


Revitalizing Auto Communities Environmental
Response Trust

PLANTS 2 & 3 SOIL CORRECTIVE MEASURES WORK PLAN

RACER Trust Lansing Industrial Land
MID 980 700 827 and MID 005 356 928
Lansing, Michigan

Initial Submittal: March 27, 2020
Revised: September 23, 2020



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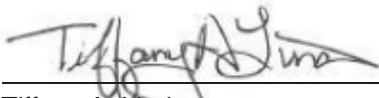
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ACRONYMS AND ABBREVIATIONS

95% UCL	95 percent upper confidence limit on the mean concentration
AMSL	above mean sea level
bgs	below ground surface
CFR	Code of Federal Regulations
DCC	Direct Contact Criteria
DRC	Declaration of Restrictive Covenant
EGLE	Michigan Department of Environment, Great Lakes and Energy
LNAPL	light non-aqueous phase liquid
MDLs	method detection limits
µg/kg	micrograms per kilogram
NR	Nonresidential
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
ppm	part per million
PSIC	Particulate Soil Inhalation Criteria
RACER	Revitalizing Auto Communities Environmental Response
TSCA	Toxic Substance Control Act
USEPA	United States Environmental Protection Agency

1 INTRODUCTION

Arcadis of Michigan, LLC (Arcadis) has revised this Plants 2 & 3 Soil Corrective Measures Work plan (Work plan) on behalf of Revitalizing Auto Communities Environmental Response (RACER) Trust based on communications with Michigan Department of Environment, Great Lakes and Energy (EGLE). The Work plan describes the installation and maintenance of exposure barriers for the RACER Trust, Plant 2 and Plant 3 properties located at 2800 West Saginaw Street and 2801 West Saginaw Street, respectively, in Lansing, Michigan (**Figure 1**), collectively referred to herein as the Site. This Work plan documents how soils exceeding the EGLE December 2013 Part 201 Generic Nonresidential (NR) Direct Contact Criteria (DCC) and Particulate Soil Inhalation Criteria (PSIC) will be addressed at the Site. Soils exceeding other December 2013 NR Generic Cleanup Criteria will be addressed through engineering controls or restrictions included in an amended and restated Declaration of Restrictive Covenant (Amended DRC) to be prepared for the Site. Comparison to NR Criteria is appropriate because the current and Amended DRC includes a restriction limiting the use of the property to nonresidential use. In addition, the perimeter of the Site was previously evaluated against the Part 201 Generic Residential criteria to determine potential impacts to off-site residences (Arcadis 2013). For areas where additional data is required to determine the size or necessity of engineering controls, further investigation is described as part of **Section 3**. The results of the proposed sampling and the final layout of engineering controls will be provided as an addendum to this work plan.

1.1 Background

The corrective measures proposed in this Work plan are based on the EGLE December 2013 Generic Criteria. Soil analytical data were compared to the NR soil DCC and adjusted PSIC as outlined in **Section 2**. The analytical data for exceedances identified at Plants 2 and Plant 3 are presented in **Table 1** and **Table 2**, respectively. Exceedances of criteria were observed in Areas 2, 5-1, 5-2, 5-3, and 5-5 at Plant 2 and in Areas 14, 16, 18, 19, 20, and 21 at Plant 3. It is noted that polychlorinated biphenyl (PCB) exceedances, located in Area 5-2 at Plant 2, will be addressed under separate cover through a Toxic Substance Control Act (TSCA) Plan.

The southwestern area of Plant 6, which is south of Plant 2, was also evaluated to determine if an exposure barrier may be required. Based on review of the soil data collected from the southwestern Plant 6 area, no NR DCC or generic PSIC exceedances were identified.

Recommendations for additional sampling, installation of exposure barriers, and/or inclusion of a notification in the Amended DRC were determined based on the area-specific evaluations and are described in **Section 3**.

2 AREA-SPECIFIC EVALUATION OF EXCEEDANCES

The following sections provide an evaluation of the NR Criteria exceedances by area. Based on the evaluation of exceedances, exposure barriers have been proposed where DCC and PSIC exceedances were noted in shallow soil samples (0 to 2 feet [ft] below ground surface [bgs]). All DCC and site-specific PSIC exceedances observed in deep soil samples (greater than 2 ft bgs) will be included as a notification in the Amended DRC being prepared for the Site.

For some areas with a limited number of exceedances for one or more constituents, an analysis of the 95 percent upper confidence limit on the mean concentration (95% UCL) was conducted to determine if an exposure barrier was needed. The 95% UCL is a statistical number calculated to represent the mean value with a high level (i.e., 95 percent) of confidence. The true arithmetic mean value for the Site is lower than the 95% UCL. The high level of confidence is used to compensate for the uncertainty in representing area conditions with a finite number of samples.

To conduct this 95% UCL analysis, 2-acre exposure areas were identified around the exceedances and a 95% UCL was calculated using the United States Environmental Protection Agency's (USEPA) ProUCL statistical software (version 5.1.002). If the 95% UCL for a constituent did not exceed the non-residential soil DCC, an exposure barrier was not proposed. The exposure area size for non-residential direct contact exposure was determined based on the EGLE (formerly MDEQ) Sampling Strategies and Statistics Training Materials for Part 201 Cleanup Criteria (S3TM; EGLE 2002), which indicates that a 2-acre exposure unit is appropriate for statistical evaluations for direct contact exposure to soil at non-residential properties. The statistical evaluation is included as **Appendix A**.

For PSIC exceedances, a site-specific NR PSIC value was calculated based on the size of the source area. To determine areas that required a site-specific PSIC comparison, concentrations of constituents in soil were first compared to the generic PSIC adjusted to account for a 100-acre source area. In areas where samples exceeded the 100-acre PSIC, individual source area size was determined based results from surrounding borings (i.e., half the distance to the next soil boring below the 100-acre PSIC). For each constituent, the individual source areas were added together, per the S3TM guidance, to identify the total area used for a site-specific PSIC correction. The concentrations of each constituent were then re-screened against the site-specific PSIC (typically 5-acre or ½-acre) to determine areas that may require corrective measures. Results of this site-specific PSIC evaluation are summarized on **Table 1** (Plant 2) and **Table 2** (Plant 3).

Deep exceedances (greater than 2 ft bgs) that were not eliminated by the UCL analysis or PSIC site-specific evaluation will be noted in the Amended DRC as well as in subsequent sections of this Work plan. For areas where exposure barriers are necessary due to shallow soil exceedances of December 2013 Criteria, existing asphalt or concrete barriers at least 6 inches in thickness will be maintained (or a barrier with similar effectiveness will be installed if the existing asphalt or concrete is disturbed or removed in the future). If the existing surface does not meet the 6-inch thickness requirement, or if the existing surface isn't a paved surface, a minimum 10-inch soil barrier will be installed.

2.1 Plant 2 Evaluation

Area 2

Arsenic exceeded the DCC and manganese exceeded the site-specific PSIC in Area 2 (**Table 1, Figure 2**). Arsenic exceeds the DCC at one location, soil boring SB-A2-PA65, between 1 and 2 ft bgs. Due to the limited number of surface soil samples (six) collected in this area, additional sampling is recommended to determine if consideration of an exposure barrier can be eliminated (i.e., 95% UCL calculation), or if an exposure barrier is warranted (**Section 3**). The site-specific source area size for manganese at Plant 2 was determined to be 5 acres. Manganese exceeds the site-specific PSIC at one location, soil boring SB-A2-PD65, between 9 and 10 ft bgs. Based on the depth being greater than 2 ft bgs, a notification of this exceedance will be included in the Amended DRC.

Area 5-1

Various polycyclic aromatic hydrocarbons (PAHs) exceed the DCC in two samples (VAP-A5.1-MT115 and SB-A5.1-MT126) located in Area 5-1 (**Figure 2, Table 1**). Manganese also exceeded the adjusted PSIC in one sample (P2-SB-35) in Area 5-1 but does not exceed the site-specific PSIC, based on a 5-acre source area. Since these DCC exceedances of PAHs are encountered at depths of 4 to 7 ft bgs, a notification will be included in the Amended DRC regarding the presence of these constituents.

Area 5-2

Polychlorinated biphenyls (PCBs), manganese, lead, and benzo(a)pyrene exceeded the DCC and/or site-specific PSIC in nine samples collected in Area 5-2 (**Table 1, Figure 2**). As stated previously, the PCB exceedances of the DCC will be addressed under separate cover through a TSCA Plan.

Manganese exceeded the site-specific PSIC for a 5-acre source area in one sample (SB-A5.2-NG127) at a depth of 2 to 3 ft bgs and it is recommended that a notification be included in the Amended DRC regarding the presence of this constituent.

The lead concentration in one sample (SB-A5.2-OG144) at 0 to 1 ft bgs, exceeded the DCC. Because only one exceedance was identified in this area, a 95% UCL was calculated for surface soil in a 2-acre area around the exceedance. As described in **Appendix A**, the 95% UCL did not exceed the DCC. Therefore, no exposure barrier and no notification in the Amended DRC is warranted for this exceedance.

Two benzo(a)pyrene exceedances of the DCC were detected in Area 5-2 at soil boring SB-A5.2-NE157 (3 to 4 ft bgs) and soil boring SB-A5.2-OG162 (0 to 1 ft bgs). For SB-A5.2-NE157 the exceedance was eliminated by UCL analysis. For boring SB-A5.2-OG162 the benzo(a)pyrene exceedance was not eliminated by UCL analysis, as the 95% UCL for benzo(a)pyrene in surface soil in a 2-acre area around the SB-A5.2-OG162 exceedance was greater than the DCC. Therefore, additional sampling is recommended to determine the extent of an exposure barrier for the exceedance at SB-5.2-OG162 (**Section 3**).

Area 5-3

The concentration of benzo(a)pyrene at one location, soil boring SB-A5.3-OX123 (1 to 2 ft bgs), exceeded the DCC. A UCL evaluation was completed for a 2-acre exposure area around this exceedance; however, the 95% UCL was greater than the DCC. Therefore, additional sampling is recommended to determine the extent of impacts requiring an exposure barrier (**Section 3**).

Manganese exceeded the site-specific PSIC in one sample in Area 5-3 at a depth of 1 to 2 ft bgs. A notification will be included in the Amended DRC for this exceedance.

Area 5-5

The concentration of benzo(a)pyrene in one location (P2-MW-04) from 1 to 3 ft bgs exceeded the DCC (**Figure 2**). Due to the small size of Area 5-5, the exposure area identified for this exceedance was set to the boundaries of Area 5-5 (approximately 0.72 acres). The 95% UCL for benzo(a)pyrene in the exposure area around this exceedance was less than the DCC. Therefore, no further action is warranted for this exceedance.

2.2 Plant 3 Evaluation

Area 14

Concentrations of arsenic, cyanide, and nickel exceed the DCC and/or site-specific PSIC (based on a 5-acre source area size for cyanide and nickel) in one or more samples collected in Area 14 (**Figure 3, Table 2**) at depths greater than 2 ft bgs. In addition, the concentration of cyanide in shallow soil exceeds the DCC and the site-specific PSIC. A notification will be included in the Amended DRC regarding the presence of the deep exceedances, and a requirement for the maintenance of the existing cover will be included in the Amended DRC.

Area 16

Concentrations of benzo(a)pyrene and lead exceeded the DCC in Area 16 (**Figure 3, Table 2**). The concentration of benzo(a)pyrene in one location, SB-A16-HU165 at 4 to 5 ft bgs, exceeded the DCC. Concentrations in surface soil (0 to 1 ft bgs) did not exceed the DCC, and the 95% UCL for the 0 to 15 ft bgs interval did not exceed the DCC. Therefore, no additional actions are warranted for this exceedance.

The concentration of lead in two deeper samples (4 to 5 ft bgs and 9 to 10 ft bgs) in Area 16 exceeded the DCC. In addition, the 95% UCL for the 0-15 ft bgs interval exceeded the DCC. Therefore, a notification will be included in the Amended DRC regarding the presence of lead at Area 16. It should be noted that this recommendation differs from previous recommendations that were made in 2015 to require an exposure barrier in this area. However, shallow soils in Area 16 do not exceed the DCC or generic PSIC; therefore, the soil that is currently overlying the deeper exceedances adequately addresses them. In addition, a site-wide soil management requirement for excavated impacted soil will be included as part of the Amended DRC. Therefore, a cover is not required to be maintained in this area,

Area 18

The concentration of benzo(a)pyrene in one sample (SB-A18-CJ150 1 to 2 ft bgs) in Area 18 exceeded the DCC (**Figure 3, Table 2**). The benzo(a)pyrene 95% UCL for surface soil for a 2-acre area around this exceedance was greater than the DCC. Due to the limited number of surface soil samples collected in this area, additional sampling is recommended to determine the extent of impacted soil requiring an exposure barrier (**Section 3**).

Area 19

Concentrations of arsenic in Area 19 surface soil and deeper soil exceeded the DCC (**Figure 3**). The 95% UCLs for arsenic in surface soil and deeper soil (0 to 15 ft bgs interval) exceeded the criteria. Therefore, an exposure barrier is proposed for this area (**Figure 3**).

Area 20

Manganese exceeded the site-specific PSIC in one sample in Area 20 (P3-SB-13) (**Figure 3, Table 2**). Since the exceedance is at a depth of 17 to 18 ft bgs, a notification will be included in the Amended DRC regarding the presence of manganese in Area 20.

Area 21

The concentration of arsenic in one deeper sample exceeded the DCC (**Figure 3, Table 2**). This sample was in the former "Coliseum" pit that was backfilled with 18 ft of clean fill in 2015. The sample was collected beneath the concrete floor of the former Pit and are located approximately 22 to 23 ft bgs. Arcadis proposes that a notification be included in the Amended DRC regarding the presence of this constituent.

3 SCOPE OF WORK

This Work plan outlines the exposure barriers or additional sampling proposed at various areas of Plant 2 and Plant 3. Exposure barriers or additional sampling is proposed for these areas based on the evaluation provided in **Section 2** above. In addition, where exceedances were observed in deep soil samples (greater than 2 ft bgs), it is proposed that notifications of these exceedances be included in the Amended DRC being prepared for the Site.

3.1 Plant 2

Area 2 Additional Sampling and Notification

The potential for an exposure barrier for Area 2 is based on a single concentration of arsenic exceeding DCC at 1 to 2 ft bgs at soil boring SB-A2-PA65 (**Figure 2A**). Additional sampling, following a systematic random sampling approach, is proposed to further delineate this exceedance and to evaluate if the currently proposed exposure barrier could be eliminated by 95% UCL analysis. A ¼-acre square exposure area will be identified, centered at soil boring SB-A2-PA65, and a 33-ft grid will be established.

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Each grid will be sampled at the same location, relative to the placement of soil boring SB-A2-PA65 in the center grid (with the exception of the bottom middle grid location which was previously sampled from 1 to 2 ft bgs). Sample locations are shown on **Figure 2A**. The eight (8) soil borings will be advanced to an approximate depth of 2 ft bgs using a stainless-steel hand auger. At each boring, samples will be collected from the 0 to 1 ft bgs and 1 to 2 ft bgs intervals and submitted for analysis of arsenic (with the exception of the location in the bottom middle grid which will be sampled from 0 to 1 ft bgs only as previously a 1 to 2 ft bgs sample was collected [**Figure 2A**]). In addition, soil boring location SB-A2-PA65 will be sampled at 0 to 1 ft bgs, to determine if the top foot is unimpacted and could be used as adequate cover.

Manganese exceeds the site-specific PSIC at one location, soil boring SB-A2-PD65, between 9 and 10 ft bgs (**Figure 2A**). Based on the depth being greater than 2 ft bgs, this exceedance will be addressed by providing a notification in the Amended DRC.

Area 5-1 Notification

In Area 5-1, exceedances of the DCC have been reported for benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene and dibenzo(a,h)anthracene between 4 to 7 ft bgs (**Table 1, Figure 2**). A notification of these exceedances will be included in the Amended DRC.

Area 5-2 Additional Sampling

Additional consideration of an exposure barrier in Area 5-2 at Plant 2 is based on a single concentration of benzo(a)pyrene exceeding DCC, identified from 0 to 1 ft bgs in soil boring SB-A5.2-OG162 (**Figure 2B**). Additional sampling is proposed to determine the extent of impacts requiring an exposure barrier. Three (3) additional soil samples are proposed surrounding this soil boring (**Figure 2B**). The three (3) soil borings will be advanced to an approximate depth of 3 ft bgs using a stainless-steel hand auger. At each boring, samples will be collected from the 0 to 1 ft bgs and 2 to 3 ft bgs intervals. A final recommendation for appropriate further action regarding benzo(a)pyrene will be made based on the results of the additional sampling.

Area 5-3 Additional Sampling and Notification

The potential exposure barrier at Area 5-3 at Plant 2 is based on a single concentration of benzo(a)pyrene exceeding DCC, identified from 1 to 2 ft bgs in soil boring SB-A5.3-OX123 (**Figure 2C**). Additional sampling is proposed to determine the extent of impacted soil requiring an exposure barrier. Three (3) additional soil sample locations are proposed surrounding this soil boring (**Figure 2C**). The three (3) soil borings will be advanced to an approximate depth of 3 ft bgs using a stainless-steel hand auger. At each boring, samples will be collected from the 1 to 2 ft bgs and 2 to 3 ft bgs intervals. A recommendation for appropriate further action will be made based on the results of the sampling.

Manganese exceeds the site-specific PSIC at one location, soil boring SB-A5.3-OX123, between 1 and 2 ft bgs (**Figure 2C**). This exceedance will be addressed by providing a notification in the Amended DRC.

3.2 Plant 3

Area 14 Exposure Barrier and Notifications

Exposure Barrier

In Area 14, multiple borings had samples with nickel and cyanide exceedances of DCC as well as site-specific PSIC. The proposed exposure barrier at Area 14 consists of an approximately 13,600 square feet of existing asphalt and concrete surface pavement (**Figures 3 and 3A**). In shallow soil, cyanide exceeds DCC and site-specific PSIC up to 2 ft bgs (**Table 2**). Based on soil borings advanced in this area, the concrete at Area 14 ranges from 6 to 12 inches thick. Since this area is adequately covered by this concrete there is no need for additional cover.

Notifications

In addition, a notification of the following exceedances is proposed to be included in the Amended DRC:

- Cyanide exceeds DCC and site-specific PSIC between 5 and 7 ft bgs and 10 and 30 ft bgs.
- Nickel exceeds site-specific PSIC at 15 ft bgs.

Area 16 Notification

In Area 16, borings SB-A16-HU168 and SB-A16-HU181 had lead exceedances of DCC between 4 and 5 ft bgs, and 9 and 10 ft bgs (**Table 2, Figure 3**). A notification of these exceedances will be included in the Amended DRC being prepared for the Site.

Area 18 Additional Sampling

The proposed exposure barrier under consideration for Area 18 at Plant 3 is based on a single concentration of benzo(a)pyrene exceeding DCC identified in soil boring SB-A18-CJ150 from 1 to 2 ft bgs (**Figure 3B**). Additional sampling is proposed to further delineate the extent of impacted soils requiring an exposure barrier. Five additional soil sample locations are proposed surrounding this exceedance to determine if an exposure barrier is necessary: a re-sample of the original location and four step-out borings (**Figure 3B**). The five (5) soil borings will be advanced to an approximate depth of 3 ft bgs using a hand auger. At each boring, samples will be collected from the 1 to 2 ft bgs and 2 to 3 ft bgs intervals and analyzed for benzo(a)pyrene.

Area 19 Exposure Barrier

The proposed exposure barrier at Area 19 consists of an approximately 5,500 square ft of existing asphalt and concrete surface pavement (**Figure 3C**). Arsenic exceeds DCC between (i) 1 and 2 ft bgs, and (ii) 9 and 10 ft bgs. Based on soil borings advanced in the area, the concrete at Area 19 ranges from 12 to 30 inches thick. The concrete covers almost the entire area of Area 19 and will serve as an adequate barrier. There are two (2) depressions where the former building columns were present. These two locations will be filled to grade with clean fill material.

Area 20 Notification

Manganese exceeds the site-specific PSIC at one location, soil boring P3-SB-13, between 17 and 18 ft bgs (**Table 2, Figure 3**). Based on the depth being greater than 2 ft bgs, this exceedance will be addressed by providing notification in the Amended DRC.

Area 21 Notification

In Area 21, arsenic exceeds DCC between 22 and 23 ft bgs (**Table 2, Figure 3**). Note that these depths bgs account for the former “Coliseum” press pits that were filled in with clean fill material. A notification of these exceedances is proposed to be included in the Amended DRC.

3.3 Summary of Proposed Additional Investigation

The following table provides a summary of the proposed additional investigation actions for each area discussed in Sections 3.1 and 3.2 above:

Area	Number of Borings	Parameters to be Analyzed
Area 2	8 soil borings – samples to be collected from 0 to 1 and 1 to 2 ft bgs; original location sampled at 0 to 1 ft bgs	Arsenic
Area 5-2	3 soil borings – samples to be collected from 1 to 2 ft bgs and 2 to 3 ft bgs	Benzo(a)pyrene
Area 5-3	3 soil borings – samples to be collected from 1 to 2 ft bgs and 2 to 3 ft bgs	Benzo(a)pyrene
Area 18	5 soil borings – samples to be collected from 1 to 2 ft bgs and 2 to 3 ft bgs	Benzo(a)pyrene

The following table provides a summary of the proposed notifications to be included in the Amended DRC as discussed in Sections 3.1 and 3.2 above:

Area	Constituents > DCC and/or PSIC	Description of Soil Impacts
Plant 2 - Area 2	Manganese>Site-Specific PSIC	SB-A2-PD65 – 9-10 ft bgs (854.32-853.32 above mean sea level [amsl])
Plant 2 - Area 5-1	Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene and dibenz(a,h)anthracene > DCC	SB-A5.1-MT126 – 5.5-6.5 ft bgs (855.96-854.96 amsl); VAP-A5.1-MT115 – 4-5 ft bgs (857.67-856.67 amsl)
Plant 2 – Area 5-3	Manganese>Site-Specific PSIC	SB-A5.3-OX123 – 1-2 ft bgs (861.05-860.05 amsl)
Plant 3 – Area 14	Cyanide>DCC and Site-Specific PSIC	Several Locations see Table 2 for Locations – range from 2-7 ft bgs and 10-30 ft bgs
Plant 3 – Area 14	Nickel>Site-Specific PSIC	G12 – 15 ft bgs (848.53 amsl)

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Area	Constituents > DCC and/or PSIC	Description of Soil Impacts
Plant 3 – Area 16	Lead>DCC	SB-A16-HU168 – 4-5 ft bgs (855.04-854.04 amsl) SB-A16-HU181 – 9-10 ft bgs (849.00-848.00 amsl)
Plant 3 – Area 20	Manganese>Site-Specific PSIC	P3-SB-13 – 17-18 ft bgs (844.04-843.04 amsl)
Plant 3 – Area 21	Arsenic>DCC	P3-SB-27 – 22-23 ft bgs (821.36-820.36 amsl)

3.4 Summary of Results

Following completion of the additional investigation results, a recommendation for appropriate further action will be made based on the results of the sampling and the results of this sampling and the associated recommendations will be presented in an addendum to this Work plan. If exposure barriers are needed in one or more of the areas, further construction details for the exposure barriers will be provided in the addendum to this Work plan. The addendum will be submitted to EGLE for review and approval.

3.5 Waste Management

Soil cuttings from sampling will be placed in labeled and sealed 55-gallon steel drums and stored in a secured area. Excavated soil and/or concrete from installation of the exposure barriers will be placed in a roll-off box. Solid waste will be disposed of at an appropriate landfill following characterization. No liquid waste is expected to be generated.

4 MAINTENANCE

The proposed exposure barriers will initially be inspected ninety days after installation and then on an annual basis. The inspection will evaluate signs of weathering, erosion, settlement and/or excessive vegetation growth that could allow for contact with impacted soil. Inspections will be documented on an inspection form (**Appendix B**). The inspection form will be revised to include or remove exposure barrier locations based on the additional investigations proposed in **Section 3**. The exposure barrier will be maintained as necessary to mitigate contact with underlying impacted soil. The frequency of inspections may be modified with EGLE approval.

5 INCLUSION IN AMENDED DECLARATION OF RESTRICTIVE COVENANT

The proposed exposure barriers will be included in an Amended DRC to be prepared for the Site. The Amended DRC will include a provision that prohibits any excavation or other intrusive activity that could affect the integrity of the barriers without prior EGLE and RACER Trust written approval, and that any excavation or other intrusive activity, including removing, altering or disturbing, that could affect the integrity of the barrier must be restored with a barrier that provides at least an equivalent degree of protection as the original exposure barrier.

6 SCHEDULE

Implementation of this Work plan will be scheduled after EGLE approval. The additional investigation work will be completed first. Based on the results of the additional investigation a recommendation for appropriate further action will be made. An addendum to this Work plan summarizing this investigation and recommendations will be submitted to EGLE for review and approval.

Based on approval of this addendum, RACER will install all necessary exposure barriers and then finalize the Amended DRC for the Site. A brief report will be prepared to document the installation of all exposure barriers and will be submitted to EGLE. The Amended DRC will be submitted to EGLE for review and approval prior to recording with the County.

7 REFERENCES

- Arcadis. 2013. Resource Conservation and Recovery Act Facility Investigation (RFI), Phase 2 Activities Summary Report, Plants 2, 3 &6, Industrial Land, Lansing, Michigan. April.
- EGLE. 2002. Sampling Strategies and Statistics Training Materials for Part 201 Cleanup Criteria. August. Available online at: https://www.michigan.gov/documents/deq/deq-erd-stats-s3tm_250015_7.pdf.
- EGLE. 2007. RRD Operational Memorandum No. 1, Technical Support Document – Attachment 7. Part 201 Generic Soil Inhalation Criteria for Ambient Air, Part 213 Tier I Soil Inhalation Risk-Based Screening Levels for Indoor Air. July.

TABLES



Table 1
Plant 2 Soil Exceedances Summary
RACER Trust Plants 2 and 3
Lansing, Michigan

Location	Area	Depth (feet bgs)	Compound	EGLE December 2013 Criteria			Result (µg/kg)
				DC Criteria (µg/kg)	Adjusted PSIC- 100 acres (µg/kg)	Site-Specific PSIC [a] (µg/kg)	
SB-A2-PA65	Area 2	1 - 2	Arsenic	3.70E+04	3.91E+05	9.10E+05 [b]	5.32E+04
SB-A2-PD65	Area 2	9 - 10	Manganese	9.00E+07	6.45E+05	9.90E+05	1.56E+06
P2-SB-31	Area 2	1 - 2	Manganese	9.00E+07	6.45E+05	9.90E+05	6.96E+05
P2-SB-35	Area 5-1	2 - 3	Manganese	9.00E+07	6.45E+05	9.90E+05	8.08E+05
SB-A5.1-MT126	Area 5-1	5.5 - 6.5	Benzo(a)pyrene	8.00E+03	8.17E+05	1.25E+06	6.00E+04
SB-A5.1-MT126	Area 5-1	5.5 - 6.5	Benzo(b)fluoranthene	8.00E+04	ID	ID	1.19E+05
SB-A5.1-MT126	Area 5-1	5.5 - 6.5	Dibenz(a,h)anthracene	8.00E+03	ID	ID	1.20E+04
VAP-A5.1-MT115	Area 5-1	4 - 5	Benzo(a)anthracene	8.00E+04	ID	ID	1.69E+05
VAP-A5.1-MT115	Area 5-1	4 - 5	Benzo(a)pyrene	8.00E+03	8.17E+05	1.25E+06	1.99E+05
VAP-A5.1-MT115	Area 5-1	4 - 5	Benzo(b)fluoranthene	8.00E+04	ID	ID	3.91E+05
VAP-A5.1-MT115	Area 5-1	4 - 5	Dibenz(a,h)anthracene	8.00E+03	ID	ID	2.20E+04
LMW-14-15D	Area 5-2	18 - 19	Total PCBs	1.60E+04	2.80E+06	6.50E+06 [b]	5.10E+04
SB-A5.2-NW124	Area 5-2	4 - 5	Total PCBs	1.60E+04	2.80E+06	6.50E+06 [b]	2.20E+04
VAP-A5.2-NV120	Area 5-2	6 - 7	Total PCBs	1.60E+04	2.80E+06	6.50E+06 [b]	3.90E+04
VAP-A5.2-NV120	Area 5-2	8 - 9	Total PCBs	1.60E+04	2.80E+06	6.50E+06 [b]	3.70E+04
SB-A5.2-NG127	Area 5-2	2 - 3	Manganese	9.00E+07	6.45E+05	9.90E+05	4.03E+06
SB-A5.2-OB120	Area 5-2	26 - 27	Manganese	9.00E+07	6.45E+05	9.90E+05	7.96E+05
SB-A5.2-OG144	Area 5-2	0 - 1	Lead	9.00E+05	1.89E+07	2.90E+07	1.16E+06
SB-A5.2-NE157	Area 5-2	3 - 4	Benzo(a)pyrene	8.00E+03	8.17E+05	1.25E+06	1.10E+04
SB-A5.2-OG162	Area 5-2	0 - 1	Benzo(a)pyrene	8.00E+03	8.17E+05	1.25E+06	2.80E+04
SB-A5.3-OC169	Area 5-3	6 - 7	Manganese	9.00E+07	6.45E+05	9.90E+05	7.59E+05
SB-A5.3-OQ175	Area 5-3	1 - 2	Manganese	9.00E+07	6.45E+05	9.90E+05	6.71E+05
SB-A5.3-OX123	Area 5-3	1 - 2	Benzo(a)pyrene	8.00E+03	8.17E+05	1.25E+06	2.15E+04
SB-A5.3-OX123	Area 5-3	1 - 2	Manganese	9.00E+07	6.45E+05	9.90E+05	1.21E+06
VAP-A5.5-NP194	Area 5-5	56 - 57	Manganese	9.00E+07	6.45E+05	9.90E+05	8.53E+05
P2-MW-04	Area 5-5	1 - 3	Benzo(a)pyrene	8.00E+03	8.17E+05	1.25E+06	9.40E+03

Notes

Result exceeds highlighted criteria

EGLE - Michigan Department of Environment, Great Lakes and Energy

DC = Michigan Part 201 Non-Residential Soil Direct Contact Criteria

PSIC = Michigan Part 201 Particulate Soil Inhalation Criteria

NA = Not Applicable

bgs = below ground surface

ID = insufficient data to develop a criterion

µg/kg = micrograms per kilogram

[a] based on a 5-acre source area, unless otherwise noted

[b] based on a 1/2-acre source area

Table 2
Plant 3 Soil Exceedances Summary
RACER Trust Plants 2 and 3
Lansing, Michigan

Location	Area	Depth (feet bgs)	Compound	EGLE December 2013 Criteria			Result (µg/kg)
				DC Criteria (µg/kg)	Adjusted PSIC-100 acres (µg/kg)	Site-Specific PSIC [a] (µg/kg)	
13	Area 14	43.5 - 45	Arsenic	3.70E+04	3.91E+05	9.10E+05 [b]	4.20E+04
13	Area 14	11 - 12.5	Cyanide	2.50E+05	1.08E+05	1.65E+05	1.75E+05
13	Area 14	6 - 7.5	Nickel	1.50E+08	6.88E+06	1.06E+07	7.00E+06
14	Area 14	11 - 12.5	Cyanide	2.50E+05	1.08E+05	1.65E+05	8.20E+05
14	Area 14	13.5 - 15	Cyanide	2.50E+05	1.08E+05	1.65E+05	5.25E+05
14	Area 14	16 - 17.5	Cyanide	2.50E+05	1.08E+05	1.65E+05	1.40E+05
14	Area 14	1 - 2.5	Nickel	1.50E+08	6.88E+06	1.06E+07	7.30E+06
16	Area 14	11 - 12.5	Nickel	1.50E+08	6.88E+06	1.06E+07	7.50E+06
20	Area 14	16 - 17.5	Cyanide	2.50E+05	1.08E+05	1.65E+05	3.20E+05
21	Area 14	11 - 12.5	Cyanide	2.50E+05	1.08E+05	1.65E+05	1.55E+05
21	Area 14	16 - 17.5	Cyanide	2.50E+05	1.08E+05	1.65E+05	2.95E+05
30	Area 14	16 - 17.5	Cyanide	2.50E+05	1.08E+05	1.65E+05	2.13E+05
30	Area 14	21 - 22.5	Cyanide	2.50E+05	1.08E+05	1.65E+05	3.20E+05
30	Area 14	23.5 - 25	Cyanide	2.50E+05	1.08E+05	1.65E+05	2.85E+05
63	Area 14	20	Cyanide	2.50E+05	1.08E+05	1.65E+05	1.15E+05
63	Area 14	30	Cyanide	2.50E+05	1.08E+05	1.65E+05	3.25E+05
63	Area 14	40	Cyanide	2.50E+05	1.08E+05	1.65E+05	1.40E+05
64	Area 14	20	Cyanide	2.50E+05	1.08E+05	1.65E+05	1.17E+05
65	Area 14	10	Cyanide	2.50E+05	1.08E+05	1.65E+05	1.70E+05
69	Area 14	10	Cyanide	2.50E+05	1.08E+05	1.65E+05	2.19E+05
70	Area 14	10	Cyanide	2.50E+05	1.08E+05	1.65E+05	1.11E+05
71	Area 14	20	Cyanide	2.50E+05	1.08E+05	1.65E+05	1.89E+05
72	Area 14	20	Cyanide	2.50E+05	1.08E+05	1.65E+05	5.70E+05
G1	Area 14	2	Cyanide	2.50E+05	1.08E+05	1.65E+05	1.37E+06
G2	Area 14	7	Cyanide	2.50E+05	1.08E+05	1.65E+05	3.90E+05
G3	Area 14	5	Cyanide	2.50E+05	1.08E+05	1.65E+05	7.70E+05
G7	Area 14	20	Cyanide	2.50E+05	1.08E+05	1.65E+05	1.40E+05
G12	Area 14	15	Cyanide	2.50E+05	1.08E+05	1.65E+05	2.50E+05
H4	Area 14	16	Cyanide	2.50E+05	1.08E+05	1.65E+05	1.90E+05
H7	Area 14	20	Cyanide	2.50E+05	1.08E+05	1.65E+05	2.01E+06
I10	Area 14	6	Cyanide	2.50E+05	1.08E+05	1.65E+05	2.07E+06
I5	Area 14	20	Cyanide	2.50E+05	1.08E+05	1.65E+05	4.16E+05
G12	Area 14	15	Nickel	1.50E+08	6.88E+06	1.06E+07	1.20E+07
SB-A16-HU165	Area 16	4 - 5	Benzo(a)pyrene	8.00E+03	8.17E+05	1.25E+06	3.30E+04
SB-A16-HU168	Area 16	9 - 10	Lead	9.00E+05	1.89E+07	2.90E+07	7.23E+06
SB-A16-HU181	Area 16	4 - 5	Lead	9.00E+05	1.89E+07	2.90E+07	1.25E+06
SB-A16-HD162	Area 16	8 - 9	Manganese	9.00E+07	6.45E+05	9.90E+05	7.34E+05
SB-A18-CJ150	Area 18	1 - 2	Benzo(a)pyrene	8.00E+03	8.17E+05	1.25E+06	4.22E+04
P3-SB-25	Area 19	1 - 2	Arsenic	3.70E+04	3.91E+05	9.10E+05 [b]	8.28E+04
P3-SB-25	Area 19	9 - 10	Arsenic	3.70E+04	3.91E+05	9.10E+05 [b]	7.72E+04
SB-A19-HJ148	Area 19	1 - 2	Arsenic	3.70E+04	3.91E+05	9.10E+05 [b]	4.12E+04
VAP-A19-HJ150	Area 19	1 - 2	Arsenic	3.70E+04	3.91E+05	9.10E+05 [b]	5.20E+04
P3-SB-13	Area 20	17 - 18	Manganese	9.00E+07	6.45E+05	9.90E+05	1.13E+06
P3-SB-27	Area 21	4 - 5 (22 - 23) ¹	Arsenic	3.70E+04	3.91E+05	9.10E+05 [b]	3.75E+04

Notes

Result exceeds highlighted criteria

¹ - Depth in parentheses reflects current depth below ground surface (original sample location was covered with 18 feet of fill material in 2015)

EGLE = Michigan Department of Environment, Great Lakes and Energy

DC = Michigan Part 201 Non-Residential Soil Direct Contact Criteria

PSIC = Michigan Part 201 Particulate Soil Inhalation Criteria

bgs = below ground surface

NA = Not applicable

ID = insufficient data to develop a criterion

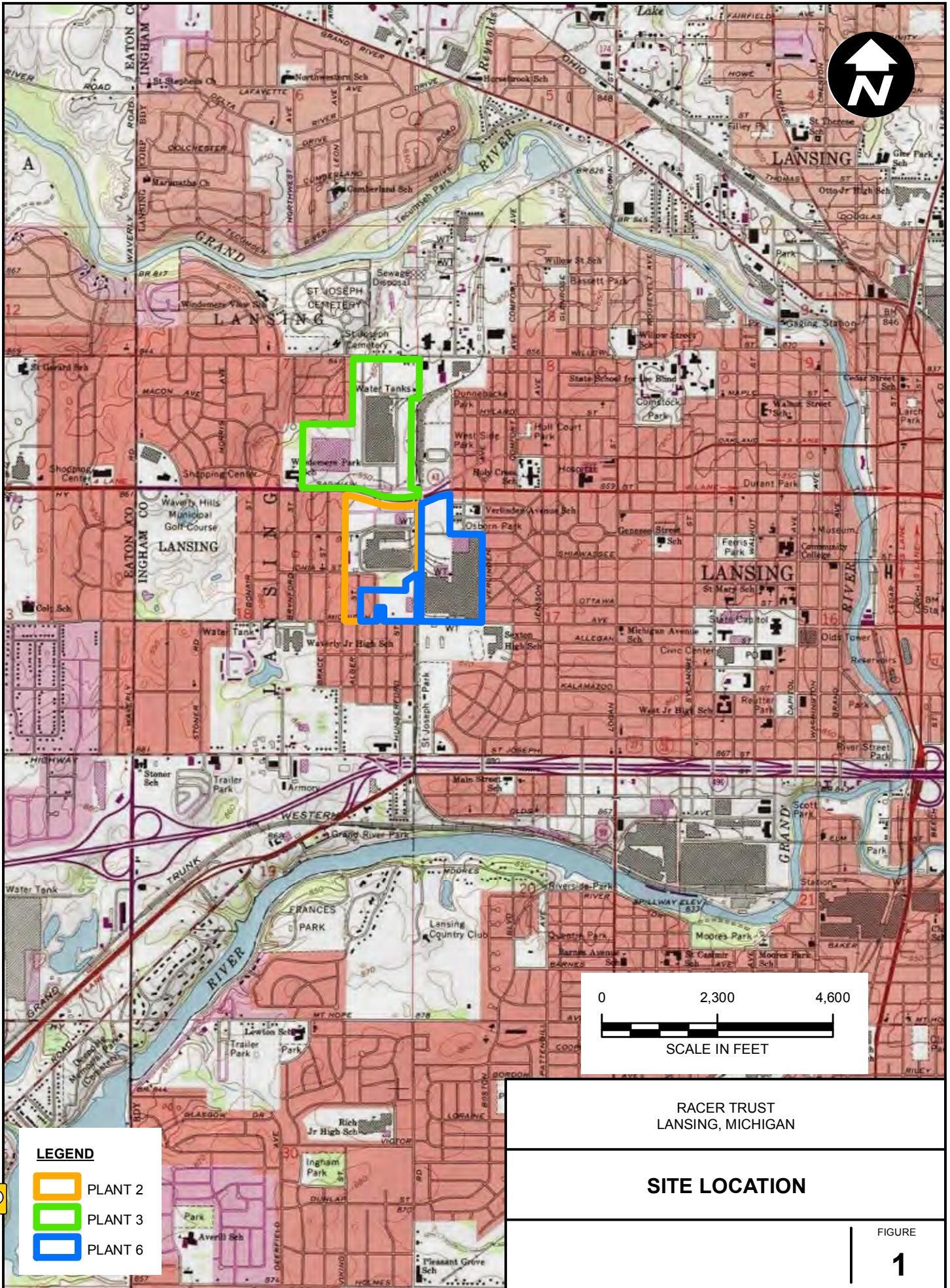
µg/kg = micrograms per kilogram

[a] based on a 5-acre source area, unless otherwise noted

[b] based on a 1/2-acre source area

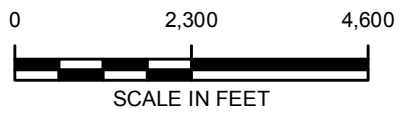
FIGURES





LEGEND

-  PLANT 2
-  PLANT 3
-  PLANT 6

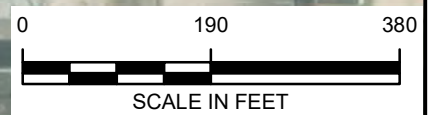
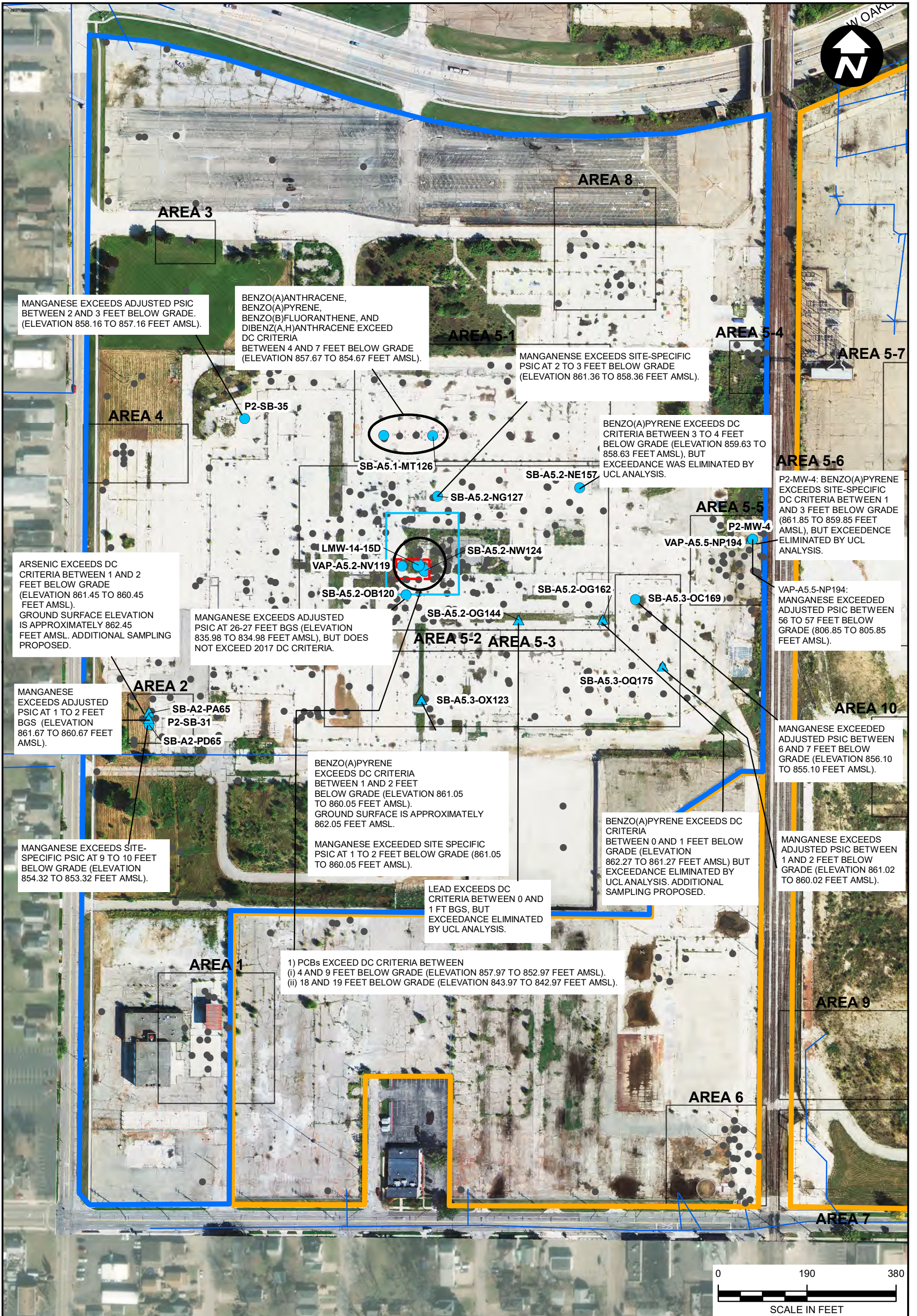


RACER TRUST
LANSING, MICHIGAN

SITE LOCATION

FIGURE

1



CITY: Novi DIV: ENV DB: TRY PIC: PM: PROJECT NUMBER: COORDINATE SYSTEM: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl TR: PROJECT NUMBER: COORDINATE SYSTEM: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl PLOT: 3/19/2020 12:26:23 PM BY: EBeyer G:\Projects\RACER\Lansing\WDXs\2020 P2 P3 Corrective Measures Workplan\Figure2_Plan12_S_Plan16_SoilCorrectiveMeasures.mxd

LEGEND

- ▲ 2013 EXCEEDANCE AT 0-2 FT BGS
- 2013 EXCEEDANCE > 2 FT BGS
- SOIL SAMPLE LOCATIONS BELOW DC AND PSIC CRITERIA
- CURRENT STORM SEWERS (OBG, MAY 2009)
- PLANT 2
- PLANT 6
- PCBs IN SOIL > 1 PPM BUT <= 10 PPM (HIGH OCCUPANCY WITH CAP)
- PCBs IN SOIL > 25 PPM BUT <= 100 PPM (LOW OCCUPANCY WITH CAP)

NOTES:
 1. ALL SOIL SAMPLES SHOWN COLLECTED PRIOR TO JULY 2012.
 2. COORDINATE SYSTEM IS IN NAD_1983_StatePlane_Michigan_South_FIPS_2113_Feet_Intl

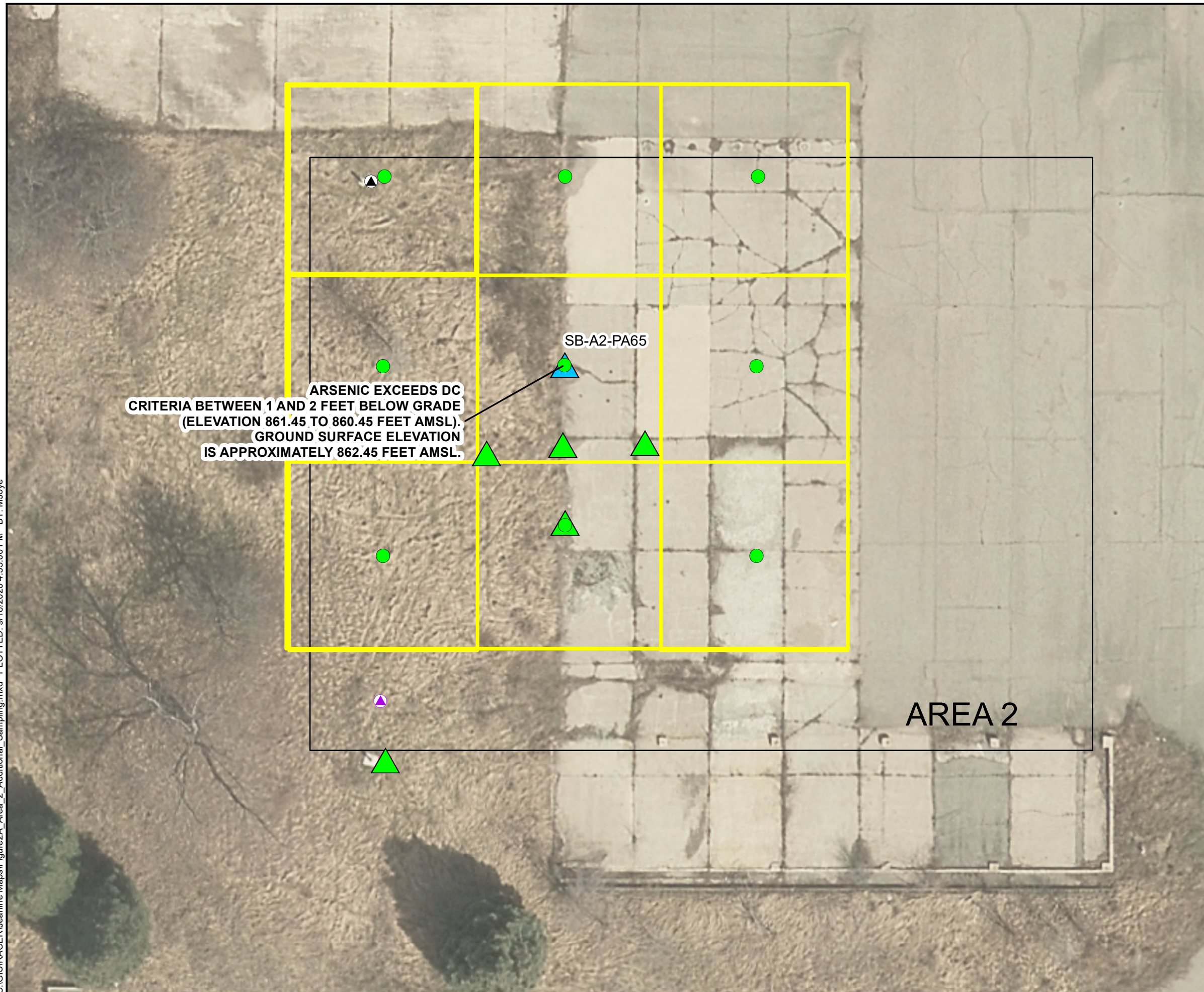
DC = NON-RESIDENTIAL DIRECT CONTACT CRITERIA (BASED ON EGLE DECEMBER 2013 CRITERIA)
 NR = NON-RESIDENTIAL
 AMSL = ABOVE MEAN SEA LEVEL
 EGLE = MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES AND ENERGY

RACER TRUST
PLANT 2
LANSING, MICHIGAN







**PLANT 2 AND SOUTHERN PLANT 6
SOIL CORRECTIVE MEASURES**

ARCADIS Design & Consultancy
for natural and built assets

FIGURE
2



LEGEND

-  2013 EXCEEDANCE AT 0-2 FT BGS
-  PERCHED ZONE MONITORING WELL
-  WEATHERED BEDROCK MONITORING WELL
-  BEDROCK MONITORING WELL
-  ADDITIONAL SAMPLING LOCATION
-  2013 NOT AN EXCEEDANCE AT 0-2 FT BGS

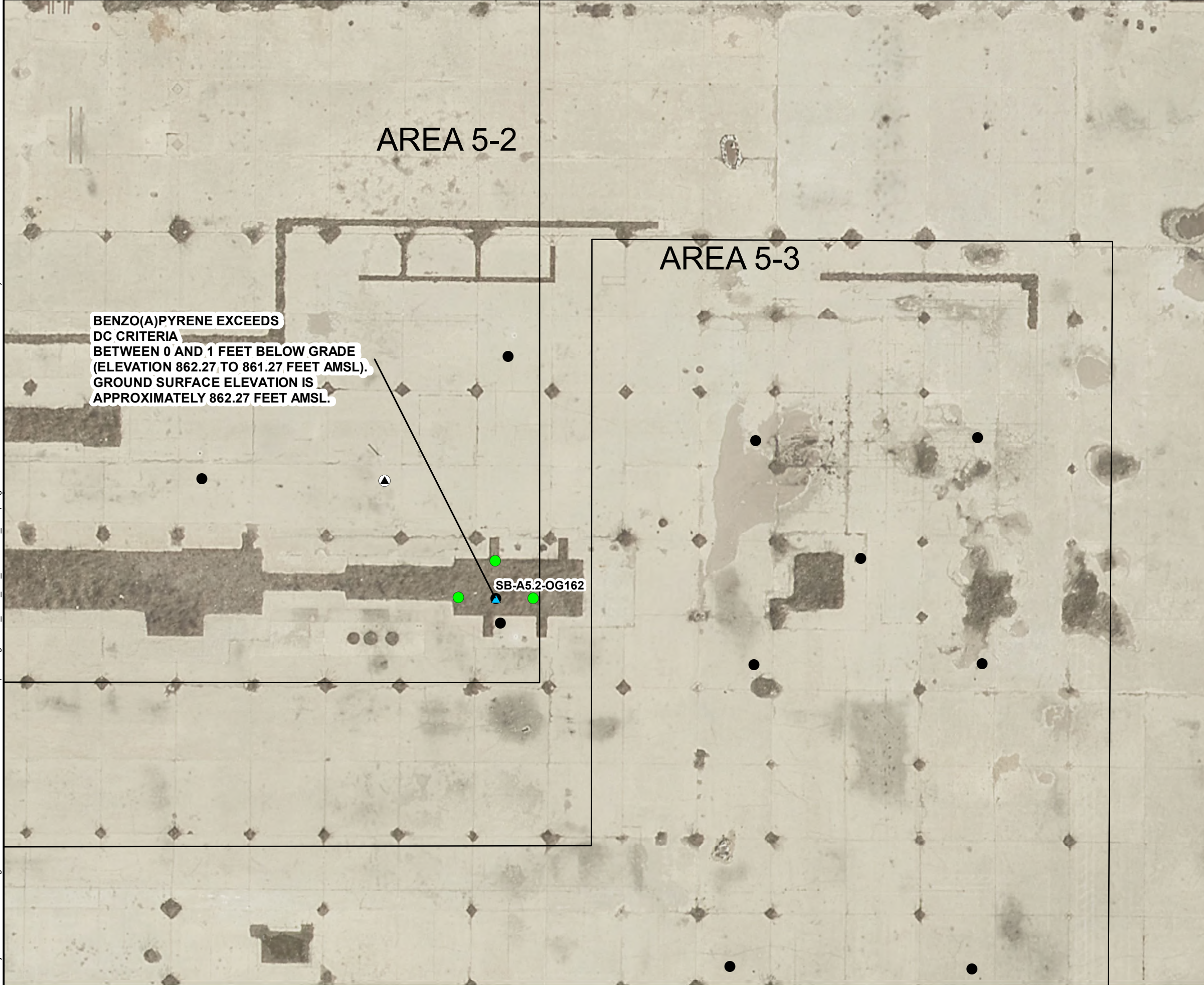
NOTE:
COORDINATE SYSTEM IS IN
NAD_1983_StatePlane_Michigan_South_FIPS_2113_Feet_Intl







RACER TRUST
PLANT 2
LANSING, MICHIGAN

AREA 2 ADDITIONAL SAMPLING

CITY: Novi DIV: ENV DB: TRY PIC: PM: TM: TR: PROJECT NUMBER: COORDINATE SYSTEM: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl
G:\Projects\RACER\Lansing\Docs\2020 P2 P3 Corrective Measures Workplan\Figure2C_Area_5-2_Additional_Sampling.mxd PLOTTED: 2/7/2020 9:02:58 AM BY: EBeyer



LEGEND

-  2013 EXCEEDANCE AT 0-2 FT BGS
-  SOIL SAMPLE LOCATIONS BELOW DC AND PSIC CRITERIA
-  PERCHED ZONE MONITORING WELL
-  ADDITIONAL SAMPLING LOCATION

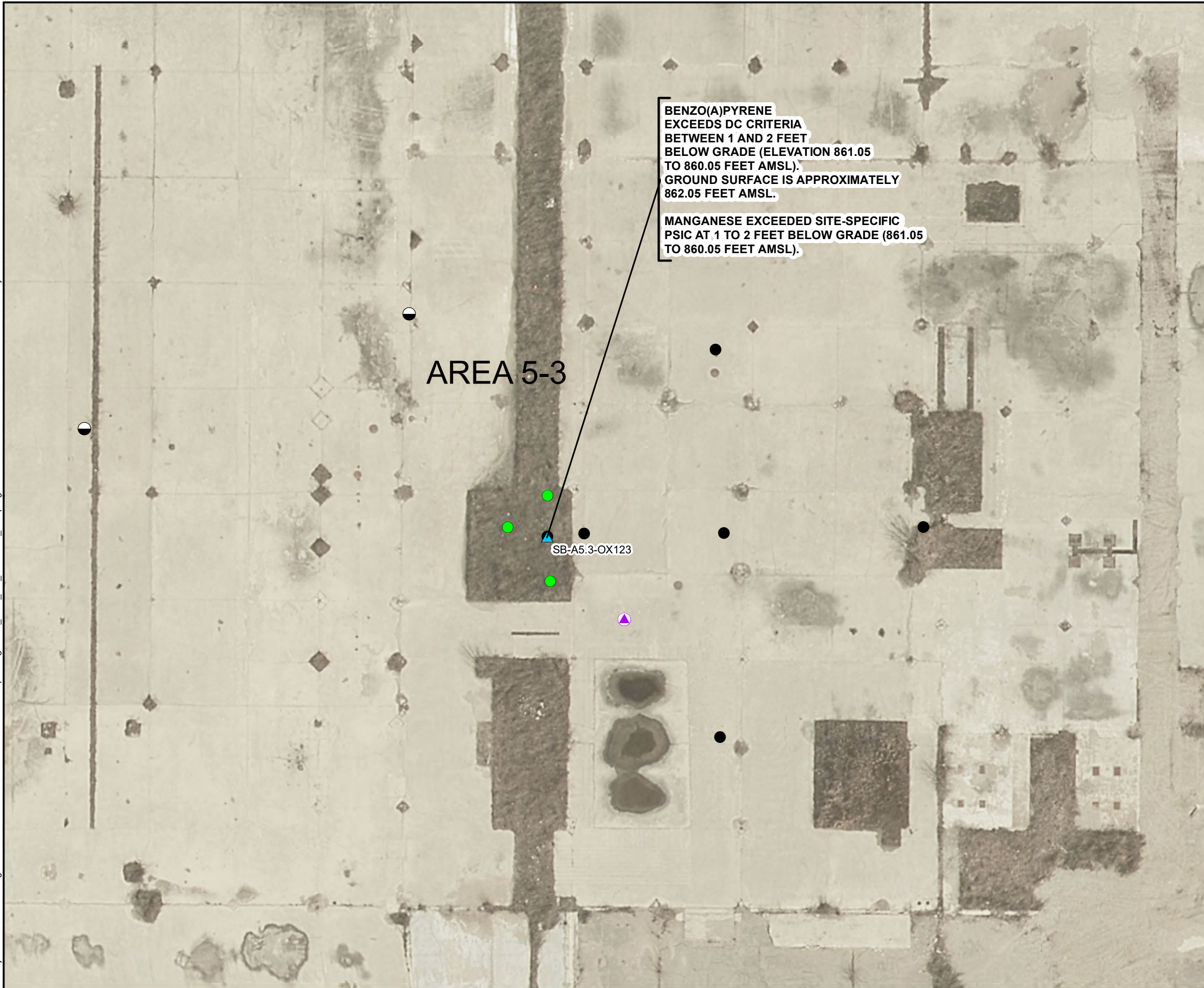
NOTE:
COORDINATE SYSTEM IS IN
NAD_1983_StatePlane_Michigan_South_FIPS_2113_Feet_Intl








RACER TRUST
PLANT 2
LANSING, MICHIGAN

AREA 5-2 ADDITIONAL SAMPLING

CITY: Novi DIV: ENV DB: TRY PIC: PM: TM: TR: PROJECT NUMBER: COORDINATE SYSTEM: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl
G:\Projects\RACER\Lansing\Docs\2020 P2 P3 Corrective Measures Workplan\Figure2D_Area_5-3_Additional_Sampling.mxd PLOTTED: 2/7/2020 12:14:19 PM BY: EBeyer



LEGEND

-  2013 EXCEEDANCE AT 0-2 FT BGS
-  HPT-VAP BORING LOCATION
-  SOIL SAMPLE LOCATIONS BELOW DC AND PSIC CRITERIA
-  WEATHERED BEDROCK MONITORING WELL
-  ADDITIONAL SAMPLING LOCATION

NOTE:
COORDINATE SYSTEM IS IN
NAD_1983_StatePlane_Michigan_South_FIPS_2113_Feet_Intl



RACER TRUST
PLANT 2
LANSING, MICHIGAN

AREA 5-3 ADDITIONAL SAMPLING



AREA 13

1) CYANIDE EXCEEDS DC CRITERIA AND SITE-SPECIFIC PSIC UP TO 2 FEET BELOW GRADE (ELEVATION 861.52 FEET AMSL).
 2) NICKEL EXCEEDS SITE-SPECIFIC PSIC 15 FEET BELOW GRADE (ELEVATION 848.52 FEET AMSL). GROUND SURFACE ELEVATION IS APPROXIMATELY 863.52 FEET AMSL.

BENZO(A)PYRENE EXCEEDS DC CRITERIA BETWEEN 1 AND 2 FEET BELOW GRADE (ELEVATION 858.69 TO 857.69 FEET AMSL). GROUND SURFACE ELEVATION IS APPROXIMATELY 859.69 FEET AMSL. ADDITIONAL SAMPLING PROPOSED.

ARSENIC EXCEEDS DC CRITERIA BETWEEN 43.5 AND 45 FEET BGS (ELEVATION 819.98 TO 818.48 FEET AMSL).

IN THESE AREAS
 1) CYANIDE EXCEEDS DC CRITERIA AND/OR SITE-SPECIFIC PSIC BETWEEN 5 AND 7 FEET BELOW GRADE (ELEVATION 858.91 TO 856.91), AND 10 AND 25 FEET BELOW GRADE (ELEVATION 853.91 TO 838.91 FEET AMSL).
 2) NICKEL EXCEEDS ADJUSTED PSIC BETWEEN 5 AND 12.5 FEET BELOW GRADE (ELEVATION 858.91 TO 851.41 FEET AMSL).

AREA 12

AREA 14

AREA 18

SB-A18-CJ150

AREA 17

110
69
15
70

AREA 20

P3-SB-13

P3-SB-13 MANGANESE EXCEEDS SITE-SPECIFIC PSIC CRITERIA FROM 17 TO 18 FEET BELOW GROUND SURFACE

MANGANESE EXCEEDS ADJUSTED PSIC BETWEEN 8-9 FEET BELOW GRADE.

1) ARSENIC EXCEEDS DC CRITERIA BETWEEN (i) 1 AND 2 FEET (ELEVATION 862.50 TO 860.50 FEET AMSL), (ii) 9 AND 10 FEET BELOW GRADE (ELEVATION 854.50 TO 853.50 FEET AMSL). GROUND SURFACE ELEVATION IS APPROXIMATELY 863.50 FEET AMSL.

AREA 16

AREA 21

P3-SB-27

AREA 11

AREA 15

AREA 19

SB-A19-HJ148

P3-SB-25

SB-A16-HD162

SB-A16-HU168

SB-A16-HU181

BENZO(A)PYRENE EXCEEDS DC CRITERIA BETWEEN 4 AND 5 FEET BELOW GRADE (ELEVATION 854.77 TO 853.77 FEET)

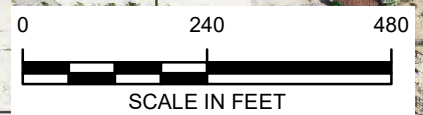
1) ARSENIC EXCEEDS DC CRITERIA BETWEEN 22 AND 23 FEET BELOW GRADE (ELEVATION 839.52 TO 838.52 FEET AMSL). APPROXIMATE GROUND SURFACE ELEVATION = 861.52 FEET AMSL.

LEAD EXCEEDS DC CRITERIA BETWEEN 9 AND 10 FEET BELOW GRADE (ELEVATION 850.04 TO 849.04 FEET AMSL).

LEAD EXCEEDS DC CRITERIA BETWEEN 4 AND 5 FEET BELOW GRADE (ELEVATION 854 TO 853 FEET AMSL).

AREA 8

AREA 3



LEGEND

- ▲ 2013 EXCEEDANCE AT 0-2 FT BGS
- 2013 EXCEEDANCE > 2 FT BGS
- SOIL SAMPLE LOCATIONS BELOW DC AND PSIC CRITERIA
- CURRENT STORM SEWERS (OBG, MAY 2009)
- PLANT 3
- PROPOSED EXPOSURE BARRIER

NOTES:
 1. COORDINATE SYSTEM IS IN NAD_1983_StatePlane_Michigan_South_FIPS_2113_Feet_Intl

DC = NON-RESIDENTIAL DIRECT CONTACT CRITERIA (BASED ON EGLE DECEMBER 2013 CRITERIA)
 PSIC = PARTICULATE SOIL INHALATION CRITERIA
 AMSL = ABOVE MEAN SEA LEVEL
 EGLE = MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES AND ENERGY

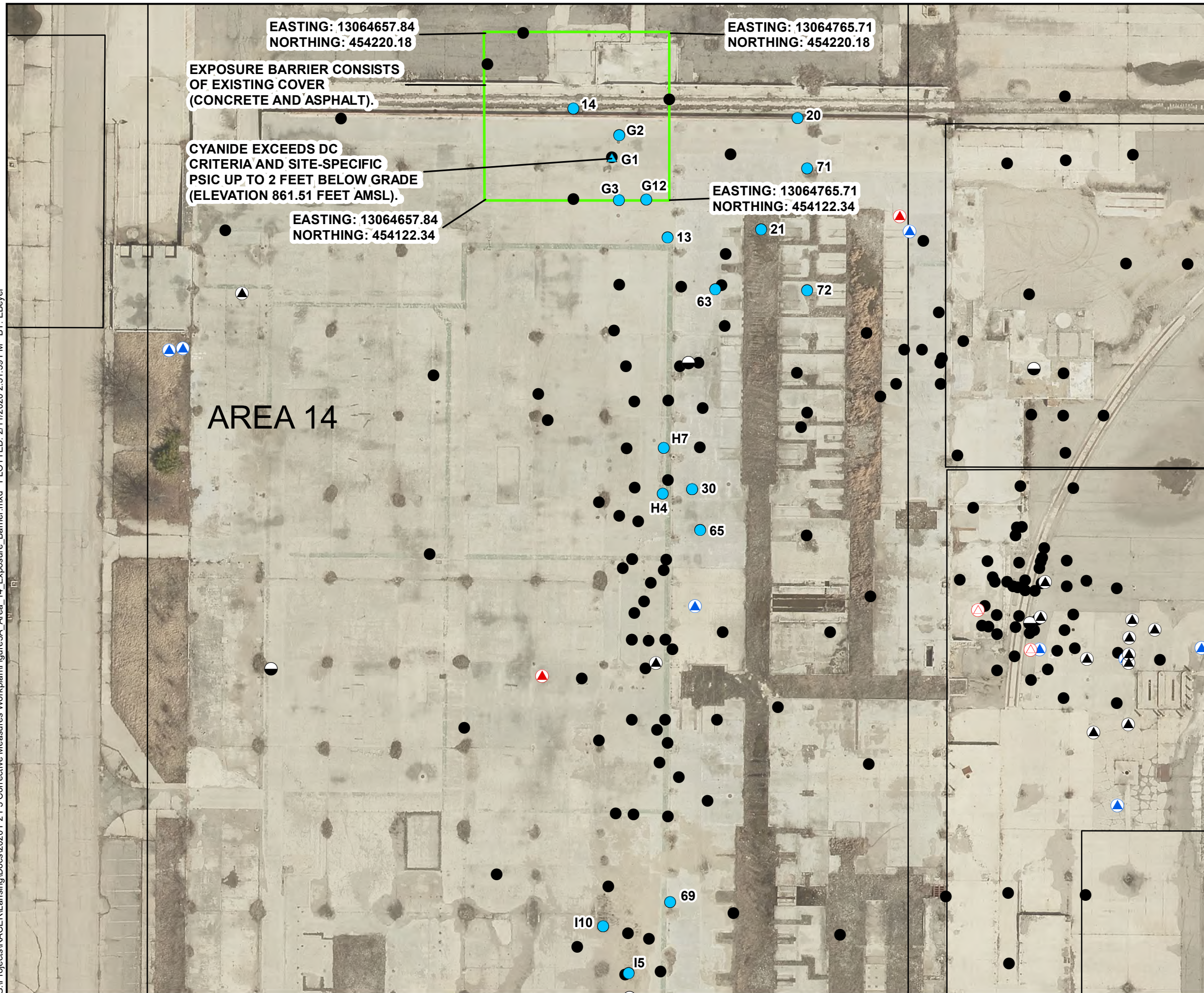
RACER TRUST
 PLANT 3
 LANSING, MICHIGAN

PLANT 3 SOIL CORRECTIVE MEASURES

ARCADIS Design & Consultancy
 for natural and built assets

FIGURE
3

CITY: Novi; DIV: ENV; DB: TRY; PIC: PM; TR: PROJECT NUMBER: COORDINATE SYSTEM: NAD_1983_StatePlane_Michigan_South_FIPS_2113_Feet_Intl; C:\GIS\RACER\Jeanine_Maps\Figure3_Plant3_Soil_Corrective_Measures.mxd; PLOTTED: 9/18/2020 5:31:23 PM; BY: MJOYE



Legend

- ▲ 2013 EXCEEDANCE AT 0-2 FT BGS
- 2013 EXCEEDANCE > 2 FT BGS
- SOIL SAMPLE LOCATIONS BELOW DC AND PSIC CRITERIA
- ▲ DEEP OVERBURDEN MONITORING WELL
- ▲ LNAPL MONITORING WELL
- ▲ PERCHED ZONE MONITORING WELL
- ▭ EXPOSURE BARRIER

NOTE:
LOCATIONS THAT HAVE EXCEEDANCES DEEPER THAN 2 FT BGS WILL BE ADDRESSED AS A NOTICE IN THE DECLARATION OF RESTRICTIVE CONVEANT FOR THE SITE. ANALYTICAL DATA FOR THESE LOCATIONS IS PROVIDED IN TABLE 2.

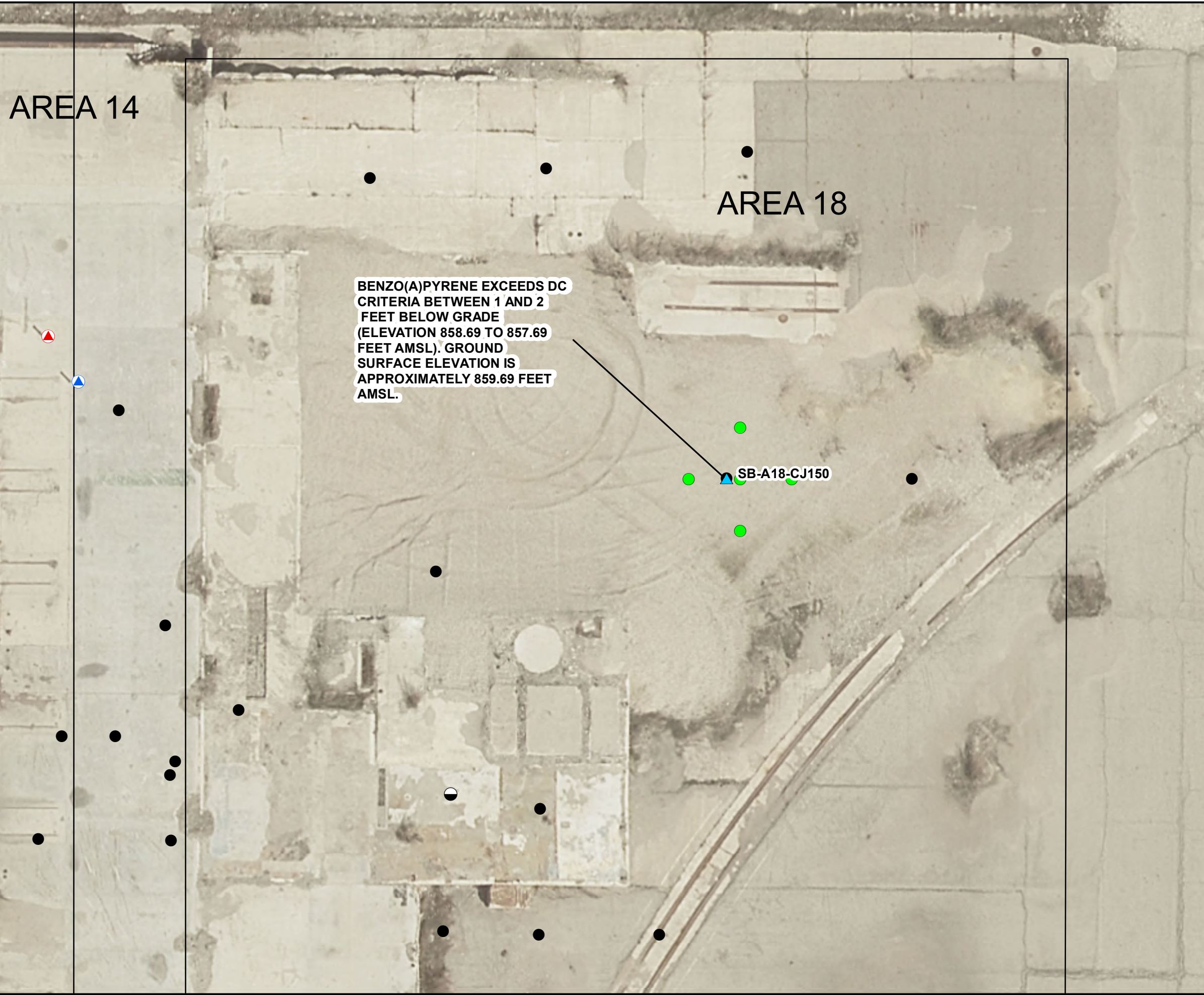
NOTE:
COORDINATE SYSTEM IS IN
NAD_1983_StatePlane_Michigan_South_FIPS_2113_Feet_Intl









RACER TRUST
PLANT 3
LANSING, MICHIGAN

AREA 14 EXPOSURE BARRIER

CITY: Novi DIV: ENV DB: TRY PIC: PM: TM: TR: PROJECT NUMBER: COORDINATE SYSTEM: NAD_1983_StatePlane_Michigan_South_FIPS_2113_Feet_Intl
G:\Projects\RACER\Lansing\Docs\2020 P2 Corrective Measures Workplan\Figure3B_Area18_Additional_Sampling.mxd PLOTTED: 2/7/2020 11:33:37 AM BY: EBeyer



Legend

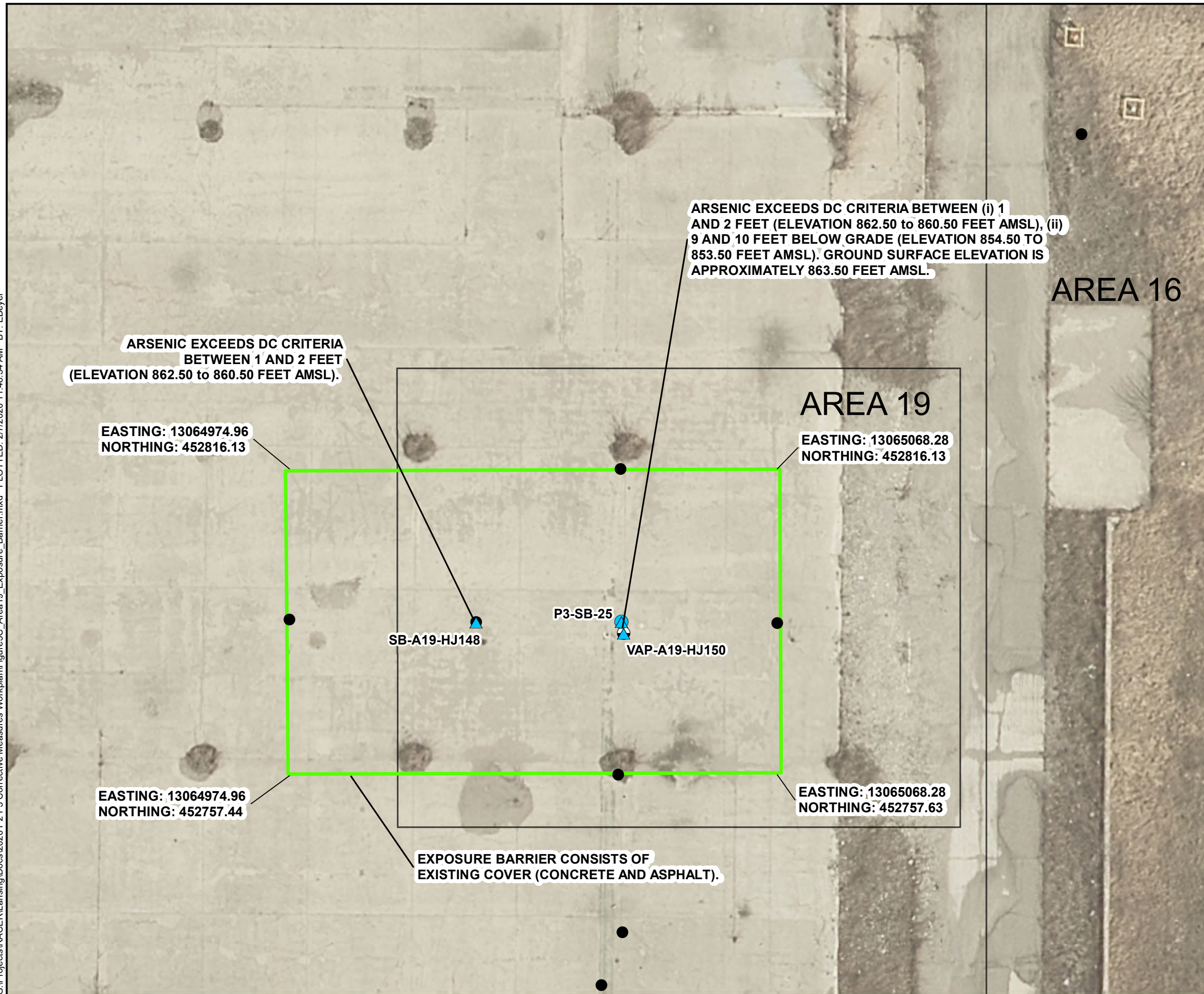
-  2013 EXCEEDANCE AT 0-2 FT BGS
-  HPT-VAP BORING LOCATION
-  SOIL SAMPLE LOCATIONS BELOW DC AND PSIC CRITERIA
-  DEEP OVERBURDEN MONITORING WELL
-  BEDROCK MONITORING WELL
-  ADDITIONAL SAMPLE LOCATION

NOTE:
COORDINATE SYSTEM IS IN
NAD_1983_StatePlane_Michigan_South_FIPS_2113_Feet_Intl







RACER TRUST
PLANT 3
LANSING, MICHIGAN

AREA 18 ADDITIONAL SAMPLING



Legend

-  2013 EXCEEDANCE AT 0-2 FT BGS
-  2013 EXCEEDANCE AT 0-2 FT BGS
-  SOIL SAMPLE LOCATIONS BELOW DC AND PSIC CRITERIA
-  EXPOSURE BARRIER

NOTE:
COORDINATE SYSTEM IS IN
NAD_1983_StatePlane_Michigan_South_FIPS_2113_Feet_Intl



RACER TRUST
PLANT 3
LANSING, MICHIGAN

AREA 19 EXPOSURE BARRIER

APPENDIX A

Statistical Evaluation



APPENDIX A – STATISTICAL EVALUATION

INTRODUCTION

As part of the Plants 2 & 3 Soil Corrective Measures Work plan (Work plan), Arcadis of Michigan, LLC (Arcadis), on behalf of Revitalizing Auto Communities Environmental Response (RACER) Trust, completed a statistical evaluation of soil data in the vicinity of exceedances of the Michigan Department of Environment, Great Lakes and Energy (EGLE) December 2013 Part 201 Generic Nonresidential (NR) Direct Contact Criteria (DCC). In general, the statistical evaluation follows the EGLE's Sampling Strategies and Statistics Training Materials for Part 201 Cleanup Criteria (S3TM; EGLE 2002) guidance.

Concentrations of arsenic, lead, and polycyclic aromatic hydrocarbons (PAHs) in several samples in Plants 2 and 3 exceeded the NR DCC and warranted additional evaluation to determine if an exposure barrier was required to limit the potential for direct contact with impacted soil. Exceedances located in the top 15 feet (ft) below ground surface (bgs) were evaluated statistically, as these soils could potentially be brought to the surface during future construction activities, while deeper exceedances will be addressed through the placement of a notification on the Amended Declaration of Restrictive Covenant (Amended DRC) that will be prepared for the Site.

Areas included in this statistical evaluation are:

- Area 5-2, Plant 2 – Lead, Benzo(a)pyrene
- Area 5-3, Plant 2 – Benzo(a)pyrene
- Area 5-5, Plant 2 – Benzo(a)pyrene
- Area 16, Plant 3 – Lead and Benzo(a)pyrene
- Area 19, Plant 3 – Arsenic
- Area 18, Plant 3 – Benzo(a)pyrene

No additional evaluation was completed for the following exceedances of the NR DCC:

- Area 5-1, Plant 2 – PAHs NR DCC exceedances at depth; notification on Amended DRC
- Area 5-2, Plant 2 – PCBs to be addressed by TSCA Plan
- Area 14, Plant 3 – Arsenic, cyanide, and nickel DCC exceedances at depth and a nickel site-specific Particulate Soil Inhalation Criteria exceedance in shallow soil; restriction on Amended DRC to maintain existing cover over a portion of Area 14; notification on Amended DRC for exceedances at depth
- Area 21, Plant 3 – Arsenic DCC exceedances at depth; notification on Amended DRC

The following sections provide an overview of the statistical evaluation process and a discussion of the results.

STATISTICAL APPROACH

The Site soil data were compared to the 2013 Part 201 NR DCC, and exceedances were identified. In general, two soil horizons (0 to 2 ft bgs and 0 to 15 ft bgs) were evaluated based on the potential for exposure to impacted soil at the Site. The 0 to 2 ft bgs soil interval was evaluated to address potential

current exposure to shallow soil as well as a future exposure scenario where limited soil disturbance has occurred (e.g., landscaping activities). The 0 to 15 ft bgs soil interval was evaluated to address future exposures during construction activities and/or where subsurface soil has been brought to the surface and redistributed. It is unlikely that soil deeper than 15 ft bgs would be encountered; therefore, for exceedances greater than 15 ft bgs, a statistical evaluation was not completed, and a notification will be placed on the Amended DRC.

Following the S3TM guidance, 2-acre exposure areas were identified for each of the NR DCC exceedances in the top 15 ft bgs, with the exception of Area 5-5, for which a smaller exposure area was identified. If a minimum of nine samples was available in an exposure area, a statistical evaluation, including the identification of the data distribution, an evaluation of potential outliers, and the calculation of a 95 percent upper confidence limit on the mean (95% UCL) was completed for that exposure area using the United States Environmental Protection Agency's (USEPA's) ProUCL software (version 5.1.002) (USEPA 2016). Although the soil sampling was not originally conducted following a random sampling approach, the available data generally provided good spatial coverage across the identified exposure areas.

If the 95% UCL is less than the NR DCC, no further action will be required for that exposure area, and a notification will not be placed in the Amended DRC. However, if the 95% UCL exceeds the NR DCC for the 0 to 2 ft bgs interval, additional sampling will be recommended to delineate the exceedance and the Amended DRC will include a requirement for maintaining the existing cover or adding cover materials if there is not currently a cover. If the 95% UCL for the 0 to 15 ft bgs interval exceeds the NR DCC and the elevated samples are located deeper than 2 ft bgs, a notification will be placed in the Amended DRC with the location of the exceedance.

AREA-SPECIFIC EVALUATIONS

The following sections provide the statistical evaluation for each specific area with exceedances. The soil data used in the statistical evaluation for each exposure area are provided in **Table A-1**. Sample locations and identified exposure areas are shown on **Figure A-1** through **Figure A-4**. A data summary is provided as **Table A-2**. The ProUCL output file is included as **Table A-3**, and an outlier analysis is included in **Table A-4**.

Plant 2, Area 5-2 – Lead

The concentration of lead (1,160,000 micrograms per kilogram [$\mu\text{g}/\text{kg}$]) in one sample (SB-A5.2-OG144 0-1 ft bgs) exceeded the NR DCC of 900,000 $\mu\text{g}/\text{kg}$ (see **Figure A-1**). The 2-acre exposure around this exceedance was identified as Exposure Area 2 (EA-2). Nine soil samples were collected and analyzed for lead in EA-2 from the 0 to 2 ft bgs interval, and the data appeared to follow a lognormal distribution. The maximum concentration in EA-2 was identified as a potential outlier (see **Table A-4**); however, this sample does not meet the definition as a “hot spot” per the S3TM guidance.¹ Therefore, a 95% UCL of

¹ The S3TM Guidance defines a “hot spot” as: “Two or more adjacent sample locations in reasonably close proximity at which concentrations are sufficiently above criteria and surrounding location (i.e., spatially correlated concentrations sufficiently above criteria) to indicate that they:

approximately 701,000 µg/kg was calculated using all nine samples (**Table A-2**). The 95% UCL does not exceed the NR DCC; therefore, no additional evaluation is warranted, and a notification will not be placed on the Amended DRC.

Plant 2, Area 5-2 – Benzo(a)pyrene

The concentration of benzo(a)pyrene in one shallow soil sample (28,000J µg/kg at SB-A5.2-OG162 0-1 ft bgs) and one deeper soil sample (11,000J µg/kg at SB-A5.2-NE157 3-4 ft bgs) exceeded the NR DCC of 8,000 µg/kg (see **Figure A-2**). The 2-acre exposure around these exceedances was identified as Exposure Area 3 (EA-3). A total of 13 soil samples were collected and analyzed for benzo(a)pyrene in EA-3 from the 0 to 2 ft bgs interval and a total of 37 soil samples were collected and analyzed for benzo(a)pyrene in EA-3 from the 0 to 15 ft bgs interval. The soil dataset from the 0 to 2 ft bgs interval followed a lognormal distribution, while the dataset from the 0 to 15 ft bgs interval did not follow a discernable distribution. The maximum concentration in EA-3, 28,000J µg/kg was identified as a potential outlier (see **Table A-4**); however, this sample does not meet the definition as a “hot spot” per the S3TM guidance. Although there are two exceedances within EA-3, they do not represent a hot spot area, as both exceedances are distinct and are well-defined by adjacent soil borings. Therefore, the 95% UCL was calculated for the 0 to 2 ft bgs interval (11,900 µg/kg) based on all 13 samples, and the 0 to 15 ft bgs interval (4,780 µg/kg) based on all 37 samples (**Table A-2**). The 95% UCL for the 0 to 15 ft bgs interval does not exceed the NR DCC; therefore, no additional evaluation is warranted for deeper soils, and a notification will not be placed on the Amended DRC. The 95% UCL for the 0 to 2 ft bgs interval exceeds the NR DCC; therefore, additional sampling is recommended to determine the extent of shallow soil impacts requiring an exposure barrier.

Plant 2, Area 5-3 – Benzo(a)pyrene

The concentration of benzo(a)pyrene (21,500J µg/kg) in one sample (SB-A5.3-OX123 1-2 ft bgs) exceeded the NR DCC of 8,000 µg/kg (see **Figure A-2**). The 2-acre exposure around this exceedance was identified as EA-2. Nine soil samples were collected and analyzed for benzo(a)pyrene in EA-2 from the 0 to 2 ft bgs interval, and the data appeared to follow a gamma and a lognormal distribution. The maximum concentration in EA-2 was identified as a potential outlier (see **Table A-4**); however, this sample does not meet the definition as a “hot spot” per the S3TM guidance. Therefore, a 95% UCL of approximately 24,900 µg/kg was calculated using all nine samples (**Table A-2**). The 95% UCL is greater than the maximum detected concentration and exceeds the NR DCC; therefore, additional sampling is recommended to determine the extent of shallow soil impacts requiring an exposure barrier.

Plant 2, Area 5-5 – Benzo(a)pyrene

The concentration of benzo(a)pyrene (9,400 µg/kg) in one sample (P2-MW-04 1-3 ft bgs) exceeded the NR DCC of 900,000 µg/kg (see **Figure A-2**). Due to the small size of Area 5-5 and the number of samples, Exposure Area 4 (EA-4) was identified as the extent of Area 5-5, which is approximately 0.72 acres. Twelve soil samples were collected and analyzed for benzo(a)pyrene in EA-4 from the 0 to 3 ft bgs

-
- *represent a different statistical population and*
 - *pose a potential risk that should not be masked by a statistical analysis.”*

interval (to be consistent with the 1 to 3 ft bgs depth of the exceedance), and the data appeared to follow a gamma and a lognormal distribution. The maximum concentration in EA-4 was identified as a potential outlier (see **Table A-4**); however, this sample does not meet the definition as a “hot spot” per the S3TM guidance. Therefore, a 95% UCL of approximately 6,810 µg/kg was calculated using all available samples (**Table A-2**). The 95% UCL does not exceed the NR DCC; therefore, no additional evaluation is warranted, and a notification will not be placed in the Amended DRC.

Plant 3, Area 16 – Lead

The concentration of lead in two deep soil samples (4,100,000 [7,230,000] µg/kg at SB-A16-HU168 9-10 ft bgs and 1,250,000 µg/kg at SB-A16-HU181 4-5 ft bgs) exceeded the NR DCC of 900,000 µg/kg (see **Figure A-3**). It should be noted that the soil samples collected from 0 to 2 ft bgs did not exceed the NR DCC. The 2-acre exposure around these deeper exceedances was identified as Exposure Area 5 (EA-5). A total of 34 soil samples were collected and analyzed for lead in EA-5 from the 0 to 15 ft bgs interval. The soil dataset from the 0 to 15 ft bgs interval did not follow a discernable distribution. The maximum concentration in EA-5, 4,100,000 [7,230,000] µg/kg, was identified as a potential outlier (see **Table A-4**). The 95% UCL calculated for the 0 to 15 ft bgs interval (964,000 µg/kg) based on all 34 samples exceeds the NR DCC. Because the shallow soil samples within the top 2 ft bgs do not exceed the NR DCC, a notification will be placed on the Amended DRC; however, a cover is not required for these exceedances.

Plant 3, Area 16 – Benzo(a)pyrene

The concentration of benzo(a)pyrene in one deep soil sample (33,000J µg/kg at SB-A16-HU165 4-5 ft bgs) exceeded the NR DCC of 8,000 µg/kg (see **Figure A-4**). It should be noted that the soil samples collected from 0 to 2 ft bgs did not exceed the NR DCC. The 2-acre exposure around this deeper exceedance was identified as Exposure Area 5 (EA-5). A total of 31 soil samples were collected and analyzed for benzo(a)pyrene in EA-5 from the 0 to 15 ft bgs interval. The soil dataset from the 0 to 15 ft bgs interval did not follow a discernable distribution. The maximum concentration in EA-5, 33,000J µg/kg was identified as a potential outlier (see **Table A-4**); however, this sample does not meet the definition as a “hot spot” per the S3TM guidance. The 95% UCL calculated for the 0 to 15 ft bgs interval (5,960 µg/kg) based on all 31 samples does not exceed the NR DCC; therefore, no additional evaluation is warranted, and a notification will not be placed in the Amended DRC.

Plant 3, Area 18 – Benzo(a)pyrene

The concentration of benzo(a)pyrene in one shallow soil sample (29,000 J µg/kg at SB-A18-CJ150 1-2 ft bgs) exceeded the NR DCC of 8,000 µg/kg (see **Figure A-4**). The 2-acre exposure around this exceedance was identified as Exposure Area 7 (EA-7). A total of 20 soil samples were collected and analyzed for benzo(a)pyrene in EA-7 from the 0 to 2 ft bgs interval. And followed a lognormal distribution. The maximum concentration in EA-7, 33,000J µg/kg was identified as an outlier (see **Table A-4**); however, this sample does not meet the definition as a “hot spot” per the S3TM guidance. The 95% UCL calculated for the 0 to 2 ft bgs interval (8,160 µg/kg) based on all 20 samples exceeds the NR DCC; therefore, additional sampling is recommended to determine the extent of shallow soil impacts requiring an exposure barrier.

Plant 3, Area 19 – Arsenic

The concentration of arsenic in two shallow soil samples (82,800 µg/kg at P3-SB-25 1-2 ft bgs and 48,100 [52,000] at VAP-A19-HJ150 1-2 ft bgs) and one deeper soil sample (77,200 µg/kg at P3-SB-25 9-10 ft bgs) exceeded the NR DCC of 37,000 µg/kg (see **Figure A-3**). The 2-acre exposure around these exceedances was identified as Exposure Area 6 (EA-6). A total of 10 soil samples were collected and analyzed for arsenic in EA-6 from the 0 to 2 ft bgs interval and a total of 33 soil samples were collected and analyzed for arsenic in EA-6 from the 0 to 15 ft bgs interval. The soil dataset from the 0 to 2 ft bgs interval followed a lognormal distribution, while the dataset from the 0 to 15 ft bgs interval did not follow a discernable distribution. The maximum concentration in EA-6, 82,800 µg/kg was not identified as a potential outlier for the 0 to 2 ft bgs but was for the 0 to 15 ft bgs interval (see **Table A-4**). The 95% UCL was calculated for the 0 to 2 ft bgs interval (58,700 µg/kg) based on all 10 samples, and the 0 to 15 ft bgs interval (24,900 µg/kg) based on all 33 samples (**Table A-2**). The 95% UCL for the 0 to 15 ft bgs interval does not exceed the NR DCC; therefore, no additional evaluation is warranted for deeper soils, and a notification for this exceedance will not be placed in the Amended DRC. The 95% UCL for the 0 to 2 ft bgs interval exceeds the NR DCC. Because this area is already mostly covered with asphalt, the existing cover will be maintained and a requirement for an exposure barrier will be placed in the Amended DRC.

Table A-1
Soil Data Used in the Statistical Evaluation
Appendix A, Statistical Evaluation
RACER Trust Plants 2 and 3
Lansing, Michigan

Group	Constituent	Sample Location	Depth (ft bgs)	Sample Date	Exposure Area	Original Data (µg/kg) (1)	Result (µg/kg) (2)	Detection Flag (3)
Lead_EA-2_0-2	Lead	SB-A5.2-OA138	1 - 2	5/10/2012	EA-2	44,800 J	44800	1
Lead_EA-2_0-2	Lead	SB-A5.2-OB120	1.5 - 2.5	5/22/2012	EA-2	2,630	2630	1
Lead_EA-2_0-2	Lead	SB-A5.2-OG138	0 - 1	5/7/2012	EA-2	55,700	55700	1
Lead_EA-2_0-2	Lead	SB-A5.2-OG138	1 - 2	5/10/2012	EA-2	1,690 J	1690	1
Lead_EA-2_0-2	Lead	SB-A5.2-OG144	0 - 1	5/4/2012	EA-2	1,160,000	1160000	1
Lead_EA-2_0-2	Lead	SB-A5.3-OT127	1 - 2	6/1/2012	EA-2	2,010	2010	1
Lead_EA-2_0-2	Lead	SB-A5.3-OX123	1 - 2	6/1/2012	EA-2	31,300	31300	1
Lead_EA-2_0-2	Lead	SB-A5.3-OX132	1 - 2	6/1/2012	EA-2	19,300	19300	1
Lead_EA-2_0-2	Lead	SB-A5.3-PC127	1 - 2	6/1/2012	EA-2	27,900	27900	1
Benzo(a)pyrene_EA-2_0-2	Benzo(a)pyrene	SB-A5.2-OA138	1 - 2	5/10/2012	EA-2	100	100	1
Benzo(a)pyrene_EA-2_0-2	Benzo(a)pyrene	SB-A5.2-OB120	1.5 - 2.5	5/22/2012	EA-2	<40	40	0
Benzo(a)pyrene_EA-2_0-2	Benzo(a)pyrene	SB-A5.2-OG138	0 - 1	5/7/2012	EA-2	960	960	1
Benzo(a)pyrene_EA-2_0-2	Benzo(a)pyrene	SB-A5.2-OG138	1 - 2	5/10/2012	EA-2	<40	40	0
Benzo(a)pyrene_EA-2_0-2	Benzo(a)pyrene	SB-A5.2-OG144	0 - 1	5/4/2012	EA-2	6,900 J	6900	1
Benzo(a)pyrene_EA-2_0-2	Benzo(a)pyrene	SB-A5.3-OT127	1 - 2	6/1/2012	EA-2	<300	300	0
Benzo(a)pyrene_EA-2_0-2	Benzo(a)pyrene	SB-A5.3-OX123	1 - 2	6/1/2012	EA-2	21,500 J	21500	1
Benzo(a)pyrene_EA-2_0-2	Benzo(a)pyrene	SB-A5.3-OX132	1 - 2	6/1/2012	EA-2	600	600	1
Benzo(a)pyrene_EA-2_0-2	Benzo(a)pyrene	SB-A5.3-PC127	1 - 2	6/1/2012	EA-2	210	210	1
Benzo(a)pyrene_EA-3_0-2	Benzo(a)pyrene	SB-A5.2-NE150	0 - 1	5/8/2012	EA-3	1,160	1160	1
Benzo(a)pyrene_EA-3_0-2	Benzo(a)pyrene	SB-A5.2-NE157	1 - 2	5/9/2012	EA-3	1,200 [800]	1000	1
Benzo(a)pyrene_EA-3_0-2	Benzo(a)pyrene	SB-A5.2-NJ162	1 - 2	5/7/2012	EA-3	<40 J	40	0
Benzo(a)pyrene_EA-3_0-2	Benzo(a)pyrene	SB-A5.2-NO150	1 - 2	5/8/2012	EA-3	50	50	1
Benzo(a)pyrene_EA-3_0-2	Benzo(a)pyrene	SB-A5.2-NO156	1 - 2	5/9/2012	EA-3	<40	40	0
Benzo(a)pyrene_EA-3_0-2	Benzo(a)pyrene	SB-A5.2-NO157	0 - 1	5/8/2012	EA-3	180	180	1
Benzo(a)pyrene_EA-3_0-2	Benzo(a)pyrene	SB-A5.2-OA162	1 - 2	5/7/2012	EA-3	<40	40	0
Benzo(a)pyrene_EA-3_0-2	Benzo(a)pyrene	SB-A5.2-OG162	0 - 1	5/7/2012	EA-3	28,000 J	28000	1
Benzo(a)pyrene_EA-3_0-2	Benzo(a)pyrene	SB-A5.2-OH162	1 - 2	5/10/2012	EA-3	<40	40	0
Benzo(a)pyrene_EA-3_0-2	Benzo(a)pyrene	SB-A5.3-OC169	1 - 2	5/31/2012	EA-3	220 J	220	1
Benzo(a)pyrene_EA-3_0-2	Benzo(a)pyrene	SB-A5.3-OC175	1 - 2	5/31/2012	EA-3	200	200	1
Benzo(a)pyrene_EA-3_0-2	Benzo(a)pyrene	SB-A5.3-OI169	1 - 2	5/31/2012	EA-3	110	110	1
Benzo(a)pyrene_EA-3_0-2	Benzo(a)pyrene	SB-A5.3-OI175	1 - 2	5/31/2012	EA-3	80	80	1
Benzo(a)pyrene_EA-3_0-15	Benzo(a)pyrene	SB-A5.2-NE150	0 - 1	5/8/2012	EA-3	1,160	1160	1
Benzo(a)pyrene_EA-3_0-15	Benzo(a)pyrene	SB-A5.2-NE157	1 - 2	5/9/2012	EA-3	1,200 [800]	1000	1
Benzo(a)pyrene_EA-3_0-15	Benzo(a)pyrene	SB-A5.2-NJ162	1 - 2	5/7/2012	EA-3	<40 J	40	0
Benzo(a)pyrene_EA-3_0-15	Benzo(a)pyrene	SB-A5.2-NO150	1 - 2	5/8/2012	EA-3	50	50	1
Benzo(a)pyrene_EA-3_0-15	Benzo(a)pyrene	SB-A5.2-NO156	1 - 2	5/9/2012	EA-3	<40	40	0
Benzo(a)pyrene_EA-3_0-15	Benzo(a)pyrene	SB-A5.2-NO157	0 - 1	5/8/2012	EA-3	180	180	1
Benzo(a)pyrene_EA-3_0-15	Benzo(a)pyrene	SB-A5.2-OA162	1 - 2	5/7/2012	EA-3	<40	40	0
Benzo(a)pyrene_EA-3_0-15	Benzo(a)pyrene	SB-A5.2-OG162	0 - 1	5/7/2012	EA-3	28,000 J	28000	1
Benzo(a)pyrene_EA-3_0-15	Benzo(a)pyrene	SB-A5.2-OH162	1 - 2	5/10/2012	EA-3	<40	40	0
Benzo(a)pyrene_EA-3_0-15	Benzo(a)pyrene	SB-A5.3-OC169	1 - 2	5/31/2012	EA-3	220 J	220	1
Benzo(a)pyrene_EA-3_0-15	Benzo(a)pyrene	SB-A5.3-OC175	1 - 2	5/31/2012	EA-3	200	200	1
Benzo(a)pyrene_EA-3_0-15	Benzo(a)pyrene	SB-A5.3-OI169	1 - 2	5/31/2012	EA-3	110	110	1
Benzo(a)pyrene_EA-3_0-15	Benzo(a)pyrene	SB-A5.3-OI175	1 - 2	5/31/2012	EA-3	80	80	1
Benzo(a)pyrene_EA-3_0-15	Benzo(a)pyrene	P2-SB-06	5 - 6	9/1/2011	EA-3	<200 J	200	0
Benzo(a)pyrene_EA-3_0-15	Benzo(a)pyrene	P2-SB-11	2 - 3	9/7/2011	EA-3	1,100	1100	1
Benzo(a)pyrene_EA-3_0-15	Benzo(a)pyrene	P2-SB-12	2 - 3	9/7/2011	EA-3	100	100	1
Benzo(a)pyrene_EA-3_0-15	Benzo(a)pyrene	P2-SB-15	4 - 5	9/7/2011	EA-3	<40	40	0
Benzo(a)pyrene_EA-3_0-15	Benzo(a)pyrene	P2-SB-15	9 - 10	9/7/2011	EA-3	<40	40	0
Benzo(a)pyrene_EA-3_0-15	Benzo(a)pyrene	SB-A5.2-NE150	5 - 6	5/8/2012	EA-3	<40 [<40]	40	0
Benzo(a)pyrene_EA-3_0-15	Benzo(a)pyrene	SB-A5.2-NE150	11 - 12	5/8/2012	EA-3	<40	40	0
Benzo(a)pyrene_EA-3_0-15	Benzo(a)pyrene	SB-A5.2-NE157	3 - 4	5/9/2012	EA-3	11,000 J	11000	1
Benzo(a)pyrene_EA-3_0-15	Benzo(a)pyrene	SB-A5.2-NE157	9 - 10	5/9/2012	EA-3	<40	40	0
Benzo(a)pyrene_EA-3_0-15	Benzo(a)pyrene	SB-A5.2-NJ162	7 - 8	5/7/2012	EA-3	<40	40	0
Benzo(a)pyrene_EA-3_0-15	Benzo(a)pyrene	SB-A5.2-NJ162	12 - 13	5/7/2012	EA-3	<40	40	0
Benzo(a)pyrene_EA-3_0-15	Benzo(a)pyrene	SB-A5.2-NO150	7 - 8	5/8/2012	EA-3	<40	40	0
Benzo(a)pyrene_EA-3_0-15	Benzo(a)pyrene	SB-A5.2-NO150	12 - 13	5/8/2012	EA-3	<40	40	0
Benzo(a)pyrene_EA-3_0-15	Benzo(a)pyrene	SB-A5.2-NO156	6 - 7	5/9/2012	EA-3	<40	40	0
Benzo(a)pyrene_EA-3_0-15	Benzo(a)pyrene	SB-A5.2-OA162	6 - 7	5/7/2012	EA-3	<400 J	400	0
Benzo(a)pyrene_EA-3_0-15	Benzo(a)pyrene	SB-A5.2-OA162	12 - 13	5/7/2012	EA-3	<40	40	0
Benzo(a)pyrene_EA-3_0-15	Benzo(a)pyrene	SB-A5.2-OD154	2 - 3	5/7/2012	EA-3	100 [60]	80	1
Benzo(a)pyrene_EA-3_0-15	Benzo(a)pyrene	SB-A5.2-OD154	9 - 10	5/7/2012	EA-3	<80	80	0
Benzo(a)pyrene_EA-3_0-15	Benzo(a)pyrene	SB-A5.2-OH162	7 - 8	5/10/2012	EA-3	<300	300	0
Benzo(a)pyrene_EA-3_0-15	Benzo(a)pyrene	SB-A5.2-OH162	13 - 14	5/10/2012	EA-3	<40	40	0
Benzo(a)pyrene_EA-3_0-15	Benzo(a)pyrene	SB-A5.3-OC169	6 - 7	5/31/2012	EA-3	<40	40	0
Benzo(a)pyrene_EA-3_0-15	Benzo(a)pyrene	SB-A5.3-OC175	5 - 6	5/31/2012	EA-3	<40	40	0
Benzo(a)pyrene_EA-3_0-15	Benzo(a)pyrene	SB-A5.3-OI169	6 - 7	5/31/2012	EA-3	<40	40	0

Table A-1
Soil Data Used in the Statistical Evaluation
Appendix A, Statistical Evaluation
RACER Trust Plants 2 and 3
Lansing, Michigan

Group	Constituent	Sample Location	Depth (ft bgs)	Sample Date	Exposure Area	Original Data (µg/kg) (1)	Result (µg/kg) (2)	Detection Flag (3)
Benzo(a)pyrene_EA-3_0-15	Benzo(a)pyrene	SB-A5.3-OI175	5 - 6	5/31/2012	EA-3	<40	40	0
Benzo(a)pyrene_EA-4_0-3	Benzo(a)pyrene	P2-B-2	1 - 2	9/8/2011	EA-4	<200	200	0
Benzo(a)pyrene_EA-4_0-3	Benzo(a)pyrene	P2-B-7	2 - 3	9/8/2011	EA-4	<40	40	0
Benzo(a)pyrene_EA-4_0-3	Benzo(a)pyrene	P2-MW-04	1 - 3	7/21/2011	EA-4	9,400	9400	1
Benzo(a)pyrene_EA-4_0-3	Benzo(a)pyrene	SB-A5.5-NL193	1 - 2	5/29/2012	EA-4	50	50	1
Benzo(a)pyrene_EA-4_0-3	Benzo(a)pyrene	SB-A5.5-NM187	1 - 2	5/24/2012	EA-4	1,800	1800	1
Benzo(a)pyrene_EA-4_0-3	Benzo(a)pyrene	SB-A5.5-NO196	1 - 2	5/25/2012	EA-4	160	160	1
Benzo(a)pyrene_EA-4_0-3	Benzo(a)pyrene	SB-A5.5-NQ185	1 - 2	5/24/2012	EA-4	<70 J	70	0
Benzo(a)pyrene_EA-4_0-3	Benzo(a)pyrene	SB-A5.5-NT196	0 - 1	5/25/2012	EA-4	180	180	1
Benzo(a)pyrene_EA-4_0-3	Benzo(a)pyrene	SB-A5.5-NU185	2 - 3	5/24/2012	EA-4	130 J	130	1
Benzo(a)pyrene_EA-4_0-3	Benzo(a)pyrene	SB-A5.5-NW194	0 - 1	5/29/2012	EA-4	900 J	900	1
Benzo(a)pyrene_EA-4_0-3	Benzo(a)pyrene	SB-A5.5-NW195	1 - 2	5/25/2012	EA-4	<40	40	0
Benzo(a)pyrene_EA-4_0-3	Benzo(a)pyrene	SB-A5.5-NX188	1 - 2	5/24/2012	EA-4	<40	40	0
Benzo(a)pyrene_EA-5_0-15	Benzo(a)pyrene	P3-SB-24	3 - 4	8/18/2011	EA-5	70	70	1
Benzo(a)pyrene_EA-5_0-15	Benzo(a)pyrene	P3-SB-24	9 - 10	8/18/2011	EA-5	<40	40	0
Benzo(a)pyrene_EA-5_0-15	Benzo(a)pyrene	P3-SB-31	2 - 3	8/18/2011	EA-5	50	50	1
Benzo(a)pyrene_EA-5_0-15	Benzo(a)pyrene	P3-SB-31	9 - 10	8/18/2011	EA-5	<40 [<40]	40	0
Benzo(a)pyrene_EA-5_0-15	Benzo(a)pyrene	SB-A16-GX162	1 - 2	6/5/2012	EA-5	<300	300	0
Benzo(a)pyrene_EA-5_0-15	Benzo(a)pyrene	SB-A16-GX162	7 - 8	6/5/2012	EA-5	<40	40	0
Benzo(a)pyrene_EA-5_0-15	Benzo(a)pyrene	SB-A16-HA159	0 - 1	6/5/2012	EA-5	470	470	1
Benzo(a)pyrene_EA-5_0-15	Benzo(a)pyrene	SB-A16-HA159	9 - 10	6/5/2012	EA-5	<40	40	0
Benzo(a)pyrene_EA-5_0-15	Benzo(a)pyrene	SB-A16-HA165	1 - 2	6/6/2012	EA-5	<70	70	0
Benzo(a)pyrene_EA-5_0-15	Benzo(a)pyrene	SB-A16-HA165	7 - 8	6/6/2012	EA-5	50 [<40]	50	1
Benzo(a)pyrene_EA-5_0-15	Benzo(a)pyrene	SB-A16-HA165	14 - 15	6/6/2012	EA-5	<40	40	0
Benzo(a)pyrene_EA-5_0-15	Benzo(a)pyrene	SB-A16-HD162	1 - 2	6/6/2012	EA-5	210	210	1
Benzo(a)pyrene_EA-5_0-15	Benzo(a)pyrene	SB-A16-HD162	8 - 9	6/6/2012	EA-5	<40 J [600 J]	600	1
Benzo(a)pyrene_EA-5_0-15	Benzo(a)pyrene	SB-A16-HP165	3 - 4	9/20/2012	EA-5	600	600	1
Benzo(a)pyrene_EA-5_0-15	Benzo(a)pyrene	SB-A16-HP165	9 - 10	9/20/2012	EA-5	<100	100	0
Benzo(a)pyrene_EA-5_0-15	Benzo(a)pyrene	SB-A16-HQ168	1 - 2	11/9/2012	EA-5	700 J [<100 J]	700	1
Benzo(a)pyrene_EA-5_0-15	Benzo(a)pyrene	SB-A16-HQ168	10 - 11	11/9/2012	EA-5	<100	100	0
Benzo(a)pyrene_EA-5_0-15	Benzo(a)pyrene	SB-A16-HR162	1 - 2	6/6/2012	EA-5	400	400	1
Benzo(a)pyrene_EA-5_0-15	Benzo(a)pyrene	SB-A16-HR162	9 - 10	6/6/2012	EA-5	<80	80	0
Benzo(a)pyrene_EA-5_0-15	Benzo(a)pyrene	SB-A16-HU160	1 - 2	6/6/2012	EA-5	200	200	1
Benzo(a)pyrene_EA-5_0-15	Benzo(a)pyrene	SB-A16-HU165	1 - 2	6/6/2012	EA-5	600 J	600	1
Benzo(a)pyrene_EA-5_0-15	Benzo(a)pyrene	SB-A16-HU165	4 - 5	6/6/2012	EA-5	33,000 J	33000	1
Benzo(a)pyrene_EA-5_0-15	Benzo(a)pyrene	SB-A16-HU168	4.5 - 5.5	9/20/2012	EA-5	600	600	1
Benzo(a)pyrene_EA-5_0-15	Benzo(a)pyrene	SB-A16-HU168	9 - 10	9/20/2012	EA-5	<100 [<100]	100	0
Benzo(a)pyrene_EA-5_0-15	Benzo(a)pyrene	SB-A16-HU171	1 - 2	11/9/2012	EA-5	<100	100	0
Benzo(a)pyrene_EA-5_0-15	Benzo(a)pyrene	SB-A16-HU171	12 - 13	11/9/2012	EA-5	<100 [<100]	100	0
Benzo(a)pyrene_EA-5_0-15	Benzo(a)pyrene	SB-A16-HX162	1 - 2	6/6/2012	EA-5	320	320	1
Benzo(a)pyrene_EA-5_0-15	Benzo(a)pyrene	SB-A16-HX162	8 - 9	6/6/2012	EA-5	500 J	500	1
Benzo(a)pyrene_EA-5_0-15	Benzo(a)pyrene	SB-A16-HX165	1 - 2	9/20/2012	EA-5	<100	100	0
Benzo(a)pyrene_EA-5_0-15	Benzo(a)pyrene	SB-A16-HY168	1 - 2	11/9/2012	EA-5	<100	100	0
Benzo(a)pyrene_EA-5_0-15	Benzo(a)pyrene	SB-A16-HY168	11 - 12	11/9/2012	EA-5	<100 [<200]	100	0
Lead_EA-5_0-15	Lead	P3-SB-24	3 - 4	8/18/2011	EA-5	6,650	6650	1
Lead_EA-5_0-15	Lead	P3-SB-24	9 - 10	8/18/2011	EA-5	9,270	9270	1
Lead_EA-5_0-15	Lead	P3-SB-31	2 - 3	8/18/2011	EA-5	9,040	9040	1
Lead_EA-5_0-15	Lead	P3-SB-31	9 - 10	8/18/2011	EA-5	2,730 [2,540]	2635	1
Lead_EA-5_0-15	Lead	SB-A16-GX162	1 - 2	6/5/2012	EA-5	17,000	17000	1
Lead_EA-5_0-15	Lead	SB-A16-GX162	7 - 8	6/5/2012	EA-5	4,700	4700	1
Lead_EA-5_0-15	Lead	SB-A16-HA159	0 - 1	6/5/2012	EA-5	20,400	20400	1
Lead_EA-5_0-15	Lead	SB-A16-HA159	9 - 10	6/5/2012	EA-5	2,740	2740	1
Lead_EA-5_0-15	Lead	SB-A16-HA165	1 - 2	6/6/2012	EA-5	8,210	8210	1
Lead_EA-5_0-15	Lead	SB-A16-HA165	7 - 8	6/6/2012	EA-5	8,380 [9,590]	8985	1
Lead_EA-5_0-15	Lead	SB-A16-HA165	14 - 15	6/6/2012	EA-5	2,000	2000	1
Lead_EA-5_0-15	Lead	SB-A16-HD162	1 - 2	6/6/2012	EA-5	13,300	13300	1
Lead_EA-5_0-15	Lead	SB-A16-HD162	8 - 9	6/6/2012	EA-5	7,100 [20,300]	13700	1
Lead_EA-5_0-15	Lead	SB-A16-HP165	3 - 4	9/20/2012	EA-5	12,800	12800	1
Lead_EA-5_0-15	Lead	SB-A16-HP165	9 - 10	9/20/2012	EA-5	29,800	29800	1
Lead_EA-5_0-15	Lead	SB-A16-HQ168	1 - 2	11/9/2012	EA-5	3,480 [4,800]	4140	1
Lead_EA-5_0-15	Lead	SB-A16-HQ168	10 - 11	11/9/2012	EA-5	8,050	8050	1
Lead_EA-5_0-15	Lead	SB-A16-HR162	1 - 2	6/6/2012	EA-5	11,400	11400	1
Lead_EA-5_0-15	Lead	SB-A16-HR162	9 - 10	6/6/2012	EA-5	7,900	7900	1
Lead_EA-5_0-15	Lead	SB-A16-HU160	1 - 2	6/6/2012	EA-5	17,200	17200	1
Lead_EA-5_0-15	Lead	SB-A16-HU165	1 - 2	6/6/2012	EA-5	18,300	18300	1
Lead_EA-5_0-15	Lead	SB-A16-HU165	4 - 5	6/6/2012	EA-5	10,600	10600	1
Lead_EA-5_0-15	Lead	SB-A16-HU168	4.5 - 5.5	9/20/2012	EA-5	5,290	5290	1

Table A-1
Soil Data Used in the Statistical Evaluation
Appendix A, Statistical Evaluation
RACER Trust Plants 2 and 3
Lansing, Michigan

Group	Constituent	Sample Location	Depth (ft bgs)	Sample Date	Exposure Area	Original Data (µg/kg) (1)	Result (µg/kg) (2)	Detection Flag (3)
Lead_EA-5_0-15	Lead	SB-A16-HU168	9 - 10	9/20/2012	EA-5	4,100,000 [7,230,000]	5665000	1
Lead_EA-5_0-15	Lead	SB-A16-HU171	1 - 2	11/9/2012	EA-5	5,390	5390	1
Lead_EA-5_0-15	Lead	SB-A16-HU171	12 - 13	11/9/2012	EA-5	7,940 [8,090]	8015	1
Lead_EA-5_0-15	Lead	SB-A16-HU181	0 - 1	7/10/2013	EA-5	427,000	427000	1
Lead_EA-5_0-15	Lead	SB-A16-HU181	4 - 5	7/10/2013	EA-5	1,250,000	1250000	1
Lead_EA-5_0-15	Lead	SB-A16-HU181	10 - 11	7/10/2013	EA-5	10,100	10100	1
Lead_EA-5_0-15	Lead	SB-A16-HX162	1 - 2	6/6/2012	EA-5	27,000	27000	1
Lead_EA-5_0-15	Lead	SB-A16-HX162	8 - 9	6/6/2012	EA-5	35,700	35700	1
Lead_EA-5_0-15	Lead	SB-A16-HX165	1 - 2	9/20/2012	EA-5	18,900	18900	1
Lead_EA-5_0-15	Lead	SB-A16-HY168	1 - 2	11/9/2012	EA-5	11,200	11200	1
Lead_EA-5_0-15	Lead	SB-A16-HY168	11 - 12	11/9/2012	EA-5	9,900 [10,300]	10100	1
Arsenic_EA-6_0-2	Arsenic	P3-SB-25	1 - 2	8/18/2011	EA-6	82800	82800	1
Arsenic_EA-6_0-2	Arsenic	SB-A15-HC113	1 - 2	5/16/2012	EA-6	1490	1490	1
Arsenic_EA-6_0-2	Arsenic	SB-A15-HC114	1 - 2	5/16/2012	EA-6	1000	1000	1
Arsenic_EA-6_0-2	Arsenic	SB-A15-HC115	1 - 2	5/16/2012	EA-6	1430	1430	1
Arsenic_EA-6_0-2	Arsenic	SB-A15-HE114	1 - 2	5/15/2012	EA-6	2930	2930	1
Arsenic_EA-6_0-2	Arsenic	SB-A19-HG150	1 - 2	6/6/2012	EA-6	1480	1480	1
Arsenic_EA-6_0-2	Arsenic	SB-A19-HJ148	1 - 2	6/6/2012	EA-6	41200	41200	1
Arsenic_EA-6_0-2	Arsenic	SB-A19-HJ153	1 - 2	6/6/2012	EA-6	580 [620]	600	1
Arsenic_EA-6_0-2	Arsenic	SB-A19-HM150	1 - 2	6/6/2012	EA-6	3580	3580	1
Arsenic_EA-6_0-2	Arsenic	VAP-A19-HJ150	1 - 2	6/6/2012	EA-6	48,100 [52,000]	50050	1
Arsenic_EA-6_0-15	Arsenic	P3-SB-25	1 - 2	8/18/2011	EA-6	82800	82800	1
Arsenic_EA-6_0-15	Arsenic	SB-A15-HC113	1 - 2	5/16/2012	EA-6	1490	1490	1
Arsenic_EA-6_0-15	Arsenic	SB-A15-HC114	1 - 2	5/16/2012	EA-6	1000	1000	1
Arsenic_EA-6_0-15	Arsenic	SB-A15-HC115	1 - 2	5/16/2012	EA-6	1430	1430	1
Arsenic_EA-6_0-15	Arsenic	SB-A15-HE114	1 - 2	5/15/2012	EA-6	2930	2930	1
Arsenic_EA-6_0-15	Arsenic	SB-A19-HG150	1 - 2	6/6/2012	EA-6	1480	1480	1
Arsenic_EA-6_0-15	Arsenic	SB-A19-HJ148	1 - 2	6/6/2012	EA-6	41200	41200	1
Arsenic_EA-6_0-15	Arsenic	SB-A19-HJ153	1 - 2	6/6/2012	EA-6	580 [620]	600	1
Arsenic_EA-6_0-15	Arsenic	SB-A19-HM150	1 - 2	6/6/2012	EA-6	3580	3580	1
Arsenic_EA-6_0-15	Arsenic	VAP-A19-HJ150	1 - 2	6/6/2012	EA-6	48,100 [52,000]	50050	1
Arsenic_EA-6_0-15	Arsenic	P3-SB-23	4 - 5	8/18/2011	EA-6	580	580	1
Arsenic_EA-6_0-15	Arsenic	P3-SB-25	9 - 10	8/18/2011	EA-6	77200	77200	1
Arsenic_EA-6_0-15	Arsenic	P3-SB-26	6 - 7	8/18/2011	EA-6	700	700	1
Arsenic_EA-6_0-15	Arsenic	P3-SB-26	11 - 12	8/18/2011	EA-6	1910	1910	1
Arsenic_EA-6_0-15	Arsenic	SB-A15-HC114	3 - 4	5/16/2012	EA-6	860	860	1
Arsenic_EA-6_0-15	Arsenic	SB-A15-HC115	12 - 13	5/16/2012	EA-6	1,500 [1,840]	1670	1
Arsenic_EA-6_0-15	Arsenic	SB-A19-HG150	6 - 7	6/6/2012	EA-6	990	990	1
Arsenic_EA-6_0-15	Arsenic	SB-A19-HG150	12.5 - 13.5	6/6/2012	EA-6	230	230	1
Arsenic_EA-6_0-15	Arsenic	SB-A19-HG150	14 - 15	6/6/2012	EA-6	760	760	1
Arsenic_EA-6_0-15	Arsenic	SB-A19-HJ144	4 - 5	9/18/2012	EA-6	1830	1830	1
Arsenic_EA-6_0-15	Arsenic	SB-A19-HJ144	7 - 8	9/18/2012	EA-6	440 [400]	420	1
Arsenic_EA-6_0-15	Arsenic	SB-A19-HJ148	8 - 9	6/6/2012	EA-6	610	610	1
Arsenic_EA-6_0-15	Arsenic	SB-A19-HJ148	13 - 14	6/6/2012	EA-6	<100	100	0
Arsenic_EA-6_0-15	Arsenic	SB-A19-HJ148	14 - 15	6/6/2012	EA-6	880	880	1
Arsenic_EA-6_0-15	Arsenic	SB-A19-HJ153	6 - 7	6/6/2012	EA-6	610	610	1
Arsenic_EA-6_0-15	Arsenic	SB-A19-HJ153	11 - 12	6/6/2012	EA-6	1170	1170	1
Arsenic_EA-6_0-15	Arsenic	SB-A19-HJ153	12 - 13	6/6/2012	EA-6	1430	1430	1
Arsenic_EA-6_0-15	Arsenic	SB-A19-HM150	8.5 - 9.5	6/6/2012	EA-6	850	850	1
Arsenic_EA-6_0-15	Arsenic	SB-A19-HM150	13 - 14	6/6/2012	EA-6	470	470	1
Arsenic_EA-6_0-15	Arsenic	SB-A19-HM150	18 - 19	6/6/2012	EA-6	1000	1000	1
Arsenic_EA-6_0-15	Arsenic	SB-A19-HQ150	2 - 3	9/18/2012	EA-6	980	980	1
Arsenic_EA-6_0-15	Arsenic	SB-A19-HQ150	9.5 - 10.5	9/18/2012	EA-6	1300	1300	1
Arsenic_EA-6_0-15	Arsenic	VAP-A19-HJ150	7 - 8	6/6/2012	EA-6	2180	2180	1
Benzo(a)pyrene_EA-7_0-2	Benzo(a)pyrene	P3-SB-06	1 - 2	8/12/2011	EA-7	<30	30	0
Benzo(a)pyrene_EA-7_0-2	Benzo(a)pyrene	SB-A17-DA145	1 - 2	5/14/2012	EA-7	<200	200	0
Benzo(a)pyrene_EA-7_0-2	Benzo(a)pyrene	SB-A17-DC142	1 - 2	5/11/2012	EA-7	270	270	1
Benzo(a)pyrene_EA-7_0-2	Benzo(a)pyrene	SB-A17-DC143	0 - 1	5/14/2012	EA-7	530	530	1
Benzo(a)pyrene_EA-7_0-2	Benzo(a)pyrene	SB-A17-DC147	1 - 2	5/14/2012	EA-7	70	70	1
Benzo(a)pyrene_EA-7_0-2	Benzo(a)pyrene	SB-A17-DE141	1 - 2	5/14/2012	EA-7	160	160	1
Benzo(a)pyrene_EA-7_0-2	Benzo(a)pyrene	SB-A17-DF142	1 - 2	5/11/2012	EA-7	<40	40	0
Benzo(a)pyrene_EA-7_0-2	Benzo(a)pyrene	SB-A17-DF146	1 - 2	5/11/2012	EA-7	<30	30	0
Benzo(a)pyrene_EA-7_0-2	Benzo(a)pyrene	SB-A17-DH145	0 - 1	5/11/2012	EA-7	1,400	1400	1
Benzo(a)pyrene_EA-7_0-2	Benzo(a)pyrene	SB-A18-CD146	0.5 - 1	5/15/2012	EA-7	<40	40	0
Benzo(a)pyrene_EA-7_0-2	Benzo(a)pyrene	SB-A18-CD150	1 - 2	9/12/2012	EA-7	<100	100	0
Benzo(a)pyrene_EA-7_0-2	Benzo(a)pyrene	SB-A18-CI138	1 - 2	5/15/2012	EA-7	<40	40	0
Benzo(a)pyrene_EA-7_0-2	Benzo(a)pyrene	SB-A18-CJ150	1 - 2	5/15/2012	EA-7	29,000 J	29000	1

Table A-1
Soil Data Used in the Statistical Evaluation
Appendix A, Statistical Evaluation
RACER Trust Plants 2 and 3
Lansing, Michigan

Group	Constituent	Sample Location	Depth (ft bgs)	Sample Date	Exposure Area	Original Data (µg/kg) (1)	Result (µg/kg) (2)	Detection Flag (3)
Benzo(a)pyrene_EA-7_0-2	Benzo(a)pyrene	SB-A18-CJ178	1 - 2	11/8/2012	EA-7	<100	100	0
Benzo(a)pyrene_EA-7_0-2	Benzo(a)pyrene	SB-A18-CQ146	0.5 - 1	5/15/2012	EA-7	2,100 J [270 J]	1185	1
Benzo(a)pyrene_EA-7_0-2	Benzo(a)pyrene	SB-A18-CS144	1 - 2	5/14/2012	EA-7	<40	40	0
Benzo(a)pyrene_EA-7_0-2	Benzo(a)pyrene	SB-A18-CS148	1 - 2	5/14/2012	EA-7	100	100	1
Benzo(a)pyrene_EA-7_0-2	Benzo(a)pyrene	SB-A18-CU146	1 - 2	5/14/2012	EA-7	100	100	1
Benzo(a)pyrene_EA-7_0-2	Benzo(a)pyrene	VAP-A17-DE144	1 - 2	5/18/2012	EA-7	<40	40	0
Benzo(a)pyrene_EA-7_0-2	Benzo(a)pyrene	VAP-A18-CP144	1 - 2	5/17/2012	EA-7	<40	40	0

Notes:

(1) Duplicate results are shown in square brackets.

(2) For duplicate pairs, if both were detected, the average is shown; if both were non-detected, the minimum reporting limit is shown; if one was detected and one was not detected, the detection is shown.

(3) 1 = detection; 0 = non-detect.

< = less than

ft bgs = feet below ground surface

J = estimated result

µg/kg = micrograms per kilogram

Table A-2
Statistical Summary
Appendix A, Statistical Evaluation
RACER Trust Plants 2 and 3
Lansing, Michigan

Exposure Area	Constituent	Depth Interval (ft bgs)	Total Sample Size	% ND	FOD%	Minimum Detected (µg/kg)	Mean Detected (µg/kg)	Maximum Detected (µg/kg)	Data Distribution	Selected UCL Method	Selected UCL Value (µg/kg)	Note	Distribution for UCL Selection
EA-2	Lead	0-2	9	0%	100%	1690	149481	1160000	Lognormal	95% Chebyshev(Mean, Sd) UCL	700,784	(1)	Nonparametric
EA-2	Benzo(a)pyrene	0-2	9	33%	67%	100	5045	21500	Gamma, Lognormal	Gamma Adjusted KM-UCL	24,886	(2)	Gamma
EA-3	Benzo(a)pyrene	0-2	13	31%	69%	50	3444	28000	Lognormal	95% KM (Chebyshev) UCL	11,885	(1)	Nonparametric
EA-3	Benzo(a)pyrene	0-15	37	65%	35%	50	3329	28000	No Discernable Distribution	95% KM (Chebyshev) UCL	4,784		Nonparametric
EA-4	Benzo(a)pyrene	0-3	12	42%	58%	50	1803	9400	Gamma, Lognormal	Gamma Adjusted KM-UCL	6,811	(2)	Gamma
EA-5	Lead	0-15	34	0%	100%	2000	226839	5665000	No Discernable Distribution	95% Chebyshev (Mean, Sd) UCL	964,049		Nonparametric
EA-5	Benzo(a)pyrene	0-15	31	52%	48%	50	2558	33000	No Discernable Distribution	95% KM (Chebyshev) UCL	5,960		Nonparametric
EA-6	Arsenic	0-2	10	0%	100%	600	18656	82800	Lognormal	95% Chebyshev(Mean, Sd) UCL	58,730	(1)	Nonparametric
EA-6	Arsenic	0-15	33	3%	97%	230	8912	82800	No Discernable Distribution	95% KM (Chebyshev) UCL	24,865		Nonparametric
EA-7	Benzo(a)pyrene	0-2	20	55%	45%	70	3646	29000	Lognormal	95% KM (Chebyshev) UCL	8,155		Nonparametric

Notes:

(1) A greater than 95 percent UCL was recommended. Therefore, the 95% UCL following the same method was selected.

(2) More than one 95% UCL was recommended; the minimum recommended 95% UCL was selected.

% = percent

FOD = frequency of detection

ft bgs = feet below ground surface

ND = non-detects

µg/kg = micrograms per kilogram

UCL = upper confidence limit on the mean

UCL Statistics for Data Sets with Non-Detects

User Selected Options
 Date/Time of Computation ProUCL 5.19/18/2020 8:49:23 AM
 From File Appendix A Tables.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Result (lead_ea-2_0-2)

General Statistics			
Total Number of Observations	9	Number of Distinct Observations	9
		Number of Missing Observations	0
Minimum	1690	Mean	149481
Maximum	1160000	Median	27900
SD	379433	Std. Error of Mean	126478
Coefficient of Variation	2.538	Skewness	2.985

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.436	Data Not Normal at 5% Significance Level	
5% Shapiro Wilk Critical Value	0.829	Lilliefors GOF Test	
Lilliefors Test Statistic	0.486	Data Not Normal at 5% Significance Level	
5% Lilliefors Critical Value	0.274		

Data Not Normal at 5% Significance Level

Assuming Normal Distribution		95% UCLs (Adjusted for Skewness)	
95% Normal UCL		95% Adjusted-CLT UCL (Chen-1995)	491994
95% Student's-t UCL	384672	95% Modified-t UCL (Johnson-1978)	405648

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	1.018	Data Not Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.801	Kolmogorov-Smirnov Gamma GOF Test	
K-S Test Statistic	0.347	Data Not Gamma Distributed at 5% Significance Level	
5% K-S Critical Value	0.3		

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics		Gamma Statistics	
k hat (MLE)	0.334	k star (bias corrected MLE)	0.297
Theta hat (MLE)	447667	Theta star (bias corrected MLE)	503844
nu hat (MLE)	6.01	nu star (bias corrected)	5.34
MLE Mean (bias corrected)	149481	MLE Sd (bias corrected)	274436
Adjusted Level of Significance	0.0231	Approximate Chi Square Value (0.05)	1.313
		Adjusted Chi Square Value	0.941

Assuming Gamma Distribution		Assuming Gamma Distribution	
95% Approximate Gamma UCL (use when n>=50)	608179	95% Adjusted Gamma UCL (use when n<50)	848445

Lognormal GOF Test		Shapiro Wilk Lognormal GOF Test	
Shapiro Wilk Test Statistic	0.899	Data appear Lognormal at 5% Significance Level	
5% Shapiro Wilk Critical Value	0.829	Lilliefors Lognormal GOF Test	
Lilliefors Test Statistic	0.195	Data appear Lognormal at 5% Significance Level	
5% Lilliefors Critical Value	0.274		

Data appear Lognormal at 5% Significance Level

Lognormal Statistics		Lognormal Statistics	
Minimum of Logged Data	7.432	Mean of logged Data	9.886
Maximum of Logged Data	13.96	SD of logged Data	2.061

Assuming Lognormal Distribution		Assuming Lognormal Distribution	
95% H-UCL	11857173	90% Chebyshev (MVUE) UCL	305218
95% Chebyshev (MVUE) UCL	397987	97.5% Chebyshev (MVUE) UCL	526746
99% Chebyshev (MVUE) UCL	779668		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs		Nonparametric Distribution Free UCLs	
95% CLT UCL	357518	95% Jackknife UCL	384672
95% Standard Bootstrap UCL	347475	95% Bootstrap-t UCL	3350454
95% Hall's Bootstrap UCL	1837724	95% Percentile Bootstrap UCL	401716
95% BCA Bootstrap UCL	530198		
90% Chebyshev(Mean, Sd) UCL	528914	95% Chebyshev(Mean, Sd) UCL	700784
97.5% Chebyshev(Mean, Sd) UCL	939333	99% Chebyshev(Mean, Sd) UCL	1407917

Suggested UCL to Use
99% Chebyshev (Mean, Sd) UCL 1407917

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness. These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Result (benzo(a)pyrene_ea-2_0-2)

General Statistics			
Total Number of Observations	9	Number of Distinct Observations	8
Number of Detects	6	Number of Non-Detects	3
Number of Distinct Detects	6	Number of Distinct Non-Detects	2
Minimum Detect	100	Minimum Non-Detect	40
Maximum Detect	21500	Maximum Non-Detect	300
Variance Detects	71696710	Percent Non-Detects	33.33%
Mean Detects	5045	SD Detects	8467
Median Detects	780	CV Detects	1.678
Skewness Detects	2.012	Kurtosis Detects	3.982
Mean of Logged Detects	7.005	SD of Logged Detects	2.054

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.685	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.788	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.352	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.325	Detected Data Not Normal at 5% Significance Level	

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
KM Mean	3383	KM Standard Error of Mean	2459
KM SD	6735	95% KM (BCA) UCL	7498
95% KM (t) UCL	7956	95% KM (Percentile Bootstrap) UCL	7383
95% KM (z) UCL	7428	95% KM Bootstrap t UCL	68294
90% KM Chebyshev UCL	10761	95% KM Chebyshev UCL	14102
97.5% KM Chebyshev UCL	18741	99% KM Chebyshev UCL	27852

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.418	Anderson-Darling GOF Test	
5% A-D Critical Value	0.747	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.29	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.352	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.428	k star (bias corrected MLE)	0.325
Theta hat (MLE)	11788	Theta star (bias corrected MLE)	15518
nu hat (MLE)	5.136	nu star (bias corrected)	3.901
Mean (detects)	5045		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	3363
Maximum	21500	Median	210
SD	7154	CV	2.127
k hat (MLE)	0.154	k star (bias corrected MLE)	0.176
Theta hat (MLE)	21893	Theta star (bias corrected MLE)	19057
nu hat (MLE)	2.765	nu star (bias corrected)	3.177
Adjusted Level of Significance (β)	0.0231	Adjusted Chi Square Value (3.18, β)	0.271
Approximate Chi Square Value (3.18, α)	0.427	95% Gamma Adjusted UCL (use when n<50)	39408
95% Gamma Approximate UCL (use when n>=50)	25042		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	3383	SD (KM)	6735
Variance (KM)	45356405	SE of Mean (KM)	2459
k hat (KM)	0.252	k star (KM)	0.242
nu hat (KM)	4.542	nu star (KM)	4.361
theta hat (KM)	13407	theta star (KM)	13962
80% gamma percentile (KM)	4857	90% gamma percentile (KM)	10175
95% gamma percentile (KM)	16528	99% gamma percentile (KM)	33512

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (4.36, α)	0.869	Adjusted Chi Square Value (4.36, β)	0.593
95% Gamma Approximate KM-UCL (use when n>=50)	16970	95% Gamma Adjusted KM-UCL (use when n<50)	24886

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.95	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.788	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.194	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.325	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	3369	Mean in Log Scale	5.492
SD in Original Scale	7150	SD in Log Scale	2.853
95% t UCL (assumes normality of ROS data)	7801	95% Percentile Bootstrap UCL	7421
95% BCA Bootstrap UCL	9743	95% Bootstrap t UCL	70166
95% H-UCL (Log ROS)	43628186		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	5.971	KM Geo Mean	392
KM SD (logged)	2.137	95% Critical H Value (KM-Log)	6.066
KM Standard Error of Mean (logged)	0.786	95% H-UCL (KM -Log)	375513
KM SD (logged)	2.137	95% Critical H Value (KM-Log)	6.066
KM Standard Error of Mean (logged)	0.786		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	3384	Mean in Log Scale	5.893
SD in Original Scale	7143	SD in Log Scale	2.4
95% t UCL (Assumes normality)	7812	95% H-Stat UCL	1992589

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Bootstrap t UCL	68294	Gamma Adjusted KM-UCL (use when k<=1 and 15 < n < 50 but k<=1)	24886
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Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulation results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Result (benzo(a)pyrene_ea-3_0-2)

General Statistics			
Total Number of Observations	13	Number of Distinct Observations	10
Number of Detects	9	Number of Non-Detects	4
Number of Distinct Detects	9	Number of Distinct Non-Detects	1
Minimum Detect	50	Minimum Non-Detect	40
Maximum Detect	28000	Maximum Non-Detect	40
Variance Detects	84963703	Percent Non-Detects	30.77%
Mean Detects	3444	SD Detects	9218
Median Detects	200	CV Detects	2.676
Skewness Detects	2.989	Kurtosis Detects	8.948
Mean of Logged Detects	5.898	SD of Logged Detects	1.937

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.425	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.829	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.487	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.274	Detected Data Not Normal at 5% Significance Level	

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
KM Mean	2397	KM Standard Error of Mean	2177
KM SD	7400	95% KM (BCA) UCL	6615
95% KM (t) UCL	6277	95% KM (Percentile Bootstrap) UCL	6624
95% KM (z) UCL	5977	95% KM Bootstrap t UCL	69155
90% KM Chebyshev UCL	8927	95% KM Chebyshev UCL 11885	
97.5% KM Chebyshev UCL	15991	99% KM Chebyshev UCL	24056

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	1.423	Anderson-Darling GOF Test	
5% A-D Critical Value	0.806	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.346	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.301	Detected Data Not Gamma Distributed at 5% Significance Level	

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.306	k star (bias corrected MLE)	0.278
Theta hat (MLE)	11257	Theta star (bias corrected MLE)	12387
nu hat (MLE)	5.508	nu star (bias corrected)	5.005
Mean (detects)	3444		

Gamma ROS Statistics using Imputed Non-Detects
 GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	2385
Maximum	28000	Median	110
SD	7706	CV	3.231
k hat (MLE)	0.15	k star (bias corrected MLE)	0.167
Theta hat (MLE)	15861	Theta star (bias corrected MLE)	14285
nu hat (MLE)	3.909	nu star (bias corrected)	4.34
Adjusted Level of Significance (β)	0.0301	Adjusted Chi Square Value (4.34, β)	0.667
Approximate Chi Square Value (4.34, α)	0.861	95% Gamma Adjusted UCL (use when n<50)	15524
95% Gamma Approximate UCL (use when n>=50)	12027		

Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	2397	SD (KM)	7400
Variance (KM)	54754283	SE of Mean (KM)	2177
k hat (KM)	0.105	k star (KM)	0.132
nu hat (KM)	2.728	nu star (KM)	3.432
theta hat (KM)	22844	theta star (KM)	18159
80% gamma percentile (KM)	2325	90% gamma percentile (KM)	6950
95% gamma percentile (KM)	13493	99% gamma percentile (KM)	33014

Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (3.43, α)	0.511	Adjusted Chi Square Value (3.43, β)	0.381
95% Gamma Approximate KM-UCL (use when n>=50)	16095	95% Gamma Adjusted KM-UCL (use when n<50)	21588

Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.85	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.829	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.269	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.274	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	2386	Mean in Log Scale	4.433
SD in Original Scale	7705	SD in Log Scale	2.839
95% t UCL (assumes normality of ROS data)	6195	95% Percentile Bootstrap UCL	6634
95% BCA Bootstrap UCL	8822	95% Bootstrap t UCL	67129
95% H-UCL (Log ROS)	1057278		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	5.218	KM Geo Mean	184.6
KM SD (logged)	1.83	95% Critical H Value (KM-Log)	4.397
KM Standard Error of Mean (logged)	0.538	95% H-UCL (KM -Log)	10043
KM SD (logged)	1.83	95% Critical H Value (KM-Log)	4.397
KM Standard Error of Mean (logged)	0.538		

DL/2 Statistics			
DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	2391	Mean in Log Scale	5.005
SD in Original Scale	7704	SD in Log Scale	2.108
95% t UCL (Assumes normality)	6199	95% H-Stat UCL	29651

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
 Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use	
97.5% KM (Chebyshev) UCL	15991
99% KM (Chebyshev) UCL	24056

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
 Recommendations are based upon data size, data distribution, and skewness.
 These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
 However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Result (benzo(a)pyrene_ea-3_0-15)

General Statistics			
Total Number of Observations	37	Number of Distinct Observations	15
Number of Detects	13	Number of Non-Detects	24
Number of Distinct Detects	12	Number of Distinct Non-Detects	5
Minimum Detect	50	Minimum Non-Detect	40
Maximum Detect	28000	Maximum Non-Detect	400
Variance Detects	63718724	Percent Non-Detects	64.86%
Mean Detects	3329	SD Detects	7982
Median Detects	200	CV Detects	2.398
Skewness Detects	2.937	Kurtosis Detects	8.802
Mean of Logged Detects	6.029	SD of Logged Detects	1.97

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.479	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.866	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.453	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.234	Detected Data Not Normal at 5% Significance Level	

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
KM Mean	1197	KM Standard Error of Mean	822.9
KM SD	4809	95% KM (BCA) UCL	2719
95% KM (t) UCL	2587	95% KM (Percentile Bootstrap) UCL	2618
95% KM (z) UCL	2551	95% KM Bootstrap t UCL	19542
90% KM Chebyshev UCL	3666	95% KM Chebyshev UCL	4784
97.5% KM Chebyshev UCL	6336	99% KM Chebyshev UCL	9385

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	1.576	Anderson-Darling GOF Test	
5% A-D Critical Value	0.824	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.311	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.255	Detected Data Not Gamma Distributed at 5% Significance Level	

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.327	k star (bias corrected MLE)	0.303
Theta hat (MLE)	10190	Theta star (bias corrected MLE)	11002
nu hat (MLE)	8.495	nu star (bias corrected)	7.868
Mean (detects)	3329		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	1170
Maximum	28000	Median	0.01
SD	4882	CV	4.174
k hat (MLE)	0.102	k star (bias corrected MLE)	0.112
Theta hat (MLE)	11457	Theta star (bias corrected MLE)	10459
nu hat (MLE)	7.555	nu star (bias corrected)	8.276
Adjusted Level of Significance (β)	0.0431	Adjusted Chi Square Value (8.28, β)	2.759
Approximate Chi Square Value (8.28, α)	2.896	95% Gamma Adjusted UCL (use when $n < 50$)	3509
95% Gamma Approximate UCL (use when $n \geq 50$)	3343		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1197	SD (KM)	4809
Variance (KM)	23127585	SE of Mean (KM)	822.9
k hat (KM)	0.062	k star (KM)	0.075
nu hat (KM)	4.587	nu star (KM)	5.548
theta hat (KM)	19316	theta star (KM)	15969
80% gamma percentile (KM)	499.5	90% gamma percentile (KM)	2719
95% gamma percentile (KM)	6934	99% gamma percentile (KM)	21861

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (5.55, α)	1.414	Adjusted Chi Square Value (5.55, β)	1.326
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	4699	95% Gamma Adjusted KM-UCL (use when $n < 50$)	5010

95% Gamma Adjusted KM-UCL (use when $k \leq 1$ and $15 < n < 50$)

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.862	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.866	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.242	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.234	Detected Data Not Lognormal at 5% Significance Level	

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1172	Mean in Log Scale	2.239
SD in Original Scale	4882	SD in Log Scale	3.49
95% t UCL (assumes normality of ROS data)	2527	95% Percentile Bootstrap UCL	2642
95% BCA Bootstrap UCL	3728	95% Bootstrap t UCL	21303
95% H-UCL (Log ROS)	138051		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	4.532	KM Geo Mean	92.93
KM SD (logged)	1.58	95% Critical H Value (KM-Log)	3.128
KM Standard Error of Mean (logged)	0.272	95% H-UCL (KM -Log)	738.4
KM SD (logged)	1.58	95% Critical H Value (KM-Log)	3.128
KM Standard Error of Mean (logged)	0.272		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1194	Mean in Log Scale	4.24
SD in Original Scale	4876	SD in Log Scale	1.836
95% t UCL (Assumes normality)	2547	95% H-Stat UCL	1089

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL 4784

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Result (benzo(a)pyrene_ea-4_0-3)

General Statistics			
Total Number of Observations	12	Number of Distinct Observations	10
Number of Detects	7	Number of Non-Detects	5
Number of Distinct Detects	7	Number of Distinct Non-Detects	3
Minimum Detect	50	Minimum Non-Detect	40
Maximum Detect	9400	Maximum Non-Detect	200
Variance Detects	11622557	Percent Non-Detects	41.67%
Mean Detects	1803	SD Detects	3409
Median Detects	180	CV Detects	1.891
Skewness Detects	2.467	Kurtosis Detects	6.219
Mean of Logged Detects	6.071	SD of Logged Detects	1.822

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.594	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.803	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.357	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.304	Detected Data Not Normal at 5% Significance Level	

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
KM Mean	1072	KM Standard Error of Mean	798.6
KM SD	2561	95% KM (BCA) UCL	2537
95% KM (t) UCL	2506	95% KM (Percentile Bootstrap) UCL	2553
95% KM (z) UCL	2386	95% KM Bootstrap t UCL	11029
90% KM Chebyshev UCL	3468	95% KM Chebyshev UCL	4553
97.5% KM Chebyshev UCL	6059	99% KM Chebyshev UCL	9018

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.589	Anderson-Darling GOF Test	
5% A-D Critical Value	0.759	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.297	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.329	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.452	k star (bias corrected MLE)	0.354
Theta hat (MLE)	3986	Theta star (bias corrected MLE)	5097
nu hat (MLE)	6.332	nu star (bias corrected)	4.952
Mean (detects)	1803		

Gamma ROS Statistics using Imputed Non-Detects
 GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	1052
Maximum	9400	Median	90
SD	2684	CV	2.552
k hat (MLE)	0.145	k star (bias corrected MLE)	0.164
Theta hat (MLE)	7264	Theta star (bias corrected MLE)	6407
nu hat (MLE)	3.475	nu star (bias corrected)	3.939
Adjusted Level of Significance (β)	0.029	Adjusted Chi Square Value (3.94, β)	0.521
Approximate Chi Square Value (3.94, α)	0.698	95% Gamma Adjusted UCL (use when n<50)	7946
95% Gamma Approximate UCL (use when n>=50)	5936		

Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	1072	SD (KM)	2561
Variance (KM)	6558845	SE of Mean (KM)	798.6
k hat (KM)	0.175	k star (KM)	0.187
nu hat (KM)	4.208	nu star (KM)	4.489
theta hat (KM)	6117	theta star (KM)	5733
80% gamma percentile (KM)	1362	90% gamma percentile (KM)	3239
95% gamma percentile (KM)	5620	99% gamma percentile (KM)	12249

Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (4.49, α)	0.924	Adjusted Chi Square Value (4.49, β)	0.707
95% Gamma Approximate KM-UCL (use when n>=50)	5210	95% Gamma Adjusted KM-UCL (use when n<50)	6811

Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.93	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.256	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.304	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	1057	Mean in Log Scale	4.395
SD in Original Scale	2681	SD in Log Scale	2.558
95% t UCL (assumes normality of ROS data)	2447	95% Percentile Bootstrap UCL	2478
95% BCA Bootstrap UCL	3535	95% Bootstrap t UCL	10972
95% H-UCL (Log ROS)	254424		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	5.128	KM Geo Mean	168.7
KM SD (logged)	1.719	95% Critical H Value (KM-Log)	4.356
KM Standard Error of Mean (logged)	0.54	95% H-UCL (KM -Log)	7077
KM SD (logged)	1.719	95% Critical H Value (KM-Log)	4.356
KM Standard Error of Mean (logged)	0.54		

DL/2 Statistics			
DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1068	Mean in Log Scale	4.97
SD in Original Scale	2677	SD in Log Scale	1.959
95% t UCL (Assumes normality)	2456	95% H-Stat UCL	17446

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use			
95% KM Bootstrap t UCL	11029	Gamma Adjusted KM-UCL (use when k<=1 and 15 < n < 50 but k<=1)	6811

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness. These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Result (lead_ea-5_0-15)

General Statistics			
Total Number of Observations	34	Number of Distinct Observations	33
		Number of Missing Observations	0
Minimum	2000	Mean	226839
Maximum	5665000	Median	10350
	SD 986176	Std. Error of Mean	169128
Coefficient of Variation	4.347	Skewness	5.425

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.248	Data Not Normal at 5% Significance Level	
5% Shapiro Wilk Critical Value	0.933	Lilliefors GOF Test	
Lilliefors Test Statistic	0.489	Data Not Normal at 5% Significance Level	
5% Lilliefors Critical Value	0.15		

Data Not Normal at 5% Significance Level

Assuming Normal Distribution		95% UCLs (Adjusted for Skewness)	
95% Normal UCL		95% Adjusted-CLT UCL (Chen-1995)	673157
95% Student's-t UCL	513064	95% Modified-t UCL (Johnson-1978)	539288

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	7.856	Data Not Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.876	Kolmogorov-Smirnov Gamma GOF Test	
K-S Test Statistic	0.434	Data Not Gamma Distributed at 5% Significance Level	
5% K-S Critical Value	0.165		

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics			
k hat (MLE)	0.26	k star (bias corrected MLE)	0.257
Theta hat (MLE)	872907	Theta star (bias corrected MLE)	884209
nu hat (MLE)	17.67	nu star (bias corrected)	17.45
MLE Mean (bias corrected)	226839	MLE Sd (bias corrected)	447853
		Approximate Chi Square Value (0.05)	8.991
Adjusted Level of Significance	0.0422	Adjusted Chi Square Value	8.691

Assuming Gamma Distribution		95% Adjusted Gamma UCL (use when n<50)	
95% Approximate Gamma UCL (use when n>=50)	440129		
		95% Adjusted Gamma UCL (use when n<50)	455343

Lognormal GOF Test		Shapiro Wilk Lognormal GOF Test	
Shapiro Wilk Test Statistic	0.74	Data Not Lognormal at 5% Significance Level	
5% Shapiro Wilk Critical Value	0.933	Lilliefors Lognormal GOF Test	
Lilliefors Test Statistic	0.248	Data Not Lognormal at 5% Significance Level	
5% Lilliefors Critical Value	0.15		

Data Not Lognormal at 5% Significance Level

Lognormal Statistics			
Minimum of Logged Data	7.601	Mean of logged Data	9.616
Maximum of Logged Data	15.55	SD of logged Data	1.619

Assuming Lognormal Distribution		90% Chebyshev (MVUE) UCL	
95% H-UCL	140630	90% Chebyshev (MVUE) UCL	107099
95% Chebyshev (MVUE) UCL	132376	97.5% Chebyshev (MVUE) UCL	167460
99% Chebyshev (MVUE) UCL	236376		

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs		95% Jackknife UCL	
95% CLT UCL	505029	95% Jackknife UCL	513064
95% Standard Bootstrap UCL	495814	95% Bootstrap-t UCL	3030041
95% Hall's Bootstrap UCL	3145789	95% Percentile Bootstrap UCL	548765
95% BCA Bootstrap UCL	854916		
90% Chebyshev(Mean, Sd) UCL	734222	95% Chebyshev(Mean, Sd) UCL	964049
97.5% Chebyshev(Mean, Sd) UCL	1283041	99% Chebyshev(Mean, Sd) UCL	1909639

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL 964049

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness. These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Result (benzo(a)pyrene_ea-5_0-15)

General Statistics			
Total Number of Observations	31	Number of Distinct Observations	15
Number of Detects	15	Number of Non-Detects	16
Number of Distinct Detects	11	Number of Distinct Non-Detects	5
Minimum Detect	50	Minimum Non-Detect	40
Maximum Detect	33000	Maximum Non-Detect	300
Variance Detects	70971917	Percent Non-Detects	51.61%
Mean Detects	2558	SD Detects	8424
Median Detects	470	CV Detects	3.293
Skewness Detects	3.868	Kurtosis Detects	14.97
Mean of Logged Detects	5.959	SD of Logged Detects	1.538

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.307	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.881	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.521	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.22	Detected Data Not Normal at 5% Significance Level	

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
KM Mean	1261	KM Standard Error of Mean	1078
KM SD	5799	95% KM (BCA) UCL	3376
95% KM (t) UCL	3091	95% KM (Percentile Bootstrap) UCL	3378
95% KM (z) UCL	3034	95% KM Bootstrap t UCL	33263
90% KM Chebyshev UCL	4495	95% KM Chebyshev UCL	5960
97.5% KM Chebyshev UCL	7994	99% KM Chebyshev UCL	11988

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	2.859	Anderson-Darling GOF Test	
5% A-D Critical Value	0.824	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.455	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.238	Detected Data Not Gamma Distributed at 5% Significance Level	

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.355	k star (bias corrected MLE)	0.329
Theta hat (MLE)	7199	Theta star (bias corrected MLE)	7782
nu hat (MLE)	10.66	nu star (bias corrected)	9.861
Mean (detects)	2558		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	1238
Maximum	33000	Median	0.01
SD	5900	CV	4.767
k hat (MLE)	0.12	k star (bias corrected MLE)	0.13
Theta hat (MLE)	10323	Theta star (bias corrected MLE)	9535
nu hat (MLE)	7.434	nu star (bias corrected)	8.048
Adjusted Level of Significance (β)	0.0413	Adjusted Chi Square Value (8.05, β)	2.593
Approximate Chi Square Value (8.05, α)	2.763	95% Gamma Adjusted UCL (use when $n < 50$)	3841
95% Gamma Approximate UCL (use when $n \geq 50$)	3605		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1261	SD (KM)	5799
Variance (KM)	33629296	SE of Mean (KM)	1078
k hat (KM)	0.0473	k star (KM)	0.0642
nu hat (KM)	2.931	nu star (KM)	3.981
theta hat (KM)	26671	theta star (KM)	19638
80% gamma percentile (KM)	365.5	90% gamma percentile (KM)	2530
95% gamma percentile (KM)	7161	99% gamma percentile (KM)	24698

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (3.98, α)	0.714	Adjusted Chi Square Value (3.98, β)	0.644
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	7029	95% Gamma Adjusted KM-UCL (use when $n < 50$)	7793

95% Gamma Adjusted KM-UCL (use when $k \leq 1$ and $15 < n < 50$)

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.805	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.881	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.284	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.22	Detected Data Not Lognormal at 5% Significance Level	

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1249	Mean in Log Scale	4.209
SD in Original Scale	5898	SD in Log Scale	2.161
95% t UCL (assumes normality of ROS data)	3046	95% Percentile Bootstrap UCL	3354
95% BCA Bootstrap UCL	4488	95% Bootstrap t UCL	32090
95% H-UCL (Log ROS)	3443		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	4.833	KM Geo Mean	125.6
KM SD (logged)	1.51	95% Critical H Value (KM-Log)	3.09
KM Standard Error of Mean (logged)	0.283	95% H-UCL (KM -Log)	919.5
KM SD (logged)	1.51	95% Critical H Value (KM-Log)	3.09
KM Standard Error of Mean (logged)	0.283		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1261	Mean in Log Scale	4.772
SD in Original Scale	5895	SD in Log Scale	1.619
95% t UCL (Assumes normality)	3058	95% H-Stat UCL	1145

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL 5960

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
 Recommendations are based upon data size, data distribution, and skewness.
 These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
 However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Result (arsenic_ea-6_0-2)

General Statistics			
Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	600	Mean	18656
Maximum	82800	Median	2210
SD	29073	Std. Error of Mean	9194
Coefficient of Variation	1.558	Skewness	1.539
Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.684	Data Not Normal at 5% Significance Level	
5% Shapiro Wilk Critical Value	0.842	Lilliefors GOF Test	
Lilliefors Test Statistic	0.398	Data Not Normal at 5% Significance Level	
5% Lilliefors Critical Value	0.262		
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	35509	95% Adjusted-CLT UCL (Chen-1995)	38560
		95% Modified-t UCL (Johnson-1978)	36255
Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	1.113	Data Not Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.786	Kolmogorov-Smirnov Gamma GOF Test	
K-S Test Statistic	0.337	Data Not Gamma Distributed at 5% Significance Level	
5% K-S Critical Value	0.282		
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.453	k star (bias corrected MLE)	0.384
Theta hat (MLE)	41147	Theta star (bias corrected MLE)	48577
nu hat (MLE)	9.068	nu star (bias corrected)	7.681
MLE Mean (bias corrected)	18656	MLE Sd (bias corrected)	30104
		Approximate Chi Square Value (0.05)	2.552
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	2.068
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50)	56158	95% Adjusted Gamma UCL (use when n<50)	69296
Lognormal GOF Test		Shapiro Wilk Lognormal GOF Test	
Shapiro Wilk Test Statistic	0.837	Data Not Lognormal at 5% Significance Level	
5% Shapiro Wilk Critical Value	0.842	Lilliefors Lognormal GOF Test	
Lilliefors Test Statistic	0.25	Data appear Lognormal at 5% Significance Level	
5% Lilliefors Critical Value	0.262		
Data appear Approximate Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	6.397	Mean of logged Data	8.411
Maximum of Logged Data	11.32	SD of logged Data	1.811
Assuming Lognormal Distribution			
95% H-UCL	457647	90% Chebyshev (MVUE) UCL	47071
95% Chebyshev (MVUE) UCL	60753	97.5% Chebyshev (MVUE) UCL	79744
99% Chebyshev (MVUE) UCL	117046		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	33778	95% Jackknife UCL	35509
95% Standard Bootstrap UCL	32575	95% Bootstrap-t UCL	48648
95% Hall's Bootstrap UCL	33222	95% Percentile Bootstrap UCL	34569
95% BCA Bootstrap UCL	36411		
90% Chebyshev(Mean, Sd) UCL	46237	95% Chebyshev(Mean, Sd) UCL	58730
97.5% Chebyshev(Mean, Sd) UCL	76070	99% Chebyshev(Mean, Sd) UCL	110131
Suggested UCL to Use			
99% Chebyshev (Mean, Sd) UCL 110131			
Recommended UCL exceeds the maximum observation			

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness. These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Result (arsenic_ea-6_0-15)

General Statistics			
Total Number of Observations	33	Number of Distinct Observations	30
Number of Detects	32	Number of Non-Detects	1
Number of Distinct Detects	29	Number of Distinct Non-Detects	1
Minimum Detect	230	Minimum Non-Detect	100
Maximum Detect	82800	Maximum Non-Detect	100
Variance Detects	4.688E+8	Percent Non-Detects	3.03%
Mean Detects	8912	SD Detects	21652
Median Detects	1085	CV Detects	2.429
Skewness Detects	2.752	Kurtosis Detects	6.592
Mean of Logged Detects	7.438	SD of Logged Detects	1.486

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.434	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.93	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.472	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.154	Detected Data Not Normal at 5% Significance Level	

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
KM Mean	8645	KM Standard Error of Mean	3721
KM SD	21040	95% KM (BCA) UCL	15569
95% KM (t) UCL	14948	95% KM (Percentile Bootstrap) UCL	15012
95% KM (z) UCL	14766	95% KM Bootstrap t UCL	19514
90% KM Chebyshev UCL	19809	95% KM Chebyshev UCL	24865
97.5% KM Chebyshev UCL	31884	99% KM Chebyshev UCL	45670

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	5.897	Anderson-Darling GOF Test	
5% A-D Critical Value	0.833	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.378	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.167	Detected Data Not Gamma Distributed at 5% Significance Level	

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.398	k star (bias corrected MLE)	0.381
Theta hat (MLE)	22419	Theta star (bias corrected MLE)	23386
nu hat (MLE)	25.44	nu star (bias corrected)	24.39
Mean (detects)	8912		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	8642
Maximum	82800	Median	1000
SD	21367	CV	2.472
k hat (MLE)	0.339	k star (bias corrected MLE)	0.329
Theta hat (MLE)	25462	Theta star (bias corrected MLE)	26287
nu hat (MLE)	22.4	nu star (bias corrected)	21.7
Adjusted Level of Significance (β)	0.0419	Adjusted Chi Square Value (21.70, β)	11.74
Approximate Chi Square Value (21.70, α)	12.11	95% Gamma Adjusted UCL (use when n<50)	15969
95% Gamma Approximate UCL (use when n>=50)	15482		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	8645	SD (KM)	21040
Variance (KM)	4.427E+8	SE of Mean (KM)	3721
k hat (KM)	0.169	k star (KM)	0.174
nu hat (KM)	11.14	nu star (KM)	11.46
theta hat (KM)	51205	theta star (KM)	49774
80% gamma percentile (KM)	10484	90% gamma percentile (KM)	26019
95% gamma percentile (KM)	46118	99% gamma percentile (KM)	102817

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (11.46, α)	4.876	Adjusted Chi Square Value (11.46, β)	4.655
95% Gamma Approximate KM-UCL (use when n>=50)	20326	95% Gamma Adjusted KM-UCL (use when n<50)	21288

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.761	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.93	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.25	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.154	Detected Data Not Lognormal at 5% Significance Level	

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	8644	Mean in Log Scale	7.337
SD in Original Scale	21367	SD in Log Scale	1.573
95% t UCL (assumes normality of ROS data)	14944	95% Percentile Bootstrap UCL	15059
95% BCA Bootstrap UCL	17651	95% Bootstrap t UCL	23117
95% H-UCL (Log ROS)	12936		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	7.352	KM Geo Mean	1560
KM SD (logged)	1.52	95% Critical H Value (KM-Log)	3.133
KM Standard Error of Mean (logged)	0.269	95% H-UCL (KM -Log)	11483
KM SD (logged)	1.52	95% Critical H Value (KM-Log)	3.133
KM Standard Error of Mean (logged)	0.269		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	8644	Mean in Log Scale	7.331
SD in Original Scale	21367	SD in Log Scale	1.586
95% t UCL (Assumes normality)	14944	95% H-Stat UCL	13278

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL 24865

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness. These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Result (benzo(a)pyrene_ea-7_0-2)

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	11
Number of Detects	9	Number of Non-Detects	11
Number of Distinct Detects	8	Number of Distinct Non-Detects	4
Minimum Detect	70	Minimum Non-Detect	30
Maximum Detect	29000	Maximum Non-Detect	200
Variance Detects	90640174	Percent Non-Detects	55%
Mean Detects	3646	SD Detects	9521
Median Detects	270	CV Detects	2.611
Skewness Detects	2.985	Kurtosis Detects	8.931
Mean of Logged Detects	6.111	SD of Logged Detects	1.901

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.432	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.829	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.482	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.274	Detected Data Not Normal at 5% Significance Level	

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
KM Mean	1659	KM Standard Error of Mean	1490
KM SD	6284	95% KM (BCA) UCL	4570
95% KM (t) UCL	4236	95% KM (Percentile Bootstrap) UCL	4522
95% KM (z) UCL	4110	95% KM Bootstrap t UCL	37992
90% KM Chebyshev UCL	6130	95% KM Chebyshev UCL	8155
97.5% KM Chebyshev UCL	10966	99% KM Chebyshev UCL	16488

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	1.268	Anderson-Darling GOF Test	
5% A-D Critical Value	0.803	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.337	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.301	Detected Data Not Gamma Distributed at 5% Significance Level	

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.326	k star (bias corrected MLE)	0.291
Theta hat (MLE)	11200	Theta star (bias corrected MLE)	12525
nu hat (MLE)	5.86	nu star (bias corrected)	5.24
Mean (detects)	3646		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	1641
Maximum	29000	Median	0.01
SD	6452	CV	3.932
k hat (MLE)	0.111	k star (bias corrected MLE)	0.128
Theta hat (MLE)	14721	Theta star (bias corrected MLE)	12812
nu hat (MLE)	4.458	nu star (bias corrected)	5.123
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (5.12, α)	1.209	Adjusted Chi Square Value (5.12, β)	1.068
95% Gamma Approximate UCL (use when $n \geq 50$)	6950	95% Gamma Adjusted UCL (use when $n < 50$)	7870

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1659	SD (KM)	6284
Variance (KM)	39487408	SE of Mean (KM)	1490
k hat (KM)	0.0697	k star (KM)	0.0926
nu hat (KM)	2.787	nu star (KM)	3.703
theta hat (KM)	23804	theta star (KM)	17920
80% gamma percentile (KM)	1023	90% gamma percentile (KM)	4265
95% gamma percentile (KM)	9659	99% gamma percentile (KM)	27380

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (3.70, α)	0.608	Adjusted Chi Square Value (3.70, β)	0.521
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	10104	95% Gamma Adjusted KM-UCL (use when $n < 50$)	11790

95% Gamma Adjusted KM-UCL (use when $k \leq 1$ and $15 < n < 50$)

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.867	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.829	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.165	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.274	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1644	Mean in Log Scale	3.3
SD in Original Scale	6451	SD in Log Scale	3.061
95% t UCL (assumes normality of ROS data)	4138	95% Percentile Bootstrap UCL	4469
95% BCA Bootstrap UCL	6044	95% Bootstrap t UCL	37016
95% H-UCL (Log ROS)	240695		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	4.648	KM Geo Mean	104.4
KM SD (logged)	1.796	95% Critical H Value (KM-Log)	3.94
KM Standard Error of Mean (logged)	0.428	95% H-UCL (KM -Log)	2660
KM SD (logged)	1.796	95% Critical H Value (KM-Log)	3.94
KM Standard Error of Mean (logged)	0.428		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1658	Mean in Log Scale	4.541
SD in Original Scale	6447	SD in Log Scale	1.96
95% t UCL (Assumes normality)	4151	95% H-Stat UCL	4289

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL 8155

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
 Recommendations are based upon data size, data distribution, and skewness.
 These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
 However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Outlier Tests for Selected Uncensored Variables

User Selected Options

Date/Time of Computation ProUCL 5.19/18/2020 8:52:51 AM
From File Appendix A Tables.xls
Full Precision OFF

Dixon's Outlier Test for Result (lead_ea-2_0-2)

Number of Observations = 9
10% critical value: 0.441
5% critical value: 0.512
1% critical value: 0.635

1. Observation Value 1160000 is a Potential Outlier (Upper Tail)?

Test Statistic: 0.954

For 10% significance level, 1160000 is an outlier.
For 5% significance level, 1160000 is an outlier.
For 1% significance level, 1160000 is an outlier.

2. Observation Value 1690 is a Potential Outlier (Lower Tail)?

Test Statistic: 0.006

For 10% significance level, 1690 is not an outlier.
For 5% significance level, 1690 is not an outlier.
For 1% significance level, 1690 is not an outlier.

Dixon's Outlier Test for Result (benzo(a)pyrene_ea-2_0-2)

Number of Observations = 9
10% critical value: 0.441
5% critical value: 0.512
1% critical value: 0.635

1. Observation Value 21500 is a Potential Outlier (Upper Tail)?

Test Statistic: 0.680

For 10% significance level, 21500 is an outlier.
For 5% significance level, 21500 is an outlier.
For 1% significance level, 21500 is an outlier.

2. Observation Value 40 is a Potential Outlier (Lower Tail)?

Test Statistic: 0.000

For 10% significance level, 40 is not an outlier.
For 5% significance level, 40 is not an outlier.
For 1% significance level, 40 is not an outlier.

Dixon's Outlier Test for Result (benzo(a)pyrene_ea-3_0-2)

Number of Observations = 13
 10% critical value: 0.467
 5% critical value: 0.521
 1% critical value: 0.615

1. Observation Value 28000 is a Potential Outlier (Upper Tail)?

Test Statistic: 0.966

For 10% significance level, 28000 is an outlier.
 For 5% significance level, 28000 is an outlier.
 For 1% significance level, 28000 is an outlier.

2. Observation Value 40 is a Potential Outlier (Lower Tail)?

Test Statistic: 0.000

For 10% significance level, 40 is not an outlier.
 For 5% significance level, 40 is not an outlier.
 For 1% significance level, 40 is not an outlier.

Rosner's Outlier Test for Result (benzo(a)pyrene_ea-3_0-15)

Mean 1218
 Standard Deviation 4871
 Number of data 37
 Number of suspected outliers 1

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	1218	4805	28000	8	5.574	3	3.34

For 5% Significance Level, there is 1 Potential Outlier
 Potential outliers is: 28000

For 1% Significance Level, there is 1 Potential Outlier
 Potential outliers is: 28000

Table A-4
Outlier Analysis
Appendix A, Statistical Evaluation
RACER Trust Plants 2 and 3
Lansing, Michigan

Dixon's Outlier Test for Result (benzo(a)pyrene_ea-4_0-3)

Number of Observations = 12
 10% critical value: 0.49
 5% critical value: 0.546
 1% critical value: 0.642

1. Observation Value 9400 is a Potential Outlier (Upper Tail)?

Test Statistic: 0.908

For 10% significance level, 9400 is an outlier.
 For 5% significance level, 9400 is an outlier.
 For 1% significance level, 9400 is an outlier.

2. Observation Value 40 is a Potential Outlier (Lower Tail)?

Test Statistic: 0.000

For 10% significance level, 40 is not an outlier.
 For 5% significance level, 40 is not an outlier.
 For 1% significance level, 40 is not an outlier.

Rosner's Outlier Test for Result (lead_ea-5_0-15)

Mean 226839
Standard Deviation 986176
Number of data 34
Number of suspected outliers 1

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	226839	971565	5665000	24	5.597	2.97	3.3

For 5% Significance Level, there is 1 Potential Outlier
Potential outliers is: 5665000

For 1% Significance Level, there is 1 Potential Outlier
Potential outliers is: 5665000

Rosner's Outlier Test for Result (benzo(a)pyrene_ea-5_0-15)

Mean 1285
 Standard Deviation 5890
 Number of data 31
 Number of suspected outliers 1

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	1285	5794	33000	22	5.474	2.92	3.25

For 5% Significance Level, there is 1 Potential Outlier
 Potential outliers is: 33000

For 1% Significance Level, there is 1 Potential Outlier
 Potential outliers is: 33000

Dixon's Outlier Test for Result (arsenic_ea-6_0-2)

Number of Observations = 10
 10% critical value: 0.409
 5% critical value: 0.477
 1% critical value: 0.597

1. Observation Value 82800 is a Potential Outlier (Upper Tail)?

Test Statistic: 0.400

For 10% significance level, 82800 is not an outlier.
 For 5% significance level, 82800 is not an outlier.
 For 1% significance level, 82800 is not an outlier.

2. Observation Value 600 is a Potential Outlier (Lower Tail)?

Test Statistic: 0.008

For 10% significance level, 600 is not an outlier.
 For 5% significance level, 600 is not an outlier.
 For 1% significance level, 600 is not an outlier.

Rosner's Outlier Test for Result (arsenic_ea-6_0-15)

Mean 8645
 Standard Deviation 21366
 Number of data 33
 Number of suspected outliers 1

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	8645	21040	82800	1	3.524	2.95	3.29

For 5% Significance Level, there is 1 Potential Outlier
 Potential outliers is: 82800

For 1% Significance Level, there is 1 Potential Outlier
 Potential outliers is: 82800

Dixon's Outlier Test for Result (benzo(a)pyrene_ea-7_0-2)

Number of Observations = 20
 10% critical value: 0.401
 5% critical value: 0.45
 1% critical value: 0.535

1. Observation Value 29000 is a Potential Outlier (Upper Tail)?

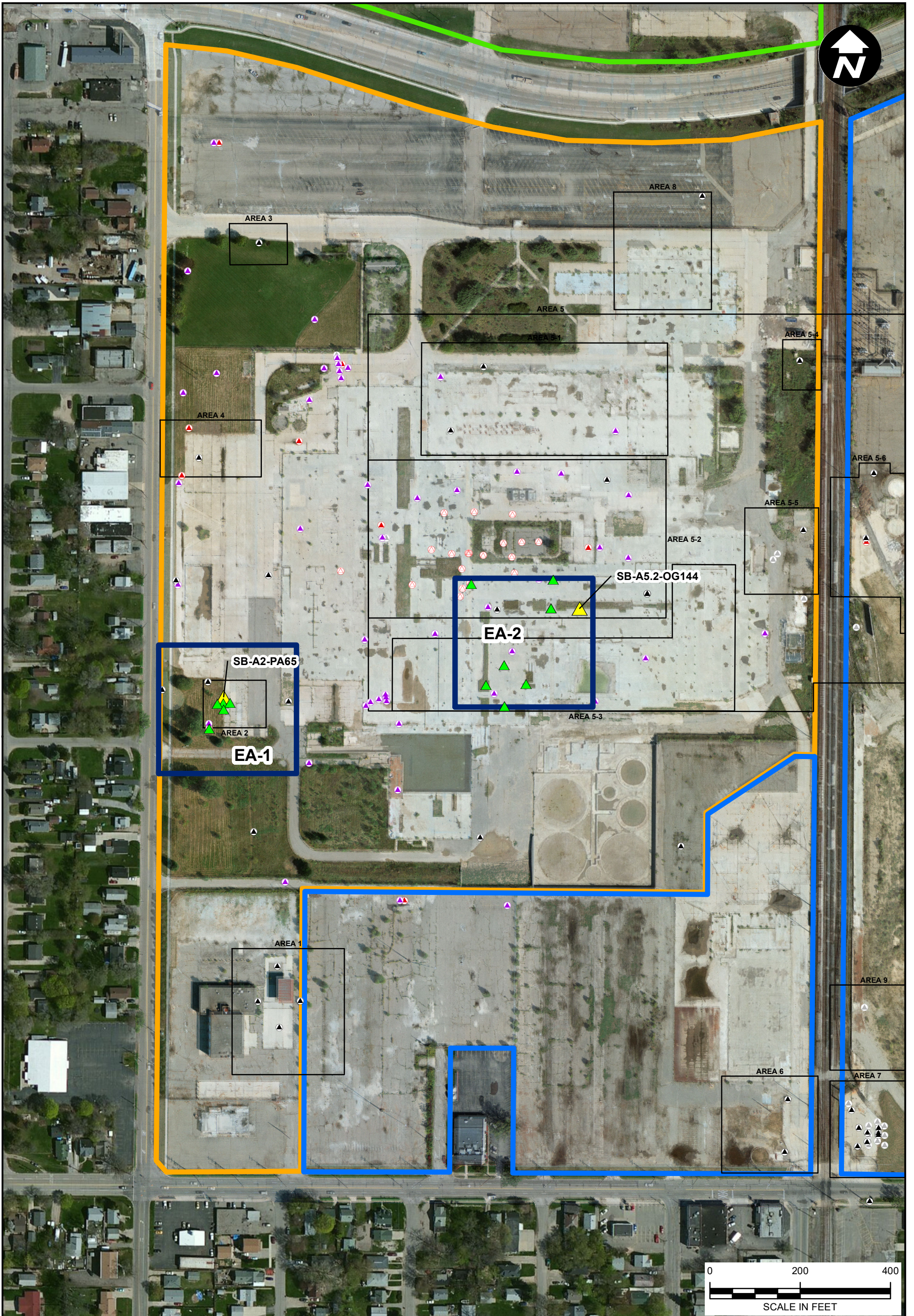
Test Statistic: 0.960

For 10% significance level, 29000 is an outlier.
 For 5% significance level, 29000 is an outlier.
 For 1% significance level, 29000 is an outlier.

2. Observation Value 30 is a Potential Outlier (Lower Tail)?

Test Statistic: 0.009

For 10% significance level, 30 is not an outlier.
 For 5% significance level, 30 is not an outlier.
 For 1% significance level, 30 is not an outlier.



LEGEND

- ▲ 2013 NOT AN EXCEEDANCE 0-2 FT BGS
- ▲ 2013 EXCEEDANCE 0-2 FT BGS
- 2013 NOT AN EXCEEDANCE >2 FT BGS
- 2013 EXCEEDANCE > 2 FT BGS
- 2 ACRE EXPOSURE AREA FOR DIRECT CONTACT

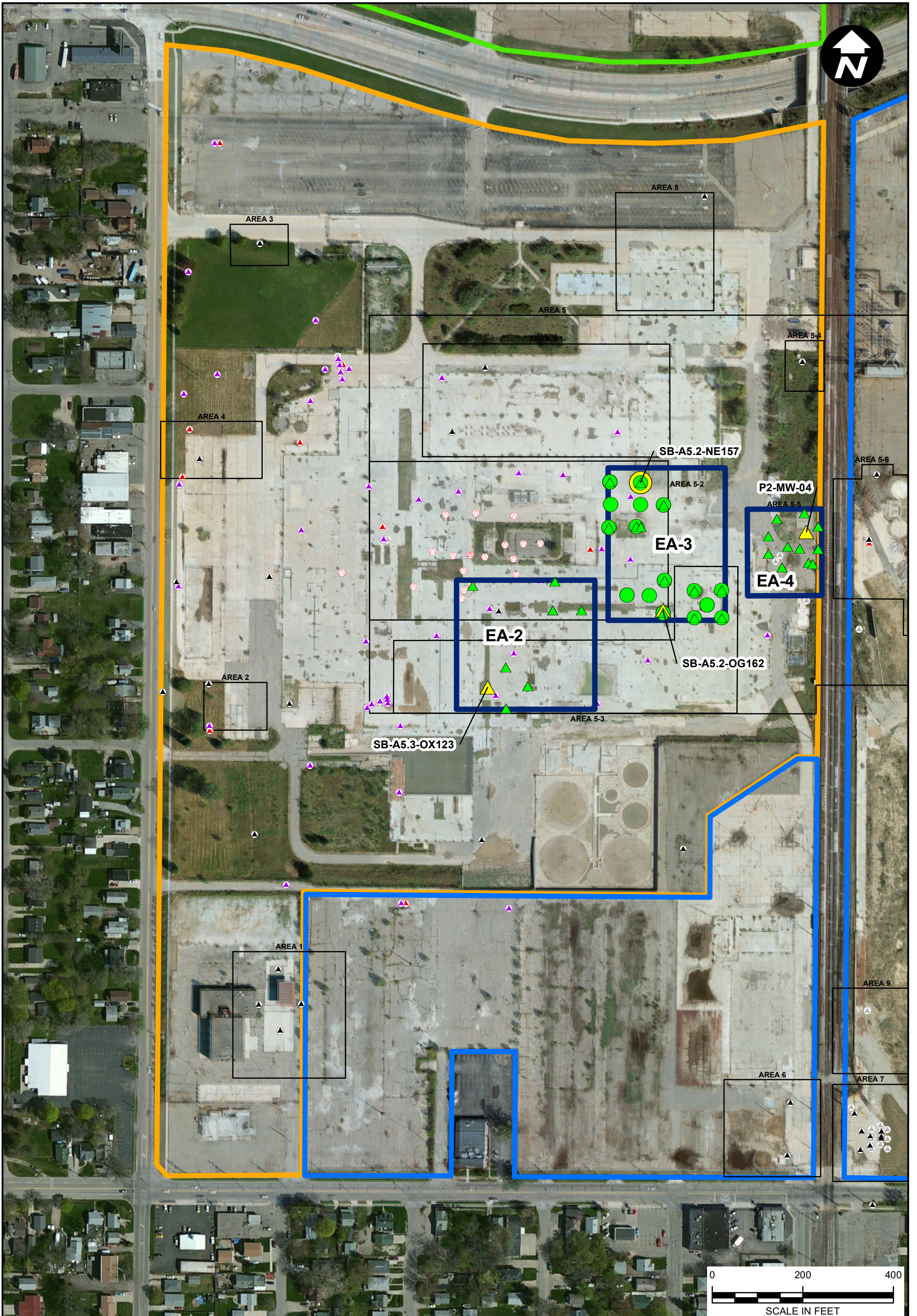
- ⊗ LNAPL MONITORING WELL
- ▲ PERCHED ZONE MONITORING WELL
- ▲ DEEP OVBURDEN MONITORING WELL
- ▲ WEATHERED BEDROCK MONITORING WELL
- ▲ BEDROCK MONITORING WELL
- ▲ ABANDONED MONITORING WELL

- PLANT 2
- PLANT 3
- PLANT 6

NOTES:
DATA COMPARED TO EGLE 2013
NON-RESIDENTIAL DIRECT CONTACT
(DC) CRITERIA
ft bgs: FEET BELOW GROUND SURFACE

RACER TRUST PLANTS 2, 3 & 6 LANSING, MICHIGAN	
PLANT 2 SAMPLES USED IN THE STATISTICAL EVALUATION FOR DC CRITERIA LEAD / ARSENIC	
	<small>Design & Consultancy for natural and built assets</small>
FIGURE A-1	

CITY: KNOXVILLE DIV: ENV DB: A.SMITH PIC: PM: TR: PROJECT NUMBER: COORDINATE SYSTEM: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl
 M:\GIS\Project Files\RACER\lansing\working\2013 Criteria Eval_P2_Benzo_2020.mxd PLOTTED: 9/22/2020 4:16:41 PM BY: MJOYE



LEGEND

2013 NOT AN EXCEEDANCE 0-2 FT BGS	LNAPL MONITORING WELL	PLANT 2
2013 EXCEEDANCE 0-2 FT BGS	PERCHED ZONE MONITORING WELL	PLANT 3
2013 NOT AN EXCEEDANCE >2 FT BGS	DEEP OVERBURDEN MONITORING WELL	PLANT 6
2013 EXCEEDANCE > 2 FT BGS	WEATHERED BEDROCK MONITORING WELL	
2 ACRE EXPOSURE AREA FOR DIRECT CONTACT	BEDROCK MONITORING WELL	
	ABANDONED MONITORING WELL	

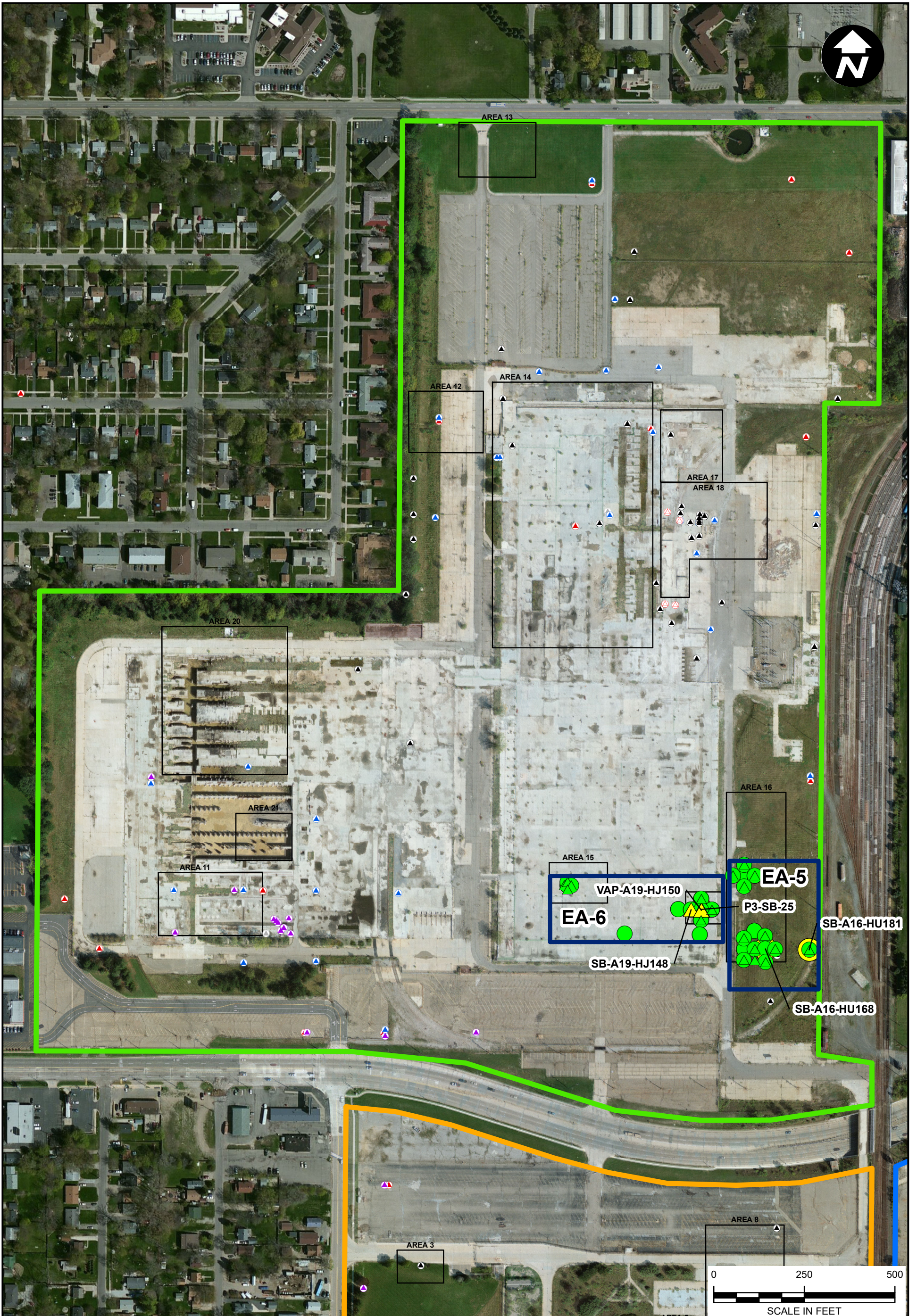
NOTES:
 DATA COMPARED TO EGLE 2013 NON-RESIDENTIAL DIRECT CONTACT (DC) CRITERIA
 ft bgs: FEET BELOW GROUND SURFACE

RACER TRUST
 PLANTS 2, 3 & 6
 LANSING, MICHIGAN

PLANT 2 SAMPLES USED IN THE STATISTICAL EVALUATION FOR DC CRITERIA BENZO(A)PYRENE

ARCADIS Design & Consultancy for natural and built assets

FIGURE **A-2**



LEGEND

- ▲ 2013 NOT AN EXCEEDANCE 0-2 FT BGS
- ▲ 2013 EXCEEDANCE 0-2 FT BGS
- ▲ 2013 NOT AN EXCEEDANCE >2 FT BGS
- 2013 EXCEEDANCE > 2 FT BGS
- 2 ACRE EXPOSURE AREA FOR DIRECT CONTACT
- ◉ LNAPL MONITORING WELL
- ▲ PERCHED ZONE MONITORING WELL
- ▲ DEEP OVBURDEN MONITORING WELL
- ▲ WEATHERED BEDROCK MONITORING WELL
- ▲ BEDROCK MONITORING WELL
- ▲ ABANDONED MONITORING WELL

- PLANT 2
- PLANT 3
- PLANT 6

NOTES:
DATA COMPARED TO EGLE 2013
NON-RESIDENTIAL DIRECT CONTACT
(DC) CRITERIA
ft bgs: FEET BELOW GROUND SURFACE

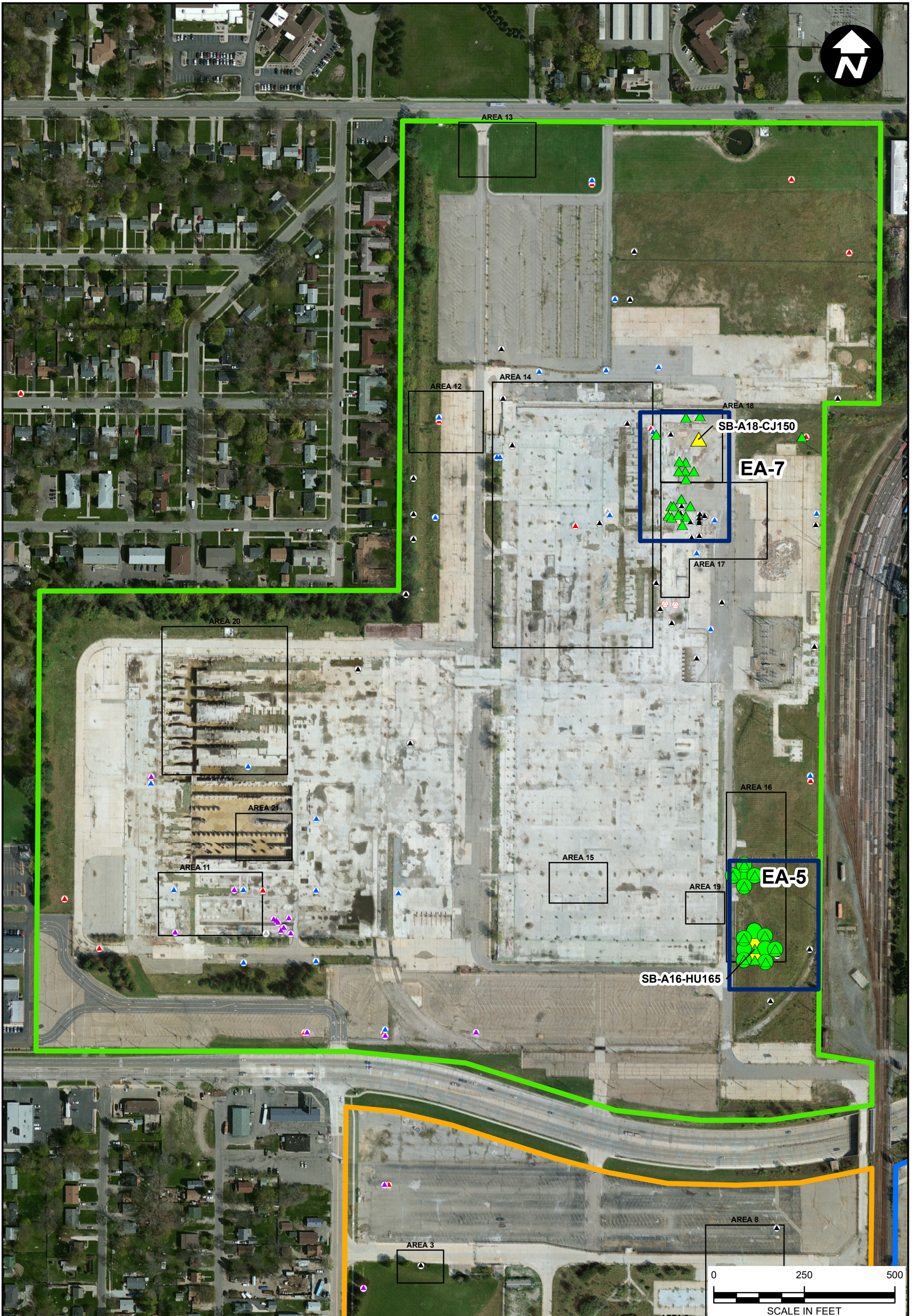
RACER TRUST
PLANTS 2, 3 & 6
LANSING, MICHIGAN

**PLANT 3 SAMPLES USED IN THE
STATISTICAL EVALUATION FOR DC CRITERIA
LEAD / ARSENIC**

FIGURE
A-3

ARCADIS Design & Consultancy
for natural and built assets

CITY: KNOXVILLE DIV: ENV DB: A.SMITH PIC: PM: TR: PROJECT NUMBER: COORDINATE SYSTEM: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl
 M:\GIS\Project Files\RACER\lansing\working\2013 Criteria Eval_P3_Benzo_2020.mxd PLOTTED: 9/22/2020 4:55:25 PM BY: MJOYE



LEGEND

- ▲ 2013 NOT AN EXCEEDANCE 0-2 FT BGS
- ▲ 2013 EXCEEDANCE 0-2 FT BGS
- ▲ 2013 NOT AN EXCEEDANCE >2 FT BGS
- ▲ 2013 EXCEEDANCE > 2 FT BGS
- 2 ACRE EXPOSURE AREA FOR DIRECT CONTACT
- ▲ LNAPL MONITORING WELL
- ▲ PERCHED ZONE MONITORING WELL
- ▲ DEEP OVBURDEN MONITORING WELL
- ▲ WEATHERED BEDROCK MONITORING WELL
- ▲ BEDROCK MONITORING WELL
- ▲ ABANDONED MONITORING WELL
- PLANT 2
- PLANT 3
- PLANT 6

NOTES:
 DATA COMPARED TO EGLE 2013
 NON-RESIDENTIAL DIRECT CONTACT
 (DC) CRITERIA
 ft bgs: FEET BELOW GROUND SURFACE

RACER TRUST
 PLANTS 2, 3 & 6
 LANSING, MICHIGAN

**PLANT 3 SAMPLES USED IN THE
 STATISTICAL EVALUATION FOR DC CRITERIA
 BENZO(A)PYRENE**

ARCADIS Design & Consultancy for natural and built assets

FIGURE
A-4

APPENDIX B

Exposure Barrier Annual Inspection Form



MAINTENANCE OF EXPOSURE BARRIERS
INSPECTION LOG SHEET
RACER Trust Plants 2 & 3 – Lansing, Michigan

DATE: _____

TIME: _____

Inspection		
Is the Surface Cover Consistent With Existing Conditions?		
Exposure Barrier	Condition Satisfactory (X)	Condition Unsatisfactory (X)
Area 2	<input type="checkbox"/>	<input type="checkbox"/>
Area 5-2	<input type="checkbox"/>	<input type="checkbox"/>
Area 5-3	<input type="checkbox"/>	<input type="checkbox"/>
Area 14	<input type="checkbox"/>	<input type="checkbox"/>
Area 18	<input type="checkbox"/>	<input type="checkbox"/>
Area 19	<input type="checkbox"/>	<input type="checkbox"/>

Comments*:

Print Name (Inspector): _____

Inspector's Signature: _____

***Comments and photos attached**

MAINTENANCE OF EXPOSURE BARRIERS
INSPECTION LOG SHEET
RACER Trust Plants 2 & 3 – Lansing, Michigan

Exposure Barrier	Groundcover Condition (Describe weathering, erosion, settling, water ponding, vegetation growth, etc.)	Overall Condition (Good / Fair / Poor)	Photo Notes (Attach labelled photographs)
Area 2 Exposure Barrier			1. 2. 3. 4.
Area 5-2 Exposure Barrier			1. 2. 3. 4.
Area 5-3 Exposure Barrier			1. 2. 3. 4.

MAINTENANCE OF EXPOSURE BARRIERS
INSPECTION LOG SHEET
RACER Trust Plants 2 & 3 – Lansing, Michigan

Area 14 Exposure Barrier			1. 2. 3. 4.
Area 18 Exposure Barrier			1. 2. 3. 4.
Area 19 Exposure Barrier			1. 2. 3. 4.

Based on the above observations, are any corrective actions (i.e., repairs) required? _____

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A decorative graphic consisting of three thin orange lines. One line is horizontal, extending across the width of the page. Two other lines are diagonal, starting from the bottom left and extending towards the top right, crossing the horizontal line.