key will also be provided to the property owner for the padlock on the disconnect switch. The key should be kept with the O&M Manual.

4.2.3 System Installation

The system installation will be completed by a State of Ohio Department of Health licensed and insured Radon Mitigation Contractor/Specialist who will perform all work in compliance with local code requirements. The installation will be conducted at no

cost to the property owner. ARCADIS will be overseeing the design and installation of each system. Systems will be installed per the requirements of ASTM Standard E 2121-03 (ASTM, 2003). A System Installation SOP (SOP 24) is included in Appendix B.

4.2.4 System Inspection

When active mitigation systems are installed in buildings with basement or slab-on-grade foundations, one to two permanent sub-slab sample points will be installed for collection of sub-slab pressure field extension readings as described in Section 6. A vacuum reading of negative 0.004 in. w.c. below the slab will indicate that the active system is successfully depressurizing the sub-slab area. The permanent sub-slab sample points will be located on opposite sides of the foundation from the suction point to ensure the depressurization of the entire slab (for active mitigation systems). The permanent sub-slab sample points will remain in place for future measurements to be taken during the two inspections conducted in the first year and the subsequent annual inspections. The location of the sample points and the initial sub-slab pressure field extension readings will be documented and included in the O&M Manual for future reference. A Sub-Slab Soil-Gas Point Installation and Sampling SOP (SOP 20) is included in Appendix B.

An ARCADIS team member will verify that the differential pressure measured by the manometer installed on the system piping is within the design range of 1 to 4 in. w.c. They will then mark the operating differential pressure on the manometer and will show the property owner how to read the manometer. If at any time the system is not functioning within the range marked on the monitoring device, or the property owner notices damage to the system, they will be encouraged to call the phone number listed on the system label. ARCADIS will also provide an O&M Manual (Appendix F) to each property owner with contact information for any necessary troubleshooting or repairs. All repairs will be made at no cost to the property owner. The property owner will be asked to sign a form stating that they have received the O&M Manual.

5. Post-Installation Proficiency Sampling

At buildings with an active mitigation system, post-installation proficiency sampling of indoor air (first floor, basement, and accessible crawlspaces) samples will be collected approximately 30 days, 180 days, and 360 days after system installation to document that the indoor air is in compliance with the U.S. EPA Regional Screening Levels at a 1 x 10^{-5} risk level (Action Levels) (Table 1). In addition, five years from completion of the 360 day system sampling, another round of indoor air sampling will be conducted at those properties with an active mitigation system. Property owners will be provided with a letter to notify them of the sampling results and an explanation if results are less than or greater than or equal to the Action Levels. An Indoor Air and Ambient Air Sampling SOP (SOP 22) is included in Appendix B.

If the post-installation proficiency sampling results are not below the Action Levels, ARCADIS personnel will evaluate the performance of the active mitigation system and complete any necessary system modifications and/or sealing within 30 days of receiving validated sample results. System modifications could consist of replacing the existing fan with a different size fan or the installation of additional suction point(s). For sub-membrane depressurization systems, appropriate system modifications will be included to help the pressure field extend adequately around the crawlspace or dirt floor. Following completion of the system modifications, an additional post-installation proficiency sampling event will be conducted for indoor air (first floor, basement, and accessible crawlspaces) within 30 days.

6. System Operation and Maintenance

An annual inspection will be conducted by ARCADIS to inspect the active mitigation systems (i.e., sub-slab, sub-membrane, and inaccessible crawlspace depressurization systems) and ensure that they are functioning properly. Two inspections will be conducted in the first year and the systems will be inspected annually thereafter. The following items will be inspected and recorded on the Inspection Form included in the O&M SOP (SOP 25) in Appendix B.

- The manometer reading will be checked to ensure the system is operating in the design range.
- Sub-slab pressure field extension readings will be measured at the permanent sub-slab sample points to ensure sub-slab depressurization of negative 0.004 in. w.c. (active systems with slab foundations only).
- The fan will be checked for unusual noise or vibration.
- The vent piping will be checked for any damage.
- The pipe supports will be checked to ensure they are secure.
- Accessible crawlspaces or other areas sealed with reinforced, polyethylene sheeting will be inspected for damage.
- For inaccessible crawlspaces, openings from the crawlspace to the first floor, cracks within the crawlspace foundation walls, and larger openings in the foundation that required sealing will be inspected for damage.
- The foundation sealing and sealing around system piping penetrations will be checked for any additional areas requiring sealing.
- The presence of the padlock on the disconnect switch will be checked.
- The presence of the O&M Manual at the residence will be checked.
- If the results of post-installation proficiency sampling (see Section 5) indicate that indoor air concentrations remain above the Action Levels (see Table 1),

appropriate system modifications will be included to help the pressure field extend adequately around the crawlspace or dirt floor.

An example of the property owner O&M Manual is included in Appendix F. Repairs to the mitigation system or additional sealing will be conducted at no cost to the property owner.

A payment will be issued annually to reimburse the property owner for the cost of operating the electric powered fan. The mitigation fans are designed to minimize energy usage, and the cost to operate the fan will be calculated by ARCADIS using local electric rates and the fan wattage.

7. System Decommissioning

The determining criteria for discontinuing operation of individual vapor mitigation systems will be as follows:

- Evaluation of the potential for discontinuing operation of the SSDS, SMDS, or CSDS would only be completed once the Pre-Design Investigation (PDI) (ARCADIS, Inc. 2010b) is completed and the final remedies outlined in the Corrective Measures Proposal (CMP) (ARCADIS, Inc. 2008) and CMP Addendum (ARCADIS, Inc. 2010c) are implemented.

- Based on the information collected from the PDI, an updated Conceptual Site Model (CSM) will be completed. The source of the VOC-containing soil-gas vapor will be evaluated utilizing the updated CSM. ARCADIS will use the information collected during the Revised Vapor Intrusion Verification Work Plan (ARCADIS, Inc. 2010d) to calculate site-specific attenuation factors.

- Following this evaluation, a work plan outlining sampling frequency and standards for groundwater in the upper aquifer and soil-gas within the Riverview Plat will be submitted to the U.S. EPA. Potential sampling will include the collection of groundwater from upper aquifer within the Riverview Plat neighborhood and on-site along the property boundary (southern boundary of the closed South Settling Lagoon and western boundary of Landfill L1) and Soil-Gas Sampling Points (SGP-1 through SGP-8). Additional monitor wells or grab groundwater sampling locations may be necessary to collect the data needed for future evaluation of groundwater concentrations at the water table within the Riverview Plat neighborhood.

- Based on the data collected it will be determined if concentrations are expected to be below sub-slab Action Levels (see Table 1) for selected properties.

- After concurrence with the U.S. EPA, two rounds of confirmatory sampling will be completed. Samples will be collected from the permanent sub-slab sample point or points (refer to SOP 20 and 21 in Appendix B) and the sampling will be completed during the "worst case" sampling scenario, during the heating season. To accommodate this, one sampling event will be completed in November/December and one sampling event will be completed in February/March. Prior to sampling, a request will be submitted to the property owner to shutdown the SSDS, SMDS, CSDS for 48-hours prior to sampling. As

soon as the first round of data (November/December) is available the property owner will be notified of the results. If the results are above the sub-slab Action Levels, the property owner will be notified to restart the SSDS, SMDS, or CSDS. If the results are below the Action Levels, the property owner will be notified to keep the SSDS, SMDS, or CSDS off until the second round (February/March) of confirmatory sampling can be completed.

- After completion of the second round of confirmatory sampling, assuming the results are below the Action Levels, the property owner will be provided with the option of removing the system (at RACER's cost), operating the system at the owner's expense for radon mitigation, or shutting the system off and leaving the components in place.

8. Quality Objectives

The data quality objectives for the sub-slab soil-gas and indoor air samples collected will be performed in accordance with the Revised Work Plan (ARCADIS, Inc. 2011). A Construction Quality Assurance Plan (CQAP) has been prepared to provide a quality assurance protocol that will ensure that construction of VI mitigation systems meet or exceed a certain level of quality and workmanship as defined in the construction drawings and technical specifications. CQAP documentation (i.e., personnel involved, quality assurance methods, test results, etc.) will be included in the O&M Manual provided to each property owner. A copy of the O&M Manual will also be provided to the U.S. EPA to document that the VI mitigation systems were installed in accordance with technical specifications and drawings. The CQAP is included in Appendix G.

9. References

American Society for Testing and Materials (ASTM) Standard E2121. 2003. Standard Practice for Installing Radon Mitigation Systems in Existing Low-Rise Residential Buildings. March 2001.

ARCADIS, Inc. 2008. Draft Corrective Measures Proposal, General Motors Corporation, Moraine, Ohio. August 25, 2008.

ARCADIS, Inc. 2010a. Sub-Slab and Indoor Air Sampling Work Plan, Motors Liquidation Company, Moraine, Ohio. December 2010.

ARCADIS, Inc. 2010b. Draft Pre-Design Investigation Work Plan, Motors Liquidation Company, Moraine, Ohio, November 5, 2010.

ARCADIS, Inc. 2010c. Draft Corrective Measures Proposal Addendum, General Motors Corporation, Moraine, Ohio. March 22, 2010.

ARCADIS, Inc. 2010d. Revised Vapor Intrusion Verification Work Plan, Motors Liquidation Company, Moraine, Ohio, September 16, 2010.

ARCADIS, Inc. 2011. Revised Sub-Slab and Indoor Air Sampling Work Plan, Motors Liquidation Company, Moraine, Ohio. March 4, 2011.

U.S. EPA. 1993. 625 Radon Reduction Techniques for Existing Detached Houses. October 1993.

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U.S. EPA. Region 5, Vapor Intrusion Guidebook. October 2010.

U.S. EPA. 2011a. Draft Sub-Slab and Indoor Air Sampling Work Plan – Motors Liquidation Company - Former Delphi Harrison Thermal Systems (OHD 000 817 577) and Former Moraine Engine Plant (OHD 980 569 388) and Former Moraine Assembly Plant (OHD 041 063 074). February 8, 2011.

U.S. EPA. 2011b. Comments on 4/7 draft Mitigation Workplan -- RACER Trust Moraine Facilities. April 18, 2011.

U.S. EPA. 2011c. Draft comments on mitigation and EPA-RACER calls -- Re: Moraine VI Mitigation. April 21, 2011.

U.S. EPA. 2011d. U.S. EPA comments on draft revisions -- Re: Moraine VI Mitigation. April 22, 2011.

U.S. EPA. 2011e. Draft Vapor Intrusion Mitigation Work Plan – RACER Trust – Former Delphi Harrison Thermal Systems (OHD 000 817 577), Former Moraine Engine Plant (OHD 980 569 388), and Former Moraine Assembly Plant (OHD 041 063 074). May 23, 2011.

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