Neighborhood Air Toxics Modeling Project
For
Houston and Corpus Christi
Case # 2:11-MC-00044

Phase 1B
Monitoring Network Extension

Quarterly Report for the Period

July 1, 2014 through September 30, 2014

Submitted to

The Honorable Janis Graham Jack
United States District Court for the Southern District of Texas
Corpus Christi, Texas

Mr. John L. Jones
United States Environmental Protection Agency, Region 6
Dallas, Texas

Ms. Susan Clewis
Texas Commission on Environmental Quality, Region 14
Corpus Christi, Texas

Submitted by

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November 18, 2014

I. Introduction

On February 1, 2008, the United States District Court entered an Order (D.E. 981, Order (pp.1, 7-11)) regarding unclaimed settlement funds in Lease Oil Antitrust Litigation (No.11) Docket No. MDL No.1206. The Court requested a detailed project proposal from Dr. David Allen, the Gertz Regents Professor in Chemical Engineering and the Director of the Center for Energy and Environmental Resources at The University of Texas at Austin (UT Austin), regarding the use of $9,643,134.80 in the Settlement Fund. The proposal was for a project titled "Neighborhood Air Toxics Modeling Project for Houston and Corpus Christi" (hereinafter "Air Toxics Project"). The Air Toxics Project was proposed in two stages. In Stage 1, UT Austin was to develop, apply, demonstrate and make publicly available, neighborhood-scale air quality modeling tools for toxic air pollutants in Corpus Christi, Texas (Phase 1A) and extend the operation of the air quality monitoring network in Corpus Christi, Texas (Phase 1B). The ambient monitoring results from Stage 1 Phase 1A were to be used in synergy with the neighborhood-scale models to improve the understanding of emissions and the spatial distribution of air toxics in the region.

On February 21, 2008, the United States District Court for the Southern District of Texas issued an order to the Clerk of the Court to distribute funds in the amount of $4,586,014.92, plus accrued interest, to UT Austin for the purposes of implementing Stage 1 of the Air Toxics Project as described in the detailed proposal submitted to the Court by UT Austin on February 15, 2008 (D.E. 998).

Under the Order to Distribute Funds in MDL No. 1206, on March 3, 2008, at the direction of the Settlement Administrator, $4,602,598.66 was disbursed to UT Austin for Stage 1 of the Project. This amount includes the interest accrued prior to distribution from the MDL No. 1206 Settlement Fund.

In Stage 2, subject to the availability of funds, it was planned that UT Austin would extend the modeling to the Houston, Texas ship channel region, develop a mobile monitoring station that could be deployed in Corpus Christi and in other regions of Texas and/or further extend the operating life of the existing stationary network in the same or a modified spatial configuration. Based on the decision of the U.S. Court of Appeals for the 5th Circuit on June 27, 2011, UT Austin will not be receiving the Stage 2 funding at any point in the future. Further, work on the modeling portion of Stage 1 (Phase 1A) was completed June 30, 2011. Hence, all future progress reports will describe only work on Stage 1 Phase 1B (extending the operation of the air quality monitoring network).

The air quality monitoring network was originally authorized on October 1, 2003, when the United States District Court for the Southern District of Texas issued an order to the Clerk of the Court to distribute funds in the amount of $6,700,000, plus interest accrued, to The University of Texas at Austin (UT Austin) to implement the court ordered condition of probation (COCP) project *Corpus Christi Air Monitoring and Surveillance Camera Installation and Operation* (Project). Those funds have been expended. Funding for the air quality monitoring network originally created for the COCP Project is now provided through Stage 1 Phase 1B of the Air Toxics Project.

This Stage 1 Phase 1B quarterly report has been prepared pursuant to the requirements of the Air Toxics project and is being submitted to the United States District Court, the United States Environmental Protection Agency (EPA), and the Texas Commission on Environmental Quality (TCEQ).

II. Air Toxics Project – Stage 1 - Phase 1B Overview

Phase 1B of the project reserved approximately 65% of the initial Stage 1 project funds, or approximately $3 million, to extend the operation of the Corpus Christi ambient air monitoring network. Under Phase 1B, the project team will use these funds to continue the operation and maintenance of the monitoring network initiated under the Corpus Christi Air Monitoring and Surveillance Camera Project.

III. Air Toxics Project – Stage 1 – Phase 1B Progress Report

The focus of work during the quarter ending September 30, 2014, has been directed to the following activities funded by the Stage 1 Phase 1B extension of the Corpus Christi Air Monitoring network.

A. Operations and Maintenance Phase of the Project

The Project currently consists of a network of six (6) air monitoring stations with air monitoring instruments and surveillance camera equipment. A map showing locations of the COCP Project monitoring sites along with TCEQ sites appears in Figure 1, on page 4. Table 1, on pages 4 and 5, identifies the location and instrumentation found at each of the COCP Project sites. TCEQ sites and some of the sites farther from the COCP area than the TCEQ sites, operated by Texas A&M at Kingsville (TAMUK), provide additional data used in these analyses.

Figure 1. Corpus Christi Monitoring Sites, "X" marks site terminated in 2012

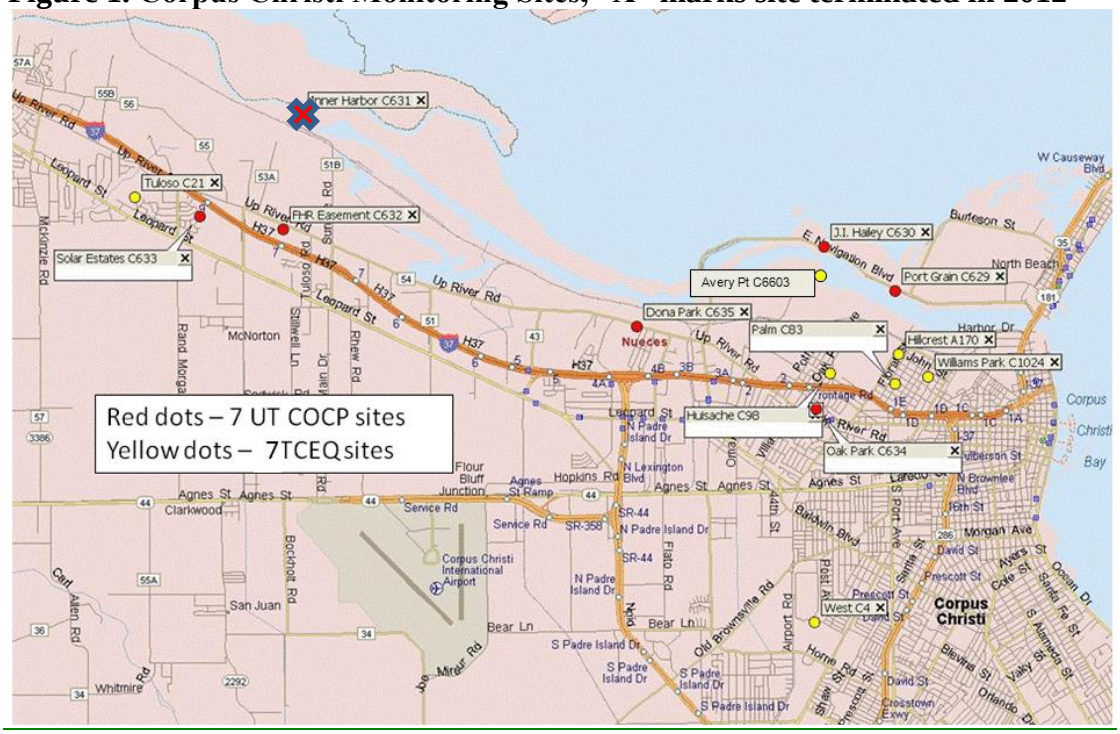

Table 1. Schedule of Air Monitoring Sites, Locations and Major Instrumentation

TCEQ CAMS#	Description of Site Location	Monitoring Equipment showing month/year of operations				
		Auto-GC	TNMHC (T) / Canister (C)	H_2S & SO_2	Met Station	Camera
634	Oak Park Recreation Center (**OAK**)	3/05 to date	C: 12/04 to 2/09 T: 12/04 to 4/12		12/04 to date	
629	Grain Elevator @ Port of Corpus Christi (**CCG**)		T&C: 12/04 to date	12/04 to date	12/04 to date	
630	J. I. Hailey Site @ Port of Corpus Christi (**JIH**)		T&C: 12/04 to date	12/04 to date	12/04 to date	
635	TCEQ Monitoring Site C199 @ Dona Park (**DPK**)		T&C: 12/04 to date	12/04 to date	12/04 to date	1/05 to date
632	Off Up River Road on Flint Hills Resources Easement (**FHR**)		T&C: 12/04 to date	12/04 to date	12/04 to date	
633	Solar Estates Park at end of Sunshine Road (**SOE**)	3/05 to date	C: 12/04 to 2/09 T: 12/04 to 4/12	12/04 to date	12/04 to date	1/05 to date
631	*Port of Corpus Christi on West End of CC Inner Harbor (**WEH**) (terminated)*		T&C: 12/04 to 5/12	12/04 to 5/12	12/04 to 5/12	

Legend

CAMS	continuous ambient monitoring station
Auto-GC	automated gas chromatograph
TNMHC	total non-methane hydrocarbon analyzer (all except CAMS 633 & 634 also have canister hydrocarbon samplers)

Table 1 (Continued)
Legend

H_2S	hydrogen sulfide analyzer
SO_2	sulfur dioxide analyzer
Met Station	meteorology station consisting of measurement instruments for wind speed, wind direction, ambient air temperature and relative humidity
Camera	surveillance camera

A detailed description of the data analyses and findings for this quarter appears in Appendix A, pages 8 through 26. Specifically, the appendix contains the following elements:

- **Auto-GC Data Summary –** In examining the validated second quarter of 2014 hourly auto-GC data from Oak Park, Solar Estates, and TCEQ's Palm sites, no individual measurements were found to have exceeded a short-term air monitoring comparison value (AMCV). The validated second quarter average concentrations were below each compound's long-term AMCVs. For third quarter 2014 data, the preliminary values were also below respective AMCVs. A summary of data appears on pages 13 through 18. In examining all the data over the course of the project, it does appear that for some hydrocarbon species mean concentrations are higher in 2014 than in recent years.

- **Benzene Summary** – A review of ten years of data is presented, with a focus on overall trends and the third quarter average concentrations from 2005 through 2014, and appears on pages 19 through 25.

- **Analysis of Sulfur Dioxide at Several Sites** – In past years the JIH CAMS 630 site had measured concentrations high enough and often enough to violate the SO_2 annual National Ambient Air Quality Standards (NAAQS), but concentrations have declined since mid-2012. A summary of a talk on this subject given at the TCEQ by Mr. Chris Owen is summarized on pages 25 and 26.

B. Project Management and Planning

Project Management and Planning during this period has focused on the following four (4) major activities.

1. **Air Monitoring Operations**
   Operations and maintenance of the six monitoring sites reporting data via the TCEQ LEADS is on-going. The data can be accessed and reviewed at the project website (http://www.utexas.edu/research/ceer/ccaqp/).

2. **Communication and Reporting**
   The status of the Project has been communicated through the website, which is operational with portions under continual updating, quarterly and annual reports, and meetings of a Community Advisory Board.

3. **Budget Monitoring**
   Budget monitoring during the period has focused on projects costs for Stage 1 Phase IB – Sites Operation and Maintenance costs. Financial reports for the quarter are included in Appendix B, pages 27 through 29.

4. **Other Contributions**
   There were no other contributions made to the project during this quarter.

III. Financial Report

As required, the following financial summary information is provided. Details supporting this financial summary are included in Appendix B, pages 27 through 29.

A. Total Amount of Air Toxics Project Funds and Other Funds Received Under the Project
   The Air Toxics Project interest earned received through September 30, 2014 totals $391,551.29. This total includes interest earned through September 30, 2014, in the amount of $3,136,922.97.

B. Detailed List of the Actual Expenditures Paid from Air Toxics Project Funds Stage 1 Phase 1B through September 30, 2014
   Expenditures of Air Toxics Project funds during this quarter totaled $229,262.92. The funds remaining in the Air Toxics account (not spent for Stage 1 Phase 1A) are in a separate account so that separate financial reports can be generated.

C. Total Interest Earned on Air Toxics Project Funds through September 30, 2014
   The interest earned during this quarter totaled $299.19. A report providing detailed calculations of the interest earned on the Air Toxics Project funds is included in Appendix B, pages 27 through 29.

D. Balance as of September 30, 2014, in the Air Toxics Project Account
   The balance in the Air Toxics Project account, including interest earned totals $1,649,265.93.

E. Anticipated Expenditures for the Funds Remaining in the Air Toxics Project Account – Stage 1 Phase 1A
   There are no additional expenditures anticipated for Stage 1 Phase 1A.

F. Anticipated Expenditures for the Funds Remaining in the Air Toxics Project Account – Stage 1 Phase 1B
   All funds remaining after the close of Stage 1, Phase 1A have been allocated to Stage 1, Phase 1B, and the extension of the operation of the Corpus Christi ambient monitoring network.

The Stage 1 Phase 1A Neighborhood Air Toxics Modeling Project was originally allocated a budget of $2,277,564. As of June 30, 2011, final expenditures on Phase 1A totaled $1,863,081.22. The remaining funds totaling $414,482.78, have been transferred, with the Court's permission, to a new account to allow for easier tracking of the expenses as they are utilized for Stage 1 Phase 1B, the extension of the Corpus Christi Air Monitoring Project.

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Members of the Community Advisory Board of the *Corpus Christi Air Monitoring and Surveillance Camera Project*

APPENDIX A

Data Analysis for Corpus Christi Quarterly Report

July 1, 2014 through September 30, 2014

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Data Analysis for Corpus Christi Quarterly Report

This technical report describes results of the monitoring and analysis of data under the Air Toxics Project Stage 1 Phase 1B. The primary focus is on the period July 1 through September 30, 2014. The monitoring network is shown earlier in this report in Figure 1, on page 4, and is described in Table 2, below. This report contains the following elements:

- A summary of Oak Park, Solar Estates, and Palm (TCEQ) auto-GC data for the second and third quarters of 2014;
- Information on the trends for benzene concentrations at the two project auto-GCs in residential areas, now with ten years of third quarter data, and at the TCEQ's Palm auto-GC, with four years of third quarter data (since 2010); and
- A discussion of elevated sulfur dioxide (SO_2) at the UT JIH site and at the TCEQ Avery Point site.

Table 2. Schedule of air monitoring sites, locations and major instrumentation

TCEQ CAMS#	Description of Site Location	Monitoring Equipment showing month/year of operations				
		Auto-GC	TNMHC (T) / Canister (C)	H_2S & SO_2	Met Station	Camera
634	Oak Park Recreation Center (**OAK**)	3/05 to date	C: 12/04 to 2/09 T: 12/04 to 4/12		12/04 to date	
629	Grain Elevator @ Port of Corpus Christi (**CCG**)		T&C: 12/04 to date	12/04 to date	12/04 to date	
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633	Solar Estates Park at end of Sunshine Road (**SOE**)	3/05 to date	C: 12/04 to 2/09 T: 12/04 to 4/12	12/04 to date	12/04 to date	1/05 to date
631	*Port of Corpus Christi on West End of CC Inner Harbor (**WEH**) (terminated)*		T&C: 12/04 to 5/12	12/04 to 5/12	12/04 to 5/12	

Legend

CAMS	continuous ambient monitoring station
Auto-GC	automated gas chromatograph
TNMHC	total non-methane hydrocarbon analyzer (all except CAMS 633 & 634 also have canister hydrocarbon samplers)
H_2S	hydrogen sulfide analyzer
SO_2	sulfur dioxide analyzer
Met Station	meteorology station consisting of measurement instruments for wind speed, wind direction, ambient air temperature and relative humidity
Camera	surveillance camera

Glossary of terms

- **Pollutant concentrations** – Concentrations of most gaseous pollutants are expressed in units denoting their "mixing ratio" in air; i.e., the ratio of the number molecules of the pollutant to the total number of molecules per unit volume of air. Because concentrations for all gases other than molecular oxygen, nitrogen, and argon are very low, the mixing ratios are usually scaled to express a concentration in terms of "parts per million" (ppm) or "parts per billion" (ppb). Sometimes the units are explicitly expressed as ppm-volume (ppmV) or ppb-volume (ppbV) where 1 ppmV indicates that one molecule in one million molecules of ambient air is the compound of interest and 1 ppbV indicates that one molecule in one billion molecules of ambient air is the compound of interest. In general, air pollution standards and health effects screening levels are expressed in ppmV or ppbV units. Because hydrocarbon species may have a chemical reactivity related to the number of carbon atoms in the molecule, mixing ratios for these species are often expressed in ppb-carbon (ppbV times the number of carbon atoms in the molecule), to reflect the ratio of carbon atoms in that species to the total number of molecules in the volume. This is relevant to our measurement of auto-GC species and TNMHC, which are reported in ppbC units. For the purpose of relating hydrocarbons to health effects, this report notes hydrocarbon concentrations in converted ppbV units. However, because TNMHC is a composite of all species with different numbers of carbons, it cannot be converted to ppbV. Pollutant concentration measurements are time-stamped based on the start time of the sample, in Central Standard Time (CST), with sample duration noted.

- **Auto-GC** – The automated gas chromatograph collects a sample for 40 minutes, and then automatically analyzes the sample for a target list of 46 hydrocarbon species. These include benzene and 1,3-butadiene, which are air toxics, various species that have relatively low odor thresholds, and a range of gasoline and vehicle exhaust components. Auto-GCs operate at Solar Estates CAMS 633 and Oak Park CAMS 634. In June 2010 TCEQ began operating an auto-GC at Palm CAMS 83 at 1511 Palm Drive in the Hillcrest neighborhood.

- **Total non-methane hydrocarbons (TNMHC)** – TNMHC represent a large fraction of the total volatile organic compounds released into the air by human and natural processes. TNMHC is an unspeciated total of all hydrocarbons, and individual species must be resolved by other means, such as with canisters or auto-GCs. However, the time resolution of the TNMHC instrument is much shorter than the auto-GC, and results are available much faster than with canisters. TNMHC analyzers operate at the sites that do not take continuous hydrocarbon measurements with auto-GCs (CAMS 629, 630, 632, and 635).

- **Canister** – Electro-polished stainless steel canisters are filled with air samples when an independent sensor detects that *elevated* (see below) levels of hydrocarbons (TNMHC) are present. Samples are taken for 20 minutes to try to capture the chemical make-up of the air. In most cases, the first time on any day that the monitored TNMHC concentration exceeds 2000 ppbC at a site for a continuous period of 15 minutes or more, the system will trigger and a sample will be collected. Samples are sent to UT Austin and are

analyzed in a lab to resolve some 60 hydrocarbon and 12 chlorinated species. Canister samplers operate at the four active sites that do not take continuous hydrocarbon measurements with auto-GCs (CAMS 629, 630, 632, and 635).

- **Air Monitoring Comparison Values (AMCV) –** The TCEQ uses AMCVs in assessing ambient data. Two valuable online documents ("Fact Sheet" and "Uses of ESLs and AMCVs Document") that explain AMCVs are at http://www.tceq.texas.gov/toxicology/AirToxics.html (accessed October 2014). The following text is an excerpt from the TCEQ "Fact Sheet" document:

  > Effects Screening Levels are chemical-specific air concentrations set to protect human health and welfare. Short-term ESLs are based on data concerning acute health effects, the potential for odors to be a nuisance, and effects on vegetation, while long-term ESLs are based on data concerning chronic health and vegetation effects. Health-based ESLs are set below levels where health effects would occur whereas welfare-based ESLs (odor and vegetation) are set based on effect threshold concentrations. The ESLs are screening levels, **not ambient air standards.** Originally, the same long- and short-term ESLs were used for both air permitting and air monitoring.
  >
  > There are significant differences between performing health effect reviews of air permits using ESLs, and the various forms of ambient air monitoring data. The Toxicology Division is using the term "air monitoring comparison values" (AMCVs) in evaluations of air monitoring data in order to make more meaningful comparisons. "AMCVs" is a collective term and refers to all odor-, vegetative-, and health-based values used in reviewing air monitoring data. Similar to ESLs, AMCVs are chemical-specific air concentrations set to protect human health and welfare. Different terminology is appropriate because air *permitting* and air *monitoring* programs are different.

- **Rationale for Differences between ESLs and AMCVs** – A very specific difference between the permitting program and monitoring program is that permits are applied to one company or facility at a time, whereas monitors may collect data on emissions from several companies or facilities or other source types (e.g., motor vehicles). Thus, the protective ESL for permitting is set lower than the AMCV in anticipation that more than one permitted emission source may contribute to monitored concentrations.

- **National Ambient Air Quality Standards (NAAQS) –** U.S. Environmental Protection Agency (EPA) has established a set of standards for several air pollutions described in the Federal Clean Air Act. NAAQS are defined in terms of *levels* of concentrations and particular *forms*. For example, the NAAQS for particulate matter with size at or less than 2.5 microns ($PM_{2.5}$) has a *level* of 12 micrograms per cubic meter averaged over 24-hours, and a *form* of the annual average based on four quarterly averages, averaged over three years. Individual concentrations measured above the level of the NAAQS are called *exceedances*. The number calculated from a monitoring site's data to compare to the level of the standard is called the site's *design value*, and the highest design value in the area for a year is the regional design value used to assess overall NAAQS compliance. A monitor or a region that does not comply with a NAAQS is said to be *noncompliant*. At some point after a monitor or region has been in noncompliance, the U.S. EPA may choose to label the region as *nonattainment*. A nonattainment designation triggers

requirements under the Federal Clean Air Act for the development of a plan to bring the region back into compliance.

A more detailed description of NAAQS can be found on the EPA's Website at http://www.epa.gov/air/criteria.html (accessed October 2014).

One species measured by this project and regulated by a NAAQS is sulfur dioxide (SO_2). EPA set the SO_2 NAAQS to include a level of 0.075 ppm, or 75 ppb averaged over one hour, with a form of the three-year average of the annual 99^{th} percentiles of the daily maximum one-hour averages. If measurements are taken for a full year at a monitor, then the 99^{th} percentile would be the fourth highest daily one hour maximum. There is also a secondary SO_2 standard of 0.500 ppm (500 ppb) over three hours, not to be exceeded more than once in any one year.

- **Elevated Concentrations** – In the event that measured pollutant concentrations are above a set threshold they are referred to as "elevated concentrations." The values for these thresholds are summarized by pollutant below. As a precursor to reviewing the data, the reader should understand the term "*statistical significance*." In the event that a concentration is higher than one would typically measure over, say, the course of a week, then one might conclude that a specific transient assignable cause may have been a single upwind pollution source, because experience shows the probability of such a measurement occurring under normal operating conditions is small. Such an event may be labeled "statistically significant" at level 0.01, meaning the observed event is rare enough that it is not expected to happen more often than once in 100 trials. This does not necessarily imply the occurrence of a violation of a health-based standard. A discussion of "elevated concentrations" and "statistical significance" by pollutant type follows:

    - For H_2S, any measured concentration greater than the level of the state residential standards, which is 80 ppb over 30 minutes, is considered "elevated." For SO_2, any measured concentration greater than the level of the NAAQS, which is 75 ppb over one hour, is considered "elevated." Note that the concentrations of SO_2 and H_2S need not persist long enough to constitute an exceedance of the standard to be regarded as elevated. In addition, any closely spaced values that are statistically significantly (at 0.01 level) greater than the long-run average concentration for a period of one hour or more will be considered "elevated" because of their unusual appearance, as opposed to possible health consequence. The rationale for doing so is that unusually high concentrations at a monitor may suggest the existence of unmonitored concentrations closer to the source area that are potentially above the state's standards.
    - For TNMHC, any measured concentration greater than the canister triggering threshold of 2000 ppbC is considered "elevated." Note that the concentrations need not persist long enough to trigger a canister (900 seconds) to be considered elevated.
    - For benzene and other air toxics in canister samples or auto-GC measurements, any concentration above the AMCV is considered "elevated." Note that 20-

minute canister samples and 40-minute auto-GC measurements are both compared with the short-term AMCV.

- Some hydrocarbon species measured in canister samples or by the auto-GC generally appear in the air in very low concentrations close to the method detection level. Similar to the case above with H_2S and SO_2, any values that are statistically significantly (at 0.01 level) greater than the long-run average concentration at a given time or annual quarter will be considered "elevated" because of their unusual appearance, as opposed to possible health consequence. The rationale for doing so is that unusually high concentrations at a monitor may suggest an unusual emission event in the area upwind of the monitoring site.

1. Auto-GC Data Summaries in Residential Areas

In this section the results of semi-continuous sampling for 27 hydrocarbon species at the three Corpus Christi auto-GC sites – UT's Solar Estates CAMS 633, UT's Oak Park CAMS 634, and TCEQ's Palm CAMS 83 – are presented. These three sites are located in residential areas. Solar Estates and Oak Park are generally downwind of industrial emissions under northerly winds. Palm, located near the TCEQ's Hillcrest and Williams Park sites in Figure 1, on page 4, is generally downwind of industries under northerly and westerly winds. In examining the aggregated data, one observes similar patterns of hydrocarbon species at all three sites.

Table 3, below, lists the data completeness from the project auto-GCs from January 2012 through mid-2014 for months for which data validation has been completed. When data are missing, the reason is generally owing to quality assurance steps or maintenance procedures. The project regularly exceeds the minimum 75 percent data recovery goal.

Table 3. Percent data recovery by month, 2012-2014, validated data only

Month	Oak Park	Solar Est.	Month	Oak Park	Solar Est.	Month	Oak Park	Solar Est.
Jan-12	94	99	Jan-13	100	100	Jan-14	97	96
Feb-12	90	98	Feb-13	94	99	Feb-14	99	100
Mar-12	97	100	Mar-13	97	100	Mar-14	93	97
Apr-12	94	100	Apr-13	100	100	Apr-14	98	100
May-12	77*	96	May-13	99	99	May-14	95	98
Jun-12	65	97	Jun-13	75*	91*	Jun-14	100	84*
Jul-12	98	93*	Jul-13	98	99	Jul-14	80*	100
Aug-12	99	93*	Aug-13	87	98	Aug-14	96	99
Sep-12	99	100	Sep-13	82	99			
Oct-12	98	93	Oct-13	99	99			
Nov-12	99	88	Nov-13	91	100			
Dec-12	97	99	Dec-13	99	99			
Average 2012	**92**	**96**	**Average 2013**	**93**	**99**	**Average 2014**	**95**	**97**

* Months with planned preventive maintenance

Table 4, on page 15, summarizes the statistics (maximum and average values) on validated data from the second quarter of 2014. Data in this table are available to TCEQ staff at http://rhone3.tceq.texas.gov/cgi-bin/agc_summary.pl (accessed September 2014). Table 5, on page 16, summarizes the as-yet-unvalidated average data values from the third quarter of 2014.

As noted in the preceding paragraph, Tables 4 and 5 show the averages (arithmetic mean of measured values) for 27 hydrocarbon species for the periods of interest, and Table 4 also shows the maximum one-hour values and the maximum 24-hour average concentrations for the second quarter's validated data. All concentration values in the tables are in ppbV units. No concentrations or averages of concentrations from the 27 species were greater than TCEQ's air monitoring comparison values (AMCV). The average data columns in Table 4 for the validated second quarter 2014 data and Table 5 for the as-yet-unvalidated third quarter 2014 data are shown graphically in Figures 2 and 3, respectively, on page 17. Figures 2 and 3 are plotted on the same y-axis scale, so they can be compared directly. For species measured consistently above their respective method detection limits at the Corpus Christi auto-GCs, mean concentrations are generally similar in the second and third quarters of the year, and similar in the first and fourth quarters of the year. More frequent maritime southerly flow in the spring and summer is a contributor to lower concentrations in the spring-summer second and third quarters, while lower wind speeds and more northerly wind directions contribute to higher concentrations in the fall-winter fourth and first quarters. As can be observed by comparing Figures 2 and 3, average concentrations were similar in the second quarter compared with the third quarter at all three Corpus Christi sites.

The rows for ***benzene*** are bold-faced in Tables 4 and 5 owing to the concern that the concentrations for this species tend to be closer to the AMCV than are concentrations of other species. The benzene short-term AMCV is 180 ppbV and the benzene long-term AMCV is 1.4 ppbV.

Table 4. Validated auto-GC statistics, 2nd quarter 2014

Units ppbV	Oak 2Q14			Solar 2Q14			Palm 2Q14		
Species	**Peak 1hr**	**Peak 24hr**	**Mean**	**Peak 1hr**	**Peak 24hr**	**Mean**	**Peak 1hr**	**Peak 24hr**	**Mean**
Ethane	108.635	21.950	4.058	145.021	20.947	4.910	99.117	22.516	3.936
Ethylene	8.496	0.873	0.230	7.333	0.721	0.146	17.543	1.336	0.222
Propane	133.950	14.951	2.246	67.432	13.455	2.409	64.148	15.269	1.994
Propylene	3.232	0.546	0.121	5.643	0.549	0.091	3.725	0.516	0.099
Isobutane	20.497	6.671	0.721	23.692	3.422	0.743	24.101	4.927	0.714
n-Butane	35.706	11.299	1.113	19.559	5.954	1.050	29.430	7.466	1.089
t-2-Butene	0.528	0.178	0.038	0.171	0.081	0.009	0.678	0.223	0.036
1-Butene	0.456	0.128	0.021	0.221	0.093	0.008	40.051	1.854	0.081
c-2-Butene	0.410	0.137	0.020	0.125	0.063	0.004	0.650	0.188	0.021
Isopentane	17.639	5.908	0.700	8.266	2.478	0.540	25.402	4.407	0.686
n-Pentane	12.226	4.581	0.425	6.105	1.876	0.380	15.280	2.691	0.383
1,3-Butadiene	0.598	0.064	0.017	0.310	0.043	0.010	0.179	0.037	0.023
t-2-Pentene	0.390	0.114	0.016	0.260	0.047	0.003	1.637	0.243	0.037
1-Pentene	0.259	0.060	0.009	0.096	0.036	0.003	0.889	0.137	0.023
c-2-Pentene	0.202	0.058	0.007	0.135	0.017	0.001	0.842	0.127	0.018
n-Hexane	4.626	1.516	0.181	2.214	0.595	0.156	4.825	1.091	0.168
Benzene	**2.829**	**0.698**	**0.114**	**1.763**	**0.283**	**0.069**	**59.412**	**4.844**	**0.190**
Cyclohexane	2.309	0.429	0.050	2.968	0.233	0.064	7.583	0.574	0.052
Toluene	7.221	0.921	0.155	1.596	0.394	0.079	7.002	1.291	0.160
Ethyl Benzene	0.228	0.065	0.014	0.204	0.030	0.007	0.337	0.101	0.011
m&p -Xylene	0.893	0.238	0.055	2.654	0.392	0.054	1.254	0.432	0.069
o-Xylene	0.297	0.080	0.016	0.299	0.050	0.009	0.370	0.117	0.020
Isopropyl Benzene	0.430	0.088	0.006	0.527	0.058	0.003	0.634	0.083	0.003
1,3,5-Tri-methylbenzene	0.127	0.028	0.004	0.757	0.050	0.005	0.211	0.031	0.006
1,2,4-Tri-methylbenzene	0.234	0.062	0.022	0.187	0.041	0.007	0.320	0.066	0.019
n-Decane	0.635	0.054	0.011	2.259	0.164	0.016	0.411	0.043	0.012
1,2,3-Tri-methylbenzene	0.197	0.037	0.006	0.217	0.032	0.004	0.225	0.044	0.020

Table 5. Unvalidated auto-GC mean statistics, 3rd quarter 2014

Units ppbV	Oak 3Q14	Solar 3Q14	Palm 3Q14
Species	**Mean**	**Mean**	**Mean**
Ethane	3.680	5.808	5.548
Ethylene	0.309	0.326	0.240
Propane	2.442	3.069	2.778
Propylene	0.201	0.154	0.097
Isobutane	0.801	1.096	0.789
n-Butane	1.052	1.492	1.133
t-2-Butene	0.045	0.035	0.025
1-Butene	0.028	0.014	0.055
c-2-Butene	0.036	0.014	0.015
Isopentane	0.826	0.933	0.686
n-Pentane	0.471	0.576	0.411
1,3-Butadiene	0.022	0.005	0.020
t-2-Pentene	0.047	0.010	0.027
1-Pentene	0.025	0.006	0.016
c-2-Pentene	0.021	0.004	0.012
n-Hexane	0.234	0.295	0.228
Benzene	**0.169**	**0.113**	**0.099**
Cyclohexane	0.088	0.123	0.059
Toluene	0.190	0.155	0.154
Ethyl Benzene	0.023	0.020	0.009
m&p -Xylene	0.081	0.116	0.060
o-Xylene	0.028	0.024	0.018
Isopropyl Benzene	0.020	0.007	0.001
1,3,5-Trimethylbenzene	0.010	0.007	0.006
1,2,4-Trimethylbenzene	0.030	0.019	0.020
n-Decane	0.019	0.024	0.014
1,2,3-Trimethylbenzene	0.013	0.008	0.027

Figure 2. Mean ppbV for 27 species at three auto-GCs, 2nd quarter 2014 (validated data)

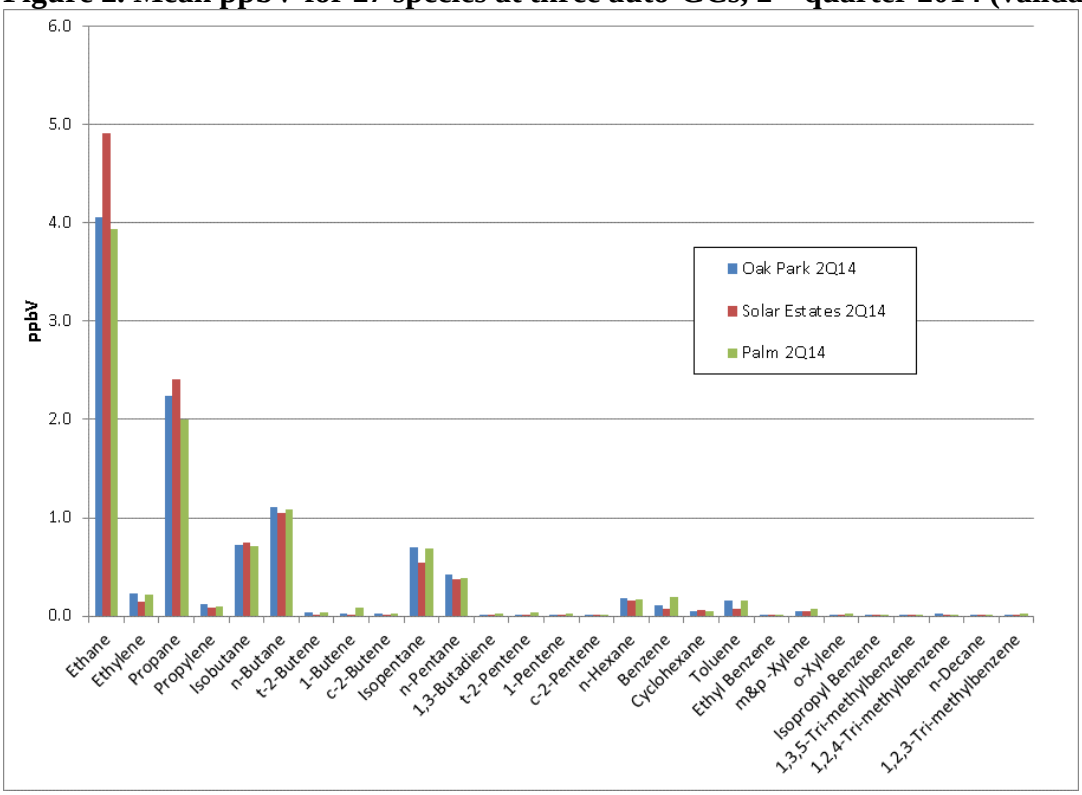
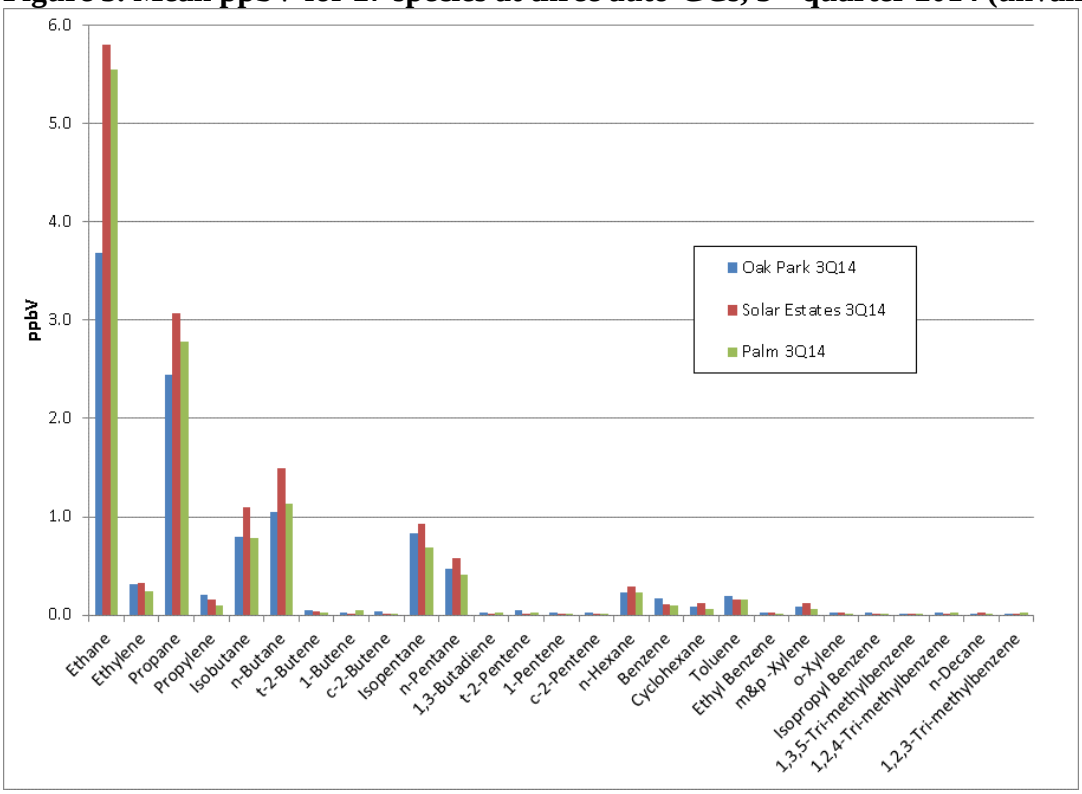


Figure 3. Mean ppbV for 27 species at three auto-GCs, 3rd quarter 2014 (unvalidated data)



As was reported in the last two quarterly reports and in the 2013 annual report, the annual and quarterly means concentrations from Solar Estates and Oak Park are higher over the last three years under northerly winds for ethane and propane and some other light alkane species than in the preceding three years. A preliminary hypothesis is that increased natural gas emissions is a possible assignable cause for the higher mean concentrations. Figures 4 and 5, below, show graphical summaries of the mean concentrations of propane, a species found in natural gas, under northerly winds (285 through 45 degrees), at the Solar Estates auto-GCs for the second quarters and third quarters of the years 2005 through 2014, respectively.

Figure 4. Mean concentrations of propane during second quarters of each year at Solar Estates winds between 285 - 45 degrees

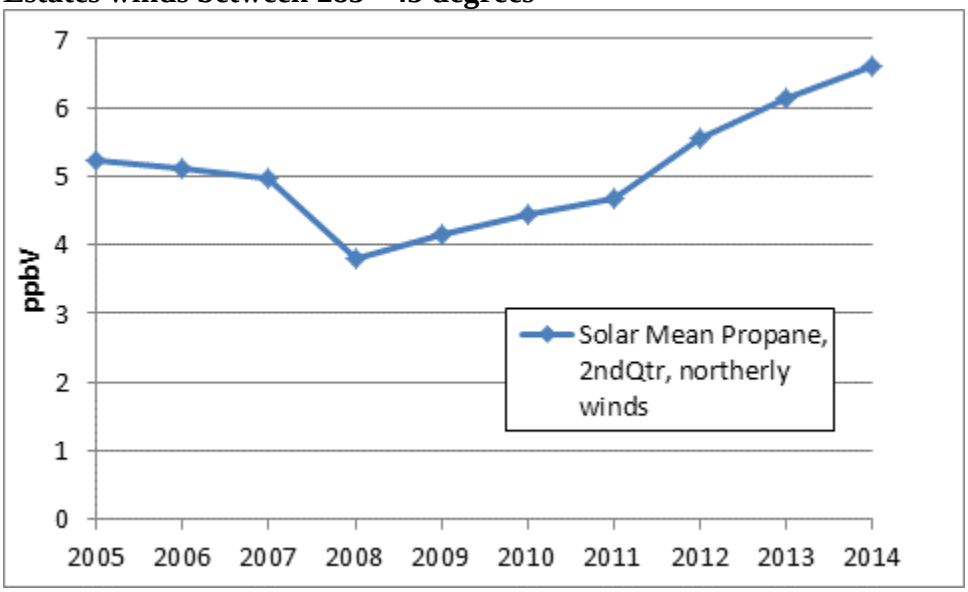
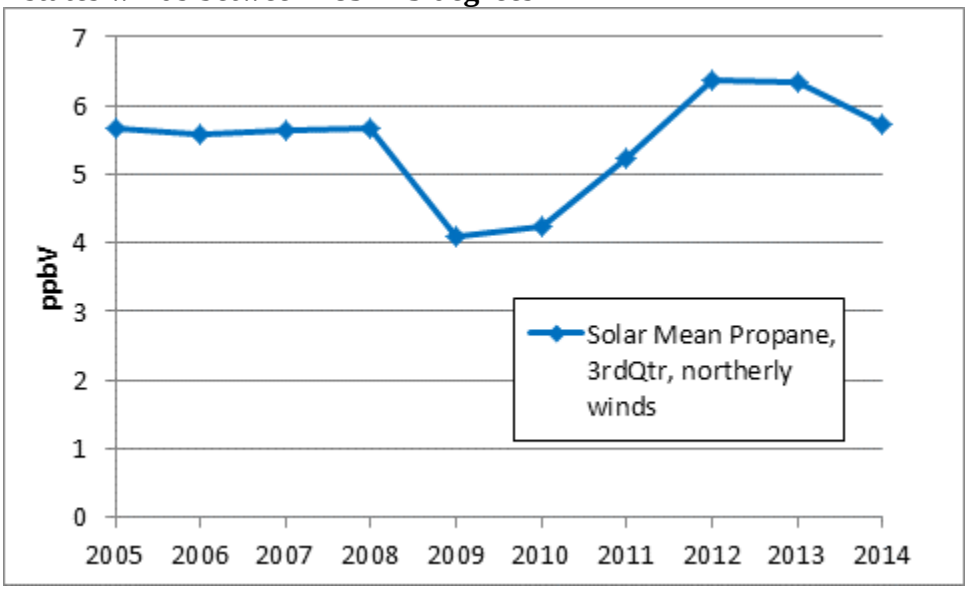


Figure 5. Mean concentrations of propane during third quarters of each year at Solar Estates winds between 285 - 45 degrees



2. Benzene Concentrations in Residential Areas

As has been discussed in past reports, benzene concentrations in the recent years are lower than in the first three years of operation at the two auto-GCs operated at Oak Park CAMS 634 and Solar Estates CAMS 633. Also, in recent years (2008 through 2014), concentration averages have generally shown relatively little variation compared to earlier years. No individual one-hour benzene values have been measured above the AMCV since the beginning of monitoring. A time series for Oak Park hourly benzene in ppbV units with two points annotated by date appears in Figure 6, below. The two points from 6:00 CST Saturday, January 27, 2007, and 4:00 CST Friday, November 6, 2009, are identified as statistical outliers in that they are unusually high given the balance of the data. The same graph is reproduced without the two outlier points in Figure 7, on page 20. The time series for Solar Estates appears in Figure 8, on page 20. Note the different y-axis scales for the two sites, as Oak Park does tend to measure higher benzene concentrations than Solar Estates. Figure 9, on page 21, shows the time series for the TCEQ Palm auto-GC, with an apparent outlier on January 30, 2012 and a more recent May 13, 2014 measurement indicated. Note that for all three sites, the data from the third quarter 2014, have not all been validated yet.

Figure 6. Oak Park hourly benzene March 2005 – September 30, 2014, ppbV units, individual elevated values noted, no observations greater than the TCEQ's AMCV

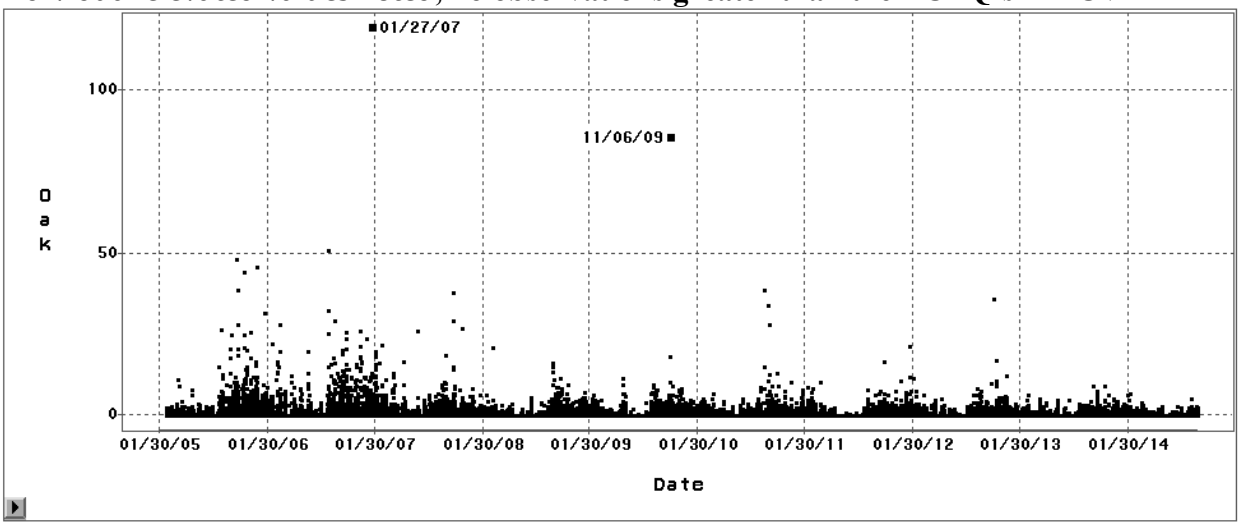


Figure 7. Oak Park hourly benzene Mar. 2005 – September 30, 2014, ppbV units, two outliers from January 27, 2007 and November 6, 2009 removed

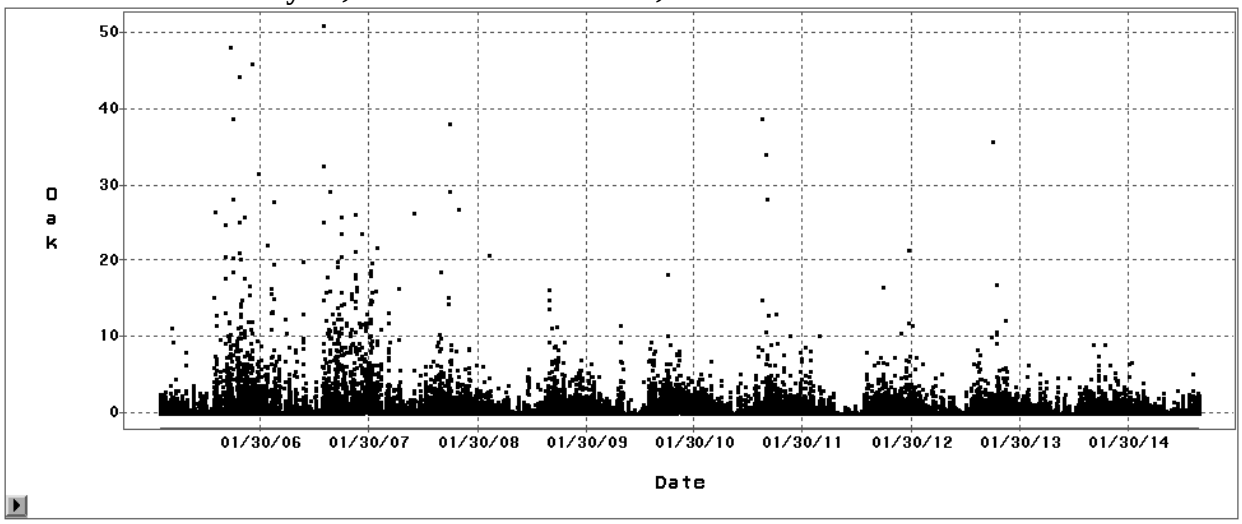


Figure 8. Solar Estates hourly benzene Mar. 2005 – September 30, 2014, ppbV units, no observations greater than the TCEQ's AMCV

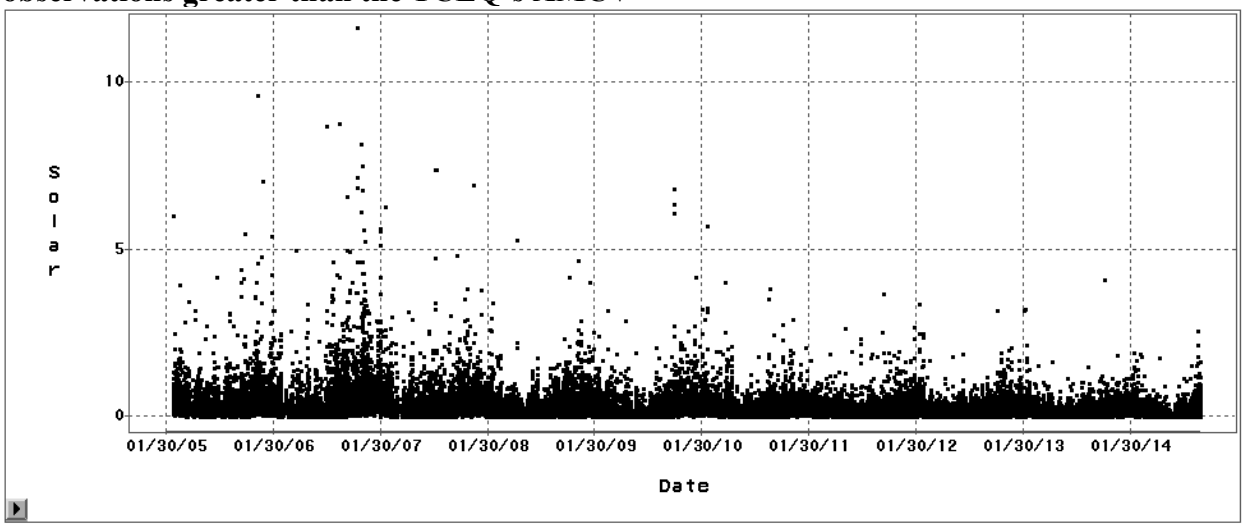
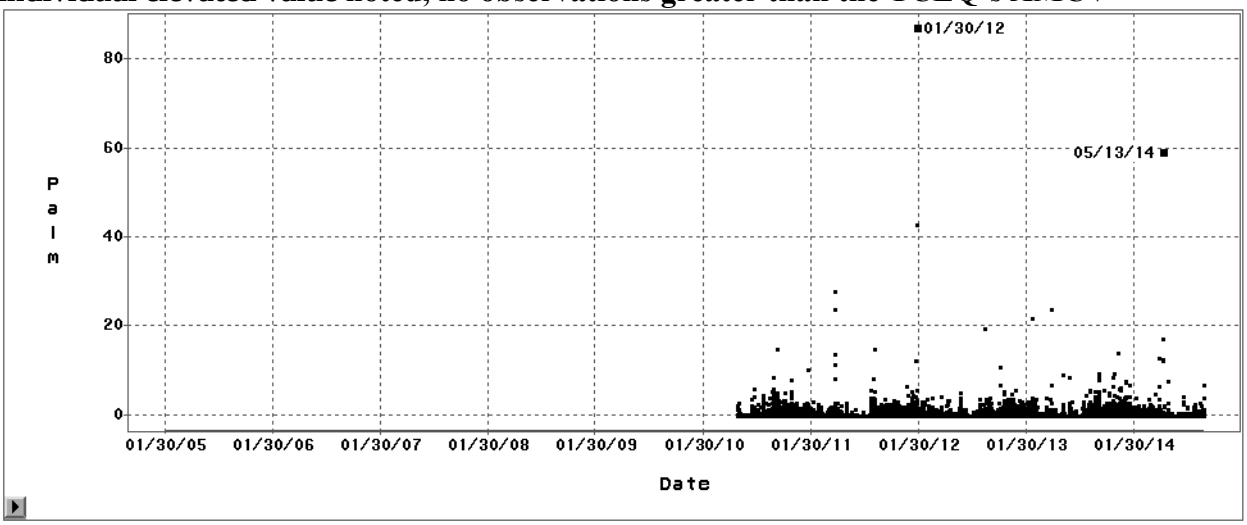


Figure 9. TCEQ Palm hourly benzene June 1, 2010 – September 30, 2014, ppbV units, individual elevated value noted, no observations greater than the TCEQ's AMCV



The January 30, 2012, 5 CST and May 13, 2014, 14 CST benzene measurements at TCEQ's Palm site in the Hillcrest neighborhood – highlighted in preceding Figure 9 – were both made under northerly winds. Figure 10, below, and Figure 11, on page 22, show the surface back-trajectories from the Palm auto-GC site starting 20 minutes after the top of the hour for the start times of these two 40-minute benzene measurements. While not directly overlapping, the trajectories travel within a few degrees of each other. Figure 12, on page 22, shows the percentage compositions by mass for the two elevated benzene samples showing that benzene comprised around 80 percent of the mass in each. Figure 13, on page 23, shows the Palm site in the context of the residential neighborhood and the nearby industrial areas to the west and north. The source was possibly a leak from a source, such as a benzene storage tank, north of Palm.

Figure 10. Surface back-trajectory from TCEQ Palm auto-GC at 5:20 a.m. CST on January 30, 2012, benzene at site measured at 87.4 ppbV

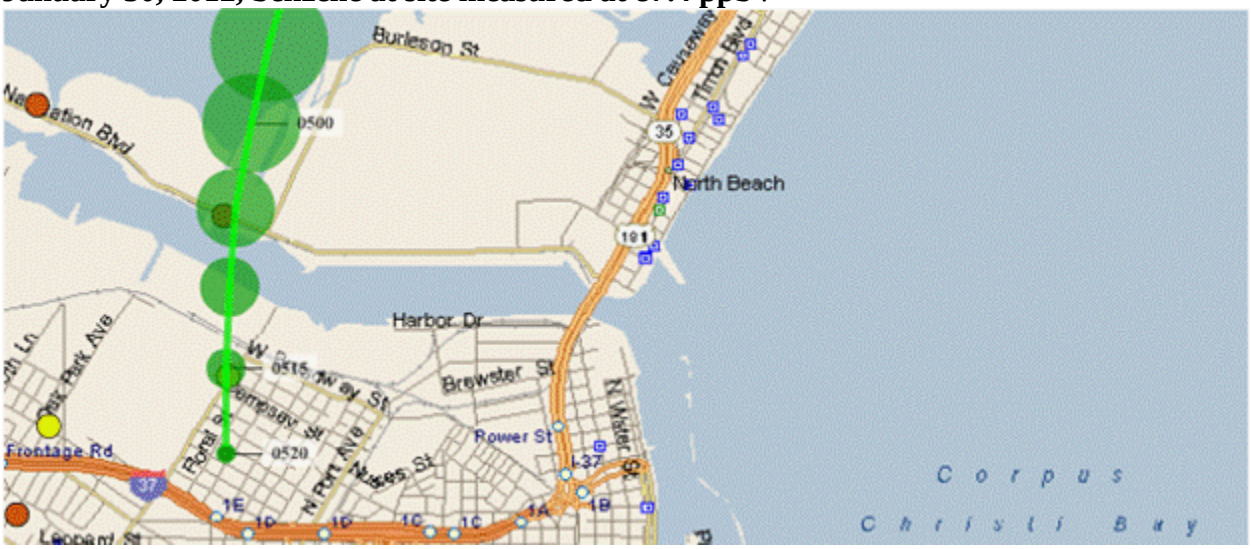


Figure 11. Surface back-trajectory from TCEQ Palm auto-GC at 2:20 p.m. CST on May 13, 2014, benzene at site measured at 59.4 ppbV

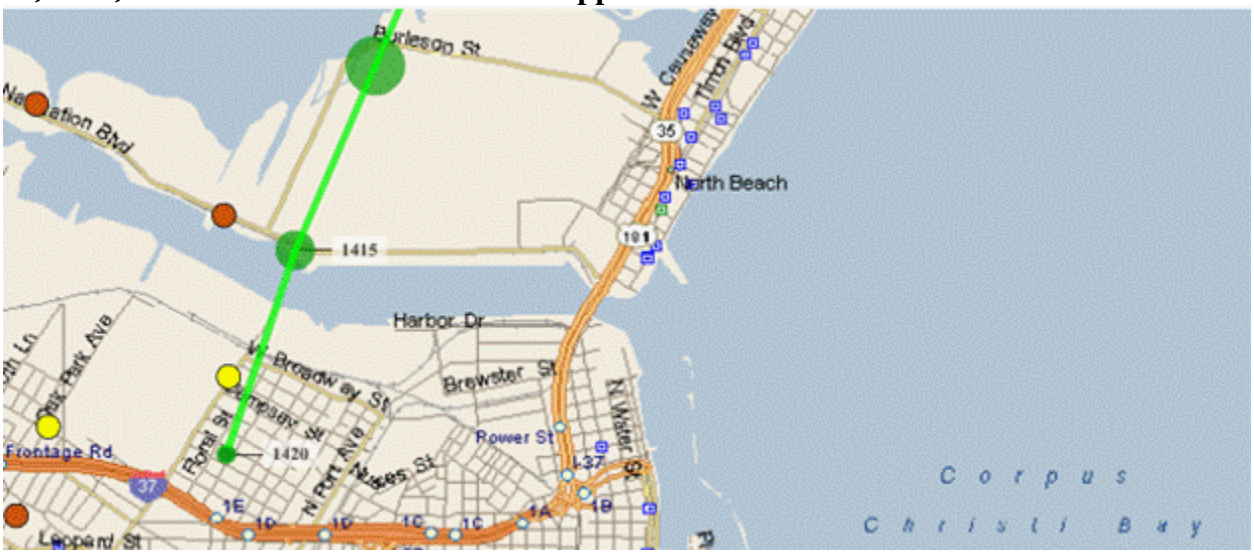


Figure 12. Comparison of one-hour auto-GC samples composition by mass from 2 p.m. CST 5/13/2014 and 5 a.m. CST 1/30/2012 at TCEQ's Palm site

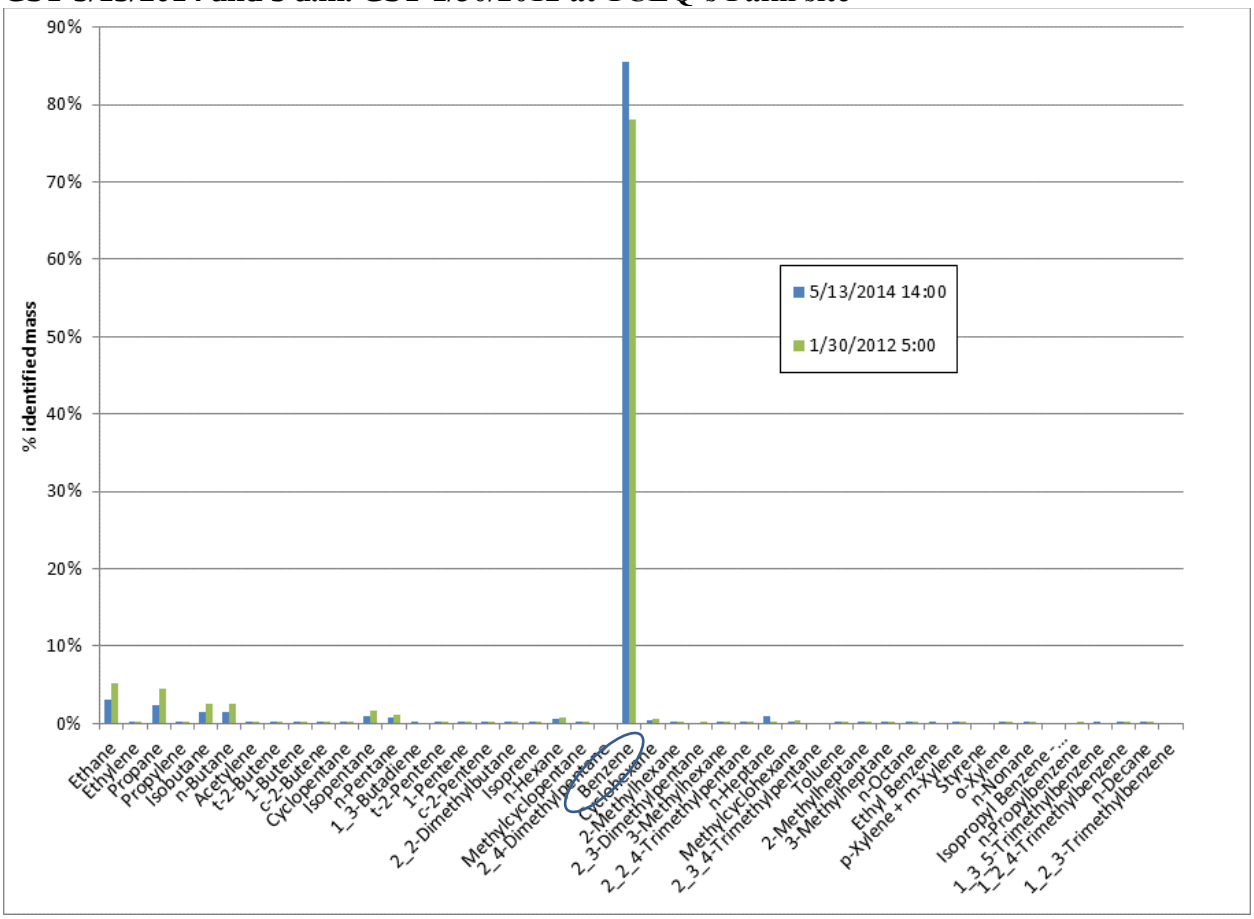


Figure 13. Area around and to the north of the TCEQ Palm auto-GC site, industrial properties highlighted

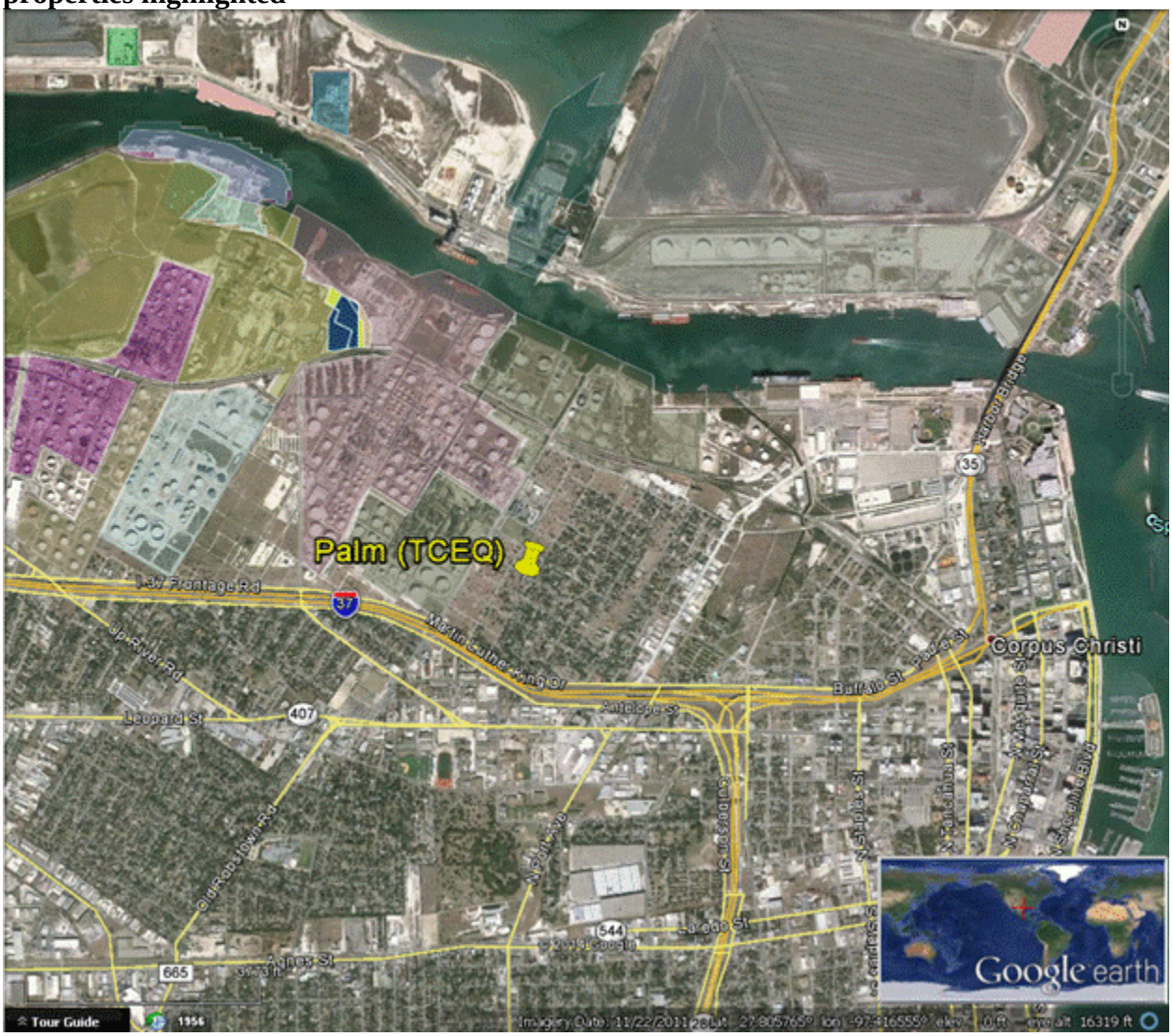


Table 6, on page 24, show the third quarter average concentrations from the three auto-GCs for benzene from 2005 through 2014 (2014 data unvalidated). The project now has ten years of complete third quarter data. The third quarter means are graphed in Figure 14, on page 24. The means for TCEQ's Palm site are shown for 2010 through 2014 only. The third quarter averages at UT sites from 2008 through 2014 are statistically significantly lower than in the third quarters of the project's first three years, and this finding is similar to findings for other quarters in recent reports on this project. Figure 15, on page 25, shows the quarterly means for the three sites since each started operation. This figure shows the strong seasonal effects, the early downward trend and subsequent flattening out in the trends at Oak Park and Solar Estates, and similarity between the Oak Park and TCEQ Palm benzene concentration means.

Table 6. Mean statistics for Benzene at Oak Park and Solar Estates, 3rd quarter 2005 – 2014, Palm 2010 – 2014, ppbV units (2014 - data unvalidated)

3rd qtr/year	Oak	Solar	Palm
2005	0.30	0.27	
2006	0.52	0.32	
2007	0.42	0.25	
2008	0.23	0.17	
2009	0.28	0.12	
2010	0.27	0.16	0.20
2011	0.18	0.11	0.18
2012	0.28	0.10	0.15
2013	0.17	0.11	0.15
2014	0.17	0.11	0.10

Figure 14. Mean concentrations of benzene during third quarters of each year at Oak Park (blue) and Solar Estates (red), 2005 – 2014 with lower values in 2008 – 2014 compared with 2005 – 2007, and Palm (green) 2010 – 2014 (2014 data unvalidated)

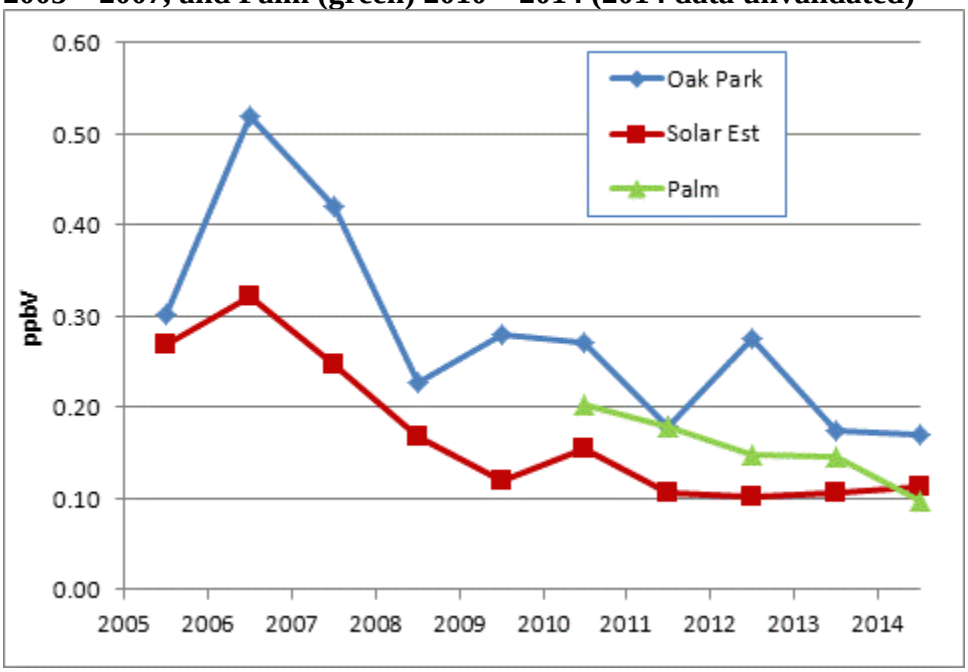
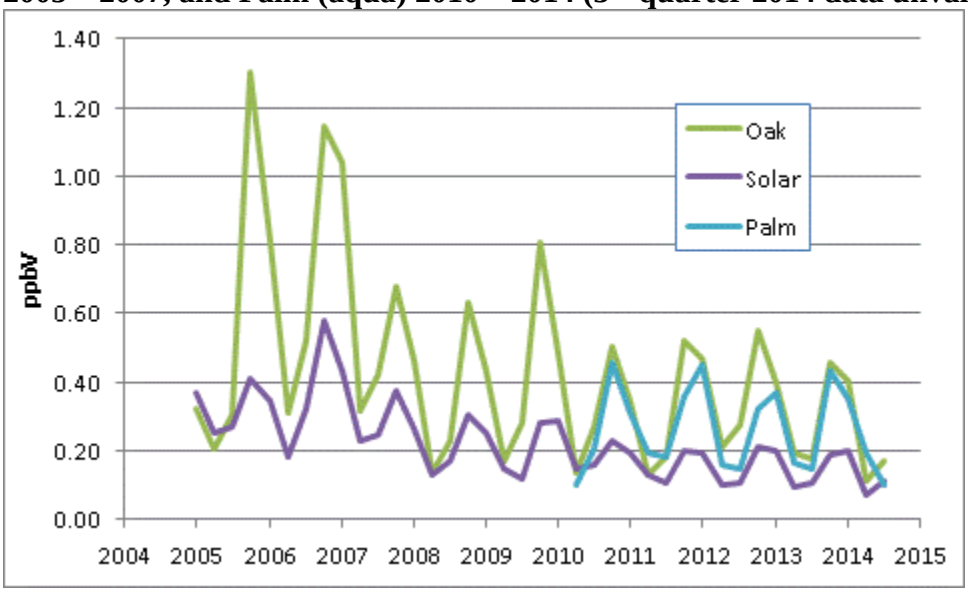


Figure 15. Mean concentrations of benzene by quarter of each year at Oak Park (green) and Solar Estates (purple), 2005 – 2014 with lower values in 2008 – 2014 compared with 2005 – 2007, and Palm (aqua) 2010 – 2014 (3rd quarter 2014 data unvalidated)



3. Sulfur Dioxide Measurements at Corpus Christi Monitors

At a meeting with TCEQ staff on October 2, 2014, Mr. Chris Owen of the TCEQ presented work that he and his colleagues, with some help from UT, had produced on SO_2 issues around the Port of Corpus Christi. The presentation was a review of elevated SO_2 concentrations or "events" at both TCEQ's Avery Point site and JIH CAMS 630 during 2012 and 2013. Events were counted based on 5-minute measurements exceeding 75 ppb; to wit, some events were composed of multiple 5-minute measurements over several hours, while some events were a single 5-minute measurement. There were a total of 29 events in 2012 and 2013 at these two sites, as shown in Table 7, on page 26. TCEQ accessed the Port's records to be able to directly relate the occurrence of elevated SO_2 and the presence of an ocean-going ship at dock.

Avery Point Summary: Of the 25 events at Avery during 2012 and 2013, all but two events occurred under northerly winds and were associated with ocean-going ships at the Avery Point Oil Docks. The 23 events at Avery correlated to specific docks and ocean-going ships and each ship's orientation at dock, i.e., smokestack west of dock or east of dock. At these docks, the ship orientation is a function of product loading or unloading. There were two events (one 5-minute event and one event composed of three elevated 5-minute measurements) at Avery Point during southerly winds that were likely associated with industrial sources to the south of the site.

JIH Summary: There were a total of four events in 2012 and 2013 at JIH. During 2012, three events were correlated to specific docks and ocean-going ships and each's orientation at dock. The only event in 2013 was a single 5-minute measurement that was likely associated with industrial sources to the south of the site.

Table 7. Counts of SO2 events at JIH and Avery Point, 2012 and 2013

Year	Site	Number of 5-min. values > 75 ppb	Number of 1-hour values > 75 ppb	Number of days 1-hr values > 75 ppb	Number of events
2012	JIH	35	0	0	3
2013	JIH	4	0	0	1
2012	Avery	359	26	13	21
2013	Avery	10	0	0	4

Conclusions from the Third Quarter 2014 Data

In this quarter's report, several findings have been made:

- No exceedances of the EPA SO_2 NAAQS level were measured this quarter at UT sites or at TCEQ sites. Dockside ship emissions that had affected the UT JIH CAMS 630 site and the TCEQ's temporary Avery Point sites appear to have diminished since June 2012, which is likely relatable to new federal rules on marine fuel. However, some SO_2 emissions may still be occurring.
- Second and third quarter 2014 concentrations at the auto-GCs remain well below the TCEQ's AMCVs for all species tracked for this project. Trends in quarterly average benzene concentrations remain relatively flat. Mean concentrations for several hydrocarbon species, possibly associated with natural gas, have increased in the past three years under northerly winds; however, the low incidence of northerly winds in the third quarter reduces the effect of concentrations under north winds on quarterly statistics.
- Periodic air pollution events continue to be measured on a routine basis.

Further analyses will be provided upon request.

APPENDIX B

Financial Report of Expenditures
Financial Report of Interest Earned

Neighborhood Air Toxics Modeling Project for Houston and Corpus Christi - Phase 1B

Accounting Report for the Quarter
07/01/14 - 09/30/14

A. Total Amount of Air Toxics Funds and Other Funds Received Under This Proposal

Total Grant Amount:	$2,745,371.68
Total Interest Earned:	$391,551.29
Total Funds Received:	**$3,136,922.97**

B. Summary of Expenditures Paid by Air Toxics Funds

		Yr 1 Budget	Year 2 Budget	Year 3 Budget	Year 4 Budget	Adjustments Prior Quarter	Adjustments This Quarter	Adjusted Budget	Prior Activity	Current Activity 07/01/14 - 09/30/14	Encumbrances	Remaining Balance 07/01/14 - 09/30/14
Salaries-Prof	12	$111,654.00	$183,063.49	$31,566.18	$31,566.18	($29,495.84)	$0.00	$296,787.83	($133,629.56)	($36,541.93)	($13,673.22)	$112,943.12
Fringe	14	$24,563.88	$40,273.97	$11,051.05	$11,051.05	$0.00	$0.00	$75,888.90	($38,220.31)	($10,438.85)	($2,524.42)	$24,705.32
Salaries-CEER	15	$0.00	$0.00	$10,538.09	$0.00	$29,495.84	$0.00	$40,033.93	($25,458.94)	($13,914.50)	$0.00	$660.49
Salary Holding	16	$133,401.93	$0.00	$0.00	$0.00	($133,401.93)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Quality Assurance	41	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Cell Phone Allowance	42	$0.00	$300.00	$360.00	$360.00	$60.00	$0.00	$720.00	($630.00)	($90.00)	$0.00	$0.00
SEP Reserve	43	$10,800.00	$0.00	$0.00	$0.00	($10,800.00)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Contingency	47	$0.00	$0.00	$5,000.00	$5,000.00	$0.00	($5,000.00)	$0.00	$0.00	$0.00	$0.00	$0.00
Monthly M&O	50	$0.00	$0.00	$20,908.45	$20,908.45	$30,957.32	($4,312.00)	$47,553.77	($38,434.68)	($3,820.33)	($4,637.62)	$661.14
Equipment & Spare Parts	51	$0.00	$32,584.00	$17,539.29	$17,539.29	$0.00	($3,858.00)	$46,265.29	($27,516.25)	($15.85)	$0.00	$18,733.19
Telephone SWB-DSL/RR	52	$0.00	$8,454.00	$8,707.47	$8,707.47	$1,946.00	$0.00	$19,107.47	($14,842.57)	($2,379.21)	$0.00	$1,885.69
Electric	53	$0.00	$22,438.00	$23,086.69	$23,086.69	$4,062.00	$0.00	$49,586.69	($38,905.10)	($5,252.36)	$0.00	$5,429.23
Gases	54	$0.00	$10,811.00	$10,676.72	$10,676.72	$1,439.00	$3,600.00	$26,526.72	($21,820.21)	($1,572.57)	($798.65)	$2,335.29
Other Costs	55	$0.00	$0.00	$260,000.00	$260,000.00	$0.00	$0.00	$260,000.00	$0.00	$0.00	$0.00	$260,000.00
Consultant Services - Holding	60	$80,000.00	$0.00	$0.00	$0.00	($80,000.00)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Consultant Services - ORSAT/TMSI	61-62	$0.00	$194,750.38	$466,081.72	$466,081.72	$218,430.02	$0.00	$879,262.12	($651,153.12)	($121,475.46)	$0.00	$106,633.54
Analytical	68	$0.00	$27,839.39	$6,458.00	$6,458.00	$22,960.61	$9,570.00	$66,828.00	($57,112.00)	($3,858.00)	$0.00	$5,858.00
Travel	75	$0.00	$3,000.00	$1,000.62	$1,000.62	$300.00	$0.00	$4,300.62	($2,833.00)	$0.00	$0.00	$1,467.62
Equipment	80	$0.00	$0.00	$0.00	$0.00	$43,700.00	$0.00	$43,700.00	($43,700.00)	$0.00	$0.00	$0.00
Indirect Costs	90	$54,062.97	$78,527.13	$130,946.14	$130,946.14	$14,947.95	$0.00	$278,484.19	($164,138.38)	($29,903.86)	$0.00	$84,441.95
TOTALS		**$414,482.78**	**$602,041.36**	**$1,003,920.42**	**$993,382.33**	**$114,600.97**	**$0.00**	**$2,135,045.53**	**($1,258,394.12)**	**($229,262.92)**	**($21,633.91)**	**$625,754.58**

C. Interest Earned by Air Toxics Funds as of 07/01/14 - 09/30/14

Prior Interest Earned:	$391,252.10
Interest Earned This Quarter:	$299.19
Total Interest Earned to Date:	$391,551.29

D. Balance of Air Toxics Funds as of 07/01/14 - 09/30/14

Total Grant Amount:	$2,745,371.68
Total Interest Earned:	$391,551.29
Total Expenditures:	($1,487,657.04)
Remaining Balance:	**$1,649,265.93**

I certify that the numbers are accurate and reflect acutal expenditures for the quarter

Accounting Certification

26-7700-99

Neighborhood Air Toxics Modeling Project for Houston and Corpus Christi - Stage 1 Phase 1A

Accounting Report for the Quarter
07/01/14 - 09/30/14

A. Total Amount of Air Toxics Funds and Other Funds Received Under This Proposal

Total Grant Amount:	$1,863,081.22
Total Interest Earned:	$344,222.10
Interest Transferred to Phase 1B	($344,222.10)
Total Funds Received:	**$1,863,081.22**

B. Summary of Expenditures Paid by Air Toxics Funds

		Yr 1 and Yr2 Budget	Year 3 Budget	Adjustments Prior Quarter	Adjustments This Quarter	Adjusted Budget	Prior Activity	Current Activity 07/01/13 - 09/30/13	Encumbrances	Remaining Balance 07/01/13 - 09/30/13
Salaries-Prof	**12**	$616,882.00	$228,508.00	($95,903.26)	$0.00	$749,486.74	($749,486.74)	$0.00	$0.00	$0.00
Salaries-CEER	**15**	$66,780.00	$24,045.00	($11,435.81)	$0.00	$79,389.19	($79,389.19)	$0.00	$0.00	$0.00
Fringe	**14**	$149,185.00	$55,852.00	($22,669.10)	$0.00	$182,367.90	($182,367.90)	$0.00	$0.00	$0.00
Supplies	**50**	$61,991.00	-$5,831.00	($21,633.36)	$0.00	$34,526.64	($34,526.64)	$0.00	$0.00	$0.00
Contingency	**51**	$6,746.00	$27,805.00	($34,551.00)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Consultants	**60**	$22,500.00	$2,500.00	($25,000.00)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Subcontracts	**61-63**	$600,000.00	$0.00	($54,943.78)	$0.00	$545,056.22	($545,056.22)	$0.00	$0.00	$0.00
Modeling/Computer Svs	**67**	$46,500.00	$12,500.00	($59,000.00)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Computation Center	**68**	$0.00	$1,800.00	$0.00	$0.00	$1,800.00	($1,800.00)	$0.00	$0.00	$0.00
Tuition	**71**	$17,727.00	$0.00	($125.00)	$0.00	$17,602.00	($17,602.00)	$0.00	$0.00	$0.00
Travel	**75**	$15,000.00	$5,000.00	($17,403.03)	$0.00	$2,596.97	($2,596.97)	$0.00	$0.00	$0.00
Equipment	**80**	$17,500.00	$7,500.00	($17,755.00)	$0.00	$7,245.00	($7,245.00)	$0.00	$0.00	$0.00
Indirect Costs	**90**	$243,122.00	$53,952.00	($54,063.44)	$0.00	$243,010.56	($243,010.56)	$0.00	$0.00	$0.00
TOTALS		$1,863,933.00	$413,631.00	($414,482.78)	$0.00	$1,863,081.22	($1,863,081.22)	$0.00	$0.00	$0.00

C. Interest Earned by COCP Funds as of 09/30/13

Prior Interest Earned:	$344,222.10
Interest Earned This Quarter:	$0.00
Interest Transferred to Phase 1B	-$344,222.10
Total Interest Earned to Date:	**$0.00**

D. Balance of COCP Funds as of 09/30/13

Total Grant Amount:	$1,863,081.22
Total Interest Earned:	$0.00
Total Expenditures:	($1,863,081.22)
Remaining Balance:	**$0.00**

I certify that the numbers are accurate
and reflect acutal expenditures
for the quarter

Accounting Certification

26-7696-41