CITY SECRETARY
CONTRACT NO. 40728

CONTRACT

Between

CITY OF FORT WORTH

and

EASTERN RESEARCH GROUP, INC.

For

Professional Services for Natural Gas Air Quality Study Final Work Plan

DEM 10-05: NGAQS

Environmental Management Department

August 2010

08-20-10 PM3:05 IN

STATE OF TEXAS §
§ KNOWN ALL BY THESE PRESENTS:
COUNTY OF TARRANT §

CONTRACT FOR PROFESSIONAL SERVICES
DEM: 10-05 - NATURAL GAS AIR QUALITY STUDY
FINAL WORK PLAN

This Contract is entered into by and between the City of Fort Worth ("City"), a home-rule municipality located within Tarrant, Denton, Parker, and Wise Counties, Texas, acting through Fernando Costa, its duly authorized Assistant City Manager, and Eastern Research Group, Inc., a Massachusetts corporation ("Contractor"), acting through John Eyraud, its duly authorized Vice President. City and Contractor may be referred to herein individually as a Party, or collectively as the Parties.

WITNESSETH:

That for and in consideration of mutual covenants and agreements herein contained, the Parties hereto mutually agree as follows:

ARTICLE 1.
DEFINITIONS

City means the City of Fort Worth.

Change Order means an officially authorized and executed written amendment to this contract or to a Task Order, issued by the City.

Contract Documents shall consist of the written, printed, typed and drawn instruments which comprise and govern the performance of the work. Said Contract Documents include, but are not limited to, the Request for Qualifications (RFQ), addenda to the RFQ, the Statement of Qualifications, work plan, proposals, other plans, specifications, maps, blueprints, notice of award, general conditions, special conditions, supplementary conditions, general provisions, special provisions, task order(s), work order(s), change orders, amendments, this Contract and the payment, performance, and maintenance bonds. The Contract Documents shall also include any and all supplemental agreements approved by the City which may be necessary to complete the work in accordance with the intent of the plans and specifications in an acceptable manner, and shall also include the additional instruments bound herewith.

Contractor means Eastern Research Group, Inc.

Final Work Plan or Work Plan means the document entitled “City of Fort Worth Natural Gas Air Quality Study – Final Work Plan”.

Notice to Proceed means the official letter issued by the City, pursuant to the Code of the City of Fort Worth and City ordinances and policies that authorizes Contractor to begin work.

Task Order means an officially authorized and executed written description and specification directing the Contractor to perform specific services within the scope of this contract, issued by the City.

ARTICLE 2.
SERVICES

Contractor hereby agrees to perform as an independent contractor the services set forth in the Scope of Work attached hereto as Attachment “A”.

This contract is to provide the City of Fort Worth with professional services for an assessment of the air quality impacts related to natural gas facilities (Air Quality Study).

This contract is for work to be performed for the City of Fort Worth Air Quality Study as described in the City of Fort Worth Council Resolution Number 3866, City of Fort Worth Request for Qualifications DEM10-05: NGAQS, and the Contractor’s Final Work Plan. Nothing in this contract is to be construed as an exclusive agreement with the contractor to provide the City with professional services of this type or as an agreement by the City to guarantee the Contractor any specific projects or quantities of work. THERE IS NO MINIMUM GUARANTEE OF ANY WORK UNDER THIS CONTRACT OR ANY GUARANTEE OF ADDITIONAL FUTURE WORK OTHER THAN AS STRICTLY DEFINED BY THIS CONTRACT.

Individual projects will be authorized on a Task Order basis when the City elects to proceed with each specific effort. City shall not pay for any work performed by Contractor or its subcontractors, subcontractors and/or suppliers that has not been specifically ordered by the City in writing on a duly executed Task Order or Change Order. Contractor shall not be compensated for any work that is verbally ordered by any person and shall rely only upon written authorization to conduct work.

ARTICLE 3.
COMPENSATION

Section 1.
Fee Schedule.

City and Contractor agree to the unit prices, employee labor rates, and other costs as specified in this contract. Contractor shall be compensated in accordance with the Fee Schedule shown in Attachment “B”. Payment shall be considered full compensation for

all labor, materials, supplies, and equipment necessary to complete the services described in Attachment "A". However the total fee paid by the City shall not exceed a total of six hundred thousand dollars ($600,000.00) and the City will not be liable for any Contractor fees, costs, or other remuneration in excess of this amount unless the City has signed and issued a formal and duly authorized modification, amendment, or change order to this contract.

Section 2.
Task Orders.

City will issue a Task Order to Contractor that details the work to be performed by the Contractor. Task Orders will include at a minimum a unique Task Order Number, project address, scope of work, date to commence work, time period to complete work and the not to exceed payment amount for the task.

Section 3.
Invoice and Payment.

The Contractor shall provide monthly invoices to the City. All invoices must reflect the City Task Order number. Invoices shall contain a detailed breakdown to include: labor including employee name, functional title, date and hours of work performed; internal supplies and services provided; and external supplies and services provided.

Payment for services rendered shall be due within thirty (30) days of the uncontested performance of the particular services so ordered and receipt by City of Contractor's invoice for payment of same. In the event of a disputed or contested billing, only that portion so contested may be withheld from payment, and the undisputed portion will be paid. No interest will accrue on any contested portion of the billing until mutually resolved. City will exercise reasonableness in contesting any billing or portion thereof.

The Contractor shall also provide the City with quarterly updates showing the total and itemized costs incurred to the City for each task ordered and the amount remaining in the contract not-to-exceed amount.

Contractor shall receive no additional compensation for work delays or hindrances except when direct and unavoidable extra costs to the Contractor are caused by the City's gross negligence.

ARTICLE 4.
TIME TO COMPLETE THE PROJECT

Contractor shall complete work under this contract in accordance with the schedule in the Work Plan, subject to extensions of time as specified in a task order or if an extension of time is granted in a duly authorized contract amendment or modification.

In addition, the City may authorize an extension in the time to complete the work for good cause if delays are encountered due to events that are beyond the control of the Contractor. It shall be the duty of the Contractor to notify the City in writing of any events that may cause a delay in the completion of a task or the project as soon as practicable to allow the parties to mitigate any such delay.

The final determination for any extension in the time to complete the project or any task shall be made in the sole judgment and discretion of the City of Fort Worth and shall not be unreasonably withheld.

Should the Contractor fail to begin the work herein provided for within the time herein fixed or to carry on and complete the same according to the terms of the Contract Documents, then the City shall have the right to either (1) demand that the Contractor's surety take over the work and complete same in accordance with the plans, specifications and other Contract Documents or (2) to take charge of and complete the work in such a manner as it may deem proper, and if in the completion thereof, the cost to City shall exceed the contract price or prices set forth in the Contract Documents, the Contractor and/or its surety shall pay City upon its demand in a writing, setting forth and specifying an itemized statement of the total cost thereof, said excess cost.

ARTCLE 5.
RESERVED

ARTICLE 6.
TERM

Unless terminated pursuant to the terms herein, this Agreement shall be for a term of one year beginning upon the date of its execution or upon completion of the work as described within the scope of work, whichever occurs later.

ARTICLE 7.
INDEPENDENT CONTRACTOR

Contractor shall operate hereunder as an independent contractor, and not as an officer, agent, servant, or employee of the City. Contractor shall have exclusive control of and the exclusive right to control the details of its work to be performed hereunder and all persons performing same, and shall be solely responsible for the acts and omissions of its officers, agents, employees, contractors and subcontractors. The doctrine of *respondeat superior* shall not apply as between City and Contractor, its officers, agents, employees, contractors, and subcontractors, and nothing herein shall be construed as creating a partnership or joint venture between City and Contractor.

ARTICLE 8.
PROFESSIONAL COMPETENCE

Work performed by Contractor shall comply in all aspects with all applicable local, state and federal laws and with all applicable rules and regulations promulgated by the local, state and national boards, bureaus and agencies. Approvals issued by the City or another entity shall not constitute or be deemed to be a release of the responsibility and liability of Contractor or its officers, agents, employees, contractors and subcontractors for the accuracy and competency of its services performed hereunder, which shall be performed in accordance with the applicable professional standard of care.

ARTICLE 9.
INTELLECTUAL PROPERTY

Section 1.
Rights in data.

The City shall have unlimited rights in all data delivered under this contract, and in all data first produced in the performance of this contract.

Section 2.
Intellectual property rights and ownership.

All intellectual property work product developed by Contractor under this contract shall be the sole property of the City and the City shall have unlimited rights in such work product. All intellectual property work product developed by Contractor under this contract shall be considered “work for hire” and rights, title, and interests to all intellectual property shall vest in the City. Contactor affirmatively, by executing this contract, disclaims all such intellectual property interests in favor of the City.

In the event that any rights, title, or interest shall by operation of law or otherwise fail to vest in the City or become void or voidable, Contractor agrees to a) transfer all rights, title, and interest to intellectual property to the City; or alternatively and at the discretion of the City the Contractor shall b) grant an unlimited and exclusive license for publication, sale, reproduction, or use by the City and its authorized sublicensees of all intellectual property developed under this contract. Contractor agrees to timely execute any documents or take any other actions as may reasonably be necessary, or as the State may reasonably request, to perfect the State’s ownership, license, or other rights to any work product.

Contractor shall not use, sell, transfer, or authorize a third party to use any work product, copyrights, trademarks, or other intellectual property (or derivatives thereof) of the work product developed under this contract without the express written consent of the City.

ARTICLE 10.
INDEMNIFICATION

Section 1.
Definitions.

In this paragraph, the following words and phrases shall be defined as follows:

Environmental Damages shall mean damages which are incurred as a result of negligence, an intentional tort, or a violation of environmental requirements pertaining to work performed under this contract by the operations of the Contractor and Subcontractors, and including without limitation:

a. Damages for personal injury and death, or injury to property or natural resources;

b. Fees incurred for the services of attorneys, consultants, contractors, experts, laboratories and other reasonable costs required by any federal, state or local governmental agency or otherwise expended to remedy the environmental damages including any attorney's fees, costs and expenses incurred in enforcing this contract or collecting any sums due hereunder; and

c. Liability to any third person or governmental agency to indemnify such person or agency for costs expended in connection with the items referenced in subparagraph (b) herein.

Environmental requirements shall mean all applicable to the work performed under this agreement (or which may become applicable during the term of this agreement) statutes, regulations, rules, plans, authorizations, concessions, franchises, and similar items, of all governmental agencies, departments, commissions, boards, bureaus, or instrumentalities of the United States, states, and political subdivisions thereof and all applicable judicial, administrative, and regulatory decrees, judgments, and orders relating to the protection of human health or the environment, including without limitation:

a. All requirements, including, but not limited to, those pertaining to reporting, licensing, emissions, discharges, releases, or threatened releases of hazardous materials, pollutants, contaminants or hazardous or toxic substances, materials, or wastes whether solid, liquid, or gaseous in nature, into the air, surfacewater, groundwater, stormwater, or land, or relating to the manufacture, processing, distribution, use, treatment, storage, disposal, transport, or handling of pollutants, contaminants, or hazardous or toxic substances, materials, or wastes, whether solid, liquid, or gaseous in nature; and

b. All requirements pertaining to the protection of the health and safety of employees or the public.

Section 2.

General Indemnification. CONTRACTOR DOES HEREBY RELEASE, INDEMNIFY, REIMBURSE, DEFEND, AND HOLD HARMLESS THE CITY, ITS OFFICERS, AGENTS, AND EMPLOYEES, FROM AND AGAINST ANY AND ALL LIABILITY, CLAIMS, SUITS, DEMANDS, OR CAUSES OF ACTIONS WHICH MAY ARISE DUE TO ANY LOSS OR DAMAGE TO PERSONAL PROPERTY, OR PERSONAL INJURY, AND/OR DEATH, OCCURRING AS A CONSEQUENCE OF THE CONTRACTOR'S OPERATIONS UNDER THIS AGREEMENT, WHEN SUCH INJURIES, DEATH, OR DAMAGES ARE CAUSED BY THE SOLE NEGLIGENCE OF CONTRACTOR, ITS OFFICERS, AGENTS, EMPLOYEES, OR CONTRACTORS, OR THE JOINT NEGLIGENCE OF CONTRACTOR, ITS OFFICERS, AGENTS, EMPLOYEES, OR CONTRACTORS AND ANY OTHER PERSON OR ENTITY.

Section 3.

Environmental Indemnification. CONTRACTOR DOES HEREBY RELEASE, INDEMNIFY, DEFEND, REIMBURSE, AND HOLD HARMLESS THE CITY, ITS OFFICERS, AGENTS, AND EMPLOYEES, AGAINST ANY AND ALL ENVIRONMENTAL DAMAGES AND THE VIOLATION OF ANY AND ALL ENVIRONMENTAL REQUIREMENTS RESULTING FROM CONTRACTOR'S OPERATIONS UNDER THIS AGREEMENT WHEN SUCH ENVIRONMENTAL DAMAGES OR VIOLATION OF ENVIRONMENTAL REQUIREMENTS ARE CAUSED BY THE ACT OR OMISSION OF CONTRACTOR, ITS OFFICERS, AGENTS, EMPLOYEES, OR CONTRACTORS, OR THE JOINT ACT OR OMISSION OF CONTRACTOR, ITS OFFICERS, AGENTS, EMPLOYEES, OR CONTRACTORS AND ANY OTHER PERSON OR ENTITY AND WHICH ARE DIRECTLY RELATED TO EITHER (i) NEGLIGENCE; OR (ii) INTENTIONAL OR WILLFUL MISCONDUCT.

Section 4.

The obligations of the Contractor under this Article shall include, but not be limited to, the burden and expense of defending all claims, suits and administrative proceedings (with counsel reasonably approved by the City) and conducting all negotiations of any description, and paying and discharging, when and as the same become due, any and all judgments, penalties or other sums due against such indemnified persons.

Upon learning of a claim, lawsuit, or other liability which Contractor is required hereunder to indemnify, City shall provide Contractor with reasonable timely notice of same.

All Contractors under this contract agree that they assume joint and several liability for any claim by the City or for a third party claim against the City for general or environmental damages caused by any of the Contractors herein.

The obligations of the Contractor under this paragraph shall survive the expiration or termination of this Agreement and the discharge of all other obligations owed by the parties to each other hereunder.

ARTICLE 11.
INSURANCE AND BONDS

The Contractor certifies it has, at a minimum, current insurance coverage as detailed below and will maintain it throughout the term of this Contract. Prior to commencing work, the Contractor shall deliver to City, certificates documenting this coverage. The City may elect to have the Contractor submit its entire policy for inspection.

A. Insurance coverage and limits:

1. Commercial General Liability
   - o $1,000,000 each occurrence
   - o $2,000,000 aggregate

2. Automobile Liability
   - o $1,000,000 each accident, or
   - o $250,000 property damage / $500,000 bodily injury per person per accident

   A commercial business auto policy shall provide coverage on “any auto,” defined as autos owned, hired and non-owned during the course of this project.

   The named insured and employees of Contractor shall be covered under this policy. The City of Fort Worth shall be named an Additional Insured, as its interests may appear. Liability for damage occurring while loading, unloading and transporting materials collected under the Contract shall be included under this policy.

3. Worker's Compensation
   - o Coverage A: statutory limits
   - o Coverage B: $100,000 each accident
     $500,000 disease - policy limit
     $100,000 disease - each employee

4. Professional Liability
   - o $1,000,000 each claim
   - o $2,000,000 aggregate

The retroactive date shall be coincident with or prior to the date of this contract and the certificate of insurance shall state that the coverage is claims-made and the retroactive date. The insurance coverage shall be maintained for the duration of this contract and for five (5) years following completion of the contract (Tail Coverage). This provision shall survive the one year term of this contract. An annual certificate of insurance shall be submitted to the City for each year following completion of this contract.

5. Environmental Impairment Liability and/or Pollution Liability
   - o $2,000,000 per occurrence.

   EIL coverage(s) must be included in policies listed in the professional liability insurance above; or, such insurance shall be provided under a separate policy or policies. Liability for damage occurring while loading, unloading and transporting materials collected under the contract project shall be included under the Automobile Liability insurance or other policy(s).

B. Certificates of Insurance evidencing that the Contractor has obtained all required insurance shall be delivered to the City prior to Contractor proceeding with the Contract.

1. Applicable policies shall be endorsed to name the City an Additional Insured thereon, as its interests may appear. The term City shall include its employees, officers, officials, agents, and volunteers as respects the Contracted services. .

2. Certificate(s) of Insurance shall document that insurance coverage specified herein are provided under applicable policies documented thereon.

3. Any failure on part of the City to request required insurance documentation shall not constitute a waiver of the insurance requirements.

4. A minimum of thirty (30) days notice of cancellation or material change in coverage shall be provided to the City. A ten (10) days notice shall be acceptable in the event of non-payment of premium. Such terms shall be endorsed onto Contractor's insurance policies. Notice shall be sent to Department of Risk Management, City of Fort Worth, 1000 Throckmorton Street, Fort Worth, Texas 76102.

5. Insurers for all policies must be authorized to do business in the state of Texas or be otherwise approved by the City; and, such insurers shall be acceptable to the City in terms of their financial strength and solvency.

6. Deductible limits, or self-insured retentions, affecting insurance required herein shall be acceptable to the City in its sole discretion; and, in lieu of traditional insurance, any alternative coverage maintained through insurance pools or risk

retention groups must be also approved. Dedicated financial resources or Letters of Credit may also be acceptable to the City.

7. Applicable policies shall each be endorsed with a waiver of subrogation in favor of the City as respects the Contract.

8. The City shall be entitled, upon its request and without incurring expense, to review the Contractor's insurance policies including endorsements thereto and, at the City's discretion; the Contractor may be required to provide proof of insurance premium payments.

9. The Commercial General Liability insurance policy shall have no exclusions by endorsements unless the City approves such exclusions.

10. The City shall not be responsible for the direct payment of any insurance premiums required by the contract. It is understood that insurance cost is an allowable component of Contractor's overhead.

11. All insurance required above shall be written on an occurrence basis in order to be approved by the City.

12. Subcontractors to the Contractor shall be required by the Contractor to maintain the same or reasonably equivalent insurance coverage as required for the Contractor. When subcontractors maintain insurance coverage, Contractor shall provide City with documentation thereof on a certificate of insurance. Notwithstanding anything to the contrary contained herein, in the event a subcontractor's insurance coverage is canceled or terminated, such cancellation or termination shall not constitute a breach by Contractor of the contract.

13. Payment and Performance Bonds. Before beginning the work, the Contractor shall be required to execute to the City of Fort Worth a payment bond if the contract is in excess of $50,000 and a performance bond if the contract is in excess of $100,000. The payment bond is solely for the protection and use of payment bond beneficiaries who have a direct contractual relationship with the Contractor or subcontractor to supply labor or material; and in 100% the amount of the Contract. The performance bond is solely for the protection of the City of Fort Worth, in 100% the amount of the Contract, and conditioned on the faithful performance by Contractor of the work in accordance with the plans, specifications, and contract documents. Contractor must provide the payment and performance bonds, in the amounts and on the conditions required, within 14 calendar days after Notice of Award.

14. Requirements for Sureties. The bonds shall be issued by a corporate surety duly authorized and permitted to do business in the State of Texas that is of sufficient financial strength and solvency to the satisfaction of the City. The surety must meet all requirements of Article 7.19-1 of the Texas Insurance Code. All bonds

furnished hereunder shall meet the requirements of Chapter 2253 of the Texas Government Code, as amended.

In addition, the surety must (1) hold a certificate of authority from the United States Secretary of the Treasury to qualify as a surety on obligations permitted or required under federal law; or (2) have obtained reinsurance for any liability in excess of $100,000 from a reinsurer that is authorized and admitted as a reinsurer in the state of Texas and is the holder of a certificate of authority from the Untied States Secretary of the Treasury to qualify as a surety on obligations permitted or required under federal law. Satisfactory proof of any such reinsurance shall be provided to the City upon request. The City, in its sole discretion, will determine the adequacy of the proof required herein.

No sureties will be accepted by the City that are at the time in default or delinquent on any bonds or which are interested in any litigation against the City. Should any surety on the Contract be determined unsatisfactory at any time by the City, notice will be given to the Contractor to that effect and the Contractor shall immediately provide a new surety satisfactory to the City.

ARTICLE 12.
LICENSES AND PERMITS

Contractor certifies and warrants that on the day any work is to commence under this contract and during the duration of the contract it shall have and maintain all of the current, valid, and appropriate federal, state, and local licenses and permits necessary for the provision of services under this contract.

Contractor also certifies that if it uses any subcontractor in the performance of this contract, that such subcontractor shall have and maintain all of the current, valid, and appropriate federal, state, and local licenses and permits necessary for the provision of services under this contract.

ARTICLE 13.
TRANSFER OR ASSIGNMENT

City and Contractor each bind themselves, and their lawful successors and assigns, to this Agreement. Contractor has been engaged as a consequence of Contractor's specific and unique skills; Assignment will only be granted under unusual circumstances and at the sole discretion of the City. Contractor, its lawful successors and assigns, shall not assign, sublet or transfer any interest in this Agreement without prior written consent of the City.

ARTICLE 14.
RIGHT TO AUDIT

(a) Contractor agrees that the City shall, until the expiration of three (3) years after final payment under this Agreement, have access to and the right to examine any directly pertinent books, documents, papers and records of Contractor involving transactions relating to this Agreement. Contractor agrees that the City shall have access during normal working hours to all necessary facilities and shall be provided adequate and appropriate workspace in order to conduct audits in compliance with the provisions of this section. City shall give Contractor reasonable advance notice of intended audits. A City initiated audit of indirect costs shall be conducted by review of an appropriate existing audit by recognized federal agency if such data is made available for review to the City.

(b) Contractor further agrees to include in all its subcontracts hereunder, a provision to the effect that the subcontracting contractor agrees that the City shall, until the expiration of three (3) years after final payment under the subcontract, have access to and the right to examine any directly pertinent books, documents, papers and records of such subcontractor, involving transactions to the subcontract, and further, that City shall have access during normal working hours to all subcontractor facilities, and shall be provided adequate and appropriate work space in order to conduct audits in compliance with the provisions of this article. City shall give Contractor and any subcontractor reasonable advance notice of intended audit.

(c) Contractor and subcontractors agree to photocopy such documents as may be requested by the City. The City agrees to reimburse Contractor for the cost of copies at the rate published in the Texas Administrative Code in effect as of the time copying is performed.

ARTICLE 15.
MINORITY AND WOMAN BUSINESS ENTERPRISE (M/WBE) PARTICIPATION

In accordance with City Ordinance No. 15530, the City has goals for the participation of minority business enterprises and woman business enterprises (“M/WBE”) in City contracts. Contractor agrees to a minimum M/WBE participation of ten percent (10 %) in accordance with its proposal and the aforementioned ordinance. Contractor acknowledges the M/WBE goal established for this Agreement and its commitment to meet that goal. For the purposes of determining M/WBE participation the full 10% M/WBE participation is calculated using the combined total work performed under this contract and the prior contract for work (CS-40631) on the Air Quality Study. Any misrepresentation of facts (other than a negligent misrepresentation) and/or the commission of fraud by the Contractor may result in the termination of this Agreement and debarment from participating in City contracts for a period of time of not less than three (3) years.

ARTICLE 16.
NON-DISCRIMINATION

During the performance of this contract, Contractor shall not discriminate in its employment practices and shall comply with all applicable provisions of Chapter 17, Article III of the Code of the City of Fort Worth.

Contractor agrees not to discriminate against any employee or applicant for employment because of because of age, race, color, religion, sex, disability, national origin, sexual orientation, transgender, gender identity or gender expression in any manner involving employment, including the recruitment of applicants for employment, advertising, hiring, layoff, recall, termination of employment, promotion, demotion, transfer, compensation, employment classification, training and selection for training or any other terms, conditions or privileges of employment.

Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the provisions of the non-discrimination clause.

Contractor also agrees that in all solicitations or advertisements for employees placed by or on behalf of this contract, that Contractor is an equal opportunity employer.

Notices, advertisements, and solicitations placed in accordance with federal law, rule or regulation shall be deemed sufficient for the purpose of meeting the requirements of this section.

ARTICLE 17.
OBSERVE AND COMPLY

Contractor shall at all times observe and comply with all federal, state, and local laws and regulations and with all City ordinances and regulations which in any way affect this Agreement and the work hereunder, and shall observe and comply with all orders, laws ordinances and regulations which may exist or may be enacted later by governing bodies having jurisdiction or authority for such enactment. No plea of misunderstanding or ignorance thereof shall be considered.

ARTICLE 18.
DEFAULT

If Contractor fails to begin work or to complete work within the time specified in a Task Order City shall have the right to take charge of and complete the work in such a manner as it deems appropriate. If the City exceeds the costs detailed herein or in the Task Order, City may deliver to Contractor a written itemized statement of the excess costs and Contractor shall reimburse the City for such excess costs without delay.

If at any time during the terms of this contract, the work of the Contractor fails to meet the specifications of the Contract Documents or to meet the standards of duty, care, or proficiency of a reasonable and competent Contractor, City may notify the Contractor of

the deficiency in writing. Failure of the Contractor to correct such deficiency and complete the work required under this contract or a Task Order to the satisfaction of the City within ten (10) days after written notice shall constitute default, and shall result in termination of this contract.

Contractor shall not be deemed to be in default because of any failure to perform under this contract if the failure arises solely acts of God, acts of war or terrorism, fires, floods, epidemics, quarantine restrictions, labor strikes, freight embargoes, and events of unforeseeably severe weather.

ARTICLE 19.
TERMINATION

City may terminate this contract without cause by giving thirty (30) days written notice to Contractor. In the event of termination, any work in progress will continue to completion unless otherwise specified in the notice of termination. If the City terminates this contract under this provision, City shall pay Contractor for all services performed prior to the termination. Termination shall be without prejudice to any other remedy the City may have.

All data and completed or partially completed documents prepared under this contract shall be promptly turned over to the City upon termination of this contract.

ARTICLE 20.
VENUE AND JURISDICTION

If any action, whether real or asserted, at law or in equity, arises on the basis of any provision of this Agreement, venue for such action shall lie in state courts located in Tarrant County, Texas or the United States District Court for the Northern District of Texas – Fort Worth Division. This Agreement shall be construed in accordance with the laws of the State of Texas.

ARTICLE 21.
CONTRACT CONSTRUCTION

The Parties acknowledge that each party and, if it so chooses, its counsel have reviewed and revised this Agreement and that the normal rule of construction to the effect that any ambiguities are to be resolved against the drafting party must not be employed in the interpretation of this Agreement or any amendments or exhibits hereto.

ARTICLE 22.
HEADINGS

The headings contained herein are for the convenience in reference and are not intended to define or limit the scope of any provision of this Agreement.

ARTICLE 23.
COUNTERPARTS

This Agreement may be executed in one or more counterparts and each counterpart shall, for all purposes, be deemed an original, but all such counterparts shall together constitute but one and the same instrument.

ARTICLE 24.
SEVERABILITY

The provisions of this Agreement are severable, and if any word, phrase, clause, sentence, paragraph, section or other part of this Agreement or the application thereof to any person or circumstance shall ever be held by any court of competent jurisdiction to be invalid or unconstitutional for any reason, the remainder of this Agreement and the application of such word, phrase, clause, sentence, paragraph, section, or other part of this Agreement to other persons or circumstances shall not be affected thereby and this Agreement shall be construed as if such invalid or unconstitutional portion had never been contained therein.

ARTICLE 25.
RIGHTS AND REMEDIES NOT WAIVED

In no event shall the making by the City of any payment to Contractor constitute or be construed as a waiver by the City of any breach of covenant, or any default which may then exist, on the part of Contractor, and the making of any such payment by the City while any such breach or default exists shall in no way impair or prejudice any right or remedy available to the City with respect to such breach or default. Any waiver by either party of any provision or condition of the contract shall not be construed or decreed to be a waiver of any other provision or condition of this Contract, nor a waiver of a subsequent breach of the same provision or condition, unless such waiver be expressed in writing by the party to be bound.

All costs and attorneys fees incurred by the City in the enforcement of any provision of this contract shall be paid by the Contractor.

The remedies provided for herein are in addition to any other remedies available to the City elsewhere in this contract and by law.

ARTICLE 26.
NOTICES

Notices to be provided hereunder shall be sufficient if forwarded to the other Party by hand-delivery or via U.S. Postal Service certified mail return receipt requested, postage prepaid, to the address of the other Party shown below:

If to the City: City of Fort Worth
Environmental Management Department
Attn: Brian Boerner, CPM, CHMM, Director
1000 Throckmorton Street
Fort Worth, Texas 76102-6311

If to the Contractor: Eastern Research Group, Inc.
Attn: Linda Taylor
110 Hartwell Avenue
Boston, MA 02421

ARTICLE 27.
WARRANTY

Contractor warrants that it understands the currently known hazards and suspected hazards which are presented to persons, property and the environment by the types of work which are to be performed under this contract.

Contractor further warrants that it will perform all services under this Contract in a safe, efficient and lawful manner using industry accepted practices, and in full compliance with all applicable state and federal laws governing its activities and is under no restraint or order which would prohibit performance of services under this Contract.

ARTICLE 28.
NO THIRD-PARTY BENEFICIARIES

This Agreement shall inure only to the benefit of the parties hereto and third persons not privy hereto shall not, in any form or manner, be considered a third party beneficiary of this Agreement. Each party hereto shall be solely responsible for the fulfillment of its own contracts or commitments.

ARTICLE 29.
MODIFICATION

No modification of this Contract shall be binding on the Contractor or the City unless set out in writing and signed by both parties. No modification of this contract shall be binding upon the City unless signed by the City Manager or an Assistant City Manager of the City of Fort Worth. Any changes to the scope of work or compensation must be in the form of a written, formal, authorized modification of this contract that is in accordance with all applicable state and city laws, regulations, and ordinances. In no event shall any verbal authorization changing the scope of work or verbal agreements for additional compensation be binding upon the City. Contractor expressly agrees a) not to make changes to its legal, financial, or logistical position on any matter based on any oral representation by an employee, contractor, or agent of the City prior to obtaining a written modification to this contract; b) that it waives any claim based upon

reliance or estoppel as a result of acting or not acting due to an alleged oral change to a material term of this contract from the City, its employees, contractors, or agents; and c) that it waives any claim for compensation for work performed based upon an alleged oral change to a material term of this contract from the City, its employees, or agents.

ARTICLE 30.
ENTIRETY

This contract, the contract documents, and any other documents incorporated by reference herein are binding upon the parties and contain all the terms and conditions agreed to by the City and Contractor, and no other contracts, oral or otherwise, regarding the subject matter of this contract or any part thereof shall have any validity or bind any of the parties hereto. In the event of any conflict between this contract and any other contract documents, then the terms of this contract shall govern.

ARTICLE 31.
AUTHORITY AND EXECUTION

By signing this contract Contractor warrants that it has had the opportunity 1) to examine this contract in its entirety, 2) to have its legal counsel examine and explain the content, terms, requirements, and benefits of this contract if Contractor so chooses, and 3) to negotiate the terms of this contract within the bounds of applicable law.

Having had the opportunity to submit its SOQ, Work Plan, Fee Schedule, and other contract documents, and also to specifically negotiate the terms of this contract, Contractor agrees to be bound by this contract and expressly agrees to the terms of this contract.

The signatory to this contract represents that he or she is legally authorized by the Contractor to enter into a binding agreement on behalf of the Contractor.

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ATTACHMENT A.
SCOPE OF WORK

THERE IS NO GUARANTEE OF ANY WORK UNDER THIS CONTRACT, however the types of work which the Contractor will perform upon specific written authorization by the City shall include the following, and related environmental and engineering consulting services:

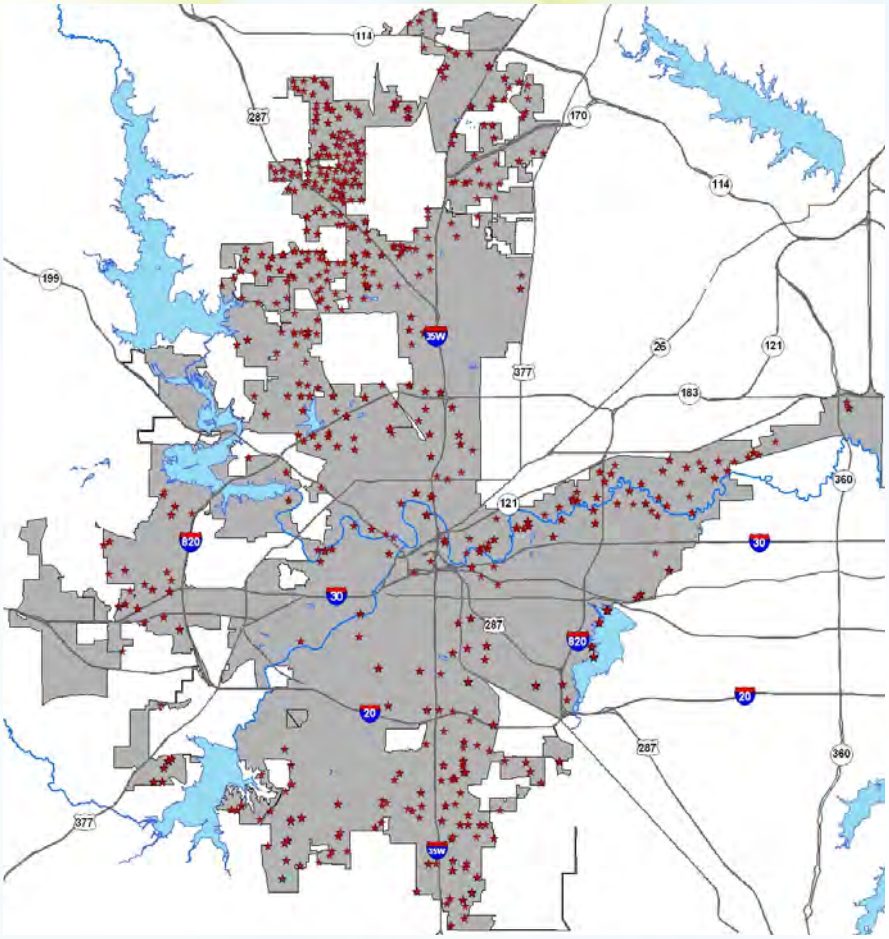
The Scope of Work detailed in the document entitled “City of Fort Worth Natural Gas Air Quality Study – Final Work Plan ” prepared by Eastern Research Group, Inc. and dated August 4, 2010. Including the addition of Appendix B on August 6, 2010 and incorporation of revised of Section 8.0 on August 16, 2010.

This scope is intended to be illustrative and not exhaustive, and additional similar or related services may be ordered subject to the terms of this contract and as authorized by the City. In addition the city may decline to issue task orders or reduce the scope of work described in the Work Plan at its sole discretion.

For all purposes relating to the performance bond, the Final Work Plan is agreed to be the benchmark for determining if performance has been completed as required under this contract, subject to duly authorized written modifications, amendments, or task orders issued by the City.

City of Fort Worth Natural Gas Air Quality Study

Final Work Plan



Prepared for:

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August 4, 2010

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INTRODUCTION

This document contains Eastern Research Group's (ERG's) work plan for performing the tasks and activities specified in Project DEM 10-05 (Natural Gas Air Quality Study). The primary objectives of this project are to answer these fundamental questions:

- What quantity of emissions (on a volume and mass basis) is coming from natural gas exploration and production sites located within the City of Fort Worth?
- Do the sites comply with applicable regulatory limits?
- What effect do emissions from natural gas exploration and production activities have on ambient air quality at the fenceline?
- Are the City's setbacks for wells, tanks, and compressors adequate to protect public health?

This work plan addresses each of the tasks that must be completed in order to answer the questions above for the City of Fort Worth (the City), to ensure that the public is kept informed throughout the duration of the project, and to prepare a final report, including findings, conclusions, and recommendations. Under this work plan, we will implement the Ambient Air Monitoring Network Design and Point Source Testing Plan that were developed under a separate contract entitled "Fort Worth Natural Gas Air Quality Study Planning".

To assist ERG in completing this project, Sage Environmental Consulting will be leading the point source testing task (Task 3) and providing technical peer review on all project tasks. Also, Hicks & Company (certified by the North Central Texas Regional Certification Agency (NCTRCA) as a Woman-Owned Business Enterprise) will be providing field sampling support.

A description of each of the project tasks is provided below in Sections 1 through 7, Section 8 provides a project time line, and Section 9 provides budget information for each task. Specific references to the four questions above are embedded in the discussion of each section showing how the tasks relate to meeting the objectives of the project. Section 9 also identifies each member of the project team and their estimated hours of participation in this project and designates Sage and Hicks staff specifically.

1.0 TASK 1 – PROJECT MANAGEMENT

This task will be used by the Project Manager (PM), the Senior Peer Reviewer, and administrative support staff to ensure this project is executed in a technically competent manner, in a timely fashion, and within the proposed budget; to prepare monthly progress reports and invoices; and to maintain communication with the City on overall project schedule and budget.

The PM for this project is Mr. Mike Pring. In this role, he will be responsible for directing this project's day-to-day activities. Mr. Pring will be the central point of contact for the City and will have overall authority and responsibility for ERG's performance on the proposed program. He will be available to City staff on a daily basis to discuss and resolve any issues regarding schedule, cost, or labor commitment. Mr. Pring will be available to consult with the

ERG staff and attend meetings where his knowledge and broad technical perspective on air quality issues as related to oil and gas exploration and production will be beneficial.

Contact information for Mr. Pring is as follows:

Telephone: 919-468-7840
Fax: 919-468-7801
Email: Mike.Pring@erg.com

The Senior Peer Reviewer for this project is Art Bedrosian of Sage Environmental Consulting, who will provide peer review on all project tasks. Mr. Bedrosian has extensive experience in all aspects of this project and will serve as a technical resource and in an advisory role as the project progresses.

The cost estimate for this task is $22,020, based on a total project period of 8 months (August, 2010 through March 2011). Details on the cost breakdown are provided in Table 8.

2.0 TASK 2 – AMBIENT AIR MONITORING

- ***What effect do emissions from natural gas exploration and production activities have on ambient air quality at the fenceline?***
- ***Are the City's setbacks for wells, tanks, and compressors adequate to protect public health?***

Task 2 involves the establishment of an ambient air monitoring network within the City to quantify the concentration of volatile organic compounds (VOCs) and hazardous air pollutants (HAPs) (such as benzene and formaldehyde) in the ambient air to assist in answering the questions above.

Task Overview

The primary purpose for this task is to determine the prevalence and magnitude of specific air toxics compounds in the ambient air at monitoring sites in accordance with applicable set-backs. This data will be used to conduct a public health evaluation as described under Task 6. As a related task, the City is interested in understanding the behavior of ambient methane and ethane, specifically related to benzene concentration levels.

In this task, the ERG Team will use the results of the planning study to implement the air toxics monitoring network which will be located throughout the City. During this time, we will: 1) work with the City to gain access to proposed sites; 2) distribute and review project-specific standard operating procedures (SOPs) to field technicians to ensure consistent sample acquisition and handling; 3) install certified monitoring equipment; and 4) make adjustments to the Quality Assurance Project Plan (QAPP) if the technical nature of the Data Quality Objectives (DQOs) has been adjusted.

Pollutants of Interest

As stated in the above primary objective of this study, we are proposing sampling for specific air toxics of:

- VOCs as identified by EPA's method TO-15 (including benzene);
- Carbonyl compounds identified by EPA's method TO-11A (including formaldehyde);
- Speciated non-methane organic compounds (SNMOC), as identified by ERG/SNMOC Analysis Method; and
- Methane, as identified by EPA's method TO-14.

The list of air toxics that will be reported from these sampling methods are listed in Tables 1-3. These three compound groups provide over 130 air toxics, including 45 hazardous air pollutants (HAPs), such as benzene, ethylbenzene, toluene, and xylenes (BTEX compounds), formaldehyde, and acetaldehyde. All HAPs are denoted with a bold typeface in each of the tables. From a toxicity standpoint, concentrations of benzene will be of primary importance for this study.

Table 1. TO-15 Reported Compounds

Acetonitrile	*o*-Dichlorobenzene	**Methyl *tert*-Butyl Ether**
Acetylene	***p*-Dichlorobenzene**	*n*-Octane
tert-Amyl Methyl Ether	Dichlorodifluoromethane	Propylene
Benzene	**1,1-Dichloroethane**	**Styrene**
Bromochloromethane	**1,2-Dichloroethane**	**1,1,2,2-Tetrachloroethane**
Bromodichloromethane	**1,1-Dichloroethene**	**Tetrachloroethylene**
Bromoform	*cis*-1,2-Dichloroethylene	**Toluene**
Bromomethane	*trans*-1,2-Dichloroethylene	**1,2,4-Trichlorobenzene**
1,3-Butadiene	**Dichloromethane**	**1,1,1-Trichloroethane**
Carbon Tetrachloride	**1,2-Dichloropropane**	**1,1,2-Trichloroethane**
Carbon Disulfide	***cis*-1,3-Dichloropropene**	**Trichloroethylene**
Chlorobenzene	***trans*-1,3-Dichloropropene**	Trichlorofluoromethane
Chloroethane	Dichlorotetrafluoroethane	Trichlorotrifluoroethane
Chloroform	**Ethyl Acrylate**	1,2,4-Trimethylbenzene
Chloromethane	Ethyl *tert*-Butyl Ether	1,3,5-Trimethylbenzene
Chloromethylbenzene	**Ethylbenzene**	**Vinyl Chloride**
Chloroprene	**Hexachloro-1,3-butadiene**	***m,p*-Xylene**
Dibromochloromethane	Methyl Ethyl Ketone	***o*-Xylene**
1,2-Dibromoethane	**Methyl Isobutyl Ketone**	
m-Dichlorobenzene	**Methyl Methacrylate**	

Table 2. TO-11A Reported Compounds

Acetaldehyde	Crotonaldehyde	Isovaleraldehyde
Acetone	2,5-Dimethylbenzaldehyde	**Propionaldehyde**
Benzaldehyde	**Formaldehyde**	Tolualdehydes
Butyraldehyde	Hexaldehyde	Valeraldehyde

Table 3. SNMOC Reported Compounds

n-Butane	*n*-Heptane	2-Methylpentane
cis-2-Butene	1-Heptene	3-Methylpentane
trans-2-Butene	***n*-Hexane**	*n*-Nonane
Cyclohexane	1-Hexene	1-Nonene
Cyclopentane	*cis*-2-Hexene	1-Octene
Cyclopentene	*trans*-2-Hexene	*n*-Pentane
n-Decane	Isobutane	1-Pentene
1-Decene	Isobutene/1-Butene	*cis*-2-Pentene
m-Diethylbenzene	Isopentane	*trans*-2-Pentene
p-Diethylbenzene	Isoprene	α-Pinene
2,2-Dimethylbutane	**Isopropylbenzene**	β-Pinene
2,3-Dimethylbutane	2-Methyl-1-butene	Propane
2,3-Dimethylpentane	3-Methyl-1-butene	*n*-Propylbenzene
2,4-Dimethylpentane	2-Methyl-1-pentene	Propyne
n-Dodecane	4-Methyl-1-pentene	*n*-Tridecane
1-Dodecene	2-Methyl-2-butene	1-Tridecene
Ethane	Methylcyclohexane	1,2,3-Trimethylbenzene
2-Ethyl-1-butene	Methylcyclopentane	2,2,3-Trimethylpentane
Ethylene	2-Methylheptane	**2,2,4-Trimethylpentane**
m-Ethyltoluene	3-Methylheptane	2,3,4-Trimethylpentane
o-Ethyltoluene	2-Methylhexane	*n*-Undecane
p-Ethyltoluene	3-Methylhexane	1-Undecene

The above pollutants also include important non-HAPs that will be useful in characterizing and differentiating between emissions from natural gas activities (such as ethane and other straight-chain hydrocarbons), mobile source activities (such as *tert*-Amyl Methyl Ether, acetylene, ethylene, ethyl-*tert*-butyl ether), other industrial processes (such as methyl ethyl ketone from surface coating operations or propylene from petrochemical manufacturing sources), and from biogenic sources (such as isoprene). Generally speaking, however, the list of analytes is specific to the analytical method and not to the target source type (e.g., natural gas sources and mobile source).

Ambient Monitoring Network and Site Objectives

Prior to setting up the monitoring network, we will use the findings from work conducted under a separate contract (Fort Worth Natural Gas Air Quality Planning Study) to identify locations of potential monitoring sites. We will attempt to place monitoring sites as close to applicable set-backs as possible, given logistical challenges such as accessibility to sites, security concerns, and/or airflow obstructions such as sound blankets. Each site will be dispersed geographically throughout the City to characterize as many natural gas sites as possible. For example, a monitoring site located in an area of high level of natural gas activity can effectively represent typical airshed conditions for up to a few miles, depending upon typical wind conditions. Using that information, we can estimate a percentage of the total well pads that are represented by the proposed monitoring network.

We are proposing setting up an air toxics monitoring network of seven sites with the following objectives:

- Site 1: Fixed site, located in a remotely populated area to be used as a background site (the concentrations measured at this site will be useful for comparisons and for calculating upwind-downwind concentration differences);
- Site 2: Fixed site, located in a populated area with a moderate level of natural gas activity conducted upwind;
- Site 3: Fixed site, located in a populated area with a moderate level of natural gas activity conducted upwind;
- Site 4: Fixed site, located in a populated area near a high level of mobile source activity (this is important to differentiate potential health impacts due to mobile sources versus natural gas sources);
- Site 5: Fixed site, located in a populated area where a high level of natural gas activities are conducted upwind;
- Site 6: Fixed site, located in a populated area where a high level of natural gas activities are conducted upwind; and
- Site 7: Fixed site, to be located initially at a pre-production operation such as a drilling, fracturing, or completion site, or at other areas of interest. This site may be relocated during the course of the project to a site in various stages of pre-production.

This type of network design has been utilized in our work for many of our Agency for Toxic Substances and Disease Registry's (ATSDR) exposure investigations, which included two studies characterizing ambient air impacts from oil and natural gas wells. Using the above network design (up to five sites dedicated to characterizing ambient air from natural gas activities, a remote background site, and a site close to mobile source activity), we are confident that we will be able to evaluate the impacts of natural gas activity as close to the setbacks as possible in a scientifically defensible manner.

Sampling Frequency

During this study, ERG is proposing sampling every 1 in 3 days at each of these sites. Over the course of two months, this short-term sampling schedule will yield approximately 20 sampling days, which we believe is a sufficient number of data points to calculate an estimate of long-term concentrations for a number of air toxics. This type of "short-term" average is currently being used by EPA in their evaluation of monitoring data for the Schools Air Toxics Initiative. These estimates will then be compared to various public health exposure levels to assist in determining whether or not we recommend that monitoring be extended to an annual period.

Each sample conducted will be 24-hour samples targeting VOCs and SNMOC. Specific monitoring at the sites will be:

1) Three fixed sites collecting integrated 24-hour whole air samples for concurrent analysis resolving TO-15 and SNMOC target compounds. These sites would use the Veriflow collection technology and not require sheltering or 110vAC power. Collection frequency is 1-in-3 days for every site.

2) Two fixed sites collecting integrated 24-hour whole air samples for concurrent analysis resolving TO-15 and SNMOC target compounds and integrated 24-hour whole air samples for TO-11A target compounds. All duplicate collections for A.T./SNMOC and Carbonyls would be conducted at these sites also. These sites would use conventional collection technology and would require sheltering, temperature control, and 110vAC electric power. Collection frequency is 1-in-3 days for every site.

3) Two fixed sites collecting integrated 24-hour whole air samples for Methane and air toxics analyses. These sites would use the Veriflow collection technology and not require sheltering or 110vAC power. Collection frequency is 1-in-3 days for every site.

Table 4 presents the sampling schedule.

Table 4. Proposed Approach and Schedule of Collection Events

Date	Concurrent A.T./SNMOC Collection	Carbonyl Collection	A.T./SNMOC Duplicate Samples	Carbonyl Duplicate Samples	Methane and A.T. Samples
8-17	From 5 Fixed Sites (Site Numbers 1-5)	From 2 Fixed Sites (Site Numbers 4-5)	--	--	From 2 Fixed Sites (Site Numbers 6-7)
8-20			--	--	
8-23			--	--	
8-26			From 2 Sites	From 2 Sites	
8-29			--	--	
9-01			--	--	
9-04			--	--	
9-07			From 2 Sites	From 2 Sites	
9-10			--	--	
9-13			--	--	
9-16			--	--	
9-19			From 2 Sites	From 2 Sites	
9-22			--	--	
9-25			--	--	
9-28			--	--	
10-01			From 2 Sites	From 2 Sites	
10-04			--	--	
10-07			--	--	
10-10			--	--	
10-13			From 2 Sites	From 2 Sites	
	Sub-Total Samples = 100	Sub-Total Samples = 40	Sub-Total Samples = 10	Sub-Total Samples = 10	Subtotal Samples = 40
Overall Total Samples = 200					

Pre-Field Operations

In this section, ERG describes pre-field activities which will occur prior to sampling initiation, which include:

1) ERG will check-out, certify (as required), calibrate (as required), all equipment that will be deployed to the field.
2) ERG will ship the field collection systems to the field for deployment, approximately 9 days prior to the first scheduled sampling event. This shipment will include everything required to assemble and install the 7 sample collection systems. This would include all system components, ancillary materials (i.e., fittings, stainless steel tubing, timers, chargers, etc.), associated Standard Operating Procedures, and tools. The only materials/items envisioned for

purchase in the field would be those that are required do to specific site considerations after site inspections have been performed.

3) ERG will travel to study location and install and check-out the sample collection systems at each site approximately 7 days prior to the first scheduled collection event.
4) ERG will train all field staff in the proper operation of the five Timer/Veriflow collection systems and the two Canister/Carbonyl collection systems, and the required procedure for collecting valid representative samples using these systems.
5) ERG will train field staff in the proper procedures for receiving, handling, and shipping samples media.
6) ERG will travel to study location and install and recover the sample collection systems at each site approximately 3 days after the last scheduled collection event, and ship this equipment back to the ERG Laboratory.
7) Upon receipt, ERG will repair/refurbish all field equipment as required.

Field Operations

In this section, ERG describes field activities which will occur as part of normal sample pre-collection procedures and operations associated with collecting Air Toxics VOC and Carbonyl Compounds samples on a 1-in-3 day frequency.

1) Approximately 1 week prior to each scheduled collection event, the field operator will receive via Federal Express a shipment of prepared media (i.e., cleaned evacuated 6-L SUMMA canisters and or DNPH Carbonyl tubes) in quantities consistent with conducting an entire weeks worth of field sample collections. The DNPH Carbonyl tubes will be shipped in a cooler with blue ice. They will be placed in a refrigerator at the common staging area until ready for use collecting field samples. The blue ice will be placed in a freezer until ready for re-use shipping the samples back to the laboratory. Along with the media, specific associated multi-copy Chain-of-Custody (COC) forms will be provided. The COC forms will already have all laboratory origination information completed on them.
2) Two days prior to each scheduled sampling event, for the canister collection systems that are battery powered, the operator will charge the digital control timers using the transformers provided for each system. The charging will occur at the common staging location.
3) One day prior to each collection event, a field operator will visit each site to perform the following:
    a. Carefully transport and deploy each of the battery operated canister collection systems (at locations where fixed systems are not deployed);
    b. Install new collection media (i.e., cleaned evacuated 6-L SUMMA canister for battery operated sites and cleaned evacuated 6-L SUMMA canisters and DNPH Carbonyl tubes for fixed system sites);
    c. Program the digital timer to initiate sampling at 00:01 and terminate sampling at 11:59on the date of the scheduled event;

d. Enable collection for each media type (e.g., open canister bellows valve); and
e. Complete all associated paper work including completion of pre-collection COC information (e.g., document initial canister pressure, document initial DNPH carbonyl tube collection flow rate, etc.) and site log book entries.

Post-collection Field Operations

In this section, ERG describes field activities which will occur as part of normal sample post-collection procedures and operations associated with collecting Air Toxics VOC and Carbonyl Compounds samples on a 1-in-3 day frequency.

1) One day after each collection event, a field operator will visit each site to perform the following:
   a. Inspect the site for anything unusual (e.g., damaged/broken equipment, vandalism, evidence of tampering, etc.). If problems are noted, the operator will immediately contact the ERG Project Manager and the pertinent City staff to report the problems. At that time, a corrective action may occur (i.e., resample, relocating the equipment, etc.). If no problems are observed, then proceed to the next step;
   b. Disable collection for each media type (e.g., close canister bellows valve, ensure that each canister inlet valve port is capped);
   c. Complete all associated paper work including completion of post-collection COC information (e.g., document final canister pressure, document final DNPH carbonyl tube collection flow rate, document elapsed time, etc.) and site log book entries. If final canister pressure and/or flow rate do not meet the method criteria, then the operator will notify the ERG Project Manager immediately. If possible, a make-up sample may be taken immediately. If there are no problems with the sample collection, proceed to the next step;
   d. Recover collection media (i.e., whole air canister samples for battery operated sites and whole air canister and DNPH Carbonyl samples for fixed system sites).
2) Carefully transport each of the battery operated canister collection systems (from locations were fixed systems are not deployed) and recovered sample media back to the common staging area.
3) Place the DNPH Carbonyl samples in the refrigerator at the common staging area until they are ready to be shipped back to the laboratory for analysis.

At this point steps the operator is ready to begin the Pre-collection steps in preparation for the next collection event.

Sample Shipping

In this section, ERG describes sample shipping activities which will occur as part of normal sample post-collection procedures and operations associated with collecting Air Toxics VOC and Carbonyl Compounds samples on a 1-in-3 day frequency.

1) One day after each sample collection, place a canister sample and its associated COC inside of the large bubble bag provided with each canister. Place the bagged canister inside the shipping box provided with each canister. Secure the shipping box with the packing tape provided.
2) Place one events worth of DNPH Carbonyl samples in a zip lock baggie. Place their associated COCs in another zip lock baggie. Place the two baggies in the small cooler as provided. Place blue ice in the cooler as provided.
3) Complete a Federal Express (FedEx) preprinted bill of laden (i.e., over night service) for each canister sample shipping box and each DNPH Carbonyl samples cooler prepared for shipment. Secure the bill of laden to each parcel.
4) Have parcels picked up by FedEx, or deliver the parcels to FedEx, for overnight shipment the same day that they are prepared.

Sample Handling, Tracking, Analysis, and Reporting

In this section, ERG describes laboratory activities which will occur as part of normal sample handling, tracking, analysis, and reporting Air Toxics VOC and Carbonyl Compounds samples.

1) The day after they are shipped from the field, samples will be delivered to the loading dock at ERG's laboratory complex. A dedicated receiving specialist will take custody of the parcels. Each sample will be inspected to ensure that it arrived intact and to establish that the validity of the sample was not compromised in any way during shipment.
2) The receiving specialist will complete all associated paper work including as received COC information (e.g., document as received canister pressure, calculate and document DNPH carbonyl sample total collection volume, etc.) and receiving log book entries.
3) The receiving specialist will then log each sample into ERG's state-of-the-art Laboratory Information Management System (LIMS). During sample login, each sample will receive the following (this information allows the sample to be tracked and status-checked throughout all laboratory process):
    a. A unique sample identification number;
    b. A batching descriptor specifying specifically what analyses the sample is to undergo and data turn-around time requirements.
4) Air Toxics samples will be prepared and analyzed in strict accordance with the guidelines presented in EPA Compendium Method TO-15 and the EPA NATTS Technical Assistance Document (TAD). Speciated Nonmethane Organic Compounds analyses will be performed in accordance with the guidelines presented in the EPA Carbon Bond 4 Method and the EPA Ozone Precursors

Sampling and Analysis TAD. Carbonyl Compounds will be analyzed in strict accordance with the guidelines presented in EPA Compendium Method TO-11A and the EPA Ozone Precursors Sampling and Analysis TAD. Figures 1 and 2 present ERG's Air Toxics/SNMOC laboratory and ERG's carbonyl laboratory.

Figure 1. ERG's Air Toxics/SNMOC Analysis Laboratory

Figure 2. ERG's Carbonyl Laboratory and Analytical Instrumentation

5) Raw data is transmitted electronically from each analytical system directly to ERG's LIMS. Within LIMS, the raw analytical data is converted into quantitated measurement values.
6) ERG employs a robust multi-check, multi-level data review process to ensure that all data generated is valid and representative.
7) Data is generated in a form that is easily imported into spreadsheets (e.g. Microsoft Excel) or database management programs (e.g. Microsoft Access or SQL).
8) Data quality will be assessed as follows:
   a. Precision will be assessed by analyzing collocated samples from the fixed monitoring sites in replicate (i.e., nested). The CV provides a relative measure of variability by expressing standard deviations to the magnitude of the arithmetic mean. The lower the CV, the less likelihood that analytical results would vary due to sampling error.
   b. Bias will be assessed by analyzing blind performance evaluation (PE) samples as provided by EPA as part of the National Monitoring Programs. Bias will be expressed in terms of relative percent difference (RPD). ERG regularly receives these blind PE samples from EPA and the associated performance data provided by EPA will be made available for this study.

The cost estimate for this task is $228,071. Details on the cost breakdown are provided in Table 8.

3.0 TASK 3 – POINT SOURCE TESTING

- ***What quantity of emissions (on a volume and mass basis) is coming from natural gas exploration and production sites located within the City of Fort Worth?***

The focus of this task is to characterize hydrocarbon emissions from natural gas point sources located within the boundaries of the City. We propose to do this through a detailed and near comprehensive point sources testing plan as explained below. While surveying all 600+ point source locations (wells, well pads, compressor stations, and treatment and disposal facilities) would be desirable, it may not be feasible given time and resource constraints. However, our plan (outlined below) attempts to survey, at a minimum, 75% of the existing point sources. We also understand that the City would like to have this testing conducted in the late summer to early fall months when elevated ambient temperatures can be expected.

To accomplish this, we propose to deploy two point source teams, each fully equipped with the necessary sampling instrumentation. Specifically, we will perform the following sub-tasks:

1) Survey, at a minimum, 75% of the existing natural gas emission point sources with the FLIR infrared (IR) camera;

2) Conduct screening with a Thermo Environmental TVA 1000B analyzer on a subset of point source components at each location following the procedures of EPA Method 21[1];
3) Perform on-site emission rate testing at each location using the Bacharach High-Flow® Sampler;
4) Collect samples of emissions at select locations for VOC and Methane analysis in evacuated Summa™ canisters to determine compound specific emission rates;
5) Calculate point source emissions;
6) Field Data Collection; and
7) Quality assurance.

At the conclusion of this task, we will prepare draft and final reports to the City summarizing the point source testing results, as well provide all information used to generate emissions (spreadsheets, video footage, equipment characteristics, etc.).

3.1 Survey Natural Gas Emission Point Sources with the IR Camera

The objective of this sub-task is to survey point source equipment at natural gas facilities. We will use the IR camera to survey:

- Active well pads;
- Compressor stations;
- Processing facilities;
- Tank batteries;
- Saltwater evaporation facilities;
- Water recycling units; and
- Gathering stations under City control.

Natural gas transmission lines will not be included in the point source survey unless located within the battery limits of any of the above facilities. While the exact number of point sources within the City is currently unknown until the results of the planning contract are finished, we are presenting approximate counts in Table 5:

Table 5. Estimated Counts of Natural Gas Point Sources

Point Source Type	Estimated Count
Well Pads	~645
Compressor Stations	~20
Processing facility	1
Tank batteries	Estimated number unavailable
Saltwater treatment facility	1
Water recycling units	2

[1] Federal Register.Vol. 65, No. 201.Tuesday, October 17, 2000. Rules and Regulations. Method 21 – Determination of Volatile Organic Compound Leaks

As stated before, ideally we would like to capture all natural gas facilities within the City. However, this goal may not be feasible due to cost and time constraints. Therefore, we are proposing to survey, at a minimum, 75% of the natural gas facilities, randomly selected from the entire population of facilities. The exact number will be determined once the results of the planning study are completed. We feel that information gathered from a minimum of 75% of the natural gas facilities will provide a wealth of information in characterizing emissions from these sources. Additionally, scientifically defensible and statistically robust surrogates can be developed and applied to the facilities which were not surveyed. To ensure as representative coverage as possible, the City will be gridded into equal area sections with an alphanumeric identifier applied to each section. Individual Sector Survey maps of the sources of interest will be created from the GIS information provided by the City, and assigned to each Point Source Sampling Team. The two survey teams will work in adjacent sectors to facilitate communications, to provide each other with equipment and manpower support as necessary, and for safety reasons.

Equipment surveys will be performed by Level I and Level II Thermographers using FLIR GasFindIR® cameras. An example camera is presented below.

GasFindIR Camera

All emissions detected with the IR camera will be video recorded. Emission points will also be photographed with a digital camera to aid with identification. The advantage of using the IR camera is that it is able to scan large areas rapidly and visually detect emissions (i.e., large emissions greater than 10,000 ppmv) in real time. It is ideal for sensing emissions from equipment in natural gas service since it readily responds to methane, the largest constituent of natural gas, as well as ethane, propane, and butane. Another advantage of the IR camera is that the operator can effectively use this technology at a distance up to 50 feet from the source of interest.

While the IR camera is extremely good at detecting large emissions, it is limited in several important aspects:

- It does not reliably detect “minor” emissions (i.e. emissions that are less than 10,000 ppmv).
- It cannot quantify an emission’s concentration in ppmv.
- It can not provide empirical data on the emission’s mass release rate – how many pounds per year are being emitted?

- It cannot speciate the emissions. It is unable to tell, for instance, how much of the emission is methane, propane, ethane, benzene, or xylene.

The following information will be collected at each site:

- Wellpad Name/ID;
- Owner/operator information;
- Physical location information (address, GPS coordinates, facility boundaries);
- Information on activities taking place during the point source testing (i.e., drilling, fracturing, completion, production, etc.);
- Description of equipment at site/digital photograph;
- Facility Throughput (cf/d);
- Wet gas/dry gas information;
- Site operational status; and
- Valve, connector and other components counts.

Additionally, the following information will be collected at each site for each IR-detected emission point:

- Timestamp;
- Equipment ID/Description;
- Equipment Size;
- Camera ID/Operator ID;
- Detection Distance (feet);
- Screening Value (ppm);
- Video File Name;
- Ambient temperature (^{o}F), wind information, relative humidity (%); barometric pressure (kPa), and cloud cover (%) using a hand-held device;
- Ambient lighting;
- IR background; and
- Maximum siting distance.

Finally, the following modeling information will be collected from the owner and/or operator when emissions are detected with the IR camera:

- Vents or Stack Information – release height (ft) above ground, gas temperature, gas velocity (ft/sec), stack diameter;
- Fugitive fixed point releases – release height above ground;
- Area sources information – release height above ground, geometry, width (ft), length (ft);
- Tanks information – Roof height above ground (ft), Tank diameter (ft); and
- Nearby traffic conditions.

If a site has compressor engines, we propose to collect engine operating parameters (e.g. engine make, model, and size) and contact the equipment manufacturer to obtain emission

factors (e.g., NO_x, PM, hazardous air pollutants, etc). In lieu of vendor data, U.S. EPA published emission factors may be used to estimate emissions.

3.2 Conduct Screening at Point Sources using the TVA

The objectives of this sub-task is to screen all emissions from sources identified by the IR camera, as well as to screen a subset of components from which no emissions were detected with the camera. This task will be conducted at each site. Assuming that the points of interest are accesible, screening will be performed with a Toxic Vapor Analyzer (TVA) 1000B following the procedures of U.S. EPA Method 21. An example TVA 1000B is presented below.

TVA 1000B

The TVA-1000B is a portable hydrocarbon monitor with a screening range extending from 0.5 ppmv to 50,000 ppmv. Because it is portable, operators can take measurements as close to the equipment as possible. However, we do anticipate that at some sites, using this technology may not be possible due to the locations of the sources of interest.

The analyzer uses a flame ionization detector (FID) to sample and measure gases. Concentrations in ppmv can be read on both the hand held probe and on the instrument sidepack. The response of the TVA to different hydrocarbons is determined by the response characteristics of the flame ionization detector and by the gas species used to calibrate the instrument. The unit is factory calibrated with methane. Since methane is the largest constituent of natural gas, continued methane-calibration of the TVA is appropriate for this project. Thus all concentrations detected by the TVA 1000B will be reported as methane.

Equipment Testing

All emissions that are detected by the IR Camera will be further screened with the TVA to measure their concentration in parts per million volume (ppmv). Because the camera sees large emissions (i.e. > 10,000 ppmv), the concentration of some emission points will likely exceed the upper range of the TVA (50,000 ppmv or 5%) resulting in a possible “flame-out” of

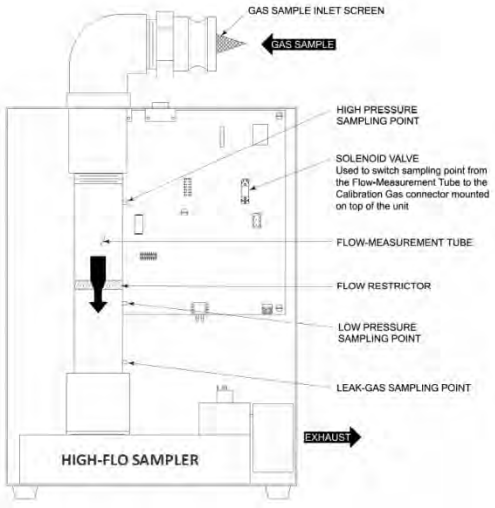
the analyzer.[2] In these instances, we will employ a common practice of using a 10:1 dilution probe to dilute the sample to a concentration level that is able to be surveyed using the TVA (the sample will be diluted to below 50,000 ppmv).

Components Testing

Because a typical wellpad may contain hundreds to thousands of components, it is not feasible from a time perspective to test each component. We will attempt to screen as many components as possible, but given the typical duration of a site visit, we anticipate that, at an average screening rate of 250 components per hour, a minimum of 10% of the total number of facility components will be screened using the TVA, including all sources identified by the IR Camera. Minor-emitting components (those not detected using the IR Camera but detected using the TVA) will be randomly selected from the following component types: Valves, Connectors, and Other Components (pumps, compressors, pressure relief devices, open ended lines, pipelines, etc.).

3.3 Collect Emission Rate Information with the HiFlow Sampler

The objective of this sub-task is to measure emission rates from equipment directly with the Bacharach HiFlow Sampler. This information is important in accurately estimating emission rates at each point source being surveyed. The HiFlow Sampler is a portable, intrinsically safe instrument designed to determine the rate of gas leakage from components in natural gas service. An example of this equipment is presented below.



A component's leak rate is measured by sampling at a high enough flow rate to ensure that all of the gas emitted from the component will be captured. The HiFlow Sampler calculates the resulting leak rate as % concentration per cubic feet/minute by accurately measuring the flow rate of the sample stream and the natural gas concentration within that stream. Emissions from a component are drawn into the unit through a flexible 1.5 inch I.D. hose. An assortment of hose-

[2] A TVA flame-out can occur when the sample concentration is sufficiently high to prevent sufficient air from reaching the detector burner assembly. As a result the hydrogen flame is extinguished and the analyzer must be re-lit.

end attachments are availabe to provide a means of capturing all the gas that is being emitted. Sample flow rate is measured as the pressure differential developed as it passes through a fixed orifice and sample concentration, as methane, is measured by an on-board combustible gas sensor with a range of 0.05% (500 ppm) to 100% gas by volume.

The HiFlow Sampler will be used to test the flow of emissions from sources that have been identified by the IR Camera. Since each Sampler run only takes 3-8 minutes, this provides a very quick and economical way to measure emission rates from these sources. The same constraints applicable to the screening of components with the TVA, will apply to testing with the HiFlow Sampler. That is, components considered Difficult to Monitor or Unsafe to Monitor, will not be able to be tested with the HiFlow Sampler. Instead, they will be documented and the list provided to the City for consideration.

The HiFlow Sampler will also be used to determine emission rates for components identified through the screening effort with the TVA to have emission concentrations greater than 500 ppmv.

Minor-Emitting Component Testing

As stated above, we will randomly collect TVA samples from minor-emitting components. To generate emission rates for these minor-emitting components, we will also us the HiFlow Sampler to characterize emission rate flows. While one inspector is surveying the facility with the IR camera, the second inspector will conduct a selective screening of components with the TVA following EPA Method 21 procedures. The purpose of this screening will be to identify equipment emissions that are below the detection threshold of the IR camera (i.e. minor emissions < 10,000 ppmv). Since the cumulative effect of these minor emission sources can possibly equal or exceed a major source emission, it is important that they be considered in a facility's overall emission potential.

Two types of "units" will be considered in this case: natural gas facilities in wet gas service and natural gas facilities in dry gas service. Since components with emission concentrations of 10,000 ppmv and above (i.e. components with emissions sufficient to be detected by the IR camera) will have already been selected for emission rate testing, additional emission rate testing would only need to be conducted in the three categories below 10,000 ppmv. Since the HiFlow Sampler cannot reliably detect emission rates at concentrations less than 500 ppmv, we propose to conduct HiFlow Sampler emission rate testing on components falling within the following two concentration groupings: 500-1000 ppmv and 1001-10,000 ppmv and to use EPA emission factors for components with emission concentrations below 500 ppmv.

Table 6 defines the proposed HiFlow Sampler test matrix for components with screening values between 500 – 10,000 ppmv.

Table 6. Minor Emitting Component Testing Matrix

Service	Screening Concentration (ppmv)	Component Type	Stream Phase	# HiFlow Sampler Tests
Dry Gas	1-500	All	Gas	EPA Emission Factors
	500-1000	Valve		6
		Connector		6
		Other		6
	1001-10,000	Valve		6
		Connector		6
		Other		6
	1-500	All	Light Liquid	EPA Emission Factors
	500-1000	Valve		6
		Connector		6
		Other		6
	1001-10,000	Valve		6
		Connector		6
		Other		6
Wet Gas	1-500	All	Gas	EPA Emission Factors
	500-1000	Valve		6
		Connector		6
		Other		6
	1001-10,000	Valve		6
		Connector		6
		Other		6
	1-500	All	Light Liquid	EPA Emission Factors
	500-1000	Valve		6
		Connector		6
		Other		6
	1001-10,000	Valve		6
		Connector		6
		Other		6
Total HiFlow Sampler Tests of Minor Emittors				**144**

The emission rates developed for each of these service-component type combinations will be used to generate equipment count-service type surrogate factors, which can then be applied to the enitre natural gas inventory.

The following information will be collected when emission rate measurements are made using the HiFlow sampler:

- Equipment ID/Description;
- Equipment Size;
- Operator ID;
- Pre-Screening Value (ppm);
- HiFlow Sampler ID;
- HiFlow Sampler Sample ID;
- HiFlow Sampler Result (% * cfm); and
- Post-Screening Value (ppm).

3.4 Collect Samples of VOC and Methane Using SUMMA Canisters

The objective of this sub-task is to determine compound-specific emission rates by collecting VOC and methane samples using SUMMA canisters. Although ideal, it is not economically feasible to collect this data at each site. Therefore, collection of these samples will be taken at a representative number of point sources, which then can be used as surrogates for the entire population. An example of a SUMMA canister is presented below.

SUMMA Canister

The canister samples will be collected at the exhaust port of the HiFlow Sampler and sent to TestAmerica laboratories in Austin, Texas for general hydrocarbon analyses (Analytical Method TO-15), and for methane analyses (Analytical Method D-1946). Information about these two analytical methods is provided in Appendix A.

Because emission rate data from the HiFlow Sampler is basically expressed as % total hydrocarbon per cubic foot/minute (i.e., methane response factors), we will be able to use the

results of the Summa canister analysis to determine the emission rate for individual compounds, such as benzene, toluene, methane, ethane, propane, butane, etc.

For typical sampling scenarios, it is expected that no more than one canister sample will need be collected to characterize multiple IR-detected emissions at any one facility. The reason is that once the emission rate as methane has been measured with the HiFlow Sampler, the same constituent proportions identified in a single canister sample can be assumed for all emission sources at that same facility. In other words, if three IR-detected emissions are identified at the same facility, the emission rate for each will be determined with the HiFlow Sampler but only one canister sample will be collected and used to calculate speciated emission rates for all three. Atypical sampling scenarios occur if the speciation profile of additional sources is expected to be different from the majority of sources. For example, sites with saltwater tanks may have a toxics speciation profile that is different, thus requiring multiple canister sampling.

Speciated emission rates will be reported in pounds per hour, unless other units are requested.

The following information will be collected when VOC and methane samples are collected:

- Canister ID#;
- Canister Sample Number;
- Canister Initial Vacuum (inch-Hg);
- Canister Sample Start Time (HH:MM:SEC);
- Canister Sample Stop Time (HH:MM:SEC); and
- Canister Final Vaccuum (inch-Hg).

In addition to the canisters that will be sent for laboratory analysis, the City is also interested in collecting additional canister samples, but not analyzing them immediately or at all. The idea is that if more speciated canister sampling data is needed to enhance the surrogate profiles, the City can have the option of having these canisters analyzed without having to go back to a site. For these canisters, we will follow the same procedures in collecting the sample mentioned above.

3.5 Calculate Point Source Emissions

The objective of this sub-task is to calculate point source emissions. We will generate emission rates for each unit/component surveyed using standard equations. For example, if the HiFlow sampler detects a 5% methane emission at a flow rate of 8 cubic feet/minute, and an analysis of a canister sample collected at the exhaust of the HiFlow sampler yields a 50 ppmv benzene concentration, then the benzene emission rate can be calculated as:

$$\text{E.R.} = \frac{C \times MW}{24.45} \times \text{FR} \times 7.7\text{E-}7$$

Where:

E.R.	=	Emission Rate (lb/hour)
C	=	Concentration (ppmv)
MW	=	Molecular Weight
24.45	=	Molar Volume @ 25^{o}C and 1 atmosphere
FR	=	Flow Rate (ft^3/min)
7.7 E-7	=	Units Conversion Factor.

In the above example, a 50 ppmv benzene canister concentration measured at a flow rate of 8 ft^3/min would correspond to a benzene emission rate of 9.84 E-4 lb/hour, using 78.11 g/mol as the molecular weight of benzene.

Emission points < 500 ppmv are outside the range of the HiFlow Sampler, but can be characterized using EPA screening correlations. Using these correlations, we can determine emission rates for components with concentrations below this threshold. Alternatively, if the City desires to quantify emission rates below 500 ppmv using the site-specific test data, the blow-through bagging method as described in EPA's *Protocol for Equipment Leak Emission Estimates*[3] can be performed as an option. The speciation profiles developed from the canister data will still be applied to these low concentration data.

Based upon previous experience at other natural gas sites, it is expected that a sufficient number of minor emitting components in both dry gas and in wet gas service will be avalable for testing to provide an good understanding of the contribution of smaller emissions (<10,000 ppmv) to a facility's overall emission profile. This information will also be valuable in determining emission increases due to future buildup.

3.6 Field Data Collection

Due to the size and nature of this study, it will be important that all data is collected during each site visit, and archived properly. Site specific information will be collected at each point source location and recorded digitally on Archer Field PCs. An example field PC is presented below.

[3] United States Environmental Protection Agency. *Protocol for Equipment Leak Emission Estimates*. EPA-453/R-95-017. November 1995.

Archer Field PC

This information will include site characterization data, IR-detected emission data, emission rate testing data and information necessary to the modeling effort. Pre-formatted electronic datasheets stored on the Archer Field PCs will be used to record site information and monitoring results. At the conclusion of each day's point source testing, data stored on the Field PCs will be downloaded to spreadsheets and backed up on dedicated hard drives.

All emissions detected with the IR Camera will be video recorded and saved as digital video files. These video files will subsequently be processed using Windows Movie Maker™ software. Processing of raw video files will consist of adding a title slide with timestamp and descriptive information followed by a digital photograph of the emission source. Some editing of the IR Camera video may be performed to improve quality of presentation. The completed video recording will then be saved with a descriptive filename as a Windows Media Video file (*.wmv).

3.7 Quality Assurance Procedures and Equipment

The objective of this sub-task is to ensure that all procdures are followed and all testing equipment is working properly. Below, we list the responsibilities of the quality assurance/quality control (QA/QC) reviewer and equipment calibration procedures.

QA/QC Reviewer

Mr. Arthur Bedrosian will serve as Quality Control reviewer of the point-source survey effort. With nearly 40 years of experience, Mr. Bedrosian has worked on numerous air quality projects within the state of Texas, and has keen insight and sensitivity to all facets of point sources testing. Mr. Bedrosian's responsibilities will include the following:

- Oversight of the survey program for conformance with this work plan, any relevent standards and instructions;
- Checking identification and completeness of project documentation;

- Checking for appropriate use of forms, logs or formats;
- Ensuring that all equipment is properly referenced and calibrated;
- Checking that equipment meets specifications; and
- Random inspection of field activities to ensure they are being performed in accordance with the procedures listed in this project plan and that instrument calibration records are complete and indicate that instruments are in a state of control during use.

Mr. Bedrosian will report any quality control concerns to the Point Source Project Manager, Mr. David Ranum who will be responsible for addressing them.

Instrument Calibration

Individual quality assurance items for each piece of equipment include, but are not limited to the following:

1. IR Camera Daily Demonstration. The following procedures will be implemented each day prior to using each IR camera for emission surveying:
   a. The camera will be turned on and allowed to cool down (cool down time is approximately 6 minutes);
   b. Following cool down, the camera will be taken outside and allowed several minutes to equilibrate to ambient conditions;
   c. After the equilibration period, several non-uniformity corrections will be performed; and
   d. The camera daily demo (daily demonstration) will then be conducted. This demonstration will be performed at two mass flow rates: a low rate equivalent to approximately 5 grams propane/hour and a high rate equivalent to approximately 25 grams propane/hour, with a video recording made of each result. The distance from which the camera operator is able to see the propane plume (***i.e.***, the sighting distance) will be recorded for each mass flow rate together with ambient temperature, wind speed, relative humidity, barometric pressure, cloud cover, and ambient lighting conditions.

2. TVA 1000B Calibration and Drift Checks. The TVA 1000B™ analyzers will be calibrated daily prior to field use with certified ±2% accurate calibration gases equipped with demand-flow regulators. Both instruments will also be performance tested (response time, precision, flow rate) at the start of the testing period. Four gas standard concentrations will be used for the daily calibrations: 0, 500, 1,000, and 10,000 ppmv methane-in-air. Drift checks will be performed using the 500-ppmv standard, at mid-day and at end-of-day. Calibration and drift check acceptance criteria will be ±10% of each calibration gas certified concentration. Any responses outside the acceptance criteria will require either re-calibration or trouble shooting and repair of the analyzer.

3. HiFlow Sampler Calibration. Both HiFlow Samplers will be calibrated each day prior to use. For calibration of the background sensor, a 2.5% methane standard will be

used. To calibrate the Gas Sample sensor, a 100% methane standard will be used. Both gas standards will be equipped with Demand Flow Regulators.

4. Canister Sample Collection QC Procedures. The vacuum of each canister will be checked and documented prior to sampling. Canisters with a vacuum of < 25 in. mercury (Hg) will not be used. A residual vacuum of 5 -10 in. Hg will be left in the canister following sample collection. This value will be documented. Appropriate chain-of-custody procedures will be followed for all canister samples. This means keeping an accurate written record to track the possession, handling, and location of the canisters from collection through analysis. Canisters in possession of the point source survey team will be kept in a secure area with access restricted to authorized personnel only. The following chain-of-custody guidelines will be observed:
   a. Only persons associated with the project will be allowed to handle the canisters.
   b. Strict documentation of the transfer of canisters and data from person to person will be kept on chain-of-custody forms.
   c. Written canister documentation will always be legible and with permanent ink.
   d. Canister serial numbers will be recorded on the chain of custody documentation.

   While Field, Trip and Ambient blanks are customary in ambient air canister sampling they are less of a consideration in point source sampling due to the high concentrations involved. No canister blanks are planned for the point source sampling effort. Field duplicates are second samples collected in the field simultaneously or near-simultaneously with the primary sample at the same location. The results of the duplicate sample may be compared with the primary sample to provide information on consistency and reproducibility of field sampling procedures. Field duplicates will be collected at a 5% rate (i.e. 1 duplicate per 20 canister samples).

5. Analytical QC Procedures**.** Analytical QC procedures will include the following:
   a. Defining in-house control limits for surrogates, matrix spikes and laboratory control samples.
   b. Batch method blank analyses.
   c. Analysis of Quality Control Samples.
   d. Canister blank checks.
   e. Laboratory control sample and control sample duplicates.
   f. Sample duplicates.
   g. Surrogate sample analyses.
   h. Internal standards analyses.
   i. Instrument performance checks.

3.8 Project Safety

Project safety is important to the City, to the Contractor, and especially to the point source team members. A project Safety & Health plan will be drafted specific to this project. Each project team will be required:

a. To keep with them a signed copy of the project safety plan.
b. To hold daily safety toolbox meetings to review specific project hazards either encountered or anticipated.
c. To have readily available an emergency first aid kit.
d. To have all required PPE as specified in the project safety plan.

3.9 Point Source Testing Costs

The cost estimate to complete this task is $246,477. Details are provided in Table 8.

4.0 TASK 4 – AIR DISPERSION MODELING

- ***What effect do emissions from natural gas exploration and production activities have on ambient air quality at the fenceline?***
- ***Are the City's setbacks for wells, tanks, and compressors adequate to protect public health?***

Using the point source emissions data obtained under Task 3, air dispersion modeling will be performed to determine the effect that natural exploration and production activities have on ambient air quality. Established air quality models will be used to determine pollutant concentrations at facility fencelines, as well as at distances required under the City's setback provisions contained in Ordinance 18449-02-2009. The data obtained as a result of this task will compliment the data determined through the ambient air monitoring network under Task 2, and collectively, these tasks will serve to answer the two questions above.

4.1 Model Selection and Scenarios

ERG has selected the AMS/EPA Regulatory Model (AERMOD) for use in determining impacts from sources of interest in this study. We believe AERMOD is the most appropriate model to implement based on the following reasons:

1. AERMOD is the U.S. EPA preferred air dispersion model for near-field (Appendix W to 40 CFR Part 51, *Guideline on Air Quality Models*, http://www.epa.gov/ttn/scram/guidance/guide/appw_05.pdf, Page 68253);
2. AERMOD is widely accepted and used in the scientific and regulatory community;
3. The study domain falls within the distance limits of AERMOD (50 km or ~30 miles);
4. AERMOD supports multiple sources types (vents, stacks, area sources for piping);
5. AERMOD needs only a single meteorological station, along with upper air data to execute, unlike grid models; and
6. Special meteorological circumstances are not at issue in this case (complex wind flows, stagnation, complex terrain); therefore, alternate models, such as CALPUFF, are unnecessary.

ERG proposes local modeling of a limited number of proposed sites spread throughout the city. Although several areas of the city are affected by the industry, it may be of interest to the City to intensely study a handful of sites, representing operations across the various phases of

the gas drilling and production cycle. In consultation with the City, ERG will select sites for more detailed modeling study. For example, we might consider a simple wellpad, a more complex wellpad with lift engines and/or a dehydrator, a gas gathering station or compressor station, and a site affected by both a wellpad and a compressor station. Each analysis will include analysis of impacts at facility property lines, at setback distances proscribed by the city, and at local sensitive receptors (such as nearby parks, schools and homes). This analysis will include our estimates of actual emissions as determined through source testing, downwash effects (if applicable), locally collected meteorological data, and detailed land use analysis.

4.2 Model Inputs

In the case of individual site modeling, ERG staff will review facility plot plans and aerial photography to identify property boundaries and fencelines, and uniquely identify all emissions sources and downwash structures of interest. For all modeling performed, sources will be correctly classified as either point, volume, or in some cases, area. Sources will also be located in an appropriate fashion, in an effort to reflect where on the property emissions actually occur. Source classification and placement will conform to TCEQ guidance; if there is any uncertainty as to how a particular source should be modeled, adequate justification will be clearly presented.

Source Parameters

The modeling submittal and electronic files will include a listing of all necessary source parameters input to the model. These include emission rates, UTM coordinates, base elevation, source height, stack exit velocity and temperature, and source dimensions, as applicable to each source type. This data will be obtained at the time of the point source testing, through development of emission factors under Task 6, or through operator interviews. In addition, locations, dimensions, and heights of structures on the property that could contribute to building downwash will be clearly presented. Effects of building downwash will be determined by use of the PRIME processor.

If sources with similar parameters are combined into one source to reduce model calculation time, justification will be provided. Effective plume heights for volume sources, if provided, will be calculated appropriately, and volume sources dimensions will be divided by a factor of 2.15 per EPA guidance. “Pseudo-point” sources (rain capped or horizontal stacks, for example) will be modeled with an exit velocity of 0.1 m/s. Area sources, if modeled, will maintain an aspect ratio of no greater than 10-to-1, and no such sources will extend off property.

Emission Rates

Actual emission rates will be derived from on-site testing, or based on information provided by site owners, as appropriate. Pollutants of interest include VOCs and HAPs, including benzene and formaldehyde; other pollutants may be modeled as well, if future consultation with the city dictates.

Meteorological Data

Meteorological data is collected at several airports and sampling stations in and around the city, and is publically available through the NOAA and TCEQ. We anticipate that annual meteorological data collected at the weather station closest to the modeled facility will be used as a basis for our analysis, subject to availability and proper quality control. If not, justification for use of an alternate station will be presented. A description of the methodology and software used to process the data will also be presented. Some meteorological data used for this analysis may initially include pre-processed and quality checked surface and upper air data for the Fort Worth area provided by TCEQ, which provides a number of data sets to choose from.

In all cases, the anemometer height, station identifier, and calendar year of the data will be provided and input to the model. The AERMET meteorological pre-processor will be used to prepare the data for input to AERMOD, as necessary.

Receptors

The receptor grids developed for individual sites will consist of both appropriate fenceline receptor spacing (likely 25-50 meters), as determined by the area of the facility, and downwind receptor spacing. Maximally impacted receptors should be located in spacing of no greater than 100 meters. ERG expects that most receptor grid spacing will increase as receptors are located further from the facility, out to distances between 5 and 10 km, but the receptor spacing must still be dense enough to identify any maxima and develop accurate concentration isopleths. Receptors will include terrain heights derived from USGS DEM information and applied using the AERMAP terrain processor. Sensitive receptors, including individual homes, schools, parks, and other area of interest may be modeled in consultation with the city.

4.3 Model Outputs

As part of the submitted modeling analysis, summaries of model outputs will be clearly presented. Annual average, maximum hourly, and other applicable short-term averaging period concentrations for the applicable public health evaluation threshold (such as TCEQ's ESL and AQMV levels) values will be reported. Summary plots of the modeled receptor grid, along with pollutant isopleths, will be included as well.

4.4 Modeling Hours and Costs

Modeling of specific sites of interest will require approximately 75 hours per site, but these costs will vary with the number of sources, receptors, and pollutants modeled. The cost estimate for this task is $39,230, based on modeling 3 single site scenarios and one combined site scenario as discussed in Section 4.1. Details on the cost breakdown are provided in Table 8.

5.0 TASK 5 – COMMUNICATION AND OUTREACH

Outreach is needed to build trust within the community and to ensure residents that this project will meet the City's objectives, address the concerns of the citizens of Fort Worth, and be

conducted in a scientifically defensible fashion. Under a separate contract (Fort Worth Natural Gas Air Quality Planning Study), ERG will provide the City with a memo delineating options and recommendations for communication and outreach activities that will achieve these goals. ERG will work closely with the City to discuss the options and recommendations presented in the memo before coming to an agreement as to how to proceed with this task.

Under this task, we will then develop a draft communication and outreach plan for conveying the goals, progress, and results of this study to the citizens of Fort Worth. Once the plan has been reviewed and finalized, we will implement the communication and outreach activities accordingly.

Note: Our cost estimate for this task includes costs for 7 1-day trips for project staff to provide project updates to the City, to the public, or to attend other meetings or conferences as requested by the City. Additional funds have been set aside for this task to develop and implement the communication and outreach plan. For purposes of providing an estimate for this work plan, the costs for this task are $45,254. However, until the full scope of this effort has been agreed upon with the City, a final cost estimate for this task cannot be determined.

6.0 TASK 6 – FULL BUILD-OUT ESTIMATES

Over the last five years, there has been a dramatic increase in natural gas exploration and production activities in the Barnett Shale, and in the City of Fort Worth itself. This increase has led to concerns by the citizens of Fort Worth that their quality of life is being impacted by deteriorating air quality due to these activities. While Tasks 1 through 5 focus on the current air quality as contributed to by the existing natural gas exploration and production sources, the expansion of the natural gas industry within the City is expected to continue into the future. Under this task, the ERG team will develop point source emission factors using the data collected under Task 3, develop growth estimates to project the number of point sources anticipated to exist within the City under "full build–out" conditions, and use these data to develop a city-wide emissions inventory. In this context, "full build-out" means the point at which the natural gas exploration and production infrastructure has been completed within the City (i.e. there will be no more wells drilled).

6.1 Point Source Emission Factor Development

Using the results of the point source testing task (Task 3), the ERG team will develop average emission factors for the following emission units:

- Wells
- Well pads
- Lift and line compressor engines
- Equipment leaks
- Storage tanks
- Dehydrators
- Pipelines

The final sub-categorization of the emission units included in the emission factor development task will be determined in consultation with the City, considering the measured variability in emission rates for each unit type (from Task 3) and the availability of process data on which to base the emission factor (from this task). Depending on availability of data, emission factors may be developed on a temporal basis (pound per hour or pound per day) or an activity basis (pound per thousand cubic feet of gas produced). Additionally, operator data will be collected on pre-production activities (drilling, fracturing, completion) to estimate emissions from mobile sources (PM generated by truck traffic) and from temporary engines used on-site for drilling, auxiliary power, and fracturing operations (PM and NOx).

6.2 Growth Estimate Development

Any projection of current emissions levels to future emissions levels will need to take into account both the total number of emission sites (wells, well pads, treatment and processing sites) as well as total natural gas production levels. At some point, production of natural gas within the City will peak, and this will likely occur prior to conclusion of full build-out (the time at which the last well is completed). An evaluation will be made to determine the point at which maximum emissions are likely to occur.

The data needed to conduct this evaluation will be obtained under this task from available resources such as the U.S. Department of Energy, Energy Information Administration (EIA), from drilling and production projections from trade groups and commercial vendors, or through other available oil and gas activity projection resources such as Baker Hughes Rig Counts. Additionally, surveys of the owners and operators can be used to augment future activity estimates under full build-out conditions.

6.3 Emissions Estimates under Full Build-Out Conditions

Final emission estimates from natural gas exploration and production that are expected to occur under full build-out conditions will be developed using the emission factors developed under Task 6.1, and the growth estimates developed under Task 6.2. All assumptions and calculations used to prepare the full build-out inventory will be documented and reviewed with the City prior to finalization.

6.4 Full Build-Out Evaluation Hours and Costs

The cost estimate for this task is $10,900, which assumes that baseline emissions will be linearly extrapolated to full build-out emissions based on the maximum projected natural gas production rate within the City at some point in the future as compared to current production. A more refined analysis, such as attempting to provide geo-specificity to the full build-out inventory, would require additional resources. Details on the cost breakdown are provided in Table 8.

7.0 TASK 7 – FINAL REPORT

An all-inclusive final report presenting the findings of this study will be prepared under Task 7. A proposed outline for the final report, including a brief description of the content of each section, is provided below.

Section 1 - Ambient Monitoring Methodology and Results

This section will present a summary of the findings of the ambient air monitoring network, with detailed analytical results for each monitoring sample presented in an Appendix. The discussion will provide details on network development, network implementation, the methodology used to collect and analyze the samples, the quality assurance/control control (QA/QC) results, and any changes made to the ambient network monitoring design as the project progressed.

Section 2 - Point Source Testing Methodology and Results

This section will present a summary of the findings of the point source testing task (Task 3), with detailed analytical results for each point source presented in an Appendix. The discussion will provide details on point source identification, the sampling approach, the methodology used to collect and analyze the samples, the QA/QC results, and any changes made to the point source testing plan as the project progressed.

Section 3 - Dispersion Modeling Methodology and Results

This section will present a summary of the dispersion modeling effort, including model input parameters (stack height, emissions rates, meteorological data), model methodology development, and modeling results.

Section 4 - Public Health Evaluation

- ***Are the City's setbacks for wells, tanks, and compressors adequate to protect public health?***

This section of the report will evaluate public health impacts associated with natural gas exploration and production activities to provide context for the question about the adequacy of setbacks. The public health evaluation will integrate findings from numerous data sources. Much of the focus will be on pollutant concentrations determined under Tasks 2 (Ambient Air Monitoring) and 3 (Dispersion Modeling), and these will be compared to relevant state, federal, and international health guidelines. Consideration will be given to both cancer and non-cancer health effects and evaluation of both acute and chronic exposure durations.

More detailed evaluations will be offered for pollutants found to exceed their corresponding health guidelines. These evaluations will summarize information on the health effects of the pollutant of concern, primarily by reviewing the relevant toxicological and epidemiological literature. The detailed evaluations will also consider any unique health risks

experienced by susceptible populations (e.g., children, the elderly, and persons with pre-existing health conditions). Uncertainties in the public health evaluation will also be identified and discussed, and some discussion will be included on the potential public health implications regarding simultaneous exposures to mixtures of multiple pollutants.

Additional context will be provided by comparing measurements made during this program to those made during other studies that have examined air quality impacts of Fort Worth's oil and gas exploration activity. The measurements will also be compared to levels typically measured in similar urban and suburban settings, for further perspective.

Section 5 - Regulatory Assessment

- ***Do the sites comply with applicable regulatory limits?***

Upon completion of the point source testing task, facility-level emission estimates developed for wells, well pads, gathering stations, treatment and processing plants, and disposal facilities will be evaluated against various regulatory thresholds and standards. Regulatory standards to be considered include TCEQ's permit-by-rule and standard permit thresholds, Title V Operating Permit thresholds, New Source Review (NSR) thresholds for Prevention of Significant Deterioration (PSD) and Nonattainment NSR, and EPA's NESHAP and Maximum Achievable Control Technology (MACT) standards.

Section 6 - Full Build-Out Estimates

This section of the report will present a summary of the results of Task 6, including the point source emission factors developed under Task 3, and an assessment of both baseline emissions (current conditions) and emissions at full build-out.

Section 7 - Conclusions and Recommendations

The final section of the report will present our conclusions as to the findings of the study, as well as recommendations for future considerations.

The cost estimate for this task is $41,092, with much of this effort dedicated to the public health evaluation in Section 4 (approximately $18,000). Details on the cost breakdown are provided in Table 8.

8.0 TIME LINE (SECTION 8.0 REVISED AUGUST 16, 2010)

The proposed schedule for this project is shown in Table 7 below. The dates in this table are based on issuance of the Notice to Proceed (NTP) on August 20, with the dates for final products based on the City's review and approval of the associated draft deliverables within seven days of receipt. If situations arise such that the City's review takes longer than seven days, subsequent project milestone dates will have to be re-evaluated to ensure they can still be met. As necessary, ERG will propose revised milestone dates.

Table 7. Projected Schedule for Fort Worth Natural Gas Air Quality Study

Milestones	Planned Date
Task 1 – Project Management	
1.1: Monthly Progress Reports and Invoices	15th of Each Month
Task 2 – Ambient Air Monitoring	
2.1: Final Ambient Air Monitoring Plan	To Be Determined [a]
2.2: Site Selection and Network Setup	August 30 – September 3, 2010
2.3: Commence Ambient Air Sample Collection	September 7, 2010
2.4: Conclude Ambient Air Sample Collection	November 16, 2010
2.5: Ambient Air Monitoring Report	December 10, 2010
Task 3 - Point Source Testing	
3.1: Final Point Source Test Plan	August 20, 2010
3.2: Commence Point Source Testing	August 30, 2010
3.3: Conclude Point Source Testing	November 30, 2010
3.4: Point Source Testing Report	January 14, 2011
Task 4 - Air Dispersion Modeling	
4.1: Complete Facility Plot Plan Review	December 10, 2010
4.2: Complete Valuation of Source Locations and Release Parameters	December 10, 2010
4.3: Complete Review of Receptor Placement and Classification	December 10, 2010
4.4: Meteorological Data Analysis (if necessary)	January 14, 2011
4.5: Model Execution and Review of Results	February 11, 2011
4.6: Air Dispersion Modeling Report	March 11, 2011
Task 5 – Communication and Outreach	
5.1: Draft Communication and Outreach Plan [b]	September 7, 2010
5.1: Final Communication and Outreach Plan	September 21, 2010
Task 6 - Full Build-Out Estimates	
6.1: Draft Full Build-Out Estimates	December 23, 2010
6.1: Final Full Build-Out Estimates	January 14, 2011

Table 7. Projected Schedule for Fort Worth Natural Gas Air Quality Study (Cont.)

Milestones	Planned Date
Task 7 - Final Report	
7.1: Draft Final Report	March 11, 2011
7.1: Final Report	March 25, 2011

[a] The Final Ambient Air Monitoring Plan under Task 2.1 will include final site locations. As such, this deliverable will be submitted within 7 days of final site selection.
[b] The deliverable date for the draft Communication and Outreach Plan is contingent upon finalization of the Communication and Outreach Memo (being done under Contract No. 40631 – Natural Gas Air Quality Study Planning) by August 24, 2010.

9.0 BUDGET

Table 8 provides a breakdown of labor costs and labor hours for the project by task. Table 9 shows the estimated hours for the project by individual staff, and indicates non-ERG staff.

Table 8. Estimated Costs to Perform Fort Worth Natural Gas Air Quality Study

Task	Total Costs	
	Hours	**Dollars**
1. Project Management	143	$22,020
2. Ambient Air Monitoring		
- Labor	982	$104,844
- ODCs (Travel, Equipment, Analytical Costs)	N/A	$123,227
3. Point Source Testing		
- Labor	1,398	$160,012
- ODCs (Travel, Equipment, Analytical Costs)	N/A	$86,465
4. Air Dispersion Modeling	310	$39,230
5. Communication and Outreach		
- Labor	256	$36,560
- ODCs (Travel, Outreach Materials)	N/A	$8,694
6. Full Build-Out Estimates	100	$10,900
7. Final Report	308	$41,092
TOTAL	**3,497**	**$633,044**

Table 9. List of Staff Members for Fort Worth Natural Gas Air Quality Study

Staff Member	Labor Classification	Total Hours
Art Bedrosian (Sage)	Consulting Engineer/Scientist	45
Dave Dayton	Principal Engineer/Scientist	128
Erik Epple (Hicks)	Staff/Technician Support	320
Karla Faught	Associate Engineer/Scientist	80
Katie Ferguson (Sage)	Staff Engineer/Scientist	140
Scott Fincher	Staff Engineer/Scientist	150
Kerry Fountain	Staff/Technician Support	16
Jamie Hauser	Associate Engineer/Scientist	20
Chris Lehman (Sage)	Mid-level Engineer/Scientist	320
Matt O'Neill (Hicks)	Staff/Technician Support	360
Regi Oommen	Mid-level Engineer/Scientist	181
Heather Perez	Associate Engineer/Scientist	100
Mike Pring	Senior Staff Engineer/Scientist	257
David Ranum (Sage)	Principal Engineer/Scientist	280
Sarah Royster	Intern Engineer/Scientist	65
Scott Sholar	Associate Engineer/Scientist	140
Arney Srackangast	Mid-level Engineer/Scientist	150
Sage Tech Support (Sage)	Staff/Technician Support	4
Jody Tisano	Staff/Technician Support	48
Stephen Treimel	Associate Engineer/Scientist	165
Peter Van Zandt (Hicks)	Staff/Technician Support	320
Tom Van Zandt (Hicks)	Consulting Engineer/Scientist	8
John Wilhelmi	Principal Engineer/Scientist	176
Rodney Williams	Associate Engineer/Scientist	24
TOTAL		**3,497**

10.0 OPTIONAL STUDIES

10.1 Ambient Air Monitoring (Optional Long-term Study)

This task was not originally listed in the Request for Qualifications, but the City expressed interest in potentially extending the short-term monitoring study to at least one-year to obtain true long-term (annual) monitoring data. After evaluating initial short-term results, it may become evident that some, if not all the short-term sites should be used for long-term monitoring. We envision that once long-term monitoring begins, the sampling schedule would convert from once every three days to once every six days. Thus, in one year, approximately 70 samples may be collected at a site, which is more than sufficient in developing an annual average suitable for long-term exposure comparisons.

Similar to the short-term study, we propose sampling for VOCs, SNMOC, and methane. Carbonyls would not be collected under this scheme unless the initial screening showed results indicating the need for a long-term evaluation. It is strongly recommended that long-term monitoring begin at the end of the short-term monitoring without delay, such that a years worth of samples can be collected by mid-August 2011. Table 10 presents the long-term number of samples needed to accomplish this task. Note that ERG's cost estimate does not include the costs for performing this task.

Table 10. Proposed Approach and Schedule of Collection Events for the Long-Term Ambient Monitoring Network Element of the FT. Worth Survey Study

Parameter	Concurrent VOC/SNMOC/Methane	VOC/SNMOC/Methane Duplicate samples
Number of Samples (1-in-6 days)	50 samples * 5 sites = 250	13 samples * 2 sites = 26
Overall Total Samples = 276		

10.2 Ambient Air Monitoring (Optional Well Site Life-cycle Study)

This task was not originally listed in the Request for Qualifications, but the City expressed interest in a specialized short-term study evaluating activities during the "lifecycle" of a production well. The lifecycle includes: pre-bit activities, drilling and fracturing activities; well completion activities; and production activities. The City estimates that these activities typically occur during a 6-month period. To accomplish this task, we envision the following schedule:

1) pre-bit activities: one site, sampling once every 6 days
2) drilling and fracturing activities: five sites, once every three days
3) well completion activities: five sites, once every three days
4) production activities: one site, sampling every 6 days

Monitoring sites would be situated around the fenceline surrounding the wellpad. Additionally, we recommend installing an anemometer at the fenceline to capture the behavior of the wind

during this study. Finally, we envision sampling for the same suite of pollutants as the long-term study (VOCs, SNMOC, and methane). Note that ERG's cost estimate does not include the costs for performing this task.

10.3 Ambient Air Quality Impact of Full Build-Out Conditions (Optional)

The impact on ambient air quality due to full build-out of natural gas exploration and production would be determined under this task using air quality modeling. Note that ERG's cost estimate does not include the costs for performing this task; however, a brief discussion of how this task could be carried out is provided, along with identification of some of the issues involved in this type of analysis.

While it is expected that the concentration of pollutants such as benzene in the ambient air due to natural gas exploration and production would increase under full build-out conditions on a *city-wide* basis, impacts to an individual street or residence are more likely to be related to their proximity to an *individual* source (e.g., well pad) rather than to the *total number* of sources within the City limits.

Given the relative magnitude of emissions from all source types (i.e., point sources, area sources, mobile sources), changes in air quality in the City due to other sources (especially motor vehicles) would most likely have a much greater impact on predicted ambient air concentrations of a specific HAP (e.g., benzene) than would changes in air quality due specifically to natural gas exploration and development activities. Additionally, any prediction of future air quality would need to take into account changes in state and federal air quality rules. Examples of these types of considerations include:

- Changes in traffic patterns and population growth
- Proposed revisions to TCEQ rules such as the Permit by Rule for Oil and Gas Production Sites (106.352)
- Additions or changes to the U.S. EPA's National Emissions Standards for Hazardous Air Pollutants (NESHAP) for oil and gas sources

Although these considerations would affect the City's air quality in the future, it is possible to develop an estimate of the impact that full build-out conditions would have on the City's air quality. ERG proposes an overall, city-wide modeling analysis conducted in "regulatory" mode, similar to what industrial facilities do for permits. In this case, we would model maximum emissions (based on the results of the point source testing, supplemented with permitted emission rates if necessary) for selected pollutants as determined under Task 6.3, using TCEQ model-ready meteorological data. Note that this is not a "real-world" analysis, but rather would be intended to provide an estimate of what the maximum impacts could potentially be. The downside of this approach is the modeling analysis will most likely overestimate impacts, due to the conservative modeling assumptions, and due to the lack of geo-specificity of the locations of the sites at full build-out. However, if conservative results obtained using worst-case assumptions are below concentrations of concern, a large degree of confidence is achieved that the public would not be subject to adverse air quality due to full build-out of natural gas exploration and production in the City.

Appendix A – Point Source Analytical Methods and Detection Limits

TestAmerica Austin

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Analytical Method Information

Analyte	MDL	Reporting Limit	Surrogate %R	Duplicate RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike / LCS %R	Blank Spike / LCS RPD
TO15_Source in Air (TO-15)								
Preservation: Store sealed at STP								
Container: Passivated Canister		**Amount Required:** 6000 mL				**Hold Time:** 30 days		
Propylene	0.00326	0.0200 ppmv		25			62 - 122	25
Chlorodifluoromethane	0.00112	0.0200 ppmv		25			71 - 131	25
Dichlorodifluoromethane	0.00159	0.0200 ppmv		25			70 - 130	25
Chloromethane	0.00119	0.0200 ppmv		25			58 - 118	25
1,2-Dichloro-1,1,2,2-tetrafluoroethan	0.00128	0.0200 ppmv		25			65 - 125	25
Vinyl chloride	0.00234	0.0200 ppmv		25			64 - 124	25
1,3-Butadiene	0.00300	0.0200 ppmv		25			64 - 124	25
Butane	0.00160	0.0200 ppmv		25			66 - 126	25
[redacted]	0.0222	0.0500 ppmv		25			79 - 139	25
Bromomethane	0.00263	0.0200 ppmv		25			66 - 126	25
Chloroethane	0.00397	0.0200 ppmv		25			67 - 127	25
Vinyl bromide	0.00283	0.0200 ppmv		25			68 - 128	25
[redacted]	0.00507	0.0200 ppmv		25			73 - 133	25
[redacted]	0.00482	0.0200 ppmv		25			76 - 136	25
Isopentane	0.00232	0.0200 ppmv		25			73 - 133	25
Trichlorofluoromethane	0.000840	0.0200 ppmv		25			70 - 130	25
Acetone	0.00434	0.0200 ppmv		25			62 - 122	25
[redacted]	0.00234	0.0200 ppmv		25			50 - 150	25
[redacted]	0.00516	0.0200 ppmv		25			68 - 128	25
n-Pentane	0.00189	0.0200 ppmv		25			65 - 125	25
Diethyl ether	0.00437	0.0200 ppmv		25			67 - 127	25
1,1-Dichloroethene	0.00208	0.0200 ppmv		25			64 - 124	25
Methylene chloride	0.00205	0.0200 ppmv		25			55 - 115	25
t-Butanol	0.00399	0.0200 ppmv		25			73 - 133	25
Carbon disulfide	0.00110	0.0200 ppmv		25			70 - 130	25
Allyl chloride	0.00289	0.0200 ppmv		25			71 - 131	25
1,1,2-Trichlorotrifluoroethane	0.00106	0.0200 ppmv		25			64 - 124	25
trans-1,2-Dichloroethene	0.00164	0.0200 ppmv		25			71 - 131	25
1,1-Dichloroethane	0.00122	0.0200 ppmv		25			66 - 126	25
Methyl tert-Butyl Ether	0.00272	0.0200 ppmv		25			80 - 140	25
Vinyl acetate	0.00264	0.0200 ppmv		25			95 - 155	25
2-Butanone (MEK)	0.00322	0.0200 ppmv		25			70 - 130	25
cis-1,2-Dichloroethene	0.00157	0.0200 ppmv		25			66 - 126	25
Hexane	0.00140	0.0200 ppmv		25			64 - 124	25
Chloroform	0.00183	0.0200 ppmv		25			73 - 133	25
[redacted]	0.00272	0.0200 ppmv		25			70 - 130	25
[redacted]	0.00259	0.0200 ppmv		25			65 - 125	25
1,2-Dichloroethane	0.000830	0.0200 ppmv		25			73 - 133	25
1,1,1-Trichloroethane	0.00155	0.0200 ppmv		25			75 - 135	25
Benzene	0.00253	0.0200 ppmv		25			61 - 121	25
Carbon tetrachloride	0.00135	0.0200 ppmv		25			80 - 140	25
[redacted]	0.00393	0.0200 ppmv		25			50 - 150	25
Cyclohexane	0.00269	0.0200 ppmv		25			66 - 126	25
Dibromomethane	0.00192	0.0200 ppmv		25			70 - 130	25
1,2-Dichloropropane	0.00144	0.0200 ppmv		25			65 - 125	25
Bromodichloromethane	0.00137	0.0200 ppmv		25			71 - 131	25

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Analytical Method Information

Analyte	MDL	Reporting Limit	Surrogate %R	Duplicate RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike / LCS %R	Blank Spike / LCS RPD
Trichloroethene	0.00552	0.0200 ppmv		25			64 - 124	25
[redacted]	0.00209	0.0200 ppmv		25			65 - 125	25
2,2,4-Trimethylpentane	0.00143	0.0200 ppmv		25			66 - 126	25
Methyl methacrylate	0.00237	0.0200 ppmv		25			77 - 137	25
Heptane	0.00246	0.0200 ppmv		25			71 - 131	25
cis-1,3-Dichloropropene	0.00211	0.0200 ppmv		25			75 - 135	25
4-Methyl-2-pentanone (MIBK)	0.00168	0.0200 ppmv		25			74 - 134	25
trans-1,3-Dichloropropene	0.00210	0.0200 ppmv		25			83 - 143	25
1,1,2-Trichloroethane	0.00196	0.0200 ppmv		25			73 - 133	25
Toluene	0.00321	0.0200 ppmv		25			69 - 129	25
2-Hexanone	0.00197	0.0200 ppmv		25			52 - 112	25
Chlorodibromomethane	0.00100	0.0200 ppmv		25			83 - 143	25
1,2-Dibromoethane (EDB)	0.00139	0.0200 ppmv		25			71 - 131	25
n-Octane	0.00187	0.0200 ppmv		25			68 - 128	25
Tetrachloroethene	0.00515	0.0200 ppmv		25			70 - 130	25
Chlorobenzene	0.00119	0.0200 ppmv		25			69 - 129	25
Ethylbenzene	0.00209	0.0200 ppmv		25			71 - 131	25
m-Xylene & p-Xylene	0.00467	0.0400 ppmv		25			76 - 136	25
Bromoform	0.000940	0.0200 ppmv		25			87 - 147	25
Styrene	0.00237	0.0200 ppmv		25			82 - 142	25
1,1,2,2-Tetrachloroethane	0.00104	0.0200 ppmv		25			81 - 141	25
o-Xylene	0.00163	0.0200 ppmv		25			78 - 138	25
[redacted]	0.00239	0.0400 ppmv		25			77 - 137	25
1,2,3-Trichloropropane	0.00104	0.0200 ppmv		25			77 - 137	25
n-Nonane	0.00183	0.0200 ppmv		25			76 - 136	25
Isopropylbenzene	0.00175	0.0200 ppmv		25			74 - 134	25
2-Chlorotoluene	0.00207	0.0200 ppmv		25			77 - 137	25
n-Propylbenzene	0.00210	0.0200 ppmv		25			81 - 141	25
4-Ethyltoluene	0.00246	0.0200 ppmv		25			86 - 146	25
1,3,5-Trimethylbenzene	0.00252	0.0200 ppmv		25			86 - 146	25
alpha-Methylstyrene	0.00213	0.0200 ppmv		25			90 - 150	25
1,2,4-Trimethylbenzene	0.00210	0.0200 ppmv		25			87 - 147	25
tert-Butylbenzene	0.00190	0.0200 ppmv		25			79 - 139	25
Benzyl chloride	0.00177	0.0200 ppmv		25			98 - 158	25
1,3-Dichlorobenzene	0.00231	0.0200 ppmv		25			94 - 154	25
n-Decane	0.00192	0.0200 ppmv		25			79 - 139	25
1,4-Dichlorobenzene	0.00265	0.0200 ppmv		25			88 - 148	25
sec-Butylbenzene	0.00199	0.0200 ppmv		25			78 - 138	25
4-Isopropyltoluene	0.00255	0.0200 ppmv		25			85 - 145	25
1,2-Dichlorobenzene	0.00243	0.0200 ppmv		25			87 - 147	25
n-Butylbenzene	0.00194	0.0200 ppmv		25			87 - 147	25
n-Undecane	0.00215	0.0200 ppmv		25			82 - 142	25
1,2,4-Trichlorobenzene	0.00514	0.0200 ppmv		25			98 - 158	25
Naphthalene	0.00629	0.0200 ppmv		25			97 - 157	25
n-Dodecane	0.00264	0.0200 ppmv		25			82 - 142	25
1,2,3-Trichlorobenzene	0.00549	0.0200 ppmv		25			86 - 146	25
Hexachlorobutadiene	0.00196	0.0200 ppmv		25			91 - 151	25
[redacted]				25			70 - 130	25
surr: 4-Bromofluorobenzene			72 - 132	25				
surr: 1,2-Dichloroethane-d4			79 - 139	25				

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Analytical Method Information

Analyte	MDL	Reporting Limit	Surrogate %R	Duplicate RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike / LCS %R	Blank Spike / LCS RPD
surr: Toluene-d8			70 - 130	25				
1,4-Difluorobenzene								
Bromochloromethane								
Chlorobenzene-d5								

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Analytical Method Information

Analyte	MDL	Reporting Limit	Surrogate %R	Duplicate RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike / LCS %R	Blank Spike / LCS RPD
D 1946_Positive in Air (D1946)								
Preservation: Store sealed at STP								
Container: Passivated Canister			**Amount Required:** 6000 mL			**Hold Time:** 30 days		
Oxygen	0.0199	1.00 %(v/v)		25			75 - 135	25
Nitrogen	0.0201	5.00 %(v/v)		25			70 - 130	25
Methane	0.0877	2.00 %(v/v)		25			73 - 133	25
Carbon monoxide	0.0545	3.00 %(v/v)		25			71 - 131	25

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Appendix B – Addendum: Clarification of Point Source Testing (August 6, 2010)

The purpose of this addendum is to acknowledge and reaffirm the requirements of the Scope of Services in the Request For Qualifications and Addendum#2, specifically related to point source testing during well completion activities. It was always our intention to conduct point sources testing for these types of activities during the preparation of our Qualifications Package, the Qualifications Interview with the Air Quality Committee on June 30, 2010, the kickoff meeting with the City after selection, throughout the negotiations and discussions with the City, and during the development of the Work Plans for Contract #1 and Contract #2. We felt like we have acknowledged our understanding of this important natural gas activity source, as we made revisions in our Work Plan for Contract #2 to address this issue. The ERG Team is committed to performing point source testing for one or more well completions, including flowback during this study.

ATTACHMENT B.
FEE SCHEDULE

Prices for professional services rendered under this contract will be as specified in the schedule provided in the following attachment entitled “Eastern Research Group, Inc. and City of Fort Worth, Contract Fee Schedule – Air Quality Study, Natural Gas Air Quality Study, Second Contract” and dated August 1, 2010, consistent with the terms of this contract and subject to the not-to-exceed amount.

Eastern Research Group, Inc and City of Fort Worth
Contract Fee Schedule - Air Quality Study
Natural Gas Air Quality Study, Second Contract
August 1, 2010

This is a time and materials (T&M) proposal. Prime and subcontract labor will be invoiced to Ft. Worth at burdened hourly rates, below.

LABOR	Category	8/1/10-9/30/11 Rate	Representative Personnel or Equivalent*
	Consulting Engineer/Scientist	$ 218	Art Bedrosian (Sage)
	Principal Engineer/Scientist	$ 179	Dave Dayton (ERG), Ray Merrill (ERG), Clint Burklin (ERG), John Wilhelmi (ERG), Paula Fields (ERG), David Ranum (Sage), Andrew Poth (Hicks), Melita Elmore (Hicks) Tom Van Zandt (Hicks)
	Senior Staff Engineer/Scientist	$ 141	Mike Pring (ERG)
	Mid-level Engineer/Scientist	$ 132	Regi Oommen (ERG), Arney Srackangast (ERG) Steve Mendenhall (ERG),
	Staff Engineer/Scientist	$ 115	Scott Fincher (ERG), Jason Renzaglia (ERG) Chris Lehman (Sage), Katie Ferguson (Sage)
	Associate Engineer/Scientist	$ 103	Rodney Williams (ERG), Scott Sholar (ERG), Heather Perez (ERG), Stephen Treimel (ERG), Stacie Enoch (ERG), Jamie Hauser (ERG), Tracy Parham (ERG), Karla Faught (ERG), Jerod McCleland (Hicks)
	Staff/Technician Support	$ 84	Anita White (ERG), Jody Tisano (ERG), Matt O'Neill (Hicks), Erik Epple (Hicks), Peter Van Zandt (Hicks)
	Intern Engineer/Scientist	$ 60	Sarah Royster (ERG)

*ERG team may substitute equivalent personnel after consultation with the City without modification to the resulting contract.

Non-labor costs will be provided at cost to prime or subcontractor.

ERG PROPRIETARY INFORMATION

HOURS AND COSTS BY TASK

LABOR CATEGORIES	Rate	Management Task 1		Ambient Monitoring Task 2		Point Source Testing Task 3		Air Dispersion Modeling Task 4		Comm. & Outreach Task 5		Full B/O Est. Task 6		RA & Final Rept. Task 7		TOTALS	
		Hours	$	Hours	$	Hours	$	Hours	$	Hours	$	Hours	$	Hours	$	Hours	$
Consulting Engineer/Scientist	$ 218	15	$ 3,270	10	$ 2,180	10	$ 2,180	10	$ 2,180	0	$ -	0	$ -	0	$ -	45	$ 9,810
Principal Engineer/Scientist	$ 179	0	$ -	92	$ 16,468	284	$ 50,836	0	$ -	116	$ 20,764	0	$ -	100	$ 17,900	592	$ 105,968
Senior Staff Engineer/Scientist	$ 141	128	$ 18,048	40	$ 5,640	0	$ -	0	$ -	24	$ 3,384	25	$ 3,525	40	$ 5,640	257	$ 36,237
Mid-level Engineer/Scientist	$ 132	0	$ -	100	$ 13,200	0	$ -	150	$ 19,800	16	$ 2,112	25	$ 3,300	40	$ 5,280	331	$ 43,692
Staff Engineer/Scientist	$ 115	0	$ -	0	$ -	460	$ 52,900	150	$ 17,250	0	$ -	0	$ -	0	$ -	610	$ 70,150
Associate Engineer/Scientist	$ 103	0	$ -	324	$ 33,372	0	$ -	0	$ -	100	$ 10,300	25	$ 2,575	80	$ 8,240	529	$ 54,487
Staff/Technician Support	$ 84	0	$ -	376	$ 31,584	644	$ 54,096	0	$ -	0	$ -	0	$ -	48	$ 4,032	1068	$ 89,712
Intern Engineer/Scientist	$ 60	0	$ -	40	$ 2,400	0	$ -	0	$ -	0	$ -	25	$ 1,500	0	$ -	65	$ 3,900
Total		143	$ 21,318	982	$ 104,844	1398	$ 160,012	310	$ 39,230	256	$ 36,560	100	$ 10,900	308	$ 41,092	3497	$ 413,956
ERG RTP Office Travel*											$ 8,694						$ 8,694
ERG Lab Travel*					$ 9,143						$ -						$ 9,143
ERG Lab ODCs (field)*					$ 16,920												$ 16,920
Testamerica for ERG					$ 16,500												$ 16,500
ERG Copies/Phone			$ 702														$ 702
ERG Fixed Price Analysis*					$ 77,731												$ 77,731
Sage Travel*							$ 18,475										$ 18,475
Sage ODCs*							$ 41,784										$ 41,784
Sage Analytical Subcontract*							$ 20,240										$ 20,240
Hicks Travel*					$ 2,633		$ 5,267										$ 7,900
Hicks ODCs*					$ 300		$ 700										$ 1,000
Total Price			$ 22,020		$ 228,071		$ 246,477		$ 39,230		$ 45,254		$ 10,900		$ 41,092		$ 633,044

*See following schedule for itemized costs.

ERG PROPRIETARY INFORMATION

ITEMIZED SCHEDULE OF TRAVEL AND ODCs FOR ERG, SAGE AND HICKS

ERG-RTP Office Travel

Assume 7 trips, RTP, NC to Fort Worth, Texas

Airfare	$	750	per trip	7	trips	$	5,250	
Lodging	$	240	per trip	7	trips	$	1,680	Assume 2 nights at $120/night
Meals	$	92	per trip	7	trips	$	644	Assume 2 days @ $46/day
Vehicle (Car) Rental	$	120	per trip	7	trips	$	840	Assume 2 days/trip @ $60/day
Fuel	$	40	per trip	7	trips	$	280	
						$	**8,694**	

Schedule by Month		
August	1	Regi Oommen
September	1	John Wilhelmi, Mike Pring/Regi Oommen already there
October	0	
November	1	Mike Pring or Regi Oommen
December	0	
January	1	Mike Pring, Regi Oommen, or John Wilhelmi
February	0	
March	3	John Wilhelmi, Mike Pring, Regi Oommen

ERG-Lab Travel

Deployment:								
Airfare	$	750	per trip	2	trips	$	1,500	2 staff members, refundable tickets
Lodging	$	120	per night	12	nights	$	1,440	6 nights, 2 staff
Meals	$	46	per day	14	days	$	644	7 days, 2 staff
Vehicle (Van) Rental	$	125	per day	7	days	$	875	
Fuel	$	350	per trip	1	trip	$	350	
Field Support:								
Airfare	$	750	per trip	1	trip	$	750	1 staff member, refundable ticket
Lodging	$	120	per night	2	nights	$	240	2 nights, 1 staff
Meals	$	46	per day	3	days	$	138	3 days, 1 staff
Vehicle (Van) Rental	$	125	per day	3	days	$	375	
Fuel	$	100	per trip	1	trip	$	100	
Field Recovery:								
Airfare	$	750	per trip	2	trips	$	1,500	2 staff members, refundable tickets
Lodging	$	120	per night	4	nights	$	480	2 nights, 2 staff
Meals	$	46	per day	6	days	$	276	3 days, 2 staff
Vehicle (Van) Rental	$	125	per day	3	days	$	375	
Fuel	$	100	per trip	1	trip	$	100	
						$	**9,143**	

ERG-Lab ODCs (Field)

In-house Prep and Field Deployment:		
1/8" S S Tubing (1)	$	300
1/4" S S Tubing (1)	$	325
Refrigerator	$	400
Misc. fittings (1)	$	630
Misc. hardware (1)	$	720
Packing tape for field use (1)	$	80
Field tools (for operators) 3 @ $60 each)	$	180
Shipping equipment/materials to site (1)	$	1,000
Copies (70 @ .07/copy)	$	5
In-house Support		
Shipping for canisters (130 @ $75/round trip, 40 @ $35 one way to Test America)	$	11,150
Veriflow rental (5 @ $210/12 weeks)	$	1,050
Packing tape for in-house use (1)	$	80
Field and In-house Recovery		
Shipping equipment/materials from site (1)	$	1,000
	$	**16,920**

ERG-Lab Fixed Price Analysis

	Qty.		Unit Pr.		
Concurrent A.T./SNMOC	110	$	578.50	$	63,635
Carbonyls	50	$	155.00	$	7,750
TO-15 Certification	7	$	805.00	$	5,635
TO-11A Certification	2	$	355.50	$	711
				$	**77,731**

Sage - Travel

Airfare (Lubbock-Dallas)	$ 400	per trip	3	trips	$ 1,200	
Airfare (Houston-Dallas)	$ 300	per trip	3	trips	$ 900	
Lodging	$ 1,200	per month	2	months	$ 2,400	2 BR apartment
Lodging (hotel)	$ 120	per day	3	days	$ 360	
Meals	$ 39	per day	75	days	$ 2,925	
Car Rental	$ 55	per day	6	days	$ 330	
Van Rental (2)	$ 1,770	per month	4	months	$ 7,080	
Fuel	$ 50	per tank	32	tanks	$ 1,600	
					$ 16,795	
Including Sage's Indirect Burden					**$** **18,475**	

Sage - ODCs			
TVAs (2) w/ dilution probes ($225/week) for 16 weeks		$	3,600
Cal Gases ($50/week for 3 weeks)		$	150
Dataloggers (2) ($50/week for 16 weeks)		$	800
IR Camera (2) ($1625/week for 16 weeks)		$	26,000
Hi Flow Sampler (2) ($360/week for 16 weeks)		$	5,760
Propane (1 at $125)		$	125
Gas Regulator (1 at $250)		$	250
Nitrogen+Regulator+Dolly		$	550
Hard Drives		$	550
Misc. Supplies		$	200
Sample Capture (100 @ $75/each)	optional		
		$	37,985
Including Sage's Indirect Burden		**$**	**41,784**
Sage - Analytical Subcontract			
Canister Analyses ($400/can x 45 cans)		$	18,000
Shipping ($100/shipment)		$	400
		$	18,400
Including Sage's Indirect Burden		**$**	**20,240**
Hicks - Travel & ODCs			
Field Work			
Lodging ($1,925/month x 2 months, accommodates 3 staff members)		$	3,850
Mileage (18 RTs x 450 miles x $.50/mile)		$	4,050
FedEx, supplies, equipment		$	1,000
		$	**8,900**

ERG PROPRIETARY INFORMATION

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SIGNATURE PAGE
CONTRACT FOR PROFESSIONAL SERVICES
DEM: 10-05 - NATURAL GAS AIR QUALITY STUDY
FINAL WORK PLAN

IN WITNESS THEREOF, the parties hereto have made and executed this Agreement in multiple originals the day and year first above written, in Fort Worth, Tarrant County, Texas.

CITY OF FORT WORTH:

Fernando Costa
Assistant City Manager

EASTERN RESEARCH GROUP, INC.

John Eyraud
Vice President

RECOMMENDED:

Brian Boerner, CHMM, Director

Witness

APPROVED AS TO FORM AND LEGALITY:

Arthur N. Bashor
Assistant City Attorney

Seal:

ATTEST:

Marty Hendrix
City Secretary

8/20/2010
Date

M&C: C-24375 approved on August 3, 2010.