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MEMORANDUM

TO:	Vicki Katko, MDEQ Grant Trigger, RACER	REF. NO.:	17358
FROM:	Beth Landale/Matt Rousseau/97/Det.	DATE:	September 26, 2011
CC:	John McCabe, MDEQ David Favero, RACER		
RE:	Light Non-aqueous Phase Liquid (LNAPL) Mobility/Recoverability Evaluation West and Central Plumes Willow Run Plant - 11991 Ypsilanti, Michigan		

DRAFT FOR DISCUSSION

This memorandum summarizes the proposed light non-aqueous phase liquid (LNAPL) mobility/recoverability evaluation to be performed on the West and Central Plumes at the former General Motors Powertrain Willow Run facility located in Ypsilanti, Michigan. This investigation will include a laser-induced fluorescence (LIF) survey followed by a soil core sampling program. The purpose of the LNAPL mobility/recoverability evaluation is to provide more detailed characterization of the referenced LNAPL areas including lateral and vertical delineation, as well as the identification of the intensity of impacts and LNAPL types encountered. The ultimate goal will be to determine the potential mobility and recoverability of the West and Central Plumes in order to focus any future LNAPL recovery efforts in areas where there is a reasonable expectation that recoverable LNAPL exists. This investigation is intended to supplement previous mobility/recoverability work performed across the Site (see Arcadis 2010 and CRA 2011).

LIF SURVEY METHODOLOGY

The LIF survey will be performed by Matrix Environmental LLC (Matrix) of Osseo, Minnesota using the Ultraviolet Optical Screening Tool (UVOST®) LIF system. The LIF equipment will be deployed via a Geoprobe® direct push rig (also supplied and operated by Matrix). Oversight will be provided by Conestoga-Rovers & Associates (CRA) throughout the survey.

The LIF technology detects LNAPL by screening for the presence of polycyclic aromatic hydrocarbons (PAHs) present in petroleum fuels during the advancement of a specialized direct-push probe. The LIF probe is equipped with a sapphire window through which a laser is directed. The laser light is adsorbed by PAH molecules in contact with the window as the probe is advanced. This addition of energy (photons) to the PAHs causes them to fluoresce as they return to ground state after excitation. A portion of the fluorescence emitted from any encountered PAHs is returned through the sapphire window and conveyed by a fiber optic cable to a detection system at surface. The emission data from the pulsed laser light is

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averaged into one reading per one-second intervals and is recorded continuously. The emission data is reported as percent of the fluorescence intensity of a "reference emitter" (%RE). The %RE is quantified with reference to the fluorescence produced by a standard proprietary hydrocarbon liquid mixture used to calibrate the equipment. For example, an LIF location producing a reading of 100%RE is fluorescing at exactly the same intensity as the standard hydrocarbon mixture. Other things being equal, LIF response is proportional to the amount of aromatic hydrocarbon present. More specifically, LIF response is proportional to LNAPL saturation (i.e., percent of the pore space that is filled with LNAPL). As a result, higher LIF response levels will represent areas with greater potential LNAPL mobility and recoverability. In addition, the LIF instrumentation measures the intensities of four different wavelengths of light produced when a given LNAPL fluoresces. The proportions of each wavelength that comprise the overall fluorescence response are unique to a given petroleum product type.

In short, an LIF survey can:

- Provide definitive delineation of LNAPL/free product impacts vertically and laterally both above and below the water table
- Identify areas of a plume with the highest mobility/recoverability potential by determining the relative intensity of impacts across the plume (i.e., a location producing an LIF response of 300%RE will generally represent a higher LNAPL saturation and greater potential for mobile and/or recoverable LNAPL than a location producing an LIF response of 100%RE)
- Provide an indication of LNAPL type

LIF survey results, by themselves, cannot:

- Specifically quantify LNAPL saturation or mobility (without follow-up targeted well installation and/or soil core testing to "calibrate" LIF responses)
- Detect dissolved or vapor phase contamination – only product phase concentrations are detected

It is anticipated that up to 110 LIF locations will be completed during the West and Central Plume LIF survey. The proposed locations of the 110 LIF survey points are identified in Figure 1. The LIF locations completed previously by Arcadis and CRA are also shown on Figure 1 (denoted as ARC-1, 2, 3… and LIF-1,2,3…). The proposed locations were selected to ensure adequate areal coverage within the plumes, specifically in areas which were not included as part of prior LIF surveys due to access limitations, as well as to provide delineation (if possible). All investigation locations will be pre-cored to maximize the efficiency of the LIF survey. The LIF survey results will serve as the basis for the evaluation of the LNAPL mobility and recoverability within the West and Central Plume areas via a program involving soil core sampling and laboratory soil core petro-physical testing.

SOIL CORE SAMPLING AND LABORATORY TEST METHODOLOGY

Following the LIF survey, CRA will arrange for the drilling and collection of relatively undisturbed soil cores using Shelby Tube or Macro-Core® sampling methods. Soil cores will be collected from locations representing the range of LIF responses and LNAPL types observed during the LIF survey. CRA will collect soil core samples from a maximum of 22 locations, with the actual number of sample locations to be determined following the LIF survey. CRA will attempt to draw correlations between existing LIF data and

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LNAPL mobility/recoverability data in order to make projections following the LIF survey that might allow the minimization of the number of new soil core locations that are needed to adequately characterize the referenced LNAPL areas (i.e., if any meaningful correlations can be found).

Samples will be appropriately packaged, preserved and stored on dry ice in preparation for shipment to PTS Laboratories, Inc. in Santa Fe Springs, California, an analytical laboratory specializing in soil core petro-physical testing (i.e., soil core photography and LNAPL mobility/recoverability evaluation testing). The laboratory will initially perform soil core photography consistent with ASTM International Method D5079. Frozen soil cores will be cut open along the vertical length of the sample (with the use of a cryogenically-cooled diamond segmented horizontal bandsaw) to enable photographs to be taken of the soil cores. Soil cores will be allowed to partially thaw along the cut surface prior to photographing. The partial thawing will enable LNAPL, where present, to pool to the surface of the profile. Photographs will be taken in both white light and UV light. The white light photographs will display the natural state (color, texture) of the soil profile including any pooled LNAPL, where applicable. The UV photographs will also be used to identify LNAPL. LNAPL, when exposed to UV light, tends to fluoresce (by the same operating principle as LIF). The intensity of fluorescence corresponds to the amount of LNAPL, with higher intensities corresponding to greater LNAPL saturations. UV photographs also provide qualitative information regarding the type of LNAPL. Generally speaking, lighter end petroleum compounds, such as gasoline or kerosene, tend to fluoresce white or blue; middle distillates including diesel and No. 2 fuel oil tend to fluoresce blue, yellow or gold; and heavier end compounds such as oils and coal tars tend to fluoresce red or brown.

Core photographs will be provided by the laboratory to CRA to enable the identification of discrete (two tenths of a foot) intervals of maximum UV fluorescence. Select intervals will then be designated for laboratory testing of LNAPL mobility/recoverability. The discrete soil intervals of maximum UV fluorescence will be determined qualitatively from the core photography in order to select sub-samples for further testing via the Residual Saturation by Water Drive test (Water Drive). The Water Drive test involves forcing multiple pore volumes of water under pressure through the soil sample in order to quantify LNAPL saturations across the test areas. A potential for mobile and/or recoverable LNAPL is indicated if LNAPL is released from the soil during the testing, which allows the quantification of residual saturation levels and the fraction of LNAPL in place that might be recoverable. This will focus any future LNAPL recovery efforts by allowing the identification of areas that exhibit a significant fraction of the LNAPL in place that may be recoverable, and, conversely, indicating the portions of the LNAPL areas where LNAPL recovery is unlikely to be successful.

REFERENCES

Arcadis. 2010. Summary of Field Activities, General Motors Willow Run Plant, January-February 2010, December 2010.

CRA. 2011. LNAPL Delineation, Mobility, and Recoverability Study Report – Eastern LNAPL Area. November 2011.

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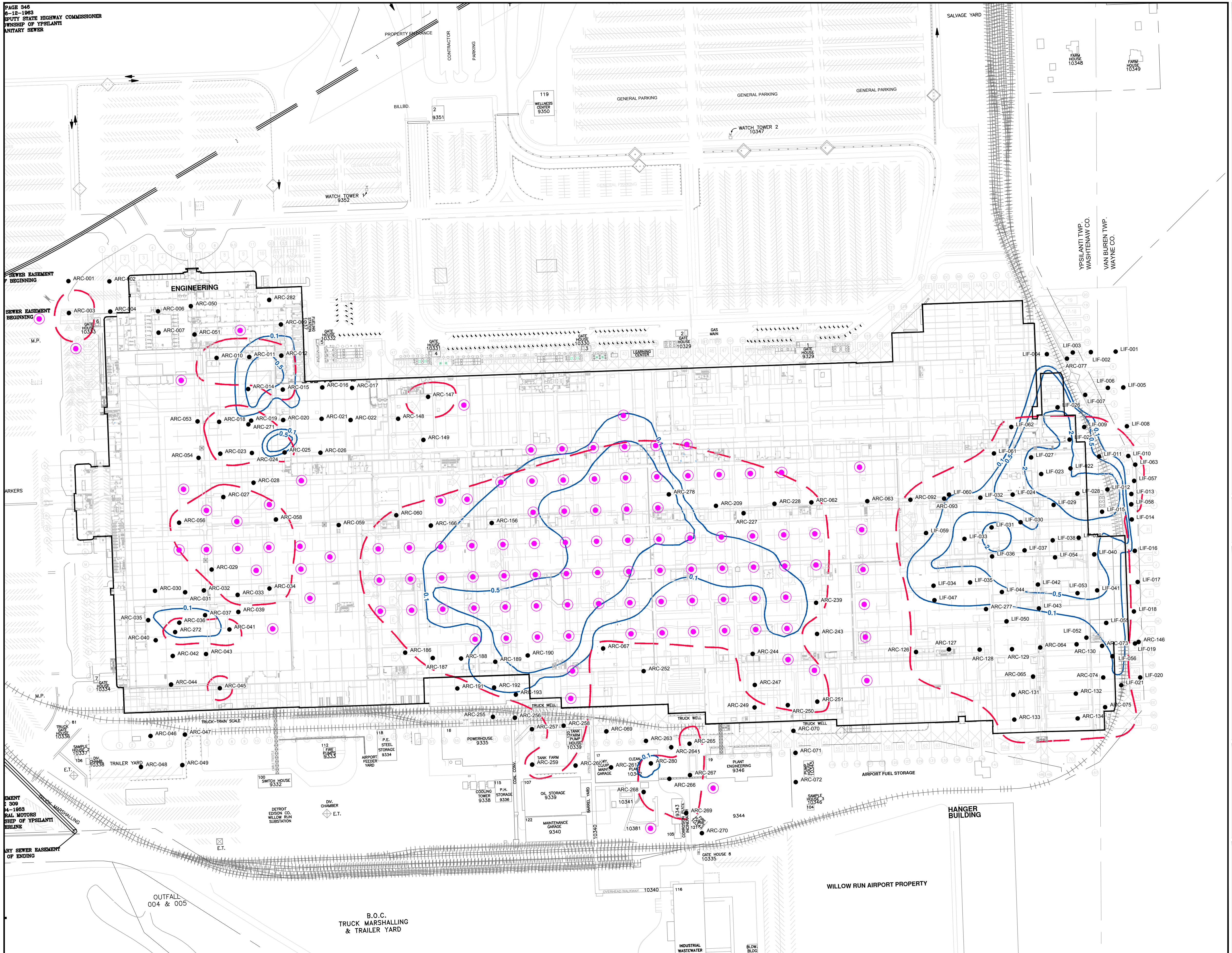
RCRA CERTIFICATION STATEMENT

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

RACER Representative



Nº	Revision	Date	Initial

N

0 75 150ft

LEGEND

- PROPERTY LINE
- BUILDING
- LIF-001 LASER-INDUCED FLOURESCENCE (LIF) BORING
- 0.5 IN-WELL LNAPL THICKNESS CONTOUR (ft.) (AUGUST 2010)
- APPROXIMATE EXTENT OF LNAPL
- PROPOSED LIF LOCATION

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

DRAWING STATUS

Status	Date	Initial

FORMER GM POWERTRAIN WILLOW RUN
Ypsilanti, MI

LIF AND LNAPL MOBILITY STUDY

PROPOSED LIF LOCATIONS WEST AND CENTRAL PLUME

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager:	Reviewed By:	Date:	
B. LANDALE	M. ROUSSEAU	SEPTEMBER 2011	
Scale:	Project Nº:	Report Nº:	Drawing Nº:
1:150	017358-T01	MEMO097	FIGURE 1

017358-T01(MEMO097)GN-DE001 SEP 26/2011