

Project Title: Ambient Air Toxics Characterization in Neighborhoods Abutting T. F. Green Airport and Comparison Sites in Warwick, Rhode Island

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Total Cost of Project: \$500,000

Project Narrative and Work Plan

Introduction

The Rhode Island Department of Environmental Management (RI DEM), Office of Air Resources, is applying for a grant to conduct an air toxics monitoring study in areas of Warwick, Rhode Island that are potentially impacted by emissions from the T.F. Green Airport. The City of Warwick, the Concerned Airport Neighbors group (CAN) and the Rhode Island Airport Corporation (RIAC) have expressed support for and the willingness to assist with this project.

The project would characterize the air toxics levels and associated cancer and non-cancer risks in several neighborhoods in Warwick and would determine the contribution of various airport-related emissions, as well as industrial and on-road mobile source emissions, to that risk. The project is particularly timely because the Rhode Island Department of Health (HEALTH) recently produced data that show elevated lung cancer rates in several census tracts that are frequently downwind of the Airport.

In addition to providing information about Warwick, the information obtained in this study would be valuable to other communities that are located in close proximity to a medium-sized airport.

Background Information

T. F. Green Airport

The T. F. Green Airport is located in the heart of the City of Warwick, Rhode Island. The airport is owned by the State of Rhode Island, managed by a quasi-public agency, the Rhode Island

Airport Corporation (RIAC), and is included in the Federal Aviation Administration's (FAA) New England Regional Airport System.

T.F. Green, the first state-owned airport in the nation, began operating in 1931. At that time, the surrounding area was largely farmland. In the ensuing years, the facility has expanded and the surrounding area has become a highly developed residential, commercial and industrial area.

In 1996, a new terminal doubling the size of the former structure was opened at the Airport and in 1998, the 15-gate facility was expanded to 19 gates to accommodate growth. Passenger traffic at T.F. Green increased by 20% per year between 1995 and 2000, reaching 5.5 million in 2001. This increase was caused by several factors, including a national increase in airline passengers, the introduction of low-fare service by Southwest Airlines, and an increase in T.F. Green's share of regional traffic due to congestion at Boston's Logan Airport. In 2003, the Airport serviced 5.2 million passengers.

T. F. Green is classified as a "medium hub" facility that services "medium haul" (500 to 1,500 miles) flights. The airfield facilities consist of three runways, a taxiway system, aircraft parking aprons and overnight aircraft parking areas. The location of these facilities is shown in Figure I. Runway 5R-23L is 7,166 feet long and is the primary arrival and departure runway for air carrier operations. Runway 5L-23R is considerably shorter, 4,432 feet, and is used by small general aviation aircraft during the daytime in good weather conditions, as an aircraft parking area at night and as a taxiway during low visibility conditions. Runway 16-34 is the crosswind runway and is 6,081 feet long.¹

From January through September 2003 there were an average of 4,978 air carrier operations (arrivals and departures) at the Airport per month. The highest number of operations occurred in May, when there were 5,851 operations. Flight volume is highest on weekdays between 6:00 and 8:30 AM and between 4:30 and 8:00 PM.

Warwick

The City of Warwick is located in Kent County and is in the Providence-Warwick-Pawtucket district/New England County Metropolitan Statistical Area. According to the 2000 U.S. Census, Warwick has a population of 85,808, making it the second largest city in Rhode Island. Compared with the State of Rhode Island as a whole, Warwick is much more densely populated and has a population with a higher median age.

T. F. Green Airport occupies approximately 1,000 acres of land in the center of the City. Land use in the areas surrounding T.F. Green Airport is primarily residential, with some retail, commercial and industrial businesses. The residential area immediately surrounding the airport is densely settled (see Figure II).

RI DEM's Air Pollution Emissions Inventory has identified approximately 18 stationary air toxics sources in the area of Warwick near the Airport. Emissions data for these sources, as well

¹ T.F. Green Airport, Master Plan Update. Section III.1.2. Runway Length Requirements. Draft, Feb. 22, 2002.

as other Rhode Island sources, has been submitted to the National Toxics Inventory. In addition, the Airport area is home to several high volume roadways. The locations of the stationary sources and high volume roadways are shown in Figure I.

Plans for the Future

The Master Plan Update of T.F. Green Airport, forecasts that passenger demand for the airport will increase by 13 percent by 2005; 38.6 percent by 2010; 67.7 percent by 2015; and 202 percent by the year 2020.

In March 2004, the RIAC Board of Directors voted to pursue lengthening Runway 5R-23L from 7,166 to 9,500 feet in order to accommodate long-haul nonstop flights. The FAA will evaluate two alternatives for accomplishing this goal in an Environmental Impact Statement (EIS), one involving expansion to the south and one involving expansion at both ends. The expansion would necessitate the acquisition of up to 359 properties in the area and the extended runway would be opened in 2010 at the earliest. The City and the neighbors of the Airport have questioned the need for an extension of this magnitude and are opposing the plan.

RIAC has issued a Request for Proposals for the construction of a compressed natural gas (CNG) fueling station at the Airport and is expecting that the facility will be functional by 2005. RIAC is currently renegotiating its contracts with shuttle bus and taxi services and plans to include goals in those contracts for the purchase of alternative fuel vehicles. Currently, virtually all ground support equipment at the Airport is diesel powered, but RIAC plans to begin to discuss the use of alternative fuel equipment with the airlines in the summer of 2004.

The State is developing plans for a rail station on the nearby Amtrak Northeast Corridor Main Line. A people mover would move passengers the 1,300 feet from the rail station to the terminal. Implementation of those plans would eventually result in the consolidation of parking facilities and the elimination of the need for parking and rental car shuttles, resulting in an 8% reduction in traffic in the area of the Airport.

Concerns

The March 1991 Comprehensive Plan Summary for the City of Warwick² refers to the city as “a community of homes” which “provides a decent place in which families can live and work and educate their children.” The general goals and objectives in that plan include protection, preservation and enhancement of residential neighborhoods and environmentally sensitive areas, rationally accommodating development, and striking a balance between a pro-development policy and an anti-growth policy.

Over the past several years, the City and neighborhood residents have raised concerns about a variety of airport-related issues, including noise, traffic congestion, the deposition of soot and air pollution. Residents living adjacent to the main taxiway have reported, and RIAC has acknowledged, seeing oily sheens on the surface of their swimming pools and soot on the noise

² Comprehensive Plan Task Force, “City of Warwick, Comprehensive Plan Summary.” March, 1991.

wall that separates the taxiway from the neighborhood. Residents also experience exhaust odors under certain meteorological conditions; those odors cause health concerns and limit the enjoyment of neighborhood properties. The neighborhood group CAN has actively participated in the development of the updated Master Plan.

In early 2004, in response to a request from Airport neighbors, HEALTH issued a preliminary analysis of lung cancer incidence rates in Warwick census tracts. Lung cancer rates were at least 30% higher than the State average for both women and men in five census tracts and at least 20% higher for both genders in eight census tracts east and south of the Airport. All of the six census tracts west of the Airport had lung cancer rates similar to or less than the State average. Note that the wind direction in the area is predominantly from the southwest in the summer and from the northwest in the winter and wind directions from the east occur very infrequently year-round.

While these data are preliminary and do not prove an association between Airport associated emissions and cancer rates, the fact that the census tracts with elevated levels are in areas that are frequently downwind of the facility has raised concerns from the City and neighbors. HEALTH is now planning a follow-up investigation of the preliminary findings.

Air Monitoring History

In response to requests from airport neighbors and the Warwick City Council, RI DEM collected six sets of upwind – downwind volatile organic compound (VOC) sample pairs in the vicinity of the Airport during the 1998 – 2000 period. Samples were collected in evacuated canisters for 30-minute periods and were analyzed using EPA Method TO-15. VOC levels in the downwind samples were not significantly higher than in the upwind samples. However, since the sampling was limited and did not reflect worst case meteorological and air traffic density conditions, RI DEM determined that the results were inconclusive.

In early 2001, concerned neighbors requested further monitoring and, in response, RI DEM asked RIAC to conduct a comprehensive air monitoring study in the area. RIAC contracted with a consultant to scope out such a study. However, after the events of September 11, 2001, the air monitoring study was postponed indefinitely.

In 2003, the Warwick City Council voted to allocate \$25,000 for air monitoring near the Airport and to request that RI DEM and RIAC also contribute funds for that purpose. Warwick has agreed to use those funds to support this study, if it is funded, and to assist RI DEM in finding and setting up monitoring sites.

In March 2004 RIAC's Board of Directors voted to support this project and to provide RI DEM with all information necessary to facilitate air monitoring efforts and the interpretation of results.

Work Plan

Study Objective

The proposed study is designed to answer the following questions:

1. To what concentrations of air toxics are Warwick residents exposed?
2. How do those concentrations vary spatially among neighborhoods?
3. How do those concentrations compare with those measured in other parts of the State (Type I and Type II PAMS sites, NATTS site, site adjacent to a high volume interstate highway)?
4. What cancer and non-cancer risks are posed by those concentrations? Does this information help explain HEALTH's cancer incidence statistics?
5. What is the impact of Airport emissions on ambient air toxics levels? Can the impacts from various airport activities (taxiing/idling aircraft, aircraft takeoffs, ground equipment, and on-site on-road vehicles such as cars, shuttles and busses) be identified?
6. What are the contributions of other source types (e.g. industrial and commercial stationary sources and on-road mobile sources) to ambient air toxics concentrations?
7. How do measured concentrations compare to those modeled by RIAC as part of the EIS analysis and to those modeled by EPA in its NATA analysis?
8. What, if any, monitoring should continue in the future to track trends in concentrations and determine whether emissions reductions efforts are effective?

Study Design

RI DEM plans to monitor air toxics at five locations in Warwick, Rhode Island for a one-year period. The sampling will include a combination of 24-hour integrated samples, short-duration samples during peak emissions periods and real-time measurements using continuous instrumentation.

Pollutants

To determine the target pollutants for this study, RI DEM reviewed aircraft emissions data and the results of ten monitoring and/or modeling studies from other airports. Those studies, although generally too limited in scope to be conclusive, identified several substances as cancer and/or non-cancer risk drivers. Those substances are: benzene, 1,3-butadiene, toluene, naphthalene, formaldehyde, acetaldehyde, polycyclic aromatic hydrocarbons (PAHs), diesel particulate, fine particles (PM_{2.5}) and acrolein.

The RI DEM study will focus on those target pollutants, although the analytical methods used will measure a number of air toxics, particularly VOCs, in addition to those listed above. Nitrogen dioxide (NO₂) and sulfur dioxide (SO₂) will also be measured at one site. Note that an accepted method for accurately measuring acrolein in ambient air is not currently available.

Sampling/Analytical Methodology

At each of the five sites, RI DEM plans to sample for VOCs using EPA Method TO-15 and for carbonyls using Method TO-11a and will operate a dual-channel aethalometer to continuously measure black carbon, an indicator of diesel particulate. Divergent readings on the two aethalometer channels (UV and IR) are indicative of the presence of PAHs.

At two sites, RI DEM will operate beta attenuation monitors (BAMs) to continuously measure

PM2.5. At one site, RI DEM will operate an OPSIS DOAS optical beam system, which will measure benzene, naphthalene, NO₂, SO₂, toluene, xylenes, styrene and formaldehyde continuously.

Sampling Locations

To address the study questions, RI DEM will site neighborhood-scale monitors as follows:

Site 1 A maximum impact site will be located in the area of Field View Drive, a residential neighborhood adjacent to the taxiway to the main runway (5R-23L) near the 5R end of the runway. According to HEALTH's analysis, lung cancer rates for both genders are substantially elevated in the census tract that includes this neighborhood (219.02). Flights taking off from the 23L end of the runway travel down the taxiway, idle in line in the section of the taxiway closest to the neighborhood while waiting for clearance, and then turn the corner and go down the runway northeast to take off. Neighborhood residents experience exhaust fumes from the taxiing and idling airplanes, especially under relatively stagnant air conditions.

This neighborhood is also potentially impacted by exhaust from airplanes taking off from the 5R end of the runway. Since that runway end is used when winds are from a generally southerly direction, it is the most highly used runway end during the summer months. Therefore, the Field View Drive neighborhood can be impacted by flights departing from the main runway in either direction. That runway is used for at least 70% departing flights during colder months and more than 90% of departing flights in the warmer months.

This site will be used both to determine maximum neighborhood impacts from aircraft operations and to attempt to distinguish between impacts from taxiing/idling operations and takeoffs. RIAC plans to purchase the houses in this neighborhood that are closest to the taxiway. However, under the current schedule, those homes will not be purchased until at least 2007. The data collected at this site will also be used to determine whether exposures are sufficiently high to cause health concerns in the interim period.

In addition to taking 24-hour VOC and carbonyl samples, RI DEM will operate three types of continuous monitors at this location: a dual channel aethalometer measuring black carbon by UV and IR as an indicator of diesel particulate and PAHs, a BAM continuous PM2.5 unit and an OPSIS DOAS optical monitor measuring benzene, naphthalene, NO₂, SO₂, toluene, xylenes, styrene and formaldehyde. The use of continuous equipment will enable RI DEM to characterize peak concentrations and, by correlating the concentration data with aircraft activity and meteorological data, to identify the sources of these peaks (e.g. to distinguish between taxiing/idling aircraft and takeoffs).

In addition, RI DEM plans to take a limited number of shorter-term (e.g. one-hour) VOC and carbonyl samples at this location during peak activity and maximum impact meteorological conditions in order to better characterize acute exposures.

Site 2 A second site will be located in the Hoxsie neighborhood, which is about 500 meters northeast of the 23L end of runway 5R-23L. The HEALTH cancer data showed substantially

elevated lung cancer incidence in both genders in this neighborhood's census tract (214.01). Hoxsie is on the opposite side of the Airport from the Field View Drive area, and thus would form an upwind-downwind pair with that site on days that the wind is from the northeast or southwest.

Hoxsie is potentially impacted by planes taking off from the 23L end of the runway and by planes taxiing down the main runway to take off at the 5R end as well as by automobile traffic from nearby Airport Road and Route 117. Airport Road, which runs through the Hoxsie neighborhood, has an Average Daily Traffic (ADT) count of 36,071.

At Site 2, RI DEM will operate all of the monitoring equipment listed above for Site 1 except for the OPSIS optical system which, due to costs, will be operated only at Site 1. RI DEM will analyze the monitoring data from Site 2 along with airport activity data and meteorological data to determine the relative impacts of the Airport and other sources, such as on-road mobile sources, on the air quality at this site. The use of the continuous BAM and aethalometer at this site will aid in this analysis. As with the Site 1, a limited number of short-duration (e.g. one-hour) VOC and carbonyl samples will also be taken at this site to evaluate acute exposures and to aid in the determination of the sources of elevated toxics levels in the area.

Site 3 According to RI DEM's air pollution inventory, the highest concentration of industrial and commercial air toxics sources in Warwick is in an area east of the Airport, on and near Jefferson Boulevard. The Hillsgrove neighborhood is adjacent to this industrial area as well as to the Airport. It is also near several high traffic roadways. The ADT count for Post Road, which bounds the neighborhood to the west, is 31,481 and that for Jefferson Blvd., which cuts through the neighborhood, is 17,600. The Airport Connector, just south of Hillsgrove, has the highest ADT in the area, 52,237. Hillsgrove is downwind of industrial sources when wind is from the west, northwest or southwest and downwind of the airport terminal and the busiest gate area when the wind is from the east or southeast.

The Hillsgrove neighborhood is in two different census tracts, 211 and 221. Lung cancer rates are not elevated in either of these tracts but, since Hillsgrove is a small part of each of these tracts, an elevation of the rates in that neighborhood may not significantly affect the tracts as a whole.

With this site, RI DEM will be looking at the cumulative and relative impacts of stationary sources, airport-related on-road and ground equipment sources and other mobile sources on neighborhood air quality. RI DEM will operate a VOC sampler, a carbonyl sampler and a dual channel aethalometer at this site. The relative impacts of the various source types will be determined by analyzing wind direction and traffic, industrial and airport activity patterns. A limited number of shorter duration (e.g. 1- 2-hour) samples will be taken as appropriate.

Site 4 RI DEM plans to site a fourth set of monitors south of the Airport in a densely populated area that may be impacted by the Airport as well as by other mobile sources, including diesel powered vehicles. However, Site 4 may be located elsewhere if, after consultation with the City and CAN, it is determined that another location would better aid the characterization of airport-related impacts. RI DEM will operate a VOC sampler, a carbonyl sampler and a dual channel

aethalometer at this site. A limited number of shorter duration (e.g. 1- 2-hour) samples will be taken as appropriate.

Site 5 The final site will be located in an area of Warwick not directly impacted by the Airport. Although the location of this site has not yet been determined, it may be placed in one of two adjacent census tracts in eastern Warwick (215.01 and 215.02) which have the highest lung cancer rates in the City. RI DEM will operate a VOC sampler, a carbonyl sampler and a dual channel aethalometer at this site. A limited number of shorter duration (e.g. 1- 2-hour) samples will be taken as appropriate.

The approximate locations of Sites 1 – 4 are shown in Figure I.

Sampling Frequency and Duration

VOC and carbonyl samplers will be operated on a 24-hours every 6th day schedule that corresponds to the collection of VOC samples at the West Greenwich PAMS site and at a site adjacent to Interstate Route 95 and of VOC and carbonyl samples at the East Providence PAMS site and the Providence NATTS site. This will allow RI DEM to compare the concentrations measured in the Warwick locations with those in areas of the State not directly affected by Airport operations.

A limited number of shorter-duration (e.g. 1 – 2- hour) VOC and carbonyl samples will be taken to investigate acute exposures and to investigate impacts from particular sources or source types, when necessary. Aethalometers, the OPSIS DOAS unit and the BAM units will be operated continuously throughout the sampling period. Sampling equipment will be operated for a one-year period beginning on or about January 1, 2005.

Meteorological Measurements

The National Weather Service operates a meteorological station at T.F. Green Airport that measures wind speed, wind direction, dew point, barometric pressure, relative humidity, sky conditions, precipitation and visibility. Hourly data from this site are available to RI DEM electronically as they are generated. If additional meteorological information is needed, RI DEM will establish an additional station in the vicinity of the Airport using meteorological equipment acquired for the Providence Air Toxics Monitoring Pilot Project in 2001.

Staffing

The project budget includes funding for a full time contract Laboratory Specialist II to perform many of the day-to-day functions associated with the project. Existing RI DEM and HEALTH personnel who are funded by other EPA grants and/or State funds will also participate. The City of Warwick has committed to staff assistance for such tasks as locating and setting up sites.

Quality Assurance/Quality Control

RI DEM is currently finalizing an update of its Air Toxics Quality Assurance Plan (QAP). If this

grant is funded, the QAP will be further modified to include the project activities before the Warwick monitoring begins. The QAP is consistent with EPA guidance.

RI DEM plans to operate a collocated site at one of the five monitoring locations (20% of sites). A VOC and carbonyl sampler and an aethalometer will be operated at that site. At least 10% of the total budget will be allocated for quality assurance.

Data Analysis and Reporting

RI DEM will analyze the data collected and write a final report that addresses the study questions, protocols, results and plans for the application of results to meet community needs. The report will include an analysis of the spatial gradient of air toxics levels, the risk associated with concentrations measured, and to the extent possible, the sources of those toxics. All data will be entered into the AIRS database within 90 days of the end of each calendar quarter. RI DEM will supply the data and report to the EPA and to all other interested parties (e.g. the City, CAN and RIAC) and present the data at EPA's annual air toxics monitoring meeting.

Conformance with the Ranking Criteria

1. Clarifying spatial concentration patterns of key HAPs (NATTS and location-specific pollutants).

RI DEM will monitor all of the VOC and carbonyl NATTS pollutants and will employ a dual channel aethalometer at each site to measure black carbon by UV and IR as an indicator of diesel particulate and PAHs. Naphthalene, a location-specific pollutant, will also be included. Monitors sites will be selected to document spatial variations in concentrations in several densely settled neighborhoods of Warwick that are potentially impacted by airport activities, stationary sources and on-road mobile equipment and in one Warwick neighborhood not directly impacted by the Airport. Concentrations measured will also be compared to those recorded at the State's NATTS site in a highly urban area of Providence, the Type I PAMS site in rural West Greenwich, the Type II PAMS site, which is located downwind of metropolitan Providence in a suburban area of East Providence, and a site adjacent to Interstate Route 95.

2. Either pre- or post-monitor for a planned air toxic reduction project or correlating results with efforts to characterize air toxics risk.

This project is designed to address both of these issues.

This project will establish baseline concentrations before the implementation of planned emissions reductions at the Airport (converting buses, shuttles and ground-service equipment to natural gas; construction of an intermodal transport station with a people mover to decrease vehicular traffic, and the gradual conversion of the aircraft fleet to newer, lower emissions, airplanes) and will also be a useful baseline to evaluate the effects of expansion of usage and/or the runway extension on air quality. The purchase of continuous instrumentation (OP SIS DOAS unit, dual channel aethalometer and BAM unit) will allow for the potential to continue monitoring in critical locations over time.

The City of Warwick has requested that HEALTH conduct a health study in the area as a follow-up to the lung cancer data. HEALTH is now developing a plan for how best to address this issue. The monitoring study design utilizes the preliminary HEALTH data, as well as other pertinent information, for selecting monitoring locations. RI DEM will work with HEALTH to determine whether concentration data collected provide some insight into the interpretation of the HEALTH statistics. The City and CAN, as well as RIAC, have expressed strong support for and are working with RI DEM to ensure that the project is as strong and as responsive to neighborhood concerns as possible. If this project is funded, RI DEM will form an advisory committee with representatives of those organizations to provide input in siting and other decisions and to facilitate community outreach and communication.

3. Projects focused on model-to-monitor relationships.

The FAA will conduct a modeling study in support of the EIS for the proposed runway expansion during the coming year. Although the EIS process only requires modeling of criteria pollutants, RI DEM has requested that RIAC fund the inclusion of air toxics modeling in the study. Monitoring data will be used to verify the modeling results.

In addition, the results of this study will be compared to the NATA modeling results. It must be remembered, however, that NATA is not designed to predict localized impacts close to sources.

4. Inclusion of one or more non-routine advanced technologies that have strong potential for routine operations.

The proposed project will employ an OPSIS DOAS optical unit at the maximum impact site. By providing highly time resolved data, the DOAS unit will enable RI DEM to better identify the sources of elevated pollutant levels which, in turn, will aid in identifying strategies to reduce those levels. In the future, the DOAS unit can also be used for tracking pollutant trends and for providing real-time data on pollutant levels to the public via the web.

5. Demonstrated effort to leverage other resources, e.g. measurements from PM, ozone and PAMS stations to assist in interpreting air toxics source-receptor and characterization needs.

For this project, RI DEM has deliberately chosen the same sampling and analytical methodologies and schedules as those employed at other sites in the State. Warwick results will be viewed in the context of measurements at the NATTS (urban) site, the Type I (rural) and Type II (downwind suburban) PAMS sites and a mobile source dominated source.

RI DEM brings to this study considerable experience and expertise in air toxics sampling, analysis and interpretation. TO-15 and TO-11a sampling and analytical methodology has been used for the State's PAMS program for more than ten years. In addition, an air toxics study was conducted at five Providence area sites in 2001-2 as part of the Air Toxics Monitoring Pilot Project. One of these sites continues to operate as a NATTS site. RI DEM will also use some of the monitoring equipment from the pilot study for this study, thereby reducing the cost of this study.