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December 2, 2016

Mr. Michael McCann
Indiana Department of Environmental Management
Voluntary Remediation Program
Office of Land Quality
100 North Senate Avenue
Indianapolis, IN 46204-6015

Subject: Hydrocarbon Plume Migration and Mass Evaluation/Cease Pump and Treat System Operation Request
Buckeye Granger Terminal
12694 Adams Road, Granger, Indiana
Site Identification No. 6150307 (formerly IDEM State Cleanup #000000025)

Dear Mr.McCann:

On behalf of Buckeye Terminals, LLC, Antea®Group is providing this Hydrocarbon Plume Migration and Mass Evaluation/Cease Pump and Treat System Operation request to the Indiana Department of Environmental Management (IDEM) Voluntary Remediation Program (VRP). The purpose of this submittal is to provide an evaluation of groundwater trends and mass removal information for the period of First Quarter 2005 through June 2016 to support the recommendation to cease operation of the P&T system and continue groundwater monitoring as proposed in Section 4.7 of the Remediation Work Plan dated March 15, 2016.

Two bound paper copies of this submittal and one compact disc (CD) containing the entire report are enclosed. An additional copy of this report will be submitted electronically to the St. Joseph County Health Department for the Granger Terminal Repository.

Please contact me by phone at (800) 477-7411, or e-mail at kendall.rannaoja@anteagroup.com if you have any questions or comments.

Sincerely,

Kendall Rannaoja
Senior Project Manager

Enclosures 2

cc: Jeff Brudereck, Buckeye
Jeff Lizzi, Buckeye
Mark Espich, SJHD
Project File

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TECHNICAL MEMORANDUM

To: Kendall Rannaoja; Antea Group (Chicago)

From: Wayne Hutchinson; Antea Group (Milwaukee)

Date: December 2, 2016

Re: Buckeye Terminal (Granger) – Hydrocarbons Plume Migration and Mass Evaluation

CC:

Purpose

The purpose of this memorandum is to describe and document the evaluation of the dissolved-phase hydrocarbon plumes associated with historical releases at the Buckeye Granger, Indiana petroleum bulk products terminal, located at 12694 Adams Road, Granger, Indiana in St. Joseph County (Site). See Figure 1 and Sheet 101. The evaluation was accomplished using the Monitoring and Remediation Optimization System (MAROS), published by Groundwater Services, Inc. (GSI) Environmental in 2012 (Version 3.0) on behalf of the Air Force Center for Engineering and Environment (AFCEE).

MAROS is the most widely used tool to evaluate groundwater data in support of monitoring optimization and has also been used as part of the decision framework for regulatory closure of remediated plumes (GSI Environmental, 2012). In addition to well-by-well analyses, MAROS includes the ability to evaluate plumes on a holistic standpoint by evaluating, both spatially and temporally, the mass of each plume and the center of its mass. The evaluation of hydrocarbon plume mass and position for the constituents of interest (COI), specifically benzene, toluene, ethylbenzene, total xylenes (BTEX), and naphthalene) associated with the Site, is the focus of this memorandum. Additional details on the MAROS 3.0 software can be accessed at this link: http://www.gsi-net.com/en/software/free-software/monitoring-and-remediation-optimization-systems-maros-version-3-0.html#MAROS%20Features

Background

Site Ownership and Operational History

Amoco Oil Company (Amoco) began operating this facility in 1953 as a refined petroleum products bulk storage and terminal facility. BP Products North America, Inc. (BP), successor by name changes, operated this terminal until July 2011 when it was sold to Buckeye Terminals, LLC (Buckeye). Buckeye is the current owner/operator of the terminal.

The facility stores and dispenses fuels from seven (7) aboveground storage tanks (ASTs) with a total capacity of 249,600 barrels. Gasoline and diesel enter by a 12-inch pipeline (owned/operated by BP) and are loaded into tanker trucks for

transport via a loading rack. Historical products include: furnace oil, heater oil, diesel fuel, leaded and unleaded gasoline, indoline, and mineral spirits.

Release Summary and Remedial Actions

The most recent release occurred on February 11, 2005 (February 2005 Release), when an estimated 3,500 gallons of gasoline leaked from a cracked fitting on the high level alarm piping for Tank No. 2. Details of this release and associated cleanup efforts were submitted to IDEM in the *Interim Response Activities, Release Characterization, and System Modification Report for February 11, 2005 Tank 2 Release* report dated July 22, 2005. Notable historical spills included approximately 81,131 gallons of gasoline released from a storage tank in July 1979, and approximately 66,654 gallons of a petroleum product released from a split pipeline in January 1972. Historical releases were formerly addressed together as one project in the Indiana Department of Environmental Management (IDEM) State Cleanup Program (Site No. 000000025).

Since 1980, numerous investigations have been performed leading to identifying two on-Site plumes: A BTEX and naphthalene plume located primarily within the Site boundaries and a light non-aqueous phase liquid (LNAPL) plume contained entirely within the Site boundaries. The source of the BTEX/Naphthalene contamination and the on-site LNAPL is petroleum products from historical AST and pipeline releases.

Remediation activities were initiated at the-Site in 1980. Between 1980 and 2016, greater than 326,000 gallons equivalent of gasoline, including 150,268 gallons of LNAPL, have been removed via various remedial actions, including operation of the Pump and Treat (P&T) System, LNAPL skimmer recovery system, and air sparge (AS)/Soil Vapor Extraction (SVE). In 2016, only intermittent LNAPL remains in two recovery wells, RW9 and RW12 (located in the northern portion of the Site), as compared to 25 wells containing LNAPL in 2006. A summary of the remediation system operational history is provided in previous Quarterly Monitoring Reports (QMRs) and Annual Remediation Summary Reports (ARSRs).

In August 2015, a Voluntary Remediation Agreement (VRA) was submitted to IDEM to enter the Site into the Voluntary Remediation Program (VRP). A Remediation Work Plan dated March 15, 2016 (RWP) was submitted to IDEM pursuant to the VRA Scope of Work requirements, and is currently undergoing the public comment period.

Dissolved BTEX/Naphthalene Hydrocarbon Plume Evaluation

As a result of the remediation efforts to date, the BTEX/naphthalene plume has been significantly reduced in size, mass, and is stable. Based on June 2016 laboratory groundwater analytical results, dissolved BTEX/naphthalene impacts are delineated, including on-Site in the direction of southerly groundwater flow. Laboratory analytical tables, figures, and associated laboratory analytical reports can be found in previously submitted QMRs.

MAROS Data Analysis

The primary use of the MAROS program was to track changes in hydrocarbon mass (Zeroth moment analysis) over time and the migration of the center of mass (1st moment analysis) for BTEX and naphthalene. Laboratory analyses of these hydrocarbons were evaluated for the period beginning in First Quarter 2005 (correlating to the most recent release at the site - February 2005 Release) through May 2016. Over that time period, groundwater sampling events were typically conducted on a quarterly basis; providing a robust dataset of temporal laboratory results from 40 monitoring or recovery wells located either on-Site or in proximity to the Site. A list of the 40 monitoring wells used in this evaluation are provided in Appendix A.

In each case, the MAROS analysis showed that the mass of each COI hydrocarbon had decreased between 2005 and June 2016, while the center of mass of each hydrocarbon plume has slightly shifted within a limited distance while remaining on the terminal (Site) property. Data input for the MAROS analysis, including the groundwater seepage velocity, plume dimensions, proximity of receptors and Site property lines to the source area and plume edge, and the COIs are provided in Appendix A. In addition, the summary shows that wells were designated as source (S), tail (T) or delineation (D) wells, and the average record count (number of unique laboratory analyses) for each well was 191.

Moment Analysis for Benzene

Sheet 1 depicts the mass of the benzene plume and the center of mass over time starting in August 2005 through May 2016. Time is referenced to days after the initial laboratory analysis (3rd quarter, 2005). The center of mass icons, color-coded from cyan (earliest) to rose (most recent), show that in about 11 years the center of mass of the benzene plume has slightly shifted from the tank farm in the northeastern part of the Site that includes Tank Nos. 1, 2, 3, 4, and 7 (main tank farm) to a tightly limited area located just south of the main tank farm.

Sheet 2 depicts the position of the center of mass of benzene on an annual basis while color-coded icons represent the mass and dotted arrows chronologically connect the center of mass icons over time. The center of mass for the benzene plume, with a mass greater than 8 kilograms, is depicted as being near the southwestern corner of the main tank farm in 2006. The center of mass then slightly shifts within the same limited area just south of the main tank farm by 2009 and has remained in this same limited area through 2015. Sheet 2 also shows that the mass of benzene declines from greater than 8 kilograms in 2007 to less than 2 kilograms in 2010, and remained less than 2 kilograms through 2015.

As summarized in Benzene MAROS Zeroth Moment Analysis Summary (Benzene MAROS Summary) in Appendix B, the benzene mass was initially calculated at 0.0 kilograms in the first and second quarters of 2005 based on analyses from just two wells. Over the rest of the time period, the benzene mass initially increased to more than 18 kilograms and then declined to less than 1 kilogram, as depicted in the inset graph on Sheet 1 and summarized in Appendix B. The Benzene MAROS Summary also notes that the Mann-Kendall S Statistic is calculated as -422, which indicates a strong trend of decreasing mass. The points to note are:

1. The center of mass of the benzene plume has remained on the Site property, in the same limited area between the southwest corner of the main tank farm and Tank No. 6 from between 2008 to 2015.
2. The mass of dissolved-phase benzene has decreased from more than 18 kilograms in 2007 to less than 1 kilogram in 2015
3. The strong negative Mann-Kendall S Statistic is further support of a decidedly downward trend in benzene mass.

Moment Analysis for Toluene

Sheet 3 depicts the mass of the toluene plume and the center of mass over time starting in August 2005 through May 2016. Time is referenced to days after the initial laboratory analysis (3rd quarter, 2005). The center of mass icons, color-coded from cyan (earliest) to rose (most recent), show that in about 11 years the center of mass of the toluene plume slightly shifts within the same limited area in the southwestern corner of the main tank farm to a tightly limited area just south of the main tank farm. The inset bar graph in Sheet 3, shows that the mass of toluene in the dissolved-phase plume was 170 kilograms in 2007, but declined to less than 10 kilograms by the end of 2008, and has been less than 2 kilograms in 2016.

Sheet 4 depicts the position of the center of mass of toluene on an annual basis while color-coded icons represent the mass and arrows chronologically connect the center of mass icons. The center of mass for the toluene plume, with a mass between 50 and 100 kilograms, is depicted as being near the west-central portion of the main tank farm in 2006. By 2008, the center of mass had slightly shifted and remains near the southern berm of the main tank farm and has remained in this limited area since. Sheet 4 also shows that the mass of toluene declined to less than 25 kilograms in 2008, and has remained less than 25 kilograms since.

As summarized in Toluene MAROS Zeroth Moment Analysis Summary in Appendix B, the toluene mass was initially calculated at 0.0 kilograms in the first and second quarters of 2005 based on analyses from just two wells. As toluene analyses were collected from more wells, the mass estimate increased to 170 kilograms by 2007. The mass of toluene has declined since 2007 and since 2015 has typically been less than 2 kilograms. The Mann-Kendall S Statistic is calculated at -530, which is indicative of a significant trend towards decreasing dissolved-phase toluene. The points to note are:

1. The center of mass of the toluene plume has remained on-Site, near the main tank farm from between 2008 and 2015.
2. The mass of dissolved-phase toluene has decreased from 170 kilograms in 2007 to less than 2 kilograms since 2015.
3. The strongly negative Mann-Kendall S Statistic confirms the significant decrease in dissolved-phase toluene over the period of the analysis.

Moment Analysis for Ethylbenzene

Sheet 5 depicts the mass of the ethylbenzene plume and the center of mass over time starting in August 2005 through May 2016. Time is referenced to days after the initial laboratory analysis (3rd quarter, 2005). The center of mass icons, color-coded from cyan (earliest) to rose (most recent), show that in about 11 years the center of mass of the ethylbenzene plume has slightly shifted from the main tank farm in the northeastern part of the Site to a tightly limited area just south of the main tank farm. The inset in Sheet 5 shows that the mass of ethylbenzene declines from greater than 140 kilograms early in the study period (2007), to approximately 40 kilograms in 2010, and further declines to approximately 30 kilograms in 2016.

Sheet 6 depicts the position of the center of mass of ethylbenzene on an annual basis while color-coded icons represent the mass and arrows chronologically connect the center of mass icons. The center of mass for the ethylbenzene plume, with a mass greater than 100 kilograms, is depicted as being near the southwestern corner of the main tank farm in 2006. The center of mass had shifted to the same limited area, just south of the main tank farm by 2008 and has remained in this same area through 2015. Sheet 6 also shows that the mass of ethylbenzene declined from greater than 100 kilograms to between 25 and 50 kilograms by 2014.

As summarized in the Ethylbenzene MAROS Zeroth Moment Analysis Summary in Appendix B, the ethylbenzene mass was initially calculated at 0.0 kilograms in the first and second quarters of 2005 based on analyses from just two wells. As ethylbenzene laboratory analyses were generated from more wells, the mass estimate increased to 140 kilograms by 2007. The mass of ethylbenzene has declined since 2007 and since 2014 has typically been around 30 kilograms. The Mann-Kendall S Statistic for the trend in ethylbenzene mass over time was calculated as -132, which indicates the mass has declined over the period of record for this analysis. The points to note are:

1. The center of mass of the ethylbenzene plume has remained on the Site property and in the same limited area from between 2007 to 2015.

2. The mass of dissolved-phase ethylbenzene has decreased from 140 kilograms in 2007 to about 30 kilograms in 2014.
3. The negative Mann-Kendall S Statistic supports the observation that ethylbenzene mass has declined within the dissolved-phase plume.

Moment Analysis for Xylenes

Sheet 7 depicts the mass of the xylenes plume and the center of mass over time starting in August 2005 through May 2016. Time is referenced to days after the initial laboratory analysis (3rd quarter, 2005). The center of mass icons, color-coded from cyan (earliest) to rose (most recent), show that in about 11 years the center of mass of the xylene plume has shifted in the same limited area, from the southwest corner of the main tank farm to a tightly limited area located just south of the main tank farm. The inset bar graph in Sheet 7 shows that in 2007 the mass of dissolved-phase toluene was in excess of 500 kilograms, but around 2010 declined to around 150 kilograms and since 2013 has typically been less than 100 kilograms.

Sheet 8 depicts the position of the center of mass of xylenes on an annual basis while color-coded icons represent the mass and arrows chronologically connect the center of mass icons. The center of mass for the xylenes plume, with a mass between 200 and 300 kilograms, is depicted as being near the southwest corner of the main tank farm in 2006, but by 2008 the center of mass had shifted and remains in the same limited area, between the southern berm of the main tank farm and just south of the main tank farm. By 2014 the mass of xylenes in the dissolved-phase plume had declined to less than 100 kilograms.

As summarized in the Total Xylenes MAROS Zeroth Moment Analysis Summary (Total Xylenes MAROS Summary) in Appendix B, the xylenes mass was initially calculated at 0.0 kilograms in the first and second quarters of 2005 based on analyses from just two wells. As xylene analyses were collected from more wells, the mass estimate increased to 680 kilograms by 2007. The mass of xylenes has declined since 2007 and since 2015 has typically been less than 100 kilograms. The Total Xylenes MAROS Summary shows that the Mann-Kendall S Statistic is negative, which supports the observation that the dissolved-phase xylene mass has decreased over the time period of the analysis. The points to note are:

1. The center of mass of the xylene plume has remained on the Site property, just south of the main tank farm from between 2008 and 2015.
2. The mass of dissolved-phase xylenes has decreased from 680 kilograms in 2007 to less than 100 kilograms since 2015.
3. The negative Mann-Kendall S Statistic indicates the trend of decreasing xylene mass over the period of analysis.

Moment Analysis for Naphthalene

Sheet 9 depicts the mass of the naphthalene plume and the center of mass over time starting in August 2005 through May 2016. Time is referenced to days after the initial laboratory analysis (3rd quarter, 2005). The center of mass icons, color-coded from cyan (earliest) to rose (most recent), show that in about 11 years the center of mass of the naphthalene plume has slightly shifted in the same limited area between the southwest corner of the main tank farm to a tightly limited area located just south of the main tank farm. The inset bar graph in Sheet 9 shows that in 2008 the mass of dissolved-phase naphthalene was in excess of 46 kilograms, but around 2010 declined to around 15 kilograms and since 2014 has typically been less than 12 kilograms.

Sheet 10 depicts the position of the center of mass of naphthalene on an annual basis while color-coded icons represent the mass and arrows chronologically connect the center of mass icons. The center of mass for the naphthalene plume, with a mass between 10 and 20 kilograms, is depicted as being near the southwest corner of the main tank farm in 2006. By 2010, the center of mass had slightly shifted and has remained in a tightly limited area between the southern berm of the main tank farm and just south of the southern berm of the main tank farm through 2015. By 2014 the mass of naphthalene in the dissolved-phase plume had declined to less than 5 kilograms.

As summarized in the Naphthalene MAROS Zeroth Moment Analysis Summary (Naphthalene MAROS Summary), the naphthalene mass was initially calculated at 0.0 kilograms in the first and second quarters of 2005 based on analyses from just one or two wells. As naphthalene analyses were collected from more wells, the mass estimate increased to 47 kilograms by 2007. The mass of naphthalene has declined since 2007 and since 2015 has typically been less than 10 kilograms. The negative Mann-Kendall S Statistic in the naphthalene MAROS Summary indicates a declining trend in the mass of dissolved-phase naphthalene. The points to note are:

1. The center of mass of the naphthalene plume has remained on the Site property, between the main tank farm and Tank No. 6 to the south from between 2009 and 2015.
2. The mass of dissolved-phase naphthalene has decreased from 47 kilograms in 2007 to less than 10 kilograms in 2015.
3. The negative Mann-Kendall S Statistic indicates a decreasing trend in dissolved-phase naphthalene over the period of analysis.

Pump and Treat System Mass Removal

Laboratory analytical results from the influent (originating from the recovery well network) into the P&T System were evaluated in September 2007, 2010, and 2016 to determine mass removal trends. Please note the following details as part of this evaluation:

CONTAMINANT OF INTEREST	SEPTEMBER 2007 INFLUENT CONCENTRATION (micrograms per liter (ug/L))	SEPTEMBER 2010 INFLUENT CONCENTRATION (ug/L)	SEPTEMBER 2016 INFLUENT CONCENTRATION (ug/L)	IDEM REMEDIATION CLOSURE GUIDE (RCG) 2015 SCREENING LEVEL
Benzene	68.4	<2.5	<2.5	5
Toluene	186	<5	<5	1,000
Ethylbenzene	25.4	15.1	7.6	700
Total Xylenes	133	64.4	30.2	10,000
Naphthalene	8.4	5.4	2	1.7

The summarized data indicates trends similar to the trends observed during the MAROS evaluation. Specifically, significant mass removal was observed in the period shortly after the 2005 release, followed by continually decreasing removal rates from approximately 2010 through September 2016. The September 2016 influent data indicates that BTEX constituents are below IDEM RCG Tap Screening Levels and only naphthalene influent exceeds the RCG 2015 Screening Level. IDEM RCG Screening Levels were only used for comparison purposes to demonstrate that recent mass removal through operation of the P&T System is minimal and the residual groundwater impacts remaining have decreased significantly over time. The September 2007 and September 2010 influent, effluent, and mass removal data was provided in previous QMRs. The September 2016 influent, effluent, and mass removal data will be provided in a future QMR.

Recent Groundwater Sampling Data

Groundwater analytical data from the most recent sampling events performed in 2016, as documented in prior reports including the First Quarter 2016 Quarterly Monitoring Report, dated May 26, 2016 and the Second Quarter 2016 Quarterly Monitoring Report, dated August 30, 2016 demonstrate that the dissolved phase hydrocarbon plumes, including BTEX and naphthalene, have been delineated on-Site, including in the direction of groundwater flow to the south and southwest.

Conclusions

The analyses performed using MAROS were focused on establishing extent, location, mass and trends of dissolved-phase BTEX and naphthalene over a period from 2005 to 2016. Over this period, a fairly consistent set of 18 to 21 monitoring wells were sampled on a quarterly basis, creating a robust data set of groundwater quality analyses.

The MAROS analyses of the groundwater quality data lead to three conclusions:

1. The center of mass of the dissolved-phase plume for each of the COIs has slightly shifted over the 11-year period of analysis but have remained on the Site property in the same limited area just south of the main tank farm since approximately 2009.
2. The mass of each of the analytes (BTEX and naphthalene) has declined over the period of analysis and would be expected to continue to decline through natural attenuation, in-situ degradation, and biodegradation.
3. The overall mass of the COIs decreased rapidly over the early (pre-2010) portion of the data set. The overall mass has then has seen a continual reduced rate of mass reduction over the latter portion of the dataset time period (approximately 2010 through part of 2016), indicating the mass has significantly reduced in size over this time period and that minimal on-going mass removal will be accomplished through continued operation of the P&T System. This timeline trend is also observed in the influent to the Pump and Treat System.

Recommendations

Over the 11-year period addressed by the MAROS analyses, the dissolved-phase mass removed by the remedial systems has been significant, as demonstrated by the strong decreasing trends and stabilized mass of each COI in the plume. Recent groundwater analytical data from sampling indicates on-Site delineation in all directions.

Based on the results of the MAROS analyses showing a stabilized plume with decreasing mass for each analyte, it is recommended that the active P&T groundwater recovery and treatment be discontinued and groundwater monitoring for four (4) quarters will be initiated in accordance with Section 4.7 of the Remediation Work Plan dated March 15, 2016 (RWP).

Continuing groundwater sampling in accordance with current protocols will sustain a consistent set of monitoring wells, analytes and sampling frequency to assess the effect on groundwater quality and permit further plume and statistical analysis.

Cited References

GSI Environmental (2012) *Monitoring and Remediation Optimization System (MAROS), Version 3.0 – User's Guide and Technical Manual*: AFCEE, 99 pp.

QMRs (First Quarter 2005 through Second Quarter 2016) and ARSRs (2005 through 2015), Hull and Associates, Delta Environmental, or Antea Group RWP (March 15, 2016), Antea Group

Figures

Figure 1 – Site Location Map

Sheets

Sheet 101 – Site Map

Sheet 1 – MAROS Days from Zero Moment Analysis – Benzene

Sheet 2 – MAROS Moment Analysis (Mass) – Benzene

Sheet 3 – MAROS Days from Zero Moment Analysis – Toluene

Sheet 4 – MAROS Moment Analysis (Mass) – Toluene

Sheet 5 – MAROS Days from Zero Moment Analysis – Ethylbenzene

Sheet 6 – MAROS Moment Analysis (Mass) – Ethylbenzene

Sheet 7 – MAROS Days from Zero Moment Analysis – Total Xylenes

Sheet 8 – MAROS Moment Analysis (Mass) – Total Xylenes

Sheet 9 – MAROS Days from Zero Moment Analysis – Naphthalene

Sheet 10 – MAROS Moment Analysis (Mass) – Naphthalene

Appendices

Appendix A – MAROS Site Summary

Appendix B – MAROS Zeroth Moment Analyses

REMARKS

The recommendations contained in this report represent Antea USA, Inc.'s professional opinions based upon the currently available information and are arrived at in accordance with currently accepted professional standards. This report is based upon a specific scope of work requested by the client. The contract between Antea USA, Inc. and its client outlines the scope of work, and only those tasks specifically authorized by that contract or outlined in this report were performed. This report is intended only for the use of Antea USA, Inc.'s client and anyone else specifically identified in writing by Antea USA, Inc. as a user of this report. Antea USA, Inc. will not and cannot be liable for unauthorized reliance by any other third party. Other than as contained in this paragraph, Antea USA, Inc. makes no express or implied warranty as to the contents of this report.

Date: 12/2/16

Wayne Hutchinson, PG, PH
Senior Hydrogeologist

Reviewed by:

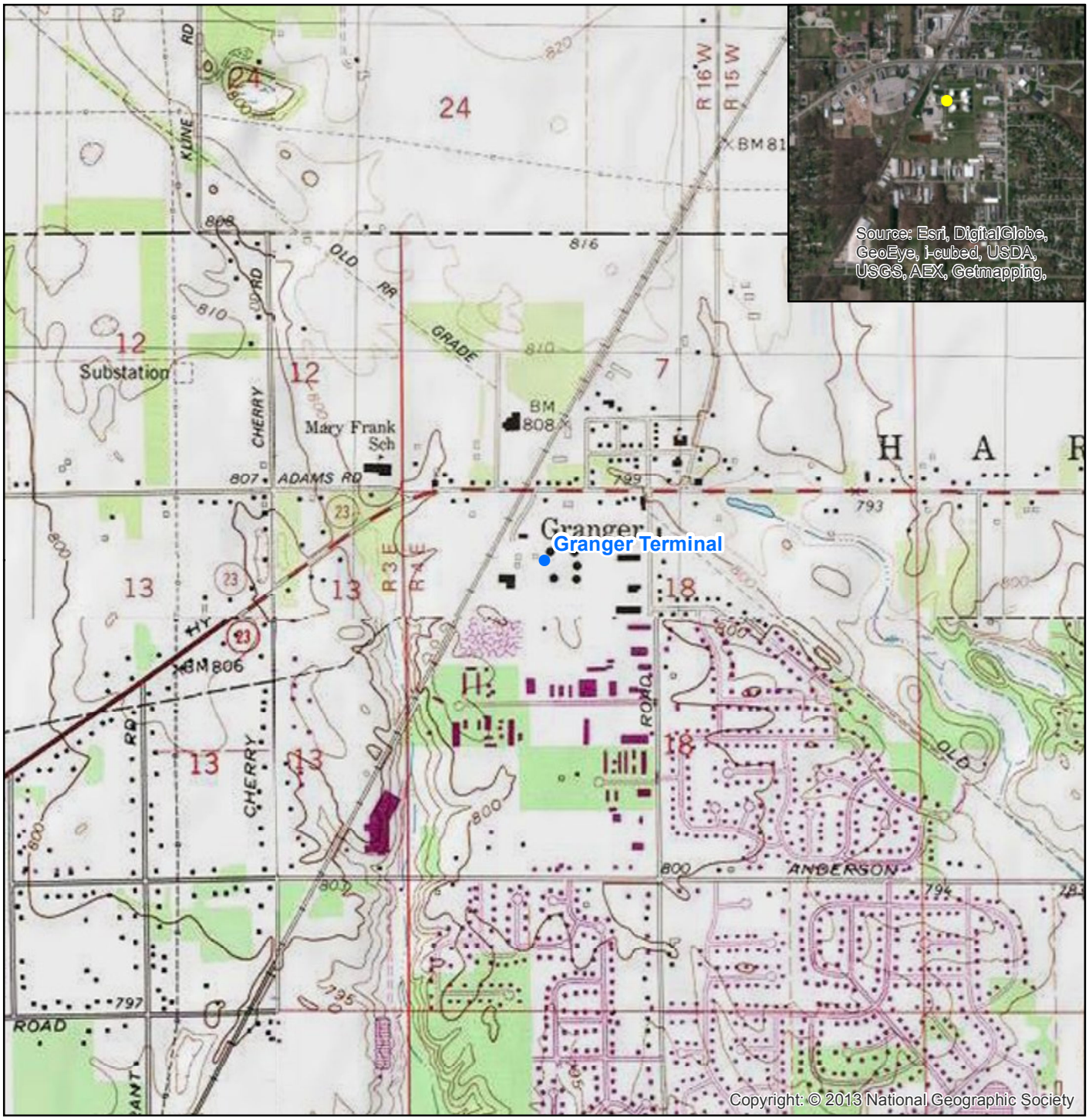
Date: 12/2/16

Kendall Rannaoja
Senior Project Manager

Date: 12/2/16

James Cuthbertson
Professional Engineer – Indiana PE No. 10200344

FIGURES



Legend

- Site Location

Source: The topographic map was acquired through the USGS Topographic Map web service. Topo quadrangle date not provided.

The aerial photo in the inset was acquired throughEsri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community. Aerial photography date not provided.

0 500 1,000 2,000 Feet

1:24,000 1 inch equals 24,000 inches

N

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Buckeye Terminals, LLC
Granger Terminal Facility

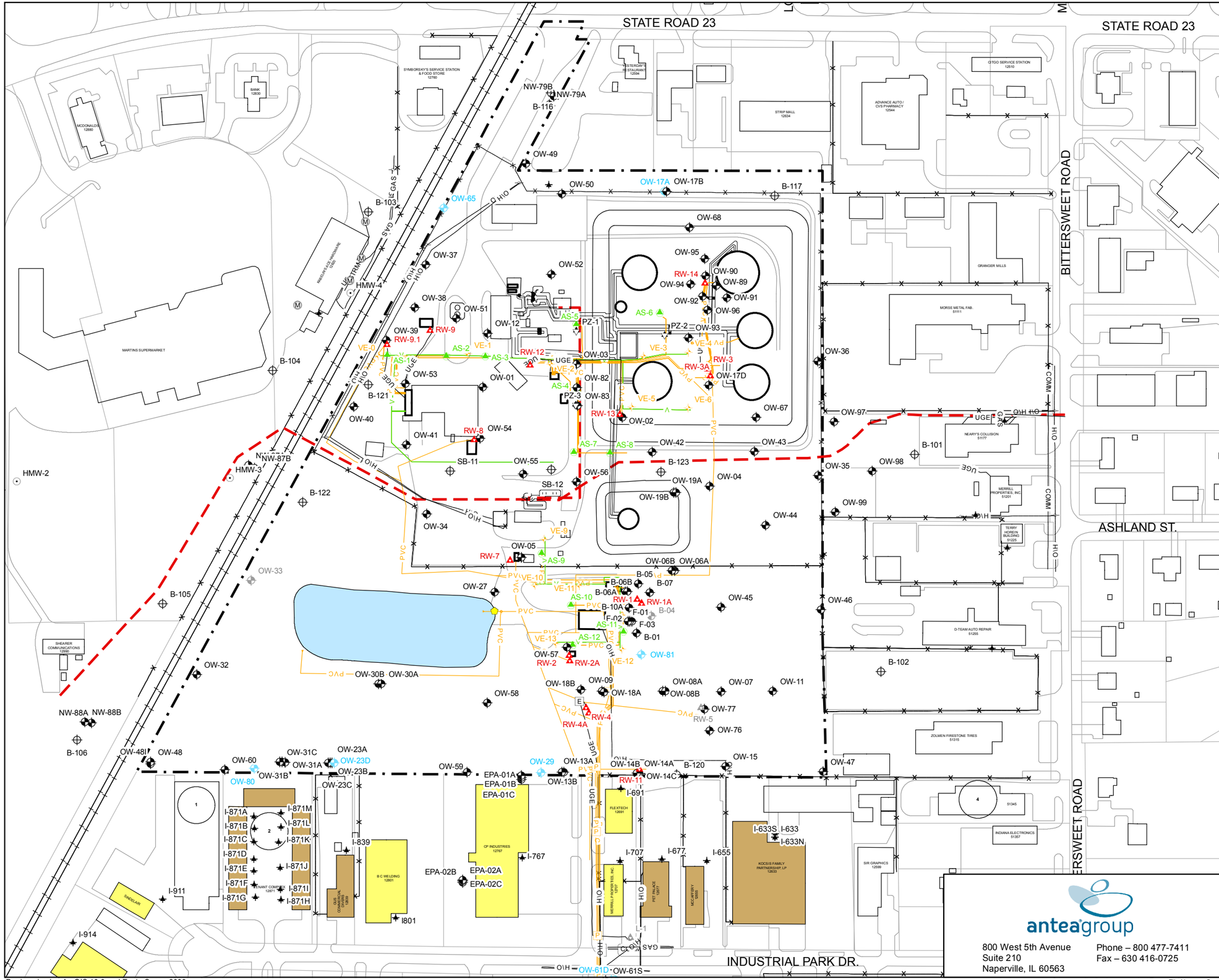
Site Location Map

12694 Adams Road
Granger, St. Joseph County, Indiana

Figure

1

SHEETS



Legend

- Property Line
- BP Pipeline
- Above Ground Piping
- Fence
- GAS Gas Line
- O\H Overhead Utilities
- STRM Storm Sewer Line
- UGE Underground Electric Line
- COMM Underground Communication Line
- PVC_Cond_GPS
- PVC PVC Conduit
- V Vacuum Line
- E Electrical Junction Box
- M Manholes
- P Electrical Pull Boxes
- Utility Pole
- Filtered Water Well
- Unfiltered Water Well
- Hoosier Environmental Monitoring Wells
- Observation Well - screened in upper medium-grained sand layer above 730.00' MSL
- Recovery Well - screened in upper medium-grained sand layer above 730.00' MSL
- Observation Well - screened in the lower coarse-grained sand layer below 730.00' MSL
- Decommissioned Observation Well
- Decommissioned Recovery Well
- Water Supply Well
- Soil Vapor Extraction Well
- Piezometer
- Soil Boring
- Air Sparge Well

Notes:

1. This map is produced from previous survey data, former consultant maps, client maps,IDEM maps, GIS data purchased from St. Joseph County, Indiana, and GPS data. It is not intended to serve as a legal document or be considered a legal survey.

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Buckeye Terminals, LLC
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Site Map

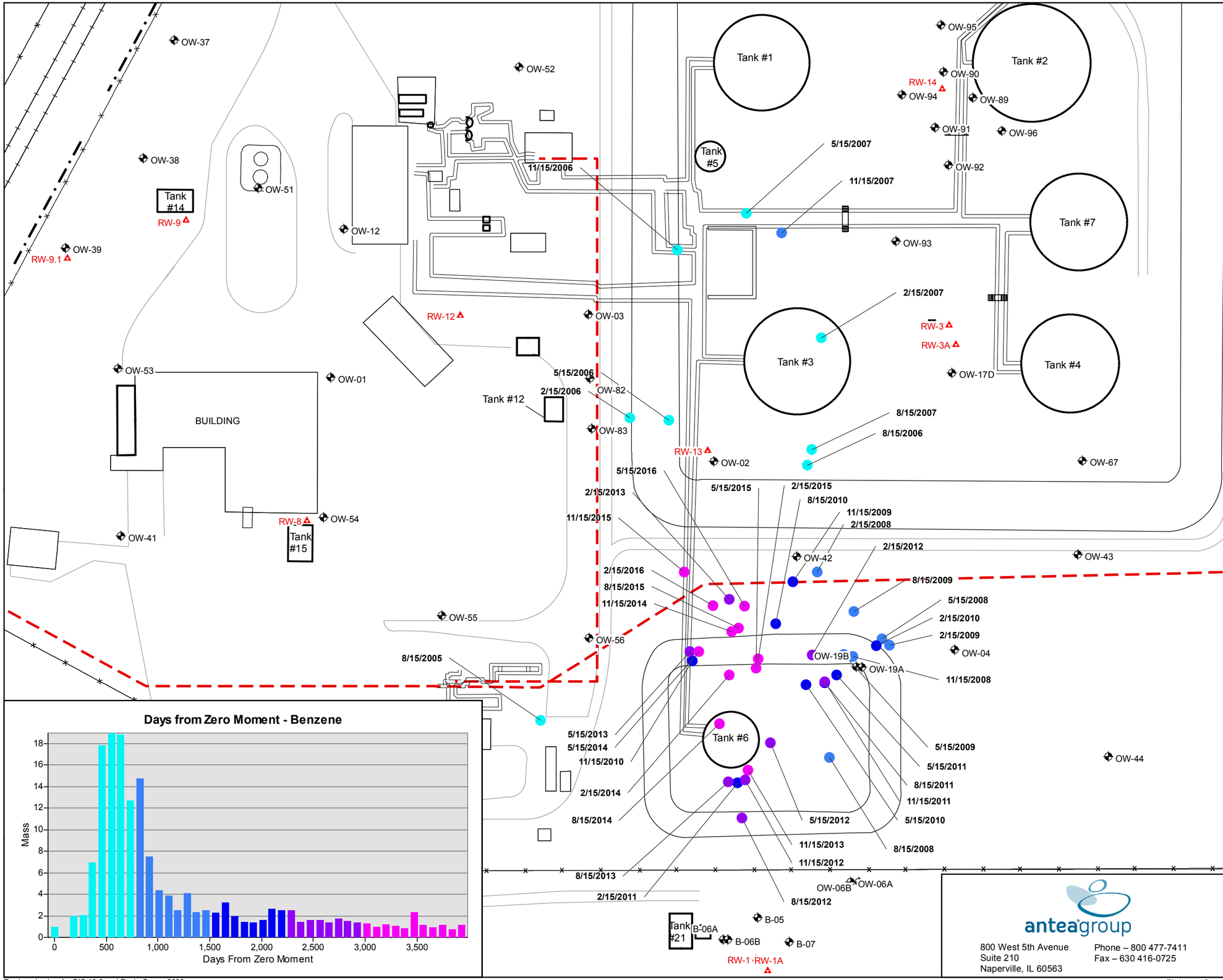
12694 Adams Road
Granger, St. Joseph County, Indiana

Sheet Number: 101

Produced using ArcGIS 10.0 and EnviroSpase 2008

File Name: Granger ActionArea2 SiteMap.mxd

Edited: 11/8/2016 By: JH



Notes:

1. This map is produced from previous survey data, former consultant maps, client maps,IDEM maps, GIS data purchased from St. Joseph County, Indiana, and GPS data. It is not intended to serve as a legal document or be considered a legal survey.

2. Data used for this evaluation is from August 2005 through May 2016.

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Buckeye Terminals, LLC
Granger Terminal Facility

MAROS Days from Zero Moment Analysis Benzene

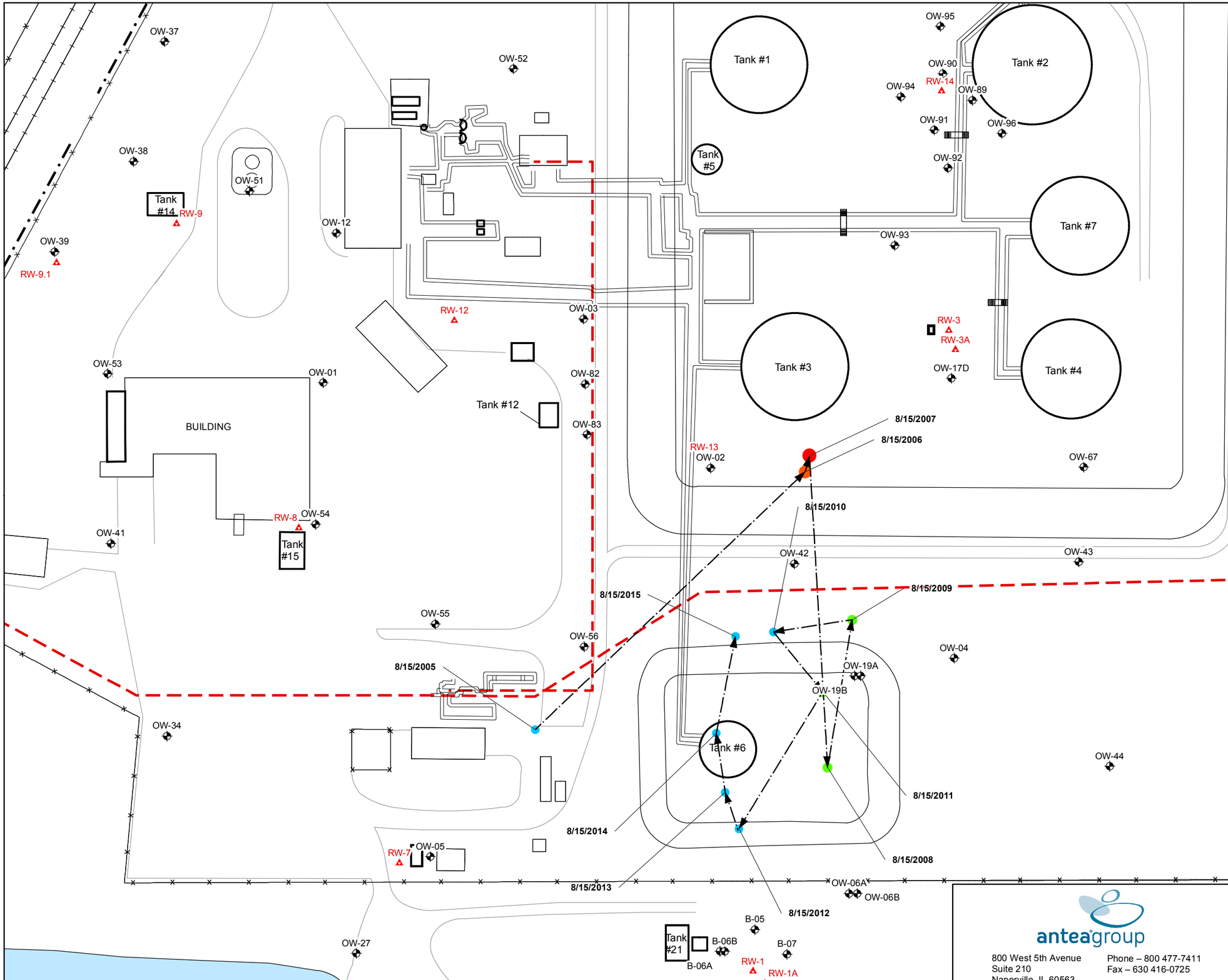
12694 Adams Road
Granger, St. Joseph County, Indiana

Sheet Number: 1

Produced using ArcGIS 10.0 and EnviroSpase 2008

File Name: Granger AA2-daysFromZeroBenzene_ed.mxd

Edited: 11/8/2016 By: JH



Legend

- Property Line
- BP Pipeline
- Above Ground Piping
- Fence
- Observation Well - screened in upper medium-grained sand layer above 720.00' above mean sea level (MSL)
- Recovery Well - screened in upper medium-grained sand layer above 730.00' MSL
- Center of Mass movement noted between years

Moment Analysis (Mass) - Benzene

- Mass < 2 kg
- Mass 2 - 4 kg
- Mass 4 - 6 kg
- Mass 6 - 8 kg
- Mass > 8 kg

kg - kilogram
Noted location indicates the center of mass that year.

Notes:

1. This map is produced from previous survey data, former consultant maps, client maps,IDEM maps, GIS data purchased from St. Joseph County, Indiana, and GPS data. It is not intended to serve as a legal document or be considered a legal survey.
2. Data used for this evaluation is from 2005 through 2015 (the most recent complete year of data available)

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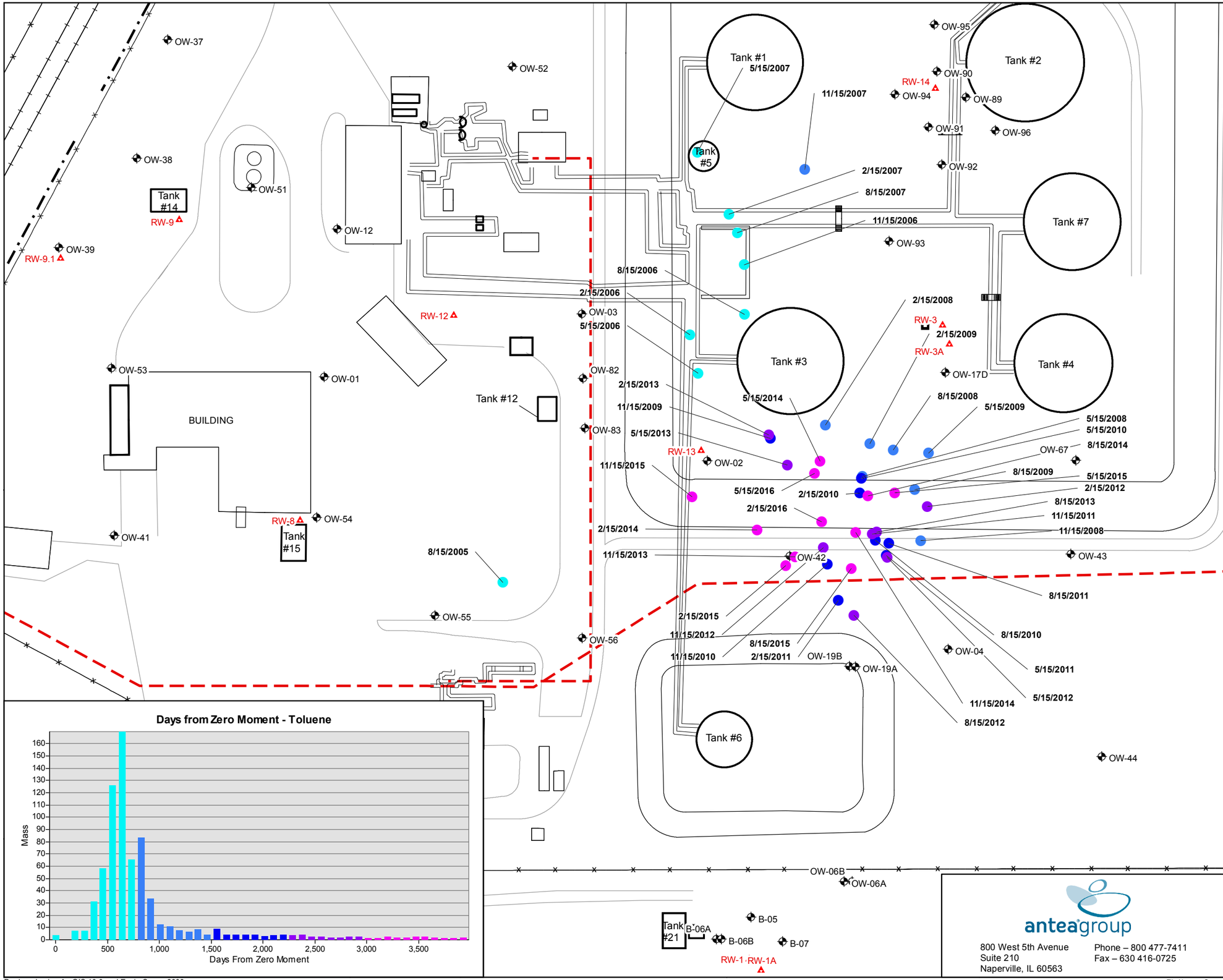
Buckeye Terminals, LLC
Granger Terminal Facility

MAROS Moment Analysis (Mass)
Benzene

12694 Adams Road
Granger, St. Joseph County, Indiana

Sheet Number: 2



Legend

- Property Line
- BP Pipeline
- Above Ground Piping
- Fence
- Observation Well - screened in upper medium-grained sand layer above 720.00' above mean sea level (MSL)
- Recovery Well - screened in upper medium-grained sand layer above 730.00' MSL

Days from Zero Moment - Toluene

- 0 - 750
- 750 - 1,500
- 1,500 - 2,250
- 2,250 - 3,000
- > 3,000

Days from Zero Moment: Number of days from the beginning date used in the data set

Notes:

1. This map is produced from previous survey data, former consultant maps, client maps,IDEM maps, GIS data purchased from St. Joseph County, Indiana, and GPS data. It is not intended to serve as a legal document or be considered a legal survey.
2. Data used for this evaluation is from August 2005 through May 2016.

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Buckeye Terminals, LLC
Granger Terminal Facility

MAROS Days from Zero Moment Analysis Toluene

12694 Adams Road
Granger, St. Joseph County, Indiana

Sheet Number: 3

Produced using ArcGIS 10.0 and EnviroSpase 2008

File Name: Granger_AA2-daysFromZeroToluene_ed.mxd

Edited: 11/8/2016 By: JH

0 40 80 160 Feet
1:960 1 inch = 80 feet
N

Tank #1
Tank #2
Tank #3
Tank #4
Tank #5
Tank #6
Tank #7
Tank #12
Tank #14
Tank #15
Tank #21
BUILDING

OW-37
OW-38
OW-39
OW-52
OW-51
OW-12
OW-53
OW-01
OW-41
OW-5
OW-03
OW-82
OW-83
OW-02
OW-95
OW-90
OW-94
OW-89
OW-91
OW-96
OW-92
OW-93
OW-17D
OW-67
OW-42
OW-43
OW-55
OW-56
OW-04
OW-19A
OW-19B
OW-34
OW-44
OW-05
OW-06A
OW-06B
OW-27
B-05
B'-06B
B-06A
B-07
RW-9
RW-9.1
RW-12
RW-13
RW-14
RW-3
RW-3A
RW-8
RW-7
RW-1
RW-1A

8/15/2007
8/15/2006
8/15/2008
8/15/2014
8/15/2009
8/15/2013
8/15/2005
8/15/2011
8/15/2010
8/15/2015
8/15/2012

Legend

- Property Line
- BP Pipeline
- Above Ground Piping
- Fence
- Observation Well - screened in upper medium-grained sand layer above 720.00' above mean sea level (MSL)
- Recovery Well - screened in upper medium-grained sand layer above 730.00' MSL
- Center of Mass movement noted between years

Moment Analysis (Mass) - Toluene

- Mass < 25 kg
- Mass 25 - 50 kg
- Mass 50 - 100 kg
- Mass 100 - 150 kg
- Mass > 150 kg

kg - kilogram
Noted location indicates the center of mass that year.

Notes:

1. This map is produced from previous survey data, former consultant maps, client maps,IDEM maps, GIS data purchased from St. Joseph County, Indiana, and GPS data. It is not intended to serve as a legal document or be considered a legal survey.
2. Data used for this evaluation is from 2005 through 2015 (the most recent complete year of data available)

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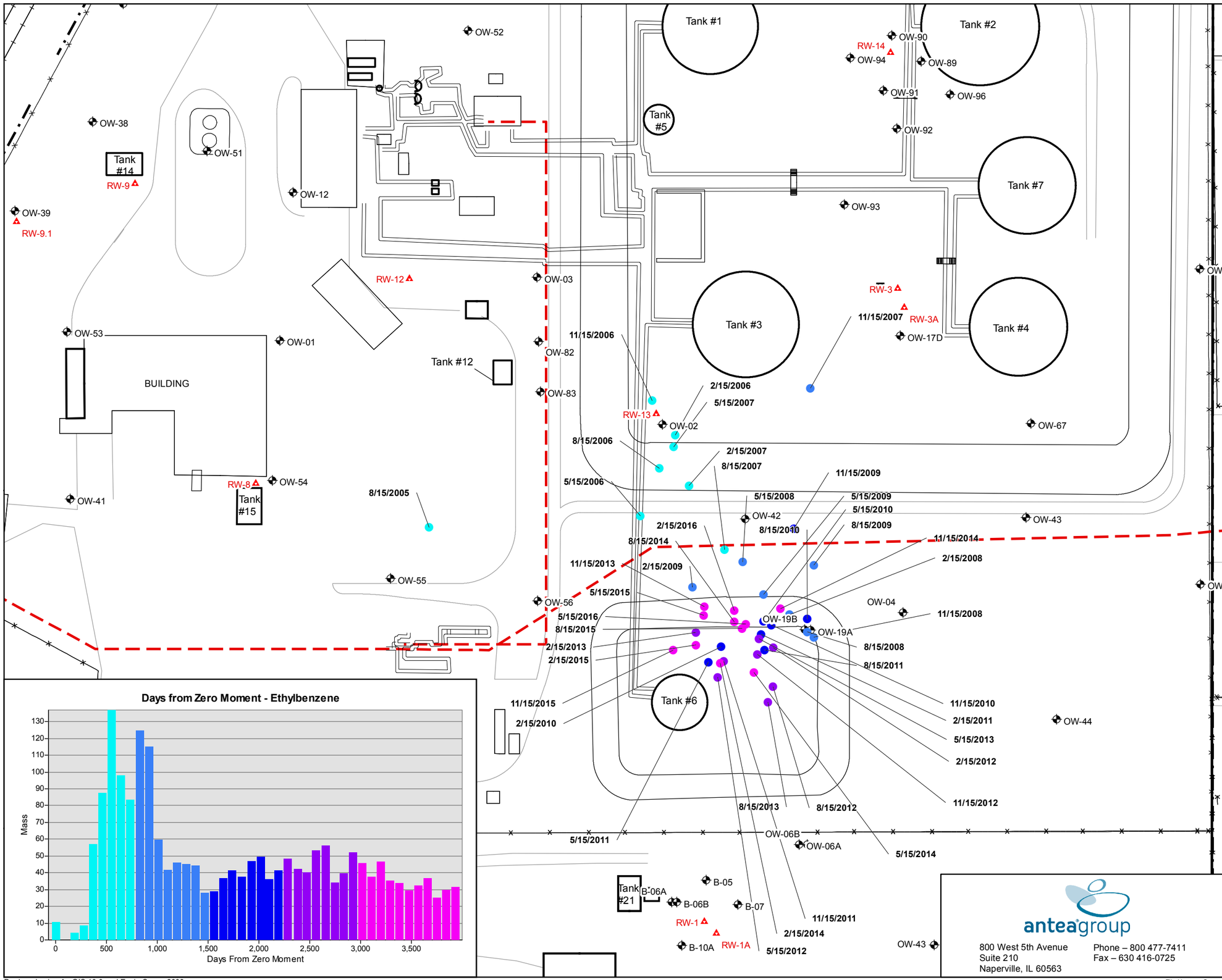
MAROS Moment Analysis (Mass)
Toluene

12694 Adams Road
Granger, St. Joseph County, Indiana

Sheet Number: 4



Notes:

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2. Data used for this evaluation is from August 2005 through May 2016.

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Buckeye Terminals, LLC
Granger Terminal Facility

MAROS Days from Zero Moment Analysis
Ethylbenzene

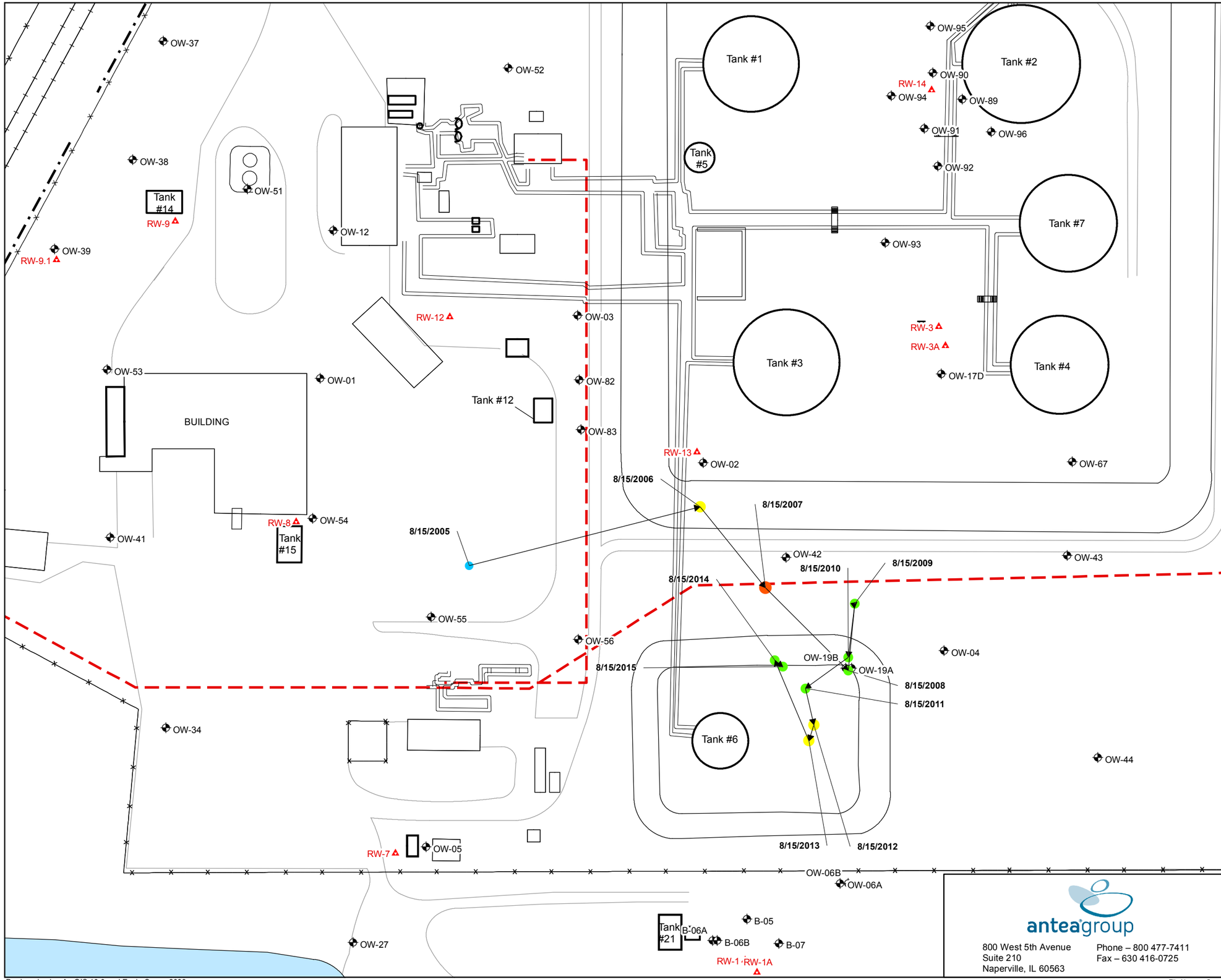
12694 Adams Road
Granger, St. Joseph County, Indiana

Sheet Number: 5

Produced using ArcGIS 10.0 and EnviroSpase 2008

File Name: Granger_AA2-daysFromZeroEthylbenzene_ed.mxd

Edited: 11/8/2016 By: JH



0 40 80 160 Feet

1:960 1 inch = 80 feet

N

Legend

- Property Line
- BP Pipeline
- Above Ground Piping
- Fence
- Observation Well - screened in upper medium-grained sand layer above 720.00' above mean sea level (MSL)
- Recovery Well - screened in upper medium-grained sand layer above 730.00' MSL
- Center of Mass movement noted between years

Moment Analysis (Mass) - Ethylbenzene

- Mass < 25 kg
- Mass 25 - 50 kg
- Mass 50 - 75 kg
- Mass 75 - 100 kg
- Mass > 100 kg

kg - kilogram
Noted location indicates the center of mass that year.

Notes:

1. This map is produced from previous survey data, former consultant maps, client maps,IDEM maps, GIS data purchased from St. Joseph County, Indiana, and GPS data. It is not intended to serve as a legal document or be considered a legal survey.
2. Data used for this evaluation is from 2005 through 2015 (the most recent complete year of data available)

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Buckeye Terminals, LLC
Granger Terminal Facility

MAROS Moment Analysis (Mass)
Ethylbenzene

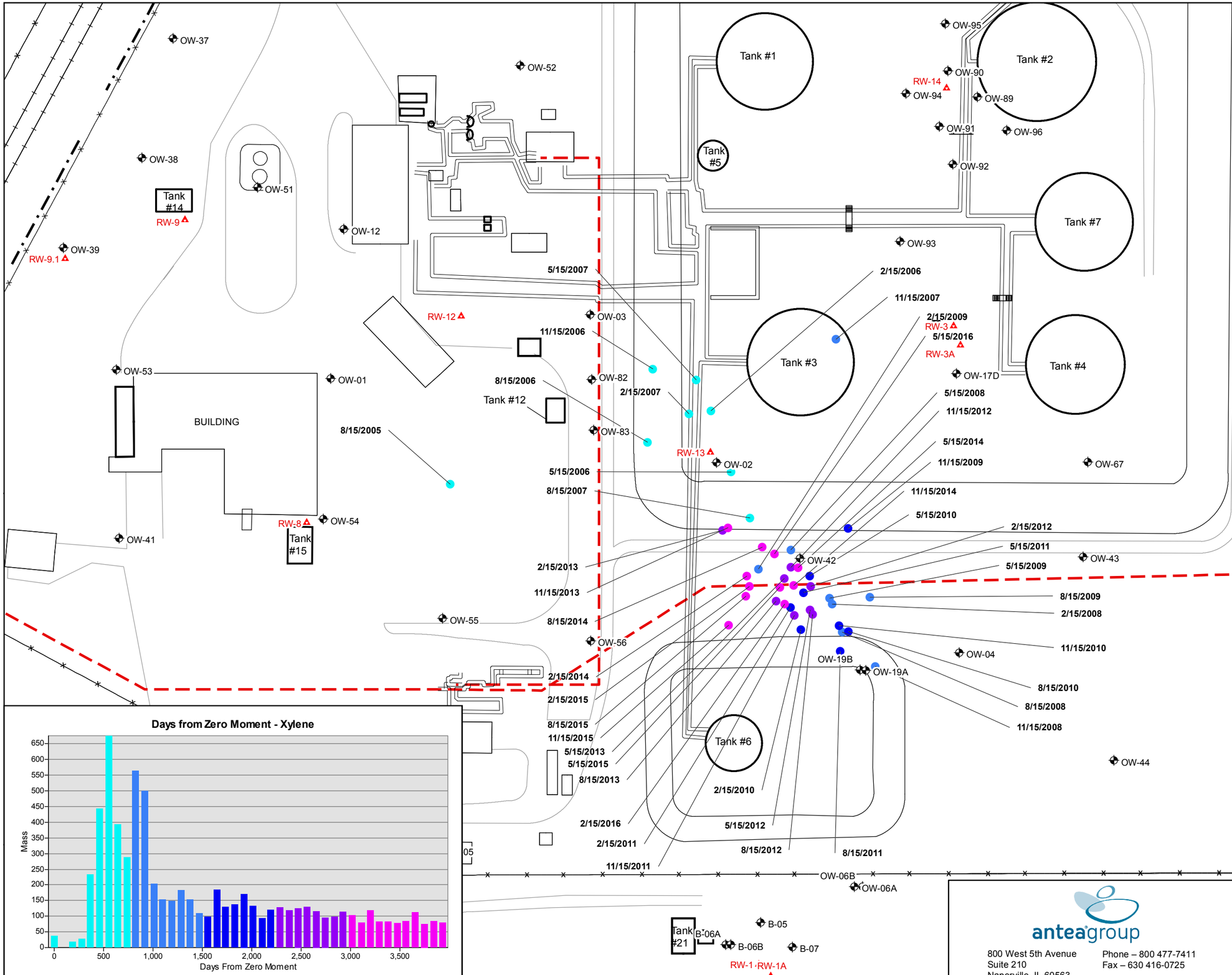
12694 Adams Road
Granger, St. Joseph County, Indiana

Sheet Number: 6

Produced using ArcGIS 10.0 and EnviroSpase 2008

File Name: Granger_AA2-momentAnalysisEthylbenzene_annualCOM_ed.mxd

Edited: 11/8/2016 By: JH



Notes:

1. This map is produced from previous survey data, former consultant maps, client maps,IDEM maps, GIS data purchased from St. Joseph County, Indiana, and GPS data. It is not intended to serve as a legal document or be considered a legal survey.

2. Data used for this evaluation is from August 2005 through May 2016.

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Granger Terminal Facility

MAROS Days from Zero Moment Analysis
Total Xylenes

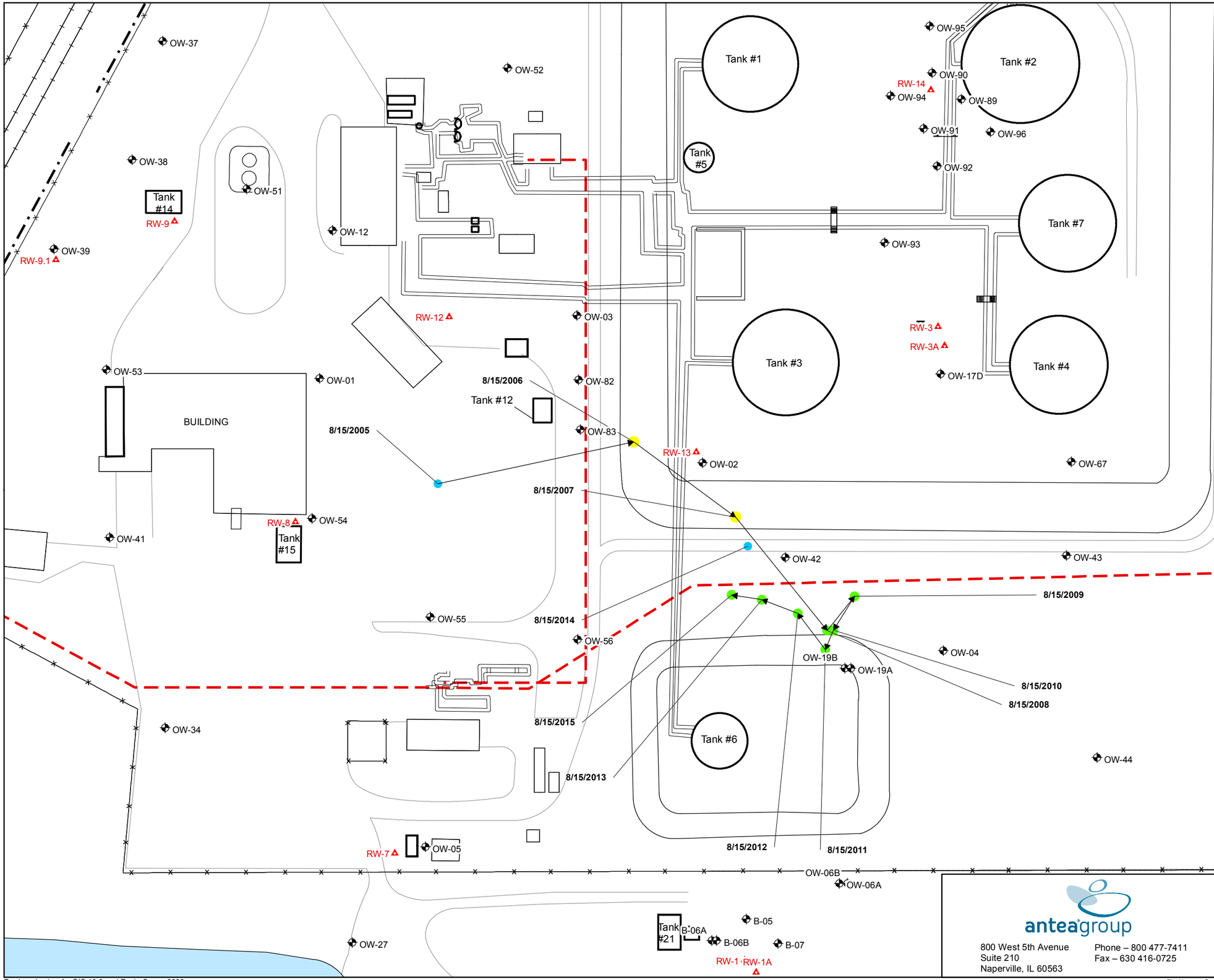
12694 Adams Road
Granger, St. Joseph County, Indiana

Sheet Number: 7

Produced using ArcGIS 10.0 and EnviroSpase 2008

File Name: Granger_AA2-daysFromZeroXylene_ed.mxd

Edited: 11/8/2016 By: JH



0 40 80 160 Feet

1:960 1 inch = 80 feet

N

Legend

- Property Line
- BP Pipeline
- Above Ground Piping
- Fence
- Observation Well - screened in upper medium-grained sand layer above 720.00' above mean sea level (MSL)
- Recovery Well - screened in upper medium-grained sand layer above 730.00' MSL
- Center of Mass movement noted between years

Moment Analysis (Mass) - Total Xylenes

- Mass < 100 kg
- Mass 100 - 200 kg
- Mass 200 - 300 kg
- Mass 300 - 500 kg
- Mass > 500 kg

kg - kilogram
Noted location indicates the center of mass that year.

Notes:

1. This map is produced from previous survey data, former consultant maps, client maps,IDEM maps, GIS data purchased from St. Joseph County, Indiana, and GPS data. It is not intended to serve as a legal document or be considered a legal survey.
2. Data used for this evaluation is from 2005 through 2015 (the most recent complete year of data available)

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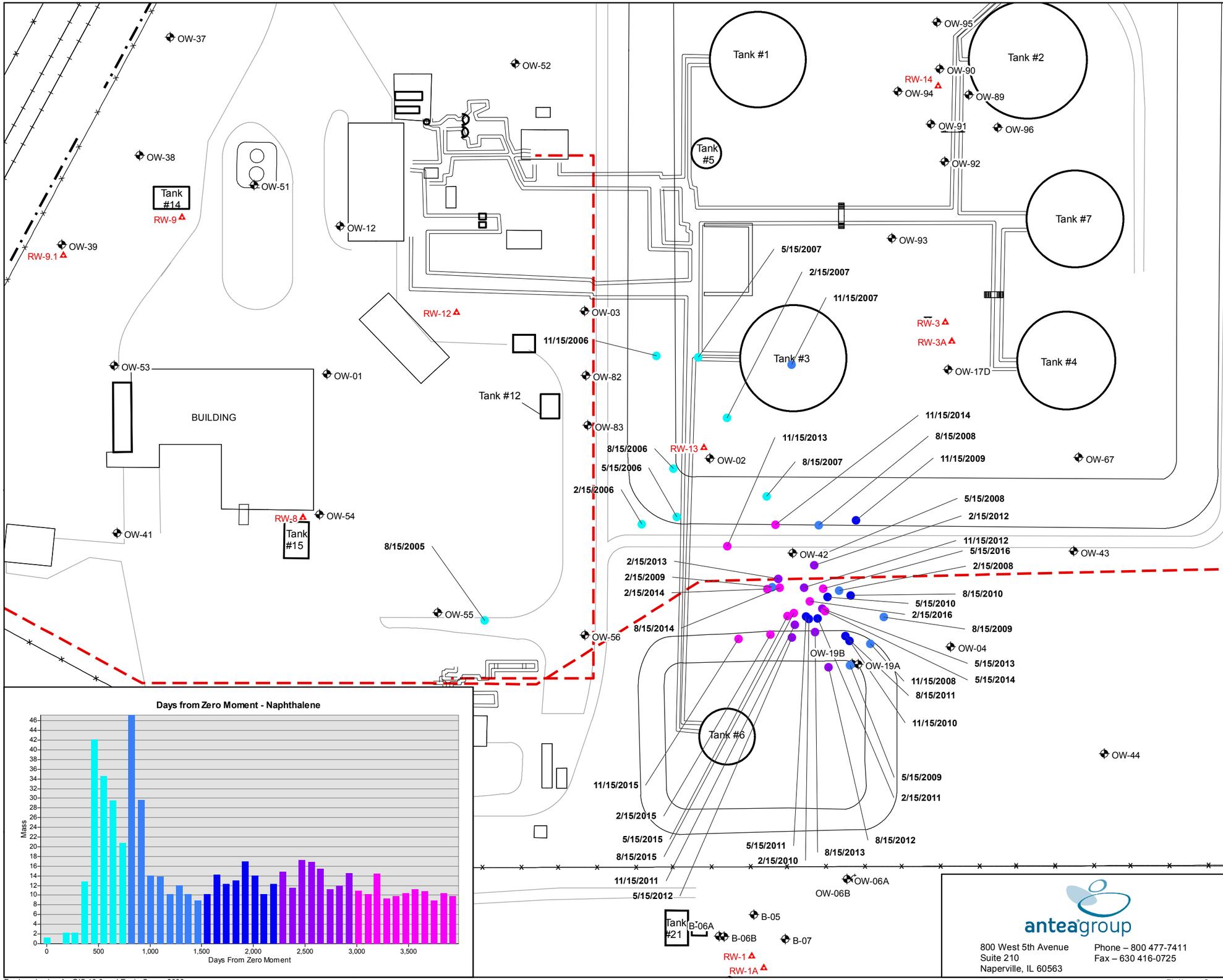
Granger Terminal Facility

MAROS Moment Analysis (Mass)
Total Xylenes

12694 Adams Road
Granger, St. Joseph County, Indiana

Sheet Number: 8



Notes:

1. This map is produced from previous survey data, former consultant maps, client maps,IDEM maps, GIS data purchased from St. Joseph County, Indiana, and GPS data. It is not intended to serve as a legal document or be considered a legal survey.

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MAROS Days from Zero Moment Analysis Naphthalene

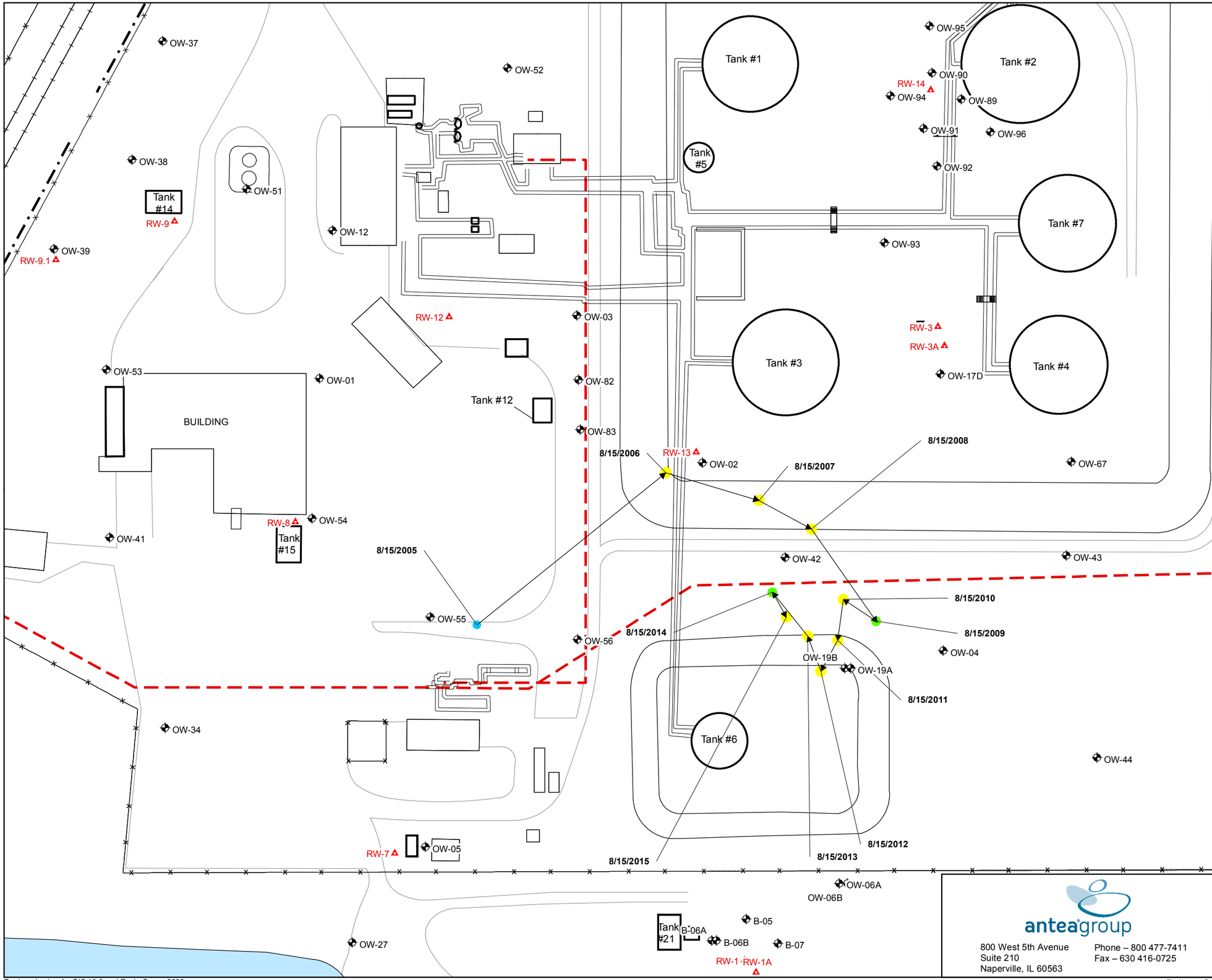
12694 Adams Road
Granger, St. Joseph County, Indiana

Sheet Number: 9

Produced using ArcGIS 10.0 and EnviroSpase 2008

File Name: Granger_AA2-daysFromZeroNaphthalene_ed.mxd

Edited: 11/8/2016 By: JH



Legend

- Property Line
- BP Pipeline
- Above Ground Piping
- Fence
- Observation Well - screened in upper medium-grained sand layer above 720.00' above mean sea level (MSL)
- Recovery Well - screened in upper medium-grained sand layer above 730.00' MSL
- Center of Mass movement noted between years

Moment Analysis (Mass) - Naphthalene

- Mass < 5 kg
- Mass 5 - 10 kg
- Mass 10 - 20 kg
- Mass 20 - 30 kg
- Mass > 30 kg

kg - kilogram
Noted location indicates the center of mass that year.

Notes:

1. This map is produced from previous survey data, former consultant maps, client maps,IDEM maps, GIS data purchased from St. Joseph County, Indiana, and GPS data. It is not intended to serve as a legal document or be considered a legal survey.
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Granger Terminal Facility

MAROS Moment Analysis (Mass)
Naphthalene

12694 Adams Road
Granger, St. Joseph County, Indiana

Sheet Number: 10

APPENDIX A
MAROS Site Summary

MAROS Site Summary

Project: Buckeye - Granger
User Name: Wayne Hutchinson
Location: Granger
State: Indiana

User Defined Site and Data Assumptions

Hydrogeology and Plume Information:

Groundwater Seepage Velocity:	80	ft/yr
Current Plume Length:	1000	ft
Current Plume Width:	500	ft
Number of Tail Wells:	13	
Number of Source Wells:	8	

Downgradient Information:

Distance from Edge of Tail to Nearest:

Downgradient receptor:	360 ft
Downgradient property:	180 ft

Distance from Source to Nearest:

Downgradient receptor:	1300 ft
Downgradient property:	1100 ft

Contaminants of Concern (COC's)

BENZENE
TOLUENE
ETHYLBENZENE
XYLENES, TOTAL
NAPHTHALENE

Well Summary

Well Name	Source / Tail / Delineation	Record Count	Sample Date Range Minimum	Sample Date Range Maximum	Priority Constituent
RW1A	T	210	8/9/2005	6/27/2016	NAPHTHALENE
RW2A	T	220	3/31/2005	6/27/2016	NAPHTHALENE
RW3A	S	215	11/9/2005	6/28/2016	NAPHTHALENE
HMW4	D	170	3/6/2008	6/28/2016	NAPHTHALENE
RW4A	T	215	6/2/2005	6/27/2016	NAPHTHALENE
RW7	T	200	8/2/2006	6/28/2016	NAPHTHALENE
OW08B	T	190	3/1/2007	6/28/2016	NAPHTHALENE
RW8	T	215	8/9/2005	6/27/2016	NAPHTHALENE
OW09	T	200	8/2/2006	6/27/2016	NAPHTHALENE
RW9	D	210	6/2/2005	6/27/2016	NAPHTHALENE
RW11	D	230	1/16/2005	6/27/2016	NAPHTHALENE
RW12	D	210	2/9/2006	6/27/2016	NAPHTHALENE
OW13B	D	230	1/16/2005	6/27/2016	NAPHTHALENE
RW13	T	215	8/9/2005	6/27/2016	NAPHTHALENE
OW14C	D	190	1/16/2005	6/27/2016	NAPHTHALENE
RW14	S	205	2/9/2006	6/27/2016	BENZENE

MAROS Site Summary

Buckeye - Granger

Granger

User Name: Wayne Hutchinson

State: Indiana

OW15	D	189	1/16/2005	6/27/2016	NAPHTHALENE
OW17D	S	150	3/5/2008	6/28/2016	NAPHTHALENE
OW23A	D	180	1/16/2005	6/27/2016	NAPHTHALENE
OW35	S	185	3/1/2007	6/28/2016	NAPHTHALENE
OW36	D	220	8/9/2005	6/28/2016	NAPHTHALENE
OW37	T	190	8/2/2006	6/28/2016	NAPHTHALENE
OW38	S	200	8/9/2005	6/28/2016	NAPHTHALENE
OW39	T	180	3/2/2007	6/28/2016	NAPHTHALENE
OW40	D	205	5/10/2006	6/28/2016	NAPHTHALENE
OW46	D	200	1/16/2005	6/27/2016	NAPHTHALENE
OW47	D	180	1/16/2005	6/27/2016	NAPHTHALENE
OW48	D	160	5/20/2008	6/27/2016	NAPHTHALENE
OW50	D	10	3/14/2016	6/28/2016	XYLENES, TOTAL
OW59	D	205	5/10/2006	6/27/2016	NAPHTHALENE
OW60	D	115	6/6/2007	6/27/2016	NAPHTHALENE
OW67	D	220	8/9/2005	6/28/2016	NAPHTHALENE
OW68	D	220	8/9/2005	6/28/2016	NAPHTHALENE
OW89	S	155	6/6/2007	6/28/2016	BENZENE
OW90	S	185	11/30/2006	6/28/2016	BENZENE
OW91	T	195	11/30/2006	6/28/2016	BENZENE
RW9.1	T	215	11/9/2005	6/28/2016	NAPHTHALENE
OW92	S	224	3/28/2005	6/28/2016	NAPHTHALENE
OW98	D	165	7/3/2006	6/28/2016	NAPHTHALENE
OW99	T	165	7/3/2006	6/28/2016	NAPHTHALENE

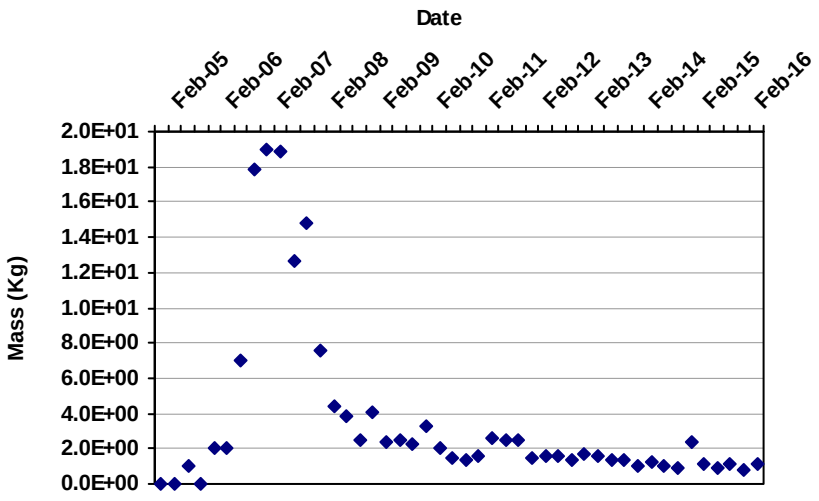
APPENDIX B
MAROS Zeroth Moment Analyses

MAROS Zeroth Moment Analysis

Project: Buckeye - Granger
User Name: Wayne Hutchinson
Location: Granger
State: Indiana

Change in Dissolved Mass Over Time

COC: BENZENE



Porosity: 0.25

Saturated Thickness:
Uniform: 55 ft

Mann-Kendall S Statistic:
-422

Confidence in Trend:
100.0%

Coefficient of Variation:
1.36

Zeroth Moment Trend:
D

Data Table:

Effective Date	Constituent	Estimated Mass (Kg)	Number of Wells
2/15/2005	BENZENE	0.0E+00	2
5/15/2005	BENZENE	0.0E+00	2
8/15/2005	BENZENE	1.0E+00	6
11/15/2005	BENZENE	0.0E+00	5
2/15/2006	BENZENE	2.0E+00	7
5/15/2006	BENZENE	2.1E+00	9
8/15/2006	BENZENE	7.0E+00	14
11/15/2006	BENZENE	1.8E+01	15
2/15/2007	BENZENE	1.9E+01	18
5/15/2007	BENZENE	1.9E+01	20
8/15/2007	BENZENE	1.3E+01	20
11/15/2007	BENZENE	1.5E+01	19
2/15/2008	BENZENE	7.5E+00	21
5/15/2008	BENZENE	4.4E+00	21
8/15/2008	BENZENE	3.8E+00	21
11/15/2008	BENZENE	2.5E+00	20
2/15/2009	BENZENE	4.1E+00	20

MAROS Zeroth Moment Analysis

Buckeye - Granger

Granger

User Name: Wayne Hutchinson

State: Indiana

Effective Date	Constituent	Estimated Mass (Kg)	Number of Wells
5/15/2009	BENZENE	2.3E+00	21
8/15/2009	BENZENE	2.5E+00	21
11/15/2009	BENZENE	2.3E+00	21
2/15/2010	BENZENE	3.2E+00	20
5/15/2010	BENZENE	2.0E+00	21
8/15/2010	BENZENE	1.4E+00	20
11/15/2010	BENZENE	1.4E+00	18
2/15/2011	BENZENE	1.6E+00	19
5/15/2011	BENZENE	2.6E+00	21
8/15/2011	BENZENE	2.5E+00	19
11/15/2011	BENZENE	2.5E+00	20
2/15/2012	BENZENE	1.4E+00	21
5/15/2012	BENZENE	1.6E+00	21
8/15/2012	BENZENE	1.6E+00	19
11/15/2012	BENZENE	1.4E+00	20
2/15/2013	BENZENE	1.7E+00	20
5/15/2013	BENZENE	1.5E+00	21
8/15/2013	BENZENE	1.4E+00	21
11/15/2013	BENZENE	1.3E+00	18
2/15/2014	BENZENE	1.0E+00	17
5/15/2014	BENZENE	1.2E+00	21
8/15/2014	BENZENE	1.1E+00	21
11/15/2014	BENZENE	8.6E-01	21
2/15/2015	BENZENE	2.3E+00	21
5/15/2015	BENZENE	1.1E+00	21
8/15/2015	BENZENE	8.8E-01	21
11/15/2015	BENZENE	1.2E+00	19
2/15/2016	BENZENE	7.9E-01	20
5/15/2016	BENZENE	1.1E+00	21

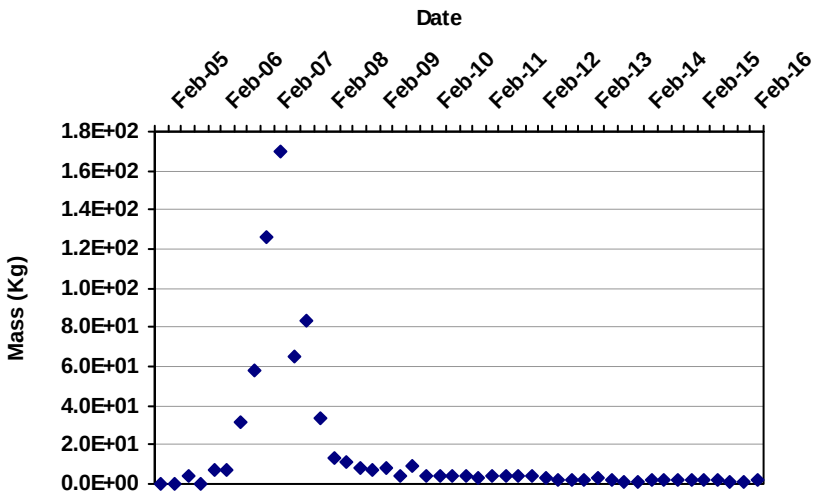
Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect. Moments are not calculated for sample events with less than 6 wells.

MAROS Zeroth Moment Analysis

Project: Buckeye - Granger
User Name: Wayne Hutchinson
Location: Granger
State: Indiana

Change in Dissolved Mass Over Time

COC: TOLUENE



Porosity: 0.25

Saturated Thickness:
Uniform: 55 ft

Mann-Kendall S Statistic:
-530

Confidence in Trend:
100.0%

Coefficient of Variation:
2.17

Zeroth Moment Trend:
D

Data Table:

Effective Date	Constituent	Estimated Mass (Kg)	Number of Wells
2/15/2005	TOLUENE	0.0E+00	2
5/15/2005	TOLUENE	0.0E+00	2
8/15/2005	TOLUENE	3.8E+00	6
11/15/2005	TOLUENE	0.0E+00	5
2/15/2006	TOLUENE	6.9E+00	7
5/15/2006	TOLUENE	7.0E+00	9
8/15/2006	TOLUENE	3.1E+01	14
11/15/2006	TOLUENE	5.8E+01	15
2/15/2007	TOLUENE	1.3E+02	18
5/15/2007	TOLUENE	1.7E+02	20
8/15/2007	TOLUENE	6.6E+01	20
11/15/2007	TOLUENE	8.3E+01	19
2/15/2008	TOLUENE	3.3E+01	21
5/15/2008	TOLUENE	1.3E+01	21
8/15/2008	TOLUENE	1.1E+01	21
11/15/2008	TOLUENE	7.7E+00	20
2/15/2009	TOLUENE	6.8E+00	20

MAROS Zeroth Moment Analysis

Buckeye - Granger

Granger

User Name: Wayne Hutchinson

State: Indiana

Effective Date	Constituent	Estimated Mass (Kg)	Number of Wells
5/15/2009	TOLUENE	8.5E+00	21
8/15/2009	TOLUENE	4.2E+00	21
11/15/2009	TOLUENE	8.9E+00	21
2/15/2010	TOLUENE	4.5E+00	20
5/15/2010	TOLUENE	4.3E+00	21
8/15/2010	TOLUENE	4.4E+00	20
11/15/2010	TOLUENE	4.1E+00	18
2/15/2011	TOLUENE	2.9E+00	19
5/15/2011	TOLUENE	3.6E+00	21
8/15/2011	TOLUENE	4.0E+00	19
11/15/2011	TOLUENE	3.7E+00	20
2/15/2012	TOLUENE	4.1E+00	21
5/15/2012	TOLUENE	2.6E+00	21
8/15/2012	TOLUENE	2.3E+00	19
11/15/2012	TOLUENE	2.0E+00	20
2/15/2013	TOLUENE	2.0E+00	20
5/15/2013	TOLUENE	2.6E+00	21
8/15/2013	TOLUENE	2.3E+00	21
11/15/2013	TOLUENE	1.3E+00	18
2/15/2014	TOLUENE	1.4E+00	17
5/15/2014	TOLUENE	2.3E+00	21
8/15/2014	TOLUENE	2.0E+00	21
11/15/2014	TOLUENE	1.7E+00	21
2/15/2015	TOLUENE	2.5E+00	21
5/15/2015	TOLUENE	2.4E+00	21
8/15/2015	TOLUENE	1.7E+00	21
11/15/2015	TOLUENE	1.3E+00	19
2/15/2016	TOLUENE	1.3E+00	20
5/15/2016	TOLUENE	1.7E+00	21

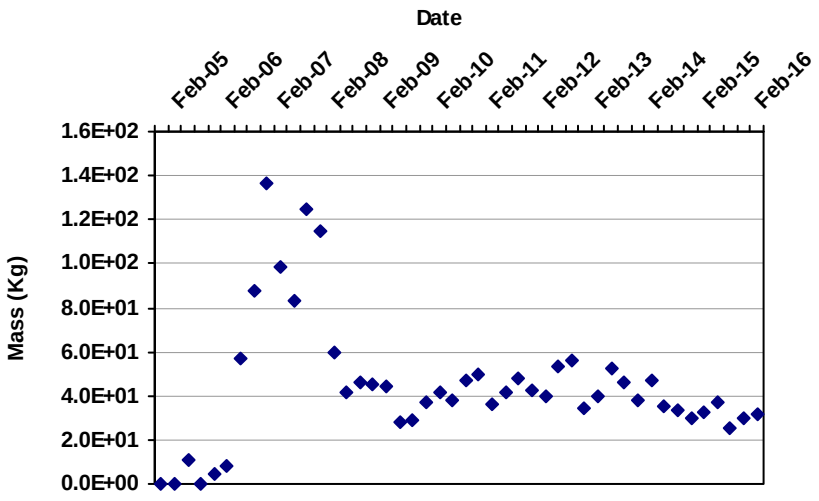
Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect. Moments are not calculated for sample events with less than 6 wells.

MAROS Zeroth Moment Analysis

Project: Buckeye - Granger
User Name: Wayne Hutchinson
Location: Granger
State: Indiana

Change in Dissolved Mass Over Time

COC: ETHYLBENZENE



Porosity: 0.25

Saturated Thickness:
Uniform: 55 ft

Mann-Kendall S Statistic:
-132

Confidence in Trend:
100.0%

Coefficient of Variation:
0.66

Zeroth Moment Trend:
D

Data Table:

Effective Date	Constituent	Estimated Mass (Kg)	Number of Wells
2/15/2005	ETHYLBENZENE	0.0E+00	2
5/15/2005	ETHYLBENZENE	0.0E+00	2
8/15/2005	ETHYLBENZENE	1.1E+01	6
11/15/2005	ETHYLBENZENE	0.0E+00	5
2/15/2006	ETHYLBENZENE	4.5E+00	7
5/15/2006	ETHYLBENZENE	8.4E+00	9
8/15/2006	ETHYLBENZENE	5.7E+01	14
11/15/2006	ETHYLBENZENE	8.8E+01	15
2/15/2007	ETHYLBENZENE	1.4E+02	18
5/15/2007	ETHYLBENZENE	9.8E+01	20
8/15/2007	ETHYLBENZENE	8.3E+01	20
11/15/2007	ETHYLBENZENE	1.2E+02	19
2/15/2008	ETHYLBENZENE	1.1E+02	21
5/15/2008	ETHYLBENZENE	6.0E+01	21
8/15/2008	ETHYLBENZENE	4.2E+01	21
11/15/2008	ETHYLBENZENE	4.6E+01	20
2/15/2009	ETHYLBENZENE	4.5E+01	20

MAROS Zeroth Moment Analysis

Buckeye - Granger

Granger

User Name: Wayne Hutchinson

State: Indiana

Effective Date	Constituent	Estimated Mass (Kg)	Number of Wells
5/15/2009	ETHYLBENZENE	4.4E+01	21
8/15/2009	ETHYLBENZENE	2.8E+01	21
11/15/2009	ETHYLBENZENE	2.9E+01	21
2/15/2010	ETHYLBENZENE	3.7E+01	20
5/15/2010	ETHYLBENZENE	4.1E+01	21
8/15/2010	ETHYLBENZENE	3.8E+01	20
11/15/2010	ETHYLBENZENE	4.7E+01	18
2/15/2011	ETHYLBENZENE	5.0E+01	19
5/15/2011	ETHYLBENZENE	3.6E+01	21
8/15/2011	ETHYLBENZENE	4.1E+01	19
11/15/2011	ETHYLBENZENE	4.8E+01	20
2/15/2012	ETHYLBENZENE	4.2E+01	21
5/15/2012	ETHYLBENZENE	4.0E+01	21
8/15/2012	ETHYLBENZENE	5.3E+01	19
11/15/2012	ETHYLBENZENE	5.6E+01	20
2/15/2013	ETHYLBENZENE	3.4E+01	20
5/15/2013	ETHYLBENZENE	4.0E+01	21
8/15/2013	ETHYLBENZENE	5.2E+01	21
11/15/2013	ETHYLBENZENE	4.6E+01	18
2/15/2014	ETHYLBENZENE	3.8E+01	17
5/15/2014	ETHYLBENZENE	4.7E+01	21
8/15/2014	ETHYLBENZENE	3.5E+01	21
11/15/2014	ETHYLBENZENE	3.3E+01	21
2/15/2015	ETHYLBENZENE	3.0E+01	21
5/15/2015	ETHYLBENZENE	3.2E+01	21
8/15/2015	ETHYLBENZENE	3.7E+01	21
11/15/2015	ETHYLBENZENE	2.5E+01	19
2/15/2016	ETHYLBENZENE	3.0E+01	20
5/15/2016	ETHYLBENZENE	3.1E+01	21

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect. Moments are not calculated for sample events with less than 6 wells.

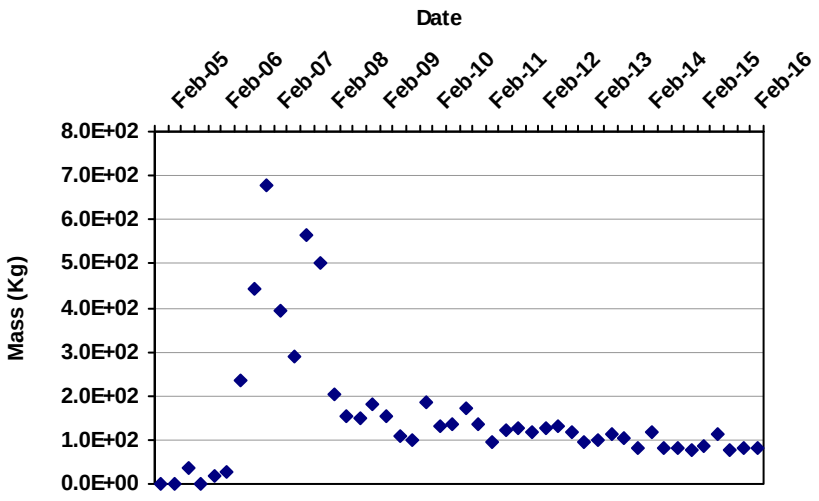
MAROS Zeroth Moment Analysis

Project: Buckeye - Granger **User Name:** Wayne Hutchinson

Location: Granger **State:** Indiana

Change in Dissolved Mass Over Time

COC: XYLENES, TOTAL



Porosity: 0.25

Saturated Thickness:

Uniform: 55 ft

Mann-Kendall S Statistic:

-312

Confidence in Trend:

100.0%

Coefficient of Variation:

0.93

Zeroth Moment Trend:

D

Data Table:

Effective Date	Constituent	Estimated Mass (Kg)	Number of Wells
2/15/2005	XYLENES, TOTAL	0.0E+00	2
5/15/2005	XYLENES, TOTAL	0.0E+00	2
8/15/2005	XYLENES, TOTAL	3.7E+01	6
11/15/2005	XYLENES, TOTAL	0.0E+00	5
2/15/2006	XYLENES, TOTAL	1.7E+01	7
5/15/2006	XYLENES, TOTAL	2.7E+01	9
8/15/2006	XYLENES, TOTAL	2.3E+02	14
11/15/2006	XYLENES, TOTAL	4.4E+02	15
2/15/2007	XYLENES, TOTAL	6.8E+02	18
5/15/2007	XYLENES, TOTAL	3.9E+02	20
8/15/2007	XYLENES, TOTAL	2.9E+02	20
11/15/2007	XYLENES, TOTAL	5.6E+02	19
2/15/2008	XYLENES, TOTAL	5.0E+02	21
5/15/2008	XYLENES, TOTAL	2.0E+02	21
8/15/2008	XYLENES, TOTAL	1.5E+02	21
11/15/2008	XYLENES, TOTAL	1.5E+02	20
2/15/2009	XYLENES, TOTAL	1.8E+02	20

MAROS Zeroth Moment Analysis

Buckeye - Granger

Granger

User Name: Wayne Hutchinson

State: Indiana

Effective Date	Constituent	Estimated Mass (Kg)	Number of Wells
5/15/2009	XYLENES, TOTAL	1.5E+02	21
8/15/2009	XYLENES, TOTAL	1.1E+02	21
11/15/2009	XYLENES, TOTAL	9.8E+01	21
2/15/2010	XYLENES, TOTAL	1.8E+02	20
5/15/2010	XYLENES, TOTAL	1.3E+02	21
8/15/2010	XYLENES, TOTAL	1.4E+02	20
11/15/2010	XYLENES, TOTAL	1.7E+02	18
2/15/2011	XYLENES, TOTAL	1.3E+02	19
5/15/2011	XYLENES, TOTAL	9.4E+01	21
8/15/2011	XYLENES, TOTAL	1.2E+02	19
11/15/2011	XYLENES, TOTAL	1.3E+02	20
2/15/2012	XYLENES, TOTAL	1.2E+02	21
5/15/2012	XYLENES, TOTAL	1.3E+02	21
8/15/2012	XYLENES, TOTAL	1.3E+02	19
11/15/2012	XYLENES, TOTAL	1.2E+02	20
2/15/2013	XYLENES, TOTAL	9.5E+01	20
5/15/2013	XYLENES, TOTAL	9.9E+01	21
8/15/2013	XYLENES, TOTAL	1.1E+02	21
11/15/2013	XYLENES, TOTAL	1.0E+02	18
2/15/2014	XYLENES, TOTAL	8.0E+01	17
5/15/2014	XYLENES, TOTAL	1.2E+02	21
8/15/2014	XYLENES, TOTAL	8.3E+01	21
11/15/2014	XYLENES, TOTAL	8.3E+01	21
2/15/2015	XYLENES, TOTAL	7.8E+01	21
5/15/2015	XYLENES, TOTAL	8.4E+01	21
8/15/2015	XYLENES, TOTAL	1.1E+02	21
11/15/2015	XYLENES, TOTAL	7.5E+01	19
2/15/2016	XYLENES, TOTAL	8.3E+01	20
5/15/2016	XYLENES, TOTAL	7.9E+01	21

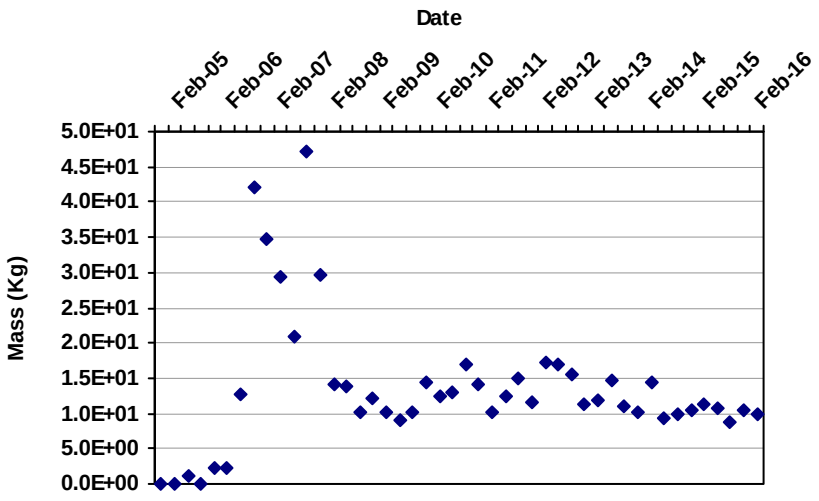
Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect. Moments are not calculated for sample events with less than 6 wells.

MAROS Zeroth Moment Analysis

Project: Buckeye - Granger
User Name: Wayne Hutchinson
Location: Granger
State: Indiana

Change in Dissolved Mass Over Time

COC: NAPHTHALENE



Porosity: 0.25

Saturated Thickness:
Uniform: 55 ft

Mann-Kendall S Statistic:
-66

Confidence in Trend:
100.0%

Coefficient of Variation:
0.71

Zeroth Moment Trend:
D

Data Table:

Effective Date	Constituent	Estimated Mass (Kg)	Number of Wells
2/15/2005	NAPHTHALENE	0.0E+00	1
5/15/2005	NAPHTHALENE	0.0E+00	2
8/15/2005	NAPHTHALENE	1.3E+00	6
11/15/2005	NAPHTHALENE	0.0E+00	5
2/15/2006	NAPHTHALENE	2.3E+00	7
5/15/2006	NAPHTHALENE	2.2E+00	9
8/15/2006	NAPHTHALENE	1.3E+01	14
11/15/2006	NAPHTHALENE	4.2E+01	15
2/15/2007	NAPHTHALENE	3.5E+01	18
5/15/2007	NAPHTHALENE	3.0E+01	20
8/15/2007	NAPHTHALENE	2.1E+01	20
11/15/2007	NAPHTHALENE	4.7E+01	19
2/15/2008	NAPHTHALENE	3.0E+01	21
5/15/2008	NAPHTHALENE	1.4E+01	21
8/15/2008	NAPHTHALENE	1.4E+01	21
11/15/2008	NAPHTHALENE	1.0E+01	20
2/15/2009	NAPHTHALENE	1.2E+01	20

MAROS Zeroth Moment Analysis

Buckeye - Granger

Granger

User Name: Wayne Hutchinson

State: Indiana

Effective Date	Constituent	Estimated Mass (Kg)	Number of Wells
5/15/2009	NAPHTHALENE	1.0E+01	21
8/15/2009	NAPHTHALENE	8.9E+00	21
11/15/2009	NAPHTHALENE	1.0E+01	21
2/15/2010	NAPHTHALENE	1.4E+01	20
5/15/2010	NAPHTHALENE	1.2E+01	21
8/15/2010	NAPHTHALENE	1.3E+01	20
11/15/2010	NAPHTHALENE	1.7E+01	18
2/15/2011	NAPHTHALENE	1.4E+01	19
5/15/2011	NAPHTHALENE	1.0E+01	21
8/15/2011	NAPHTHALENE	1.2E+01	19
11/15/2011	NAPHTHALENE	1.5E+01	20
2/15/2012	NAPHTHALENE	1.2E+01	21
5/15/2012	NAPHTHALENE	1.7E+01	21
8/15/2012	NAPHTHALENE	1.7E+01	19
11/15/2012	NAPHTHALENE	1.5E+01	20
2/15/2013	NAPHTHALENE	1.1E+01	20
5/15/2013	NAPHTHALENE	1.2E+01	21
8/15/2013	NAPHTHALENE	1.5E+01	21
11/15/2013	NAPHTHALENE	1.1E+01	18
2/15/2014	NAPHTHALENE	1.0E+01	17
5/15/2014	NAPHTHALENE	1.5E+01	21
8/15/2014	NAPHTHALENE	9.3E+00	21
11/15/2014	NAPHTHALENE	9.8E+00	21
2/15/2015	NAPHTHALENE	1.0E+01	21
5/15/2015	NAPHTHALENE	1.1E+01	21
8/15/2015	NAPHTHALENE	1.1E+01	21
11/15/2015	NAPHTHALENE	8.9E+00	19
2/15/2016	NAPHTHALENE	1.0E+01	20
5/15/2016	NAPHTHALENE	9.8E+00	21

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect. Moments are not calculated for sample events with less than 6 wells.