AIR QUALITY RESEARCH PROGRAM

Texas Commission on Environmental Quality
Contract Number 582-15-50047
Awarded to The University of Texas at Austin

Annual Report

September 1, 2017 through August 31, 2018

Submitted to

Donna Huff
Texas Commission on Environmental Quality
12100 Park 35 Circle
Austin, TX 78753

Prepared by

David T. Allen, Principal Investigator
The University of Texas at Austin
10100 Burnet Rd. MC R7100
Austin, TX 78758

October 5, 2018

The preparation of this report was financed through a grant from the Texas Commission on Environmental Quality (TCEQ), administered by The University of Texas at Austin through the Air Quality Research Program (AQRP). The contents, findings, opinions, and conclusions are the work of the author(s) and do not necessarily represent findings, opinions, or conclusions of the TCEQ.

Texas Air Quality Research Program

Annual Report

September 1, 2017 – August 31, 2018

OVERVIEW

The goals of the State of Texas Air Quality Research Program (AQRP) are:

(i) to support scientific research related to Texas air quality, in the areas of emissions inventory development, atmospheric chemistry, meteorology and air quality modeling,

(ii) to integrate AQRP research with the work of other organizations, and

(iii) to communicate the results of AQRP research to air quality decision-makers and stakeholders.

PROGRAM ACTIVITIES FOR THE YEAR

As the 2017-2018 fiscal year began, most of the research projects for 2016-2017 had just ended. Program activities centered primarily on the review of the final reports of the seven research projects that ended on August 31, 2017 and the three research projects that ended on October 31, 2017. The review team included the Project Manager from the AQRP staff, the TCEQ Liaison, and the QAPP Manager from the AQRP staff. By the end of the first quarter of the 2017-2018 fiscal year, the final reports of nine projects were approved and accepted, data was received from seven projects, and final invoices were paid on five projects. One research project remained active.

The final 2016-2017 research project ended on January 15, 2018. By the end of February, 2018, all final reports were completed and accepted, all final invoices were paid, and all project data was received. Complete project information was posted on the AQRP website. A list of the 2016-2017 projects is included in Appendix A of this report.

In October, 2017, a State of the Science Assessment project was approved/recommended by the Independent Technical Advisory Committee, the TCEQ, and the Advisory Council, and work began on November 3, 2017. The purpose of this project was to provide a comprehensive review of the research performed under the AQRP. The assessment highlighted the successes of the program and identified challenges that remain and areas that should be considered a priority for future research activities.

The draft State of the Science Assessment was completed in December, 2017 and sent to the Independent Technical Advisory Committee for review and comment. Comments received in January, 2018 were addressed and a revision of the report was sent to the TCEQ and the Advisory Council for additional review and comment. Advisory Council comments were addressed in February and a new revision was sent to TCEQ for comment. The final version was accepted in early March 2018.

Utilizing the State of the Science Assessment's evaluation of the program successes, challenges, and areas that should be considered a priority for future research activities, and in consultation with the TCEQ and the Advisory Council, a draft Strategic Research Plan was developed in February 2018. This also went through several rounds of review with the Advisory Council and the TCEQ. On March 29, the AQRP Program Management, the TCEQ, and the Advisory Council met to finalize the research priorities. On April 6, 2018, the Request for Proposals was released on the AQRP website and an email announcing the Request for Proposals went out to AQRP stakeholders.

The AQRP received a total of forty (40) proposals that were submitted by the due date of 5:00 pm central time on May 18, 2018. The review of the proposals by the Independent Technical Advisory Committee (ITAC) began on May 21. Each proposal was assigned to three different ITAC members who specialized in the proposal's research priority area, for initial review and rating. Technical ratings of the projects were received by the AQRP on May 31.

The ITAC Proposal Review meeting was held June 4 and 5, 2018, at the Pickle Research Campus of The University of Texas at Austin. Nine (9) of the ITAC members attended the meeting in person and two (2) members called in on the first day of the meeting. The ITAC members discussed each of the proposals in multiple rounds of reviews. As in previous biennia, the ITAC grouped the proposals into 3 categories: highly recommended, recommended if funding is available and not recommended. The proposals that were either highly recommended or recommended were categorized by topical area. Eight topical areas were represented in the proposals that were highly recommended or recommended. In addition, the proposals falling into the recommended category were ranked into four tiers, with Tier 1 ranked highest and Tier 4 ranked lowest in technical merit.

On June 5, the proposals and the ITAC recommendations were submitted to the TCEQ for a review of each proposal's relevancy to the air quality needs of Texas. From the relevancy review, at the end of June, the TCEQ returned a ranked subset of proposals from the highly recommended and recommended list to the AQRP.

The AQRP then convened a meeting of the Advisory Council on July 17, 2018. Three of the Advisory Council members attended the meeting in person, one member sent an approved proxy, and one member joined via conference call. One member, who was not able to attend the meeting, submitted comments and recommendations for funding via email. David Allen presented information on the AQRP program and the proposal review process that had taken place prior to the Advisory Council meeting. Funding availability was discussed. Each of the proposals that had been reviewed and ranked as highly recommended or recommended for funding by the Independent Technical Advisory Committee ***AND*** ranked as most relevant to the air quality needs of Texas by the TCEQ was described and discussed. The eight proposals that were selected for funding by the Advisory Council are listed in the Research Projects section of this report.

In the week following the Advisory Council meeting, all proposers were notified of their proposal status. An AQRP Project Manager and a TCEQ Liaison was assigned to each project. A Quality Assurance Project Plan (QAPP) Manager was assigned by both AQRP and TCEQ. Project kick-off calls were held in early August and Investigators were given instructions to move forward with the development of their project Work Plans. At the same time, the AQRP began the contracting process with each of the universities and businesses that had their

proposals approved for funding. Several of these entities had projects under the 2016-2017 biennium, and only needed to have contracts amended. The amendments were all partially executed by August 30, 2018, and fully executed in early September. Those that needed new contracts are still in progress.

Work plans have been submitted by most of the project investigators. One project has completed the review process and will have a start date of September 1, 2018. The remaining projects are in various stages of the review process and are expected to begin in September or October 2018.

BACKGROUND

Section 387.010 of HB 1796 (81st Legislative Session), directs the Texas Commission on Environmental Quality (TCEQ, Commission) to establish the Texas Air Quality Research Program (AQRP).

> Sec. 387.010. AIR QUALITY RESEARCH. (a) The commission shall contract with a nonprofit organization or institution of higher education to establish and administer a program to support research related to air quality.
>
> (b) The board of directors of a nonprofit organization establishing and administering the research program related to air quality under this section may not have more than 11 members, must include two persons with relevant scientific expertise to be nominated by the commission, and may not include more than four county judges selected from counties in the Houston-Galveston-Brazoria and Dallas-Fort Worth nonattainment areas. The two persons with relevant scientific expertise to be nominated by the commission may be employees or officers of the commission, provided that they do not participate in funding decisions affecting the granting of funds by the commission to a nonprofit organization on whose board they serve.
>
> (c) The commission shall provide oversight as appropriate for grants provided under the program established under this section.
>
> (d) A nonprofit organization or institution of higher education shall submit to the commission for approval a budget for the disposition of funds granted under the program established under this section.
>
> (e) A nonprofit organization or institution of higher education shall be reimbursed for costs incurred in establishing and administering the research program related to air quality under this section. Reimbursable administrative costs of a nonprofit organization or institution of higher education may not exceed 10 percent of the program budget.
>
> (f) A nonprofit organization that receives grants from the commission under this section is subject to Chapters 551 and 552, Government Code.

The University of Texas at Austin was selected by the TCEQ to administer the program. A contract for the administration of the AQRP was established between the TCEQ and the University of Texas at Austin on July 29, 2015 for the 2016-2017 biennium. Consistent with the provisions in HB 1796, up to 10% of the available funding is to be used for program administration; the remainder (90%) of the available funding is to be used for research projects, individual project management activities, and meeting expenses associated with an Independent Technical Advisory Committee (ITAC).

On September 4, 2017, the AQRP contract was renewed for the 2018 – 2019 biennium and additional funding was awarded.

RESEARCH PROJECT CYCLE

The Research Program is implemented through a 9 step cycle. The steps in the cycle are described from project concept generation to final project evaluation for a single project cycle.

1.) The project cycle is initiated by developing (in year 1) or updating (in subsequent years) the strategic research priorities. The AQRP Director, in consultation with the ITAC, the Council and the TCEQ, develop research priorities; the research priorities are released along with a Request for Proposals.

2.) Project proposals relevant to the research priorities are solicited. The Request for Proposals can be found at http://aqrp.ceer.utexas.edu/ .

3.) The Independent Technical Advisory Committee (ITAC) performs a scientific and technical evaluation of the proposals.

4.) The project proposals and ITAC recommendations are forwarded to the TCEQ. The TCEQ evaluates the project recommendations from the ITAC and comments on the relevancy of the projects to the State's air quality research needs.

5.) The recommendations from the ITAC and the TCEQ are presented to the Council and the Council selects the proposals to be funded. The Council also provides comments on the strategic research priorities.

6.) All Investigators are notified of the status of their proposals, either funded, not funded, or not funded at this time, but being held for possible reconsideration if funding becomes available.

7.) Funded projects are assigned an AQRP Project Manager at UT-Austin and a Project Liaison at TCEQ. The AQRP Project Manager is responsible for ensuring that project objectives are achieved in a timely manner and that effective communication is maintained among investigators involved in multi-institution projects. The AQRP Project Manager has responsibility for documenting progress toward project measures of success for each project. The AQRP Project Manager works with the researchers, and the TCEQ, to create an approved work plan for the project.

   The AQRP Project Manager also works with the researchers, TCEQ and the Program's Quality Assurance officer to develop an approved Quality Assurance Project Plan (QAPP) for each project. The AQRP Project Manager reviews monthly, annual and final reports from the researchers and works with the researchers to address deficiencies.

8.) The AQRP Director and the AQRP Project Manager for each project describe progress on the project in the ITAC and Council meetings dedicated to on-going project review.

9.) The project findings are communicated through multiple mechanisms. Final reports are posted to the Program web site; research briefings are developed for the public and air quality decision makers; and a bi-annual research conference/data workshop is held.

During this program year, the AQRP performed Steps 9 and 1 through 7.

Independent Technical Advisory Committee (ITAC)

The AQRP funding is to be used primarily for research projects, and one of three groups responsible for selecting the projects is the Independent Technical Advisory Committee (ITAC). The ITAC is composed of between 9 and 15 individuals with scientific expertise relevant to the Program. The ITAC is charged with recommending technical approaches, establishing research priorities, and reviewing, commenting, and advising on all projects to ensure that the projects facilitate air quality improvement in Texas. Members of the ITAC consist of the TCEQ Project Director (or designee), representatives with air quality expertise from research institutions with extensive expertise in air quality research in Texas. The members of the ITAC are listed in Table 1. The members of the ITAC are drawn from Texas universities active in air quality research, national laboratories that have participated in air quality studies in Texas, and institutions that have expertise not available in Texas and that have participated in air quality studies in Texas.

The ITAC membership is intentionally drawn from air quality researchers who have experience in Texas. These researchers and their colleagues will likely have interest in responding to the requests for research proposals issued by the AQRP. This raises potential confidentiality and conflict of interest issues, and the contract between TCEQ and the University of Texas at Austin requires that the AQRP maintain and implement an appropriate written policy on conflict of interest. Specifically for the ITAC, all members are required to certify:

> *Confidentiality:* As a member of ITAC I understand that I will have access to proposals submitted to the Air Quality Research Program. Subject to any legal requirements, I agree to keep the information in these proposals confidential until the selection process is completed and it is appropriate to release information to the public. I understand that there may be certain information that comes to me in my role as a member of ITAC that retains its confidential nature even after the process is concluded. I also understand that I will review said proposals and may have access to the reviews made by other ITAC members. I agree to keep these reviews and the identity of the reviewers confidential until such time as this information is released to the public. (NOTE: For the reviews and reviewers, this information may never be released.)
>
> *Conflict of Interest:* As a member of ITAC, I agree that I will not evaluate, comment on, or vote on proposals in which I or my home institution is involved, including but not limited to, any financial interest, or in which I have another form of conflict of interest. I understand that ITAC members with conflicts of interest must leave the meeting room or the conference line when a proposal with which they have a conflict is discussed, voted on or otherwise being considered. I understand that I must recuse myself from participating in or attempting to influence at any time the ITAC's or the AQRP Council's consideration or decision concerning such proposals. I agree to bring any issues concerning a possible conflict of interest to the attention of the Director of the Air Quality Research Program or the TCEQ Project Director. If there is a question of interpretation regarding whether a conflict of interest exists, I agree that the decision regarding whether a conflict of interest exists will be made by the Director of the Air Quality Research Program or the TCEQ Project Director.

All members of the ITAC agreed to abide by these conflict of interest and confidentiality provisions prior to participating in the review of proposals.

The ITAC began this grant cycle with fourteen (14) members, but currently is composed of twelve (12) members due to Peter Daum, formerly of Brookhaven National Lab, and Bryan Lambeth formerly of the TCEQ, resigning from the Committee.

Table 1. Independent Technical Advisory Committee Members

Name	Title	Organization
David Allen	Gertz Regents Professor in Chemical Engineering	The University of Texas at Austin
William Carter	Emeritus Research Chemist, Center for Environmental Research and Technology	University of California - Riverside
Don Collins	Professor and Director of the Center for Atmospheric Chemistry and the Environment	Texas A&M University
James Crawford	Research Scientist, Chemistry & Dynamics Science Directorate	NASA
Peter Daum	Head, Atmospheric Science Division	Brookhaven National Lab (Retired)(Resigned May 2018)
Mark Estes	Senior Air Quality Scientist Air Modeling and Data Analysis Section	Texas Commission on Environmental Quality
Fred Fehsenfeld	Senior Scientist, Cooperative Institute for Research in Environmental Sciences	University of Colorado – Boulder (Retired)
Joost de Gouw	Research Physicist, Earth System Research Lab	NOAA
Robert Griffin	Associate Professor, Civil and Environmental Engineering	Rice University
Tho Ching (Thomas) Ho	Aldredge Endowed Chair, Regent's Professor and Chair, Dan F. Smith Department of Chemical Engineering; Director, Texas Air Research Center	Lamar University
Bryan Lambeth	Meteorologist	TCEQ (Retired) (Resigned October 2017)
Golam Sarwar		EPA ORD
Christine Wiedinmyer	Scientist III, Atmospheric Chemistry Division	Nation Center for Atmospheric Research
Greg Yarwood	Principal	Ramboll Environ, Inc.

TCEQ Relevancy Review

Once the ITAC has reviewed and ranked research project proposals according to technical merit, they are submitted to the TCEQ for a relevancy review. The TCEQ reviews proposals for relevancy to the State's air quality research needs. TCEQ approval is required for a project to receive funding from the Program.

Advisory Council

The final group responsible for selecting AQRP research projects is the Advisory Council. The Council consists of between 7 and 11 members, all residents of the State of Texas. Two Council members with relevant scientific expertise are nominated by the TCEQ. As defined in the AQRP contract, up to four members of the Council can be county judges from the Houston-Galveston-Brazoria (HGB) and Dallas-Fort Worth (DFW) non-attainment counties. Additional members should have a general background in air quality and business practices, and can include elected officials, business community representatives, environmental group representatives, and members of the general public. The Council's responsibilities are to attend meetings with TCEQ Management and the AQRP to understand the statewide project goals for the funding period, to select for funding the projects reviewed by the ITAC and ranked by the TCEQ, and to assist with the presentation of project final results at locations throughout the state.

Table 2. Advisory Council Members

Name	Title	Organization
Ramon Alvarez	Senior Scientist	Environmental Defense Fund
Daniel Baker	Senior Consultant in Air Quality	Shell Global Solutions
Omar Garcia	President & CEO	South Texas Energy & Economic Roundtable
Chris Klaus	Senior Program Manager	North Central Texas Council on Governments
Ralph Marquez	Proprietor	Environmental Strategies and Policy
Chris Rabideau	Environmental Scientist	Chevron
Cyrus Reed	Conservation Director	Sierra Club
Kim Herndon	Assistant Director Air Quality Division	Texas Commission on Environmental Quality
Keith Sheedy	Technical Advisor to the Deputy Director for the Office of Air	Texas Commission on Environmental Quality

RESEARCH PROJECTS

FY 2018 – 2019 Projects

Project 18-005 **STATUS: Work Plan Under Review**

Next steps for improving Texas biogenic VOC and NO emission estimates

University of California-Irvine – Alex Guenther
Ramboll – Greg Yarwood
AQRP Project Manager – Elena McDonald-Buller
TCEQ Project Liaison – Doug Boyer

Funded Amount: $168,146
(UC-Irvine $139,193, Ramboll $28,953)

Abstract
The emissions of gases and particles into the atmosphere are the primary drivers of regional air quality. There are a wide variety of emission sources including automobiles, factories, and biological organisms including vegetation and microbes. While emissions from combustion sources and industrial activities dominate in urban and industrial locations, biogenic emissions dominate on global scales and contribute to atmospheric composition in urban and nearby areas.

The overall goal of this project is to improve numerical model predictions of regional ozone and aerosol distributions in Texas by reducing uncertainties associated with quantitative estimates of biogenic volatile organic compound (BVOC) and biogenic nitric oxide (BNO) emissions from Texas and the surrounding region. Although there have been significant advancements in the procedures used to simulate these biogenic emissions, there are still major uncertainties that limit predictability of Texas air quality simulations. In this project, we will improve the capability of the Model of Emissions of Gases and Aerosols from Nature (MEGAN) framework to estimate emissions of these compounds for application in numerical air quality models. To accomplish this, we will conduct high quality measurements of speciated BVOC emission factors at eastern Texas field sites near San Antonio, Dallas, and Houston. These results and other recent advances, including an improved approach for modeling BNO emissions, will be integrated into MEGAN.

The primary output of the proposed research will be a more accurate approach for estimating BVOC and BNO emissions. The overall benefit of this project will be more accurate VOC and NO emission estimates for the Texas air quality simulations that are critical for scientific understanding and the development of regulatory control strategies that will enhance efforts to improve and maintain clean air.

Project 18-007 **STATUS: Work Plan Under Review**

DDM Enhancements in CAMx: Local Chemistry Sensitivity and Deposition Sensitivity

Ramboll – Greg Yarwood

AQRP Project Manager – Elena McDonald-Buller
TCEQ Project Liaison – Jim Smith

Funded Amount: $150,000

Abstract
The Texas Commission on Environmental Quality uses the CAMx photochemical air quality model in planning activities for ground-level ozone. Estimating uncertainty in a model's predictions due to uncertainties in all the inputs and parameters, known as a global uncertainty analysis, is a challenge due to the hundreds or even thousands of inputs and parameters and the relatively long computer runtimes for photochemical models. This project will develop a new and efficient sensitivity analysis tool for CAMx called Chemistry Sensitivity Analysis (CSA) that is based on the decoupled direct method (DDM) for sensitivity analysis already present in CAMx. Then, we will use CSA to estimate the uncertainty range in ozone predictions in Texas due to chemistry uncertainty by creating alternative chemistry mechanisms with high and low ozone productivity. Also, we will extend the implementation of DDM in CAMx to calculate sensitivity to dry deposition velocity which has been identified as an important factor influencing ozone predictions. We will combine the effects of estimated uncertainty in the chemistry with uncertainty due to model emissions, boundary concentrations, and dry deposition velocity to estimate an overall uncertainty in CAMx ozone predictions for Texas.

Project 18-010 **STATUS: Work Plan Under Review**

A synthesis study of the role of mesoscale and synoptic-scale wind on the concentrations of ozone and its precursors in Houston

Texas A&M University – Qi Ying

AQRP Project Manager – Elena McDonald-Buller
TCEQ Project Liaison – Jonathan Steets

Funded Amount: $120,000

Abstract
While it is known that low synoptic-scale winds and mesoscale recirculation contribute to high ozone formation in Houston, a comprehensive synthesis of all relevant data and analyses to elucidate the interaction between the mesoscale and synoptic-scale winds and air pollutants is not yet available. An improved understanding of the roles of mesoscale and synoptic-scale processes would allow researchers and policy makers to distinguish between days dominated by local emissions and those dominated by regional contributions. The overall objective of this research is to synthesize existing data, previous analyses, and photochemical model experiments to provide a comprehensive and reconciled description of how mesoscale and synoptic-scale winds affects dispersion and accumulation of air pollutants emitted in the Houston area and from other regions, and how they contribute to high ozone events. The relationship between surface winds and boundary-layer mesoscale transport features will be clarified, and a novel source- and age-resolved regional air quality model will be applied to investigate selected high ozone events under the influence of mesoscale circulations. The results from this study will facilitate a better understanding of the interaction between the mesoscale and synoptic-scale winds and air pollutants and how they contribute to high ozone events in Houston. Such information is extremely useful for understanding high ozone events as they occur and for developing appropriate control strategies and policy options for the unique Texas meteorological environment.

Project 18-022 **STATUS: Approved – September 1, 2018**

Development and Evaluation of the FINN v.2 Global Model Application and Fire Emissions Estimates for the Expanded Texas Air Quality Modeling Domain

University of Texas at Austin – Elena McDonald-Buller
Sonoma Technology, Inc. – Fred Lurmann

AQRP Project Manager – David Sullivan
TCEQ Project Liaison – Stephanie Shirley

Funded Amount: $172,114
(UT Austin $85,768, Sonoma Tech $86,346)

Abstract
Wildland fires and open burning can be substantial sources of ozone precursors and particulate matter. Air quality in Texas can be affected by fire events that occur locally, regionally, or across longer distances from within the United States or across its international borders. With this recognition, the Texas Commission on Environmental Quality's future air quality model domain has been extended to include all of Mexico and large parts of Central America and the Caribbean. The Fire INventory from the National Center for Atmospheric Research (FINN) model estimates daily emissions of trace gases and particles from open biomass burning. The objectives of this project are to leverage new findings and data products from ongoing laboratory studies, surface and airborne field measurement campaigns, and satellite-based sensors in the development of FINN and to produce a fully operational, next generation global FINN application. The new FINN application will be used to develop fire emissions estimates for 2012-2017, a time period that includes 2016, which is the base year for the U.S. Environmental Protection Agency's national air quality modeling platform. FINN performance will be assessed using a new satellite algorithm, the Multi-Angle Implementation of Atmospheric Correction (MAIAC), for aerosol optical depth (AOD) retrievals, with a focus on fire events that originate from within Mexico, Central America, or the Caribbean and influence Texas air quality. The project is a collaborative effort between the University of Texas at Austin, Sonoma Technology, Inc., and Dr. Christine Wiedinmyer.

Project 19-023 **STATUS: Work Plan Under Review**

Emission Inventory Development and Projections for the Transforming Mexican Energy Sector

University of Texas at Austin – Elena McDonald-Buller
Ramboll – Greg Yarwood

AQRP Project Manager – David Sullivan
TCEQ Project Liaison – Michael Ege

Funded Amount: $158,309
(UT Austin $93,296, Ramboll $65,013)

Abstract
Within Texas, characterizing emission sources along its border and within Mexico has been recognized as essential for air quality modeling. Mexico's energy sector has been undergoing potentially transformational changes as part of Constitutional reforms ratified in 2013. A primary motivation is to encourage domestic and foreign investment and productivity growth in the oil, gas and power sectors. The reforms have the potential to significantly transform the magnitudes and spatial distributions of emissions from the oil and gas and power generation sectors over the next one to two decades. The overall objective of the proposed project is to apply new information to develop a bottom-up assessment of emissions for the upstream and midstream oil and gas sectors and power sector and to develop future emission projections based on likely outcomes of on-going bid rounds that are attracting new investment for exploration and production of oil and gas resources. Information and analytics for Mexico's upstream and midstream oil and gas sectors and power sector will be used to develop a 2016 base year emissions inventory, which coincides with the U.S. Environmental Protection Agency's national air quality modeling platform and will likely be the basis for future air quality modeling by the Texas Commission on Environmental Quality. Plans and results for the hydrocarbon bid rounds will be used as the basis for three future emissions projections that compare continued development of Mexico's onshore conventional and shallow water resources, which is consistent with historical practices, with expansion of its deep water and onshore shale regions that have been underdeveloped to date relative to their potential. The project is a collaborative effort between the University of Texas at Austin and Ramboll U.S Corporation.

Project 19-025 **STATUS: Work Plan Under Review**

Apportioning the Sources of Ozone Production during the San Antonio Field Study

Aerodyne Research, Inc. – Tara Yacovitch AQRP Project Manager – Elena McDonald-Buller
TCEQ Project Liaison – Bright Dornblaser

Funded Amount: $199,974

Abstract
Ozone high up in the stratosphere is protective against UV rays, but when it is present at ground-level, it is a pollutant that can cause shortness of breath and other respiratory health problems. With new federal ozone standards in effect, it is more important than ever to understand the causes of ozone in and around San Antonio.

Ozone is formed when volatile organic hydrocarbons (VOCs) react with the nitrogen oxides (NOx, the primary component in smog). A wide variety of VOCs are present in the air around cities such as San Antonio; they stem from sources as varied as vehicle exhaust, oil and gas extraction, and trees and vegetation. This project aims to discover which sources contribute to the formation of ground-level ozone in and around San Antonio, and in what quantities.

Raw data from the 2017 San Antonio Field Study (SAFS) will be examined closely and analyzed in full to identify characteristic sets of VOCs associated with different source types. Computer modeling of air transport will help identify the broad geographic areas where the measured air originated. An ozone formation computer model, in which individual source categories can be turned on, off, or varied, will be used to understand how each source type contributes to ozone formation in and around San Antonio.

Project 19-031 **STATUS: Work Plan Under Review**

Detecting events and seasonal trends in biomass burning plumes using black and brown carbon: (BC)2 El Paso

Baylor University – Rebecca Sheesley
University of Houston – James Flynn
AQRP Project Manager – David Sullivan
TCEQ Project Liaison – Erik Gribbin

Funded Amount: $131,294
(Baylor $98,087, UH $33,207)

Abstract
Recent efforts by Texas Air Quality Research Program (AQRP) and TCEQ to monitor and study air quality in Texas cities has resulted in improved understanding of the processes and sources which control urban air quality in e.g. Houston. As highlighted in the AQRP Priority Research Areas 2018-2019, El Paso is near the National Ambient Air Quality Standards for particulate matter (PM) and ozone (O_3). Reductions in anthropogenic emissions through implementation of cleaner technologies for e.g. motor vehicle exhaust, coal-fired power plants, have refocused efforts to understand the contribution of biomass burning to urban air pollution. This is particularly relevant for El Paso, which can experience large impacts of periodic biomass burning/wildfire plumes transported from out-of-state. Black carbon (BC), a marker for combustion influences on air quality, has been shown to be decreasing in urban areas across the United States due to increased regulation and the use of cleaner fuels. As a result, biomass-burning contributions are likely becoming more important for BC and for urban air quality in general.

We will provide critical insight on the influence of biomass burning on the air quality in El Paso, TX through the characterization of BC and brown carbon (BrC). BrC is the carbon fraction of an aerosol that selectively absorbs short wavelengths of light. The $(BC)^2$ El Paso field campaign will include the deployment of the Baylor air quality trailer, which will be outfitted with a suite of specific technologies developed to assess biomass burning through the monitoring of BC and BrC. Biomass burning plumes will be identified using aerosol composition and light absorption properties, including BC and BrC concentrations, absorption Ångström exponents (AAE), and aerosol light absorption coefficients for specific ultraviolet (UV) and visible wavelengths. The newest technology for real-time monitoring of aerosol absorption is the tricolor absorption photometer (TAP). The TAP measures adsorption at UV, green and red wavelengths to more specifically target biomass burning. This inexpensive and continuous photometer was designed by the National Oceanic and Atmospheric Administration (NOAA) and is commercially produced by Brechtel to address issues with previous photometers, including cost, sensitivity, noise and effective scattering corrections. Although it was only recently available, Baylor and UH PIs have run this instrument successfully during the 2017 San Antonio field campaign (SAFS) in the Baylor air quality trailer. The two goals of $(BC)^2$ El Paso are to 1) address scientific air quality questions of frequency, seasonality, and optical properties of biomass burning plumes in El Paso and 2) to evaluate the TAP instrument suite for application in long-term monitoring at urban sites in Texas.

Project 19-040 **STATUS: Work Plan Under Review**

Analysis of Ozone Production Data from the San Antonio Field Study

Drexel University – Ezra Wood

AQRP Project Manager – Elena McDonald-Buller
TCEQ Project Liaison – Mark Estes

Funded Amount: $130,264

Abstract
San Antonio is on the cusp of being in non-attainment of the U.S. Environmental Protection Agency's air quality standard for ozone, also known as photochemical smog. In order to mitigate potentially bad air quality in San Antonio, regulators will benefit from a full understanding of the sources of ozone and how future emissions can affect its concentration. During May 2017, a team of researchers from Drexel University, University of Houston, Rice University, and Aerodyne Research, Inc. conducted a field study focused on ozone air pollution in the greater San Antonio Area. The main goals were to collect data that would enable a determination of the rate at which ozone was being produced by chemical reactions in the air, to determine the relative importance of upwind and urban sources of ozone precursor emissions, and to determine the importance of different types of emissions (e.g., nitrogen oxides from fossil fuel combustion vs. biogenic volatile organic compounds from trees). The measurements from these field measurements were largely successful. In this project, the research team at Drexel University will analyze many aspects of the data in order to address the above goals. This research will consist of three tasks:

1. To characterize the relationship between the ozone production rate (calculated using measured concentrations of nitric oxide and total peroxy radicals) and the concentrations of other pollutants, including nitrogen oxides and volatile organic compounds,

2. To conduct zero-dimensional modeling of the photochemistry (in which spatial variations in pollutant concentrations are not considered) in order to determine if chemical models can successfully characterize the photochemistry, and

3. To conduct 3-dimensional air quality modeling, in which knowledge of emissions, meteorology, and the relevant chemistry are combined to predict spatially-resolved concentrations of ozone and other pollutants.

FINANCIAL STATUS REPORT

Initial funding for fiscal years 2016 and 2017 was established at $1,000,000 each, for a total award of $2,000,000 for the FY 2016/2017 biennium. On September 4, 2017, the AQRP was renewed for the 2018/2019 biennium, and funding of $750,000 per year was awarded, for a total of $1,500,000. The funds were distributed across several different reporting categories as required under the contract with TCEQ. The reporting categories are:

Program Administration – limited to 10% of the overall funding (per Fiscal Year)
This category includes all staffing, materials and supplies, and equipment needed to administer the overall AQRP. It also includes the costs for the Council meetings.

ITAC
These funds are to cover the costs, largely travel expenses, for the ITAC meetings.

Project Management – limited to 8.5% of the funds allocated for Research Projects
Each research project will be assigned a Project Manager to ensure that project objectives are achieved in a timely manner and that effective communication is maintained among investigators in multi-institution projects. These funds are to support the staffing and performance of project management.

Research Projects / Contractual
These are the funds available to support the research projects that are selected for funding.

FY 2016 funds in all spending categories were fully expended by June 2018, and reported by July 2018. On August 31, 2018, $7559.39 remained in FY 2017 funding ($1558.35 in Research Projects, $6001.04 in Project Management). These funds will all be transferred to Research Project funding and will be assigned to a FY 2018/2019 project with the expectation that they will be spent first.

As of August 31, 2018, only the Program Administration portion of FY 2018 funds have been expended. FY 2019 funds are not available until September 1, 2018.

Program Administration

Program Administration includes salaries and fringe benefits for those overseeing the program as a whole, as well as, materials and supplies, travel, equipment, and other expenses. This category allows indirect costs in the amount of 10% of salaries and wages.

During the reporting period several staff members were involved, at various levels of effort, in the administration of the AQRP. Dr. David Allen, Principal Investigator and AQRP Director, was responsible for the overall administration of the AQRP. Maria Stanzione, AQRP Program Manager, assisted Dr. Allen in the program administration, while Terri Mulvey, Maeve Cooney, and Susan McCoy each provided assistance with program organization and financial management. Denzil Smith was responsible for the AQRP Web Page development and for data management. Gina Palacios provided assistance with the website redesign.

Fringe benefits for the administration of the AQRP were initially budgeted to be 24% of salaries and wages across the term of the project. It should be noted that this was an estimate, and actual fringe benefit expenses were reported for each month. The fringe benefit amount and percentage fluctuated each month depending on the individuals being paid from the account, their salary,

their FTE percentage, the selected benefit package, and other variables. For example, the amount of fringe benefits was greater for a person with family medical insurance versus a person with individual medical insurance. Actual fringe benefit expenses to date are included in the spreadsheets below.

Beginning September 1, 2018, The University of Texas at Austin will switch to a federally negotiated fringe benefit rate. For fiscal year 2018/2019 the fringe rates will be:

Full-time/Benefits Eligible (including Graduate Students)	29%
Part-time/Benefits Eligible	39.60%
Part-time/Non-benefits Eligible	5.80%

In February 2018, both FY 2016 and FY 2017 Administration funds were rebudgeted to facilitate the expenditure of the full funding allocated to each year. All FY 2016 and 2017 Administration funds were fully expended at the end of February.

Table 3: Administration Budget

Administration Budget (includes Council Expenses)
FY 2016/2017

Budget Category		FY16 Budget	FY17 Budget	Total	Expenses	Remaining Balance
Personnel/Salary		$74,376.95	$73,027.36	$147,404.31	$147,404.31	$0.00
Fringe Benefits		$18,118.37	$18,695.22	$36,813.59	$36,813.59	$0.00
Travel		$34.00	$0.00	$34.00	$34.00	$0.00
Supplies		$32.98	$974.69	$1,007.67	$1,007.67	$0.00
Equipment						
Total Direct Costs		$92,562.30	$92,697.27	$185,259.57	$185,259.57	$0.00
Authorized Indirect Costs		$7,437.70	$7,302.73	$14,740.43	$14,740.43	$0.00
10% of Salaries and Wages						
Total Costs		**$100,000.00**	**$100,000.00**	**$200,000.00**	**$200,000.00**	**$0.00**

Administration Budget (includes Council Expenses)
FY 2018/2019

Budget Category		FY18 Budget	FY19 Budget	Total	Expenses	Remaining Balance
Personnel/Salary		$53,700.00	$53,700.00	$107,400.00	$32,942.98	$74,457.02
Fringe Benefits		$12,930.00	$12,930.00	$25,860.00	$8,440.75	$17,419.25
Travel		$0.00	$0.00	$0.00	$0.00	$0.00
Supplies		$3,000.00	$3,000.00	$6,000.00	$499.47	$5,500.53
Equipment						
Total Direct Costs		$69,630.00	$69,630.00	$139,260.00	$41,883.20	$97,376.80
Authorized Indirect Costs		$5,370.00	$5,370.00	$10,740.00	$3,294.30	$7,445.70
10% of Salaries and Wages						
Total Costs		**$75,000.00**	**$75,000.00**	**$150,000.00**	**$45,177.50**	**$104,822.50**

ITAC

All ITAC expenditures occurred in FY 2016/2017 and were charged against the FY 2016 funds, with the residual FY 2016 ITAC funds rebudgeted to the Research Project and Project Management accounts. At the same time half of the FY 2017 ITAC funds were also rebudgeted to Research Project and Project Management accounts. In February 2018, when it was determined there would be no additional ITAC expenditures, the majority of the remaining ITAC funding for FY 2017 was transferred to the Research Project/ Contractual category to increase the FY 2017 funds available to the Research Projects and a small amount was transferred to Project Management.

Table 4: ITAC Budget

ITAC Budget
FY 2016/2017

Budget Category		FY16 Budget	FY17 Budget	Total	Expenses	Remaining Balance
Personnel/Salary						
Fringe Benefits						
Travel		$4,076.57	$0.00	$4,076.57	$4,076.57	$0.00
Supplies		$1,079.20	$0.00	$1,079.20	$1,079.20	$0.00
Equipment						
Total Direct Costs		$5,155.77	$0.00	$5,155.77	$5,155.77	$0.00
Authorized Indirect Costs						
10% of Salaries and Wages						
Total Costs		**$5,155.77**	**$0.00**	**$5,155.77**	**$5,155.77**	**$0.00**

ITAC Budget
FY 2018/2019

Budget Category		FY18 Budget	FY19 Budget	Total	Expenses	Remaining Balance
Personnel/Salary						
Fringe Benefits						
Travel		$7,500.00	$7,500.00	$15,000.00	$2,963.29	$12,036.71
Supplies		$1,500.00	$1,500.00	$3,000.00	$909.74	$2,090.26
Equipment						
Total Direct Costs		$9,000.00	$9,000.00	$18,000.00	$3,873.03	$14,126.97
Authorized Indirect Costs						
10% of Salaries and Wages						
Total Costs		**$9,000.00**	**$9,000.00**	**$18,000.00**	**$3,873.03**	**$14,126.97**

Project Management

In February 2018, FY 2017 Project Management funds were increased from the reduction in ITAC funds. The funds were distributed across the salary, fringe benefit, and IDC categories. In May 2018, the remaining FY 2016 Research Project funds of approximately $150 were transferred to Project Management. These funds were then fully expended by transferring supply expenses from the FY 2017 Project Management account.

Table 5: Project Management Budget

Project Management Budget
FY 2016/2017

Budget Category		FY16 Budget	FY17 Budget	Total	Expenses	Remaining Balance
Personnel/Salary		$53,470.31	$51,912.00	$105,382.31	$105,197.89	$184.42
Fringe Benefits		$11,337.19	$12,535.00	$23,872.19	$23,573.81	$298.38
Travel		$0.00	$0.00	$0.00	$0.00	$0.00
Supplies		$176.36	$500.00	$676.36	$176.36	$500.00
Other		$0.00	$5,000.00	$5,000.00	$0.00	$5,000.00
Total Direct Costs		$64,983.86	$69,947.00	$134,930.86	$28,948.06	$5,982.80
Authorized Indirect Costs		$5,347.03	$5,191.00	$10,538.03	$10,519.79	$18.24
10% of Salaries and Wages						
Total Costs		**$70,330.89**	**$75,138.00**	**$145,468.89**	**$139,467.85**	**$6,001.04**

Project Management Budget
FY 2018/2019

Budget Category		FY18 Budget	FY19 Budget	Total	Expenses	Remaining Balance
Personnel/Salary		$38,060.00	$38,060.00	$76,120.00	$0.00	$76,120.00
Fringe Benefits		$9,134.00	$9,134.00	$18,268.00	$0.00	$18,268.00
Travel		$0.00	$0.00	$0.00	$0.00	$0.00
Supplies		$1000.00	$1000.00	$2000.00	$0.00	$2000.00
Other		$2500.00	$2500.00	$5,000.00	$0.00	$5,000.00
Total Direct Costs		$50,694.00	$50,694.00	$101,388.00	$0.00	$101,388.00
Authorized Indirect Costs		$3,806.00	$3,806.00	$7,612.00	$0.00	$7,612.00
10% of Salaries and Wages						
Total Costs		**$54,500.00**	**$54,500.00**	**$109,000.00**	**$0.00**	**$109,000.00**

Research Projects

In September 2017 most of the FY 2016-2017 research projects had just ended, but final invoices had not been submitted. Over the next few months the remaining projects were completed and final invoices were submitted and paid for all projects. The State of the Science Assessment was approved by the ITAC, the TCEQ, and the Advisory Council in October 2017, and work began in November 2017. The Assessment was funded from the unspent project funds (both FY 2016 and 2017 funds) and from the transfer of unspent ITAC funds.

In May 2018, the remaining FY 2016 Research Project funds of approximately $150 were transferred to the Project Management account and expended in June 2018.

Although the FY 2018-2019 research projects are not yet active, each project has been allocated to a particular fiscal year for funding purposes. This allocation has overburdened the FY 2019 allocation by approximately $550. The Research Project funds will be increased by transferring funds from the ITAC category.

Table 6 on the following pages shows the distribution of the projects across the fiscal years and the cumulative expenditures to date. It also further describes the process used to fund the State of the Science and how the remaining funds will be used.

Table 6: Research Project Expenditures

Research Projects
FY 2016 - 2017

Contractual Expenses				
FY 16 Contractual Funding		**$815,000**		
FY 16 Contractual Funding Transfers		**$9,513**		
FY 16 Total Contractual Funding		**$824,513**		
Project Number		Amount Awarded (Budget)	Cumulative Expenditures	Remaining Balance
16-008	University of Houston	$191,366	$189,684.87	$1,681.13
16-010	Sonoma Technology, Inc.	$69,075	$69,075.00	$0.00
16-011	Ramboll Environ	$158,134	$158,127.36	$6.64
16-019	Univ. of Texas - Austin	$118,019	$117,551.39	$467.61
16-019	Ramboll Environ	$62,622	$62,618.81	$3.19
16-031	UNC - Chapel Hill	$225,000	$223,820.08	$1,179.92
FY 16 Total Contractual Funding Awarded		$824,216		
FY 16 Contractual Funds Expended (Init. Projects)			$820,877.51	
FY 16 Contractual Funds Remaining to be Spent				$3,635.83
FY 16 Additional Expenditures				
	State of the Science	$3,788.49	$3,635.83	$152.66
			$824,513.34	
FY 16 Contractual Funds Remaining to be Spent				$0.00

Note: The State of the Science project was funded by combining the remaining Contractual Funds that were never awarded to a research project and the balances remaining in some of the research projects after the projects ended. These funds were pooled together and awarded to the State of the Science project to partially fund the project. (The remaining funding came from FY 2017 funds.) At the completion of the State of the Science project, all remaining FY 2016 funds were transferred to Project Management and expended as described in the Project Management section. The spreadsheet above is a snapshot showing a $0 remaining balance of Contractual Funds after all of these transactions took place for FY 2016 funds. The FY 2017 funds were treated similarly, though there are funds remaining, as described below. (Calculations are based on Total Contractual Funding less Cumulative Expenditures and State of the Science expenditures.)

FY 17 Contractual Funding		**$815,000**		
FY 17 Contractual Funding Transfers		**$9,862**		
FY 17 Total Contractual Funding		**$824,862**		
Project Number		Amount Awarded (Budget)	Cumulative Expenditures	Remaining Balance
17-007	Univ. of Texas - Austin	$205,500	$202,348.20	$3,151.80
17-024	Atmospheric and Environmental Research, Inc.	$170,039	$170,039.00	$0.00
17-032	Drexel University	$59,000	$58,958.17	$41.83
17-039	Univ. of Alabama - Huntsville	$149,227	$149,226.81	$0.19
17-053	Aerodyne Research, Inc.	$185,193	$185,193.00	$0.00
17-SAFS	Univ. of Texas - Austin	$46,000	$35,999.96	$10,000.04
FY 17 Total Contractual Funding Awarded		$814,959		
FY 17 Contractual Funding Expended (Init. Projects)			$801,765.14	
FY 17 Contractual Funds Remaining to be Spent				$23,096.86
FY 17 Additional Expenditures				
	State of the Science	$22,211.51	$21,538.51	$673.00
FY 17 Contractual Funds Expended			$823,303.65	
FY 17 Contractual Funds Remaining to be Spent				$1,558.35
Total Contractual Funding		$1,649,375		
Total Contractual Funding Awarded		$1,639,175		
Total Contractual Funding Remaining to be Awarded		$10,200		
Total Contractual Funds Expended to Date			$1,647,816.99	
Total Contractual Funds Remaining to be Spent				$1,558.35

As with the FY 2016 funds, the unawarded Contractual funds and the research project remaining balances were pooled together to partially fund the State of the Science. At the conclusion of the state of the Science, $1558.35 of Contractual funds remained unspent. The remaining Contractual funds will be increased by $6001.04 from the transfer of the remaining FY 2017 Project Management funds. The total remaining FY 2017 funds of $7,559.39 will then be allocated to project 19-023, and will be expended first, so that all FY 2017 funds will be spent by spring of 2019.

Research Projects
FY 2018 - 2019

Contractual Expenses				
FY 18 Contractual Funding		**$611,500**		
FY 18 Contractual Funding Transfers		**$0**		
FY 18 Total Contractual Funding		**$611,500**		
Project Number		Amount Awarded (Budget)	Cumulative Expenditures	Remaining Balance
18-005	UC - Irvine	$139,193	$0.00	$139,193.00
18-005	Ramboll	$28,953	$0.00	$28,953.00
18-007	Ramboll	$150,000	$0.00	$150,000.00
18-010	TAMU	$121,000	$0.00	$121,000.00
18-022	UT Austin	$85,768	$0.00	$85,768.00
18-022	Sonoma Tech, Inc.	$86,346	$0.00	$86,346.00
FY 18 Total Contractual Funding Awarded		$611,260		
FY 18 Contractual Funds Expended (Init. Projects)			$0.00	
FY 18 Contractual Funds Remaining to be Spent				$611,500.00
FY 19 Contractual Funding		**$611,500**		
FY 19 Contractual Funding Transfers		**$0**		
FY 19 Total Contractual Funding		**$611,500**		
Project Number		Amount Awarded (Budget)	Cumulative Expenditures	Remaining Balance
19-023	UT Austin	$85,737	$0.00	$85,736.61
19-023	Ramboll	$65,013	$0.00	$65,013.00
19-025	Aerodyne Research, Inc.	$199,974	$0.00	$199,974.00
19-031	Baylor University	$98,087	$0.00	$98,087.00
19-031	University of Houston	$33,207	$0.00	$33,207.00
19-040	Drexel University	$130,264	$0.00	$130,264.00
FY 19 Total Contractual Funding Awarded		$612,282		
FY 19 Contractual Funding Expended (Init. Projects)			$0.00	
FY 19 Contractual Funds Remaining to be Spent				$611,500.00
Total Contractual Funding		$1,223,000		
Total Contractual Funding Awarded		$1,223,542		
Total Contractual Funding Remaining to be Awarded		($542)		
Total Contractual Funds Expended to Date			$0.00	
Total Contractual Funds Remaining to be Spent				$1,223,000

Appendix A

FY 2016/2017 Research Projects

FY 2016-2017 Funded Research Projects

AQRP Project Number	Title	Start Date	End Date	Total Project Funding Awarded	Total Project Expenditures	Funding Returned to AQRP
	Institution (*Institution = Lead Institution and PI)	Principal Investigator		Project Funding Awarded to Institution	Institution Project Expenditures	Institution Funding Returned to AQRP
16-008	**High Background Ozone Events in the Houston-Galveston-Brazoria Area: Causes, Effects, and Case Studies of Central American Fires**	**9/22/2016**	**10/31/2017**	**$191,366.00**	**$189,684.87**	**$1,681.13**
	*The University of Houston	Yuxuan Wang				
16-010	**MOVES-Based NOx Analyses for Urban Case Studies in Texas**	**10/20/2016**	**8/31/2017**	**$69,075.00**	**$69,075.00**	**$0.00**
	*Sonoma Technology, Inc.	Stephen Reid				
16-011	**A Next Generation Modeling System for Estimating Texas Biogenic VOC Emissions**	**10/6/2016**	**8/31/2017**	**$158,134.00**	**$158,127.36**	**$6.64**
	*Ramboll Environ US Corporation	Gregory Yarwood				
16-019	**The Influence of Alkyl Nitrates from Anthropogenic and Biogenic Precursors on Regional Air Quality in Eastern Texas**	**9/30/2016**	**8/31/2017**	**$180,641.00**	**$180,170.20**	**$470.80**
	*The University of Texas at Austin	Elena McDonald-Buller		$118,019.00	$117,551.39	$467.61
	Ramboll Environ US Corporation	Gregory Yarwood		$62,622.00	$62,618.81	$3.19
16-031	**Condensed Chemical Mechanisms for Ozone and Particulate Matter Incorporating the Latest in Isoprene Chemistry**	**10/18/2016**	**8/31/2017**	**$225,000.00**	**$223,820.08**	**$1,179.92**
	*University of North Carolina–Chapel Hill	William Vizuete				
16-SOTS	**AQRP State of the Science Assessment FY 2016**	**11/2/2017**	**1/31/2018**	**$3,788.49**	**$3,635.83**	**$152.66**
	*The University of Texas at Austin	Elena McDonald-Buller				

17-007	**Evaluating Methods for Determining the Vapor Pressure of Heavy Refinery Liquids**	**11/3/2016**	**1/15/2018**	**$205,500.00**	**$202,348.21**	**$3,151.79**
	*The University of Texas at Austin	Vincent Torres				
17-024	**Improving the Modeling of Wildfire Impacts on Ozone and Particulate Matter for Texas Air Quality Planning**	**10/17/2016**	**8/31/2017**	**$170,039.00**	**$170,039**	**$0.00**
	*Atmospheric and Environmental Research, Inc.	Matthew Alvarado				
17-032	**Spatial Mapping of Ozone Formation near San Antonio**	**12/6/2016**	**8/31/2017**	**$59,000.00**	**$58,964.17**	**$35.83**
	*Drexel University	Ezra Wood				
17-039	**Use of Satellite Data to Improve Specifications of Land Surface Parameters**	**11/16/2016**	**10/31/2017**	**$149,227.00**	**$149,226.81**	**$0.19**
	*University of Alabama - Huntsville	Richard McNider				
17-053	**Identifying and Apportioning Ozone Producing VOCs in Central American Fires**	**1/10/2017**	**8/31/2017**	**$185,193.00**	**$185,193.00**	**$0.00**
	*Aerodyne Research, Inc.	Scott Herndon				
17-SAFS	**San Antonio Field Study Logistics**	**4/13/2017**	**10/31/2017**	**$46,000.00**	**$35,999.96**	**$10,000.04**
	*The University of Texas at Austin	David Sullivan				
17-SOTS	**AQRP State of the Science Assessment FY 2017**	**11/2/2017**	**1/31/2018**	**$22,211.51**	**$18,928.98**	**$3,282.53**
	*The University of Texas at Austin	Elena McDonald-Buller				
Notes:						