Air Quality Monitoring Work Plan for T.F. Green Airport

Prepared in Support of the:

State of Rhode Island
Permanent Air Quality Monitoring Act

Final

Prepared for the:
Rhode Island Airport Corporation (RIAC)

Prepared by:
KB Environmental Sciences, Inc.,

October 29, 2007

Executive Summary

Under Section 1-7-1 of the State of Rhode Island General Law (*The Permanent Air Quality Monitoring Act*), the Rhode Island Airport Corporation (RIAC) is to design, acquire, install, operate and maintain a long-term air quality monitoring program in the vicinity of T.F. Green Airport in Warwick. In accordance with this legislation, RIAC has prepared this *Final Air Quality Monitoring Work Plan*.

The purpose of this document is to describe and justify, with reasonable specificity, the significant aspects of the monitoring program called for in the *Act*. The following is a summary description of these important aspects:

- Monitoring Parameters – The monitoring program shall monitor ambient ("outdoor") levels of particulate matter (PM) - including $PM_{2.5}$, $PM_{0.1}$ and black carbon; volatile organic compounds (VOCs) - including (but not limited to) benzene and 1,3 butadiene; semi-volatile organic compounds - including (but not limited to) naphthalene; carbonyls - including (but not limited to) formaldehyde and acetaldehyde; and polycyclic aromatic hydrocarbons (PAHs) - including (but not limited to) those that are bound to PM. Meteorological conditions will also be recorded.

- Number, Type and Location of the Monitors – The program will include four air quality monitoring stations located in residential areas north (*Lydick Ave.*), south (*Fieldview Dr.*), east (*Pembroke Ave.*) and west (*Fire Station No. 8*) of the airport. When taken together and based on annual meteorological conditions, these sites are situated downwind, upwind and cross-wind to the airport. "Background" conditions will be determined from data collected by the Rhode Island Department of Environmental Management (RI DEM) at sites located around Providence and the rest of the state.

- Monitoring Methods – Sampling and measurements will be accomplished using methods and equipment that are specifically designed for each type of pollutant, the expected range of ambient concentrations and applicable time periods. These methods are designated as either "Reference" methods, where applicable, or accepted by the U.S. Environmental Protection Agency (EPA) and others as appropriate for the application.

- Monitoring Criteria – The monitoring criteria varies depending on the parameter. In the case of $PM_{2.5}$, the collected data will be compared with the National Ambient Air Quality Standards (NAAQS) and measured values of VOCs, carbonyls and PAH to appropriate state health benchmarks and background values. There are no federal or state criteria for $PM_{0.1}$ or black carbon.

- Quality Assurance Procedures – All in-the-field and laboratory measurements will adhere to the standard quality assurance/quality control procedures typically associated with equipment set-up/calibration, duplicate/blank samples, and data recording/reporting.

- Implementation Schedule – In accordance with the *Act*, RIAC intends that the program will be fully implemented on, or before, December 30, 2007.

RI DEM, the Rhode Island Department of Health (RI DOH) and the general public have reviewed the *Draft Work Plan* and their comments are addressed in this updated Final version. Additional information pertaining to this document can be obtained from the following contact:

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I. Introduction & Background

Under Section 1-7-1 of the State of Rhode Island General Law (*The Permanent Air Quality Monitoring Act*), the Rhode Island Airport Corporation (RIAC) is to design, acquire, install, operate and maintain a long-term air quality monitoring program in the vicinity of T.F. Green Airport in Warwick [State of Rhode Island, 2007]. In accordance with this legislation, RIAC has prepared this *Final Air Quality Monitoring Work Plan*.

The purpose of this document is to describe and justify, with reasonable specificity, the significant aspects of the monitoring program called for in the *Act*. In particular, the following components of the program are addressed:

- Monitoring Parameters;
- Number, Type and Location of the Monitors;
- Monitoring Methods;
- Monitoring Criteria;
- Quality Assurance Procedures;
- Implementation Schedule;
- Agency Coordination; and
- Funding.

The Appendix of this document contains additional information collected and developed in support of this initiative.

This *Final Work Plan* has been developed in consultation with the Rhode Island Department of Environmental Management (RI DEM) and the Department of Health (RI DOH), also in accordance with the *Act* [RI DEM, 2007a, RIAC, 2007a]. Similarly, the general public has had an opportunity to review and comment on the document.[1] According to the *Act*, the monitoring program is to be fully implemented and operational by December 30, 2007.

It should be noted that during the development of the *Draft* and *Final Work Plans*, RIAC continues to operate an "interim" air monitoring program at the airport [RIAC, 2007b].

II. Monitoring Parameters

The parameters selected for the air quality monitoring program are identified in the *Act*. Altogether, these comprise the following:

- Particulate matter (PM) - including "fine" PM of those less than 2.5 microns in diameter ($PM_{2.5}$), "ultra-fine" PM of those less than 0.1 microns in diameter ($PM_{0.1}$) and black (i.e., elemental) carbon;
- Volatile organic compounds (VOCs) - including (but not limited to) benzene and 1,3 butadiene;
- Semi-volatile organic compounds (SVOCs) - including (but not limited to) naphthalene;
- Carbonyls - including (but not limited to) formaldehyde and acetaldehyde; and

[1] The Air Quality Monitoring Public Advisory Committee (PAC) has not been appointed by the date of this publication.

- Polycyclic aromatic hydrocarbons (PAHs) - including (but not limited to) those that are bound to particulate matter.

Wind direction and wind speed and other meteorological parameters will also be recorded by RIAC.

III. Number, Type and Location of the Monitors

This section provides a description and the justification of the number, type and locations of the air quality monitors selected for this program.

In accordance with the *Act*, the RIAC monitoring network will consist of a minimum of four (4) separate monitoring sites located north, south, west and east of the airport. The locations of the sites are shown in Figure 1 and are further described below:

- North Site *(Lydick Ave.)* – Located adjacent to the Spring Green neighborhood and the airport's northeastern property line, approximately ¾ mile (3,680 feet) from the end of Runway 23. Adjoining land uses include single-family residential to the north, east and south. To the west is the runway protection zone (RPZ). This site is predominately downwind from the airport in the summer.

- South Site *(Fieldview Drive)* – Located south-southwest of the airfield approximately 450 feet from Taxiway S and 900 feet from the end of Runway 5. Adjoining landuses include single-family residential to the west and south, long-term parking for airport patrons to the north and the taxiway/runway system to the east. This site is generally upwind of the airport in the summer.

Figure 1: Air Monitoring Stations

- West Site *(Fire Station No. 8)* – Located west-northwest of the airport approximately ½ mile (2,250 feet) from the end of Runway 16. Adjoining land uses include an open field and single family residential to the north and west, commercial development to the south and the fire station and Post Road to the east. This site is typically upwind of the airport most of the year.

- East Site *(Pembroke Ave.)* – Located due east of the airport approximately ¼ mile (1,425 feet) from the intersection of Runways 5/23 and 16/34. Adjoining land uses are the airport to the west and residential or vacant land to the north, east and south. This site is mostly downwind from the airport in the fall and winter.

- Notably, the North *(Lydick Ave.)*, South *(Fieldview Drive)* and West *(Fire Station No. 8)* sites were originally part of the *Warwick Air Monitoring Study* completed in 2006 RI DEM. The East Site *(Pembroke Ave.)* is a new site and was not included in the RI DEM study.

In addition to meeting the four-station placement requirements of the *Act*, these sites also have the following important attributes: 1.) the sites are located close to the airport but outside the FAA-restricted area; 2.) the sites are accessible by public roads and have electricity and shelter; 3.) when taken together, the sites serve as "up-wind" and "down-wind" pairs under most meteorological conditions; and 4.) the sites allow comparison to the data collected during the RI DEM study. (See Appendix for site photographs and wind rose diagrams.)

The air monitoring stations themselves are specifically designed for this purpose as they provide security, weather proofing, climate-control, electricity and were originally used by RI DEM during their study. Current photographs of the four sites are contained in the Appendix along with diagrams (i.e., wind roses) showing the annual and seasonal wind directions at the airport.

Background air monitoring data (i.e., data from areas away from the airport) for $PM_{2.5}$, black carbon, VOC's, SVOCs/PAHs, etc. will be obtained from RI DEM stations located elsewhere in the state (i.e., Providence, E. Providence, Pawtucket and/or the Providence National Air Toxics Trends Site (NATTS) following it's scheduled implementation in early January, 2008). However, because ambient levels of $PM_{0.1}$ are not measured in any other part of the state, measurements of this parameter may also be made by either RI DEM or RIAC at one of these existing RI DEM stations.

IV. Monitoring Methods

Section II (*Monitoring Parameters*) above, identified and described the parameters that will be included in this air monitoring program. Based upon this listing, the equipment and methods used to collect and analyze the air samples are summarized in Table 1.

The methods in Table 1 are considered to be the most appropriate for the parameters and are based upon: 1.) the suitability of the air monitoring devices, sample collection methods and/or analytical techniques for the individual compounds; 2.) the expected pollutant levels and the method's detection limits; and 3.) the overall reliability and cost-effectiveness of the equipment or method. Wherever possible, the approach is to utilize U.S. Environmental Protection Agency (EPA) "Reference Methods" [U.S. EPA, 1999]. Where such designations do not exist, the methods identified are broadly accepted by the U.S. EPA, RI DEM and others as appropriate for the application.

Two other terms applicable to the discussion of monitoring methods are a.) "real-time" and b.) "time-integrated". Real-time measurements are based on samples taken over short time periods (from several minutes to an hour) and the results are representative of instantaneous or "at-the-moment" conditions. By comparison, time-integrated samples are collected over 24-hour intervals before they are sent for laboratory analyses and are representative of the cumulative amount of contaminates collected over the entire sampling period.

As shown, fine PM will be analyzed following the *U.S. EPA Reference Method for $PM_{2.5}$*. This method involves the collection of air over a 24-hour period with a high-volume sampler

Table 1: Air Quality Monitoring Equipment and Methods[1]

Parameters & Target Compounds[2]	Sampling & Analysis Equipment/Methods[3]	Summary Description
---- Particulate Matter (PM) ----		
Fine PM ($PM_{2.5}$) < 2.5 microns	EPA Federal Reference Method for $PM_{2.5}$	Time-integrated (24-hr.) sample collected on filters and based on sample weight.
Ultra-fine PM ($PM_{0.1}$) < 0.1 microns	Water-based Condensation Particle Counter[4]	Real-time measurements based on light (infrared) scattering characteristics of airborne PM.
Black Carbon	Aethalometer monitors	Real-time measurements based on the light-absorbing characteristics of soot.
---- Volatile Organic Compounds (VOCs)[4] ----		
Benzene[5]	EPA Method TO-15	Time-integrated (24-hr.) sample collected in canisters and based on laboratory GC/MS analysis.
1,3 butadiene[5]	EPA Method TO-15	(same as above)
---- Semi-volatile Organic Compounds (SVOCs)[4] ----		
Naphthalene[5]	EPA Method TO-13A (*with XAD-2 resin)*	(same as above
---- Carbonyls[4] ----		
Acetaldehyde[5]	EPA Method TO-11A	Time-integrated (24-hr.) sample collected on adsorbent cartridges and based on laboratory HPLC analysis.
Formaldehyde[5]	EPA Method TO-11A	(same as above)
---- Other[4] ----		
Polycyclic Aromatic Hydrocarbons (PAH) bound to particulate matter[5]	Monitors for particle-bound PAH's.	Real-time measurements based on photoionization of particle-bound PAH.
Wind Direction & Speed	Wind vane & anemometer instrumentation	Direction & speed from National Weather Service at the Airport.

[1]The program will be operated for RIAC by a specialty contractor with demonstrated experience and qualifications in the field of air quality monitoring. Therefore, some of the sampling and measurement techniques and equipment described in the *table* will be defined more definitively in collaboration with RI DEM once the contractor has been selected. For example, there are a number of different nephelometers, aethalometers and PAH monitors to choose from.

[2] Parameters taken from the State of Rhode Island General Law Section 1-7-1 (*The Permanent Air Quality Monitoring Act*).

[3] Methods cited include the following:

- Federal Register Notice (04/22/99) "Revisions to Reference Method for the Determination of Fine Particulate Matter as PM2.5 in the Atmosphere" (Direct Final Rule).
- EPA Method TO-11A, *Determination of Formaldehyde in Ambient Air Using Adsorbent Cartridge Followed by High Performance Liquid Chromatography (HPLC) [Active Sampling Methodology]*
- EPA Method TO-13A (*Determination of Polycyclic Aromatic Hydrocarbons in Ambient Air Using GC/MS*).
- EPA Method TO-15 (*Determination of VOCs in Air Collected in Specially-Prepared Canisters and Analyzed By GS/MS*).

[4] Because of the limited application of this instrumentation, the use of water-based condensation particle counters will remain under evaluation by RIAC and RI DEM.

[5]Includes the assessment of all the compounds in the classification; not just the ones identified as "target compounds". For example, EPA Method TO-15 includes additional VOCs other than benzene and 1,3 butadiene.

Source: KB Environmental Sciences, Inc

equipped with a size-segregating cyclone and pre-weighed filters. The exposed filters are analyzed gravimetrically in a laboratory and the increase in weight, combined with the amount of air sampled, is a function of the $PM_{2.5}$ particles present. This method allows direct

comparison to the NAAQS for $PM_{2.5}$. Presently, there is no U.S. EPA Reference Method for the real-time measurement of this pollutant, although some are under development and may be approved by the U.S. EPA in the near future. Therefore, RIAC will continually evaluate this method in terms of it's potential application to this monitoring program.

Ultra-fine PM ($PM_{0.1}$) will be measured using water-based condensation particle counter. instrumentation that takes real-time measurements of particulate matter.[2] Presently, there is no designated U.S. EPA Reference Method for this pollutant (either real time or time-integrated).

Black carbon will be measured using aethalometers which collect PM in real time on a quartz-fiber filter tape and use infrared light to determine the amount of optically-absorbing material in a unit volume of sampled air. Since elemental (or black) carbon is the dominant optically-absorbing material in the sample, this measurement is interpreted as a mass of black carbon according to intercomparisons with other chemical analysis techniques. Presently, there is no designated U.S. EPA Reference Method for this pollutant (either real time or time-integrated), but aethalometers are commonly used.

The VOC samplers consist of evacuated stainless steel canisters that have interior surfaces that are polished, cleaned, and conditioned using the Summa® process. Outside air is drawn into the canister over a 24-hour period through a Teflon® sampling line and a PM filter with the flow rate controlled by a calibrated volumetric flowmeter. The collected sample is then transferred to a laboratory for analysis using a chromatograph/mass spectrophotometer (GC/MS). This time-integrated method is consistent with U.S. EPA Method TO-15 (*Determination of VOCs in Air Collected in Specially-Prepared Canisters and Analyzed By GS/MS*).

SVOC's will be collected using high-volume air samplers that are equipped with a filter and sorbent cartridge containing a pre-treated polyurethane foam (PUF) plug and XAD resin Outside air is drawn into the device over a 24-hour period by a calibrated blower fan, bringing the air sample through the filter then through the sorbent plug and resin. The collected samples are transferred to a laboratory for analysis using GC/MS. This time-integrated method is consistent with U.S. EPA Method TO-13A (D*etermination of Polycyclic Aromatic Hydrocarbons (PAHs) in Ambient Air Using Gas Chromatograph/Mass Spectrometry*).

Carbonyls will be collected using a method comprised of a prepackaged cartridge containing acidified 2,4-dinitrophenylhydrazine (DNPH). A sampling pump draws the outside air through the cartridge using a Teflon sampling line having the sample rate controlled by a calibrated pump. The flow rate is established to sample a known volume of air for an appropriate integration period. The collected sample is then transferred to a laboratory for analysis using High Performance Liquid Chromatography (HPLC). This method is consistent with U.S. EPA Method TO-11A (*Determination of Formaldehyde in Ambient Air Using Adsorbent Cartridge Followed by HPLC*).

Particulate-bound PAHs will be measured using real-time monitors that work on the principle of photoionization. In these instruments, ultraviolet radiation ionizes the air sample and particles containing PAH's cause changes in the electric field. This change is compared to pre-calibrated mixtures of PAH's and is used to compute the amount of contaminate present.

[2]. Because of the limited application of this instrumentation, the use of water-based condensation particle counters will remain under evaluation by RIAC and RI DEM.

Presently, there is no designated U. S. EPA Reference Method for this pollutant (either real time or time-integrated).

Although not called for in the *Act*, wind direction, wind speed, temperature, humidity and precipitation data will be collected at the meteorological station located at the airport and operated by the National Weather Service.

Because the $PM_{0.1}$ (nephelometers / water based particle counters), black carbon (aethalometers) monitors and particulate-bound PAHs instruments are fully automated, these "real-time" measurements will be taken and recorded continuously 24-hours daily, 7 days a week. By comparison, $PM_{2.5}$, VOCs, SVOCs and carbonyls are measured with time-integrated samplers and their monitoring schedule will follow the conventional "rotation" plan used by U.S. EPA and RI DEM.[3]

See the Table A1 in the Appendix for summary matrix of monitoring parameters, by site.

V. Monitoring Criteria

For the purposes of this *Work Plan*, the term "monitoring criteria" means the standards or "benchmarks" against which the monitoring data can be compared. For $PM_{2.5}$, the NAAQS are considered the most appropriate criteria. These values are 35 and 15 micrograms/cubic meter ($\mu g/m^3$), respectively, for the 24-hour and annual average concentrations. Unfortunately, there are no NAAQS for any of the other parameters included in the monitoring program including $PM_{0.1}$ and black carbon.

For VOCs (i.e., benzene and 1,3 butadiene), SVOCs (i.e., naphthalene) and carbonyls (i.e., acetaldehyde and formaldehyde), the data can be compared to acute (i.e., short-term) and chronic (long-term) health benchmarks (both non-cancer and cancer) established by the U.S. EPA. However, it must be noted that these Reference Concentrations (RfC) and risk values assume population exposure durations and other confounding factors that are not replicated in this Work Plan and render them highly limited for this application. The Health Study called for in the *Act* and to be undertaken by the RI DOH is intended to further address this issue.

Other comparisons that can be made with the collected data include the following:

- Pollutant concentrations at RI DEM monitoring stations located in other areas of the state (i.e., Providence, E. Providence, Pawtucket);
- Results from the *RI DEM Air Monitoring Study* [RI DEM, 2007b];
- Paired results from upwind and downwind stations located around the airport (i.e., Fire Station No. 8 and Pembroke Ave. or Lydick Ave. and Fieldview Drive.

However, several factors are noteworthy with respect to these comparisons: 1.) ambient levels of SVOC's, $PM_{0.1}$ and particle-bound PAHs' are currently not measured in any other part of the state; 2.) the *RI DEM Air Monitoring Study* did not include these compounds; and 3.) no historical monitoring data exists for the Pembroke Ave. station.

[3] The "rotation" plan involves taking samples once every 6 days so that each day of the week is sampled several times annually. (See Table A2 in the Appendix.)

It is expected that these comparisons will be made by RI DEM with assistance from RIAC.

VI. Quality Assurance Procedures

As discussed previously in Section IV (*Monitoring Methods*), sampling and measurements will be accomplished using methods and equipment that are specifically designed for each type of pollutant, the expected range of ambient concentrations and the applicable time periods. These methods are designated as either "Reference" methods, where applicable, or accepted by the U.S. EPA and others as appropriate for the application.

For this *Work Plan*, the processing of the data is sub-divided into two areas: 1.) the collection of the continuous ("real-time") measurements and 2.) the field collection and laboratory analysis of the time-integrated samples. The real-time measurements comprise the $PM_{0.1}$ (nephelometers / water-based particle counters), black carbon (aethalometers) and particle-bound PAH monitors and the time-integrated sampling involves $PM_{2.5}$, VOCs, SVOCs and carbonyls.

In both cases, quality assurance will be achieved in the field by trained and qualified technicians that will visit each monitoring station on an average of twice a week to check on the operation of the continuous instruments, the shelters in which they are housed and to set up or collect the time-integrated samplers. Other tasks will include zero, span and precision calibration checks on the continuous instruments as well as beginning and ending flow rate and time clock checks on the 24-hour samplers. Site visits will be log-documented with each set of collected data receiving a unique identifier and all sample handling will be controlled following strict "chain-of-custody" procedures.

Other conditions related to Quality Assurance Procedures including the statistical methods for determining the precision and accuracy of collected data, the performance of field audit checks, and appropriate laboratory documentation will be provided in a *Quality Assurance Project Plan* (QAPP) developed specifically for this monitoring program. This QAPP will be developed separately by the independent contractor selected by RIAC and then will be submitted to RI DEM/RI DOH for review and comment prior to the commencement of monitoring activities.

VII. Implementation Schedule

The schedule in Table 2 provides the timeframe along with significant benchmarks for implementing the air monitoring program. Importantly, the dates for meeting several benchmarks are established in the *Act* while others are set in order to achieve the overall goal of having the program fully in-place and operational by December 30, 2007.

Data generated from the air monitoring program will be reported to RI DEM/RI DOH on a quarterly basis. The first data report is scheduled to be prepared and delivered in mid-April 2008. Finally, any amendments to the *Final Work Plan* may be proposed by RIAC in consultation with RI DEM and RI DOH on or before March 30, 2009 and every March 30th thereafter.

VIII. Agency Coordination

In accordance with the *Act*, RI DEM, RI DOH and the general public have reviewed and commented on the *Draft Work Plan* (see Appendix for the written comments and responses) [RIAC 2007a,c, RI DEM, 2007a, Komar, 2007] As part of this consultation process, it is expected that these agencies will continually provide RIAC with peer review, scientific knowledge and specialized expertise as necessary and relevant to this air quality monitoring program and public health.

It is also RIAC's intent to coordinate with RI DEM/RI DOH on a regular (but unscheduled) basis in support of the air monitoring program and whenever the need arises.

Table 2: Implementation Schedule

Date	Activity / Benchmark	Comments
July 3, 2007	*Permanent Air Quality Monitoring Act* signed into law.	--
Aug. 2, 2007	RIAC submited *Draft Work Plan* to RI DEM/RI DOH for review and comment.	Required by the *Act* 30 days after legislation enacted.
Sept. 1, 2007 Oct. 1, 2007	RI DEM/RI DOH submited review comments on *Draft Work Plan* to RIAC. *Draft Work Plan* made available to general public for review and comment.	Required by *Act* 30 days after receipt of *Draft Work Plan*. Also required by the *Act*.
Sept. 13, 2007 September 27, 2007 Oct. 31, 2007	RIAC issued Request for Qualifications (RFQ) to procure air monitoring services and equipment from qualified contractor. RIAC issued Request for Proposals (RFP) to procure air monitoring services and equipment from qualified contractor. RIAC to make recommendation for Board approval for contractor.	RIAC, *Request for Qualification to Provide a Long-Term Air Quality Monitoring System at T.F. Green airport, Warwick, RI,* Sept. 13, 2007 RIAC, *Request for Proposals to Provide a Long-Term Air Quality Monitoring System at T.F. Green airport, Warwick, RI,* Sept. 27, 2007 --
Oct. 30, 2007	*Final Work Plan* submitted to Governor, Speaker of the House and President of Senate.	Required by *Act.*
Nov. 1 – Dec. 29, 2007	RIAC to complete installation and calibration of monitoring equipment.	--
December 30, 2007	Air quality monitors to be procured and in effect.	Required by *Act*.

Source: KB Environmental Sciences, Inc

IX. Funding Sources

The *Act* also calls for an evaluation of funding sources, such as federal grants, that may be available to RIAC to cover some, or all, of the costs for the air quality monitoring program. RIAC will continually search for these funding sources.

References

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RIAC, 2007a, Electronic communication between Brenda Pope, Vice President of Environmental Management Systems, Rhode Island Airport corporation and Robert Vanderslice, Rhode Island Department of Health, September 7, 2007.

RIAC, 2007b, *T.F. Green Airport Air Quality Monitoring Plan* (Interim) for the Rhode Island Airport Corporation Permanent Air Quality Monitoring Act, prepared for the Rhode Island Airport Corporation (RIAC), prepared by KB Environmental Sciences, Inc. May 2007, updated July 2007.

RIAC, 2007c, Air Quality Monitoring Work Plan for T.F. Green Airport (DRAFT), prepared in support of the State of Rhode Island Permanent Air Quality Monitoring Act, prepared for the Rhode Island airport corporation (RIAC), prepared by KB Environmental Sciences, Inc. September 7, 2007.

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RI DEM 2007b, *T.F. Green Air Monitoring Study, Final Presentation*, Rhode Island Department of Environmental Management, Office of Air Resources June 12, 2007 (Not to be Cited or Quoted).

State of Rhode Island, 2007, Section 1-7-1 of the State of Rhode Island General Law (*The Permanent Air Quality Monitoring Act*), signed into law July 3, 2007.

U.S. EPA, 1999, *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air*, Second Edition, U.S. Environmental Protection Agency, January 1999.

- Federal Register Notice (04/22/99) "Revisions to Reference Method for the Determination of Fine Particulate Matter as PM2.5 in the Atmosphere" (Direct Final Rule).
- EPA Method TO-11A, *Determination of Formaldehyde in Ambient Air Using Adsorbent Cartridge Followed by High Performance Liquid Chromatography (HPLC) [Active Sampling Methodology]*
- EPA Method TO-13A (*Determination of Polycyclic Aromatic Hydrocarbons in Ambient Air Using GC/MS*).
- EPA Method TO-15 (*Determination of VOCs in Air Collected in Specially-Prepared Canisters and Analyzed By GS/MS*).

APPENDIX

Table A1: Air Monitoring Station Summary[1,2]

Site Location	North	South	West	East
Site Name	Lydick Ave.	Fieldview Dr.	Fire Station	Pembroke Ave.
Owner	RIAC	RIAC	RIAC	RIAC
Land-use(s) ▪ **On-site** ▪ **Adjoining**	 Vacant Residential north, east and south. Runway protection zone west.	 Vacant Residential east and south. Airport long-term parking north. Runway/taxiway east	 Fire station Residential north and west. Commercial south. Fire station and Post Rd. east.	 Vacant Residential north, east and west. Airport west.
Location	Adjacent to the Spring Green neighborhood and the airport's northeastern property line, approximately ¾ mile (3,680 ft.) from the end of Runway 23.	South-southwest of the T.F. Green airfield approximately 450 feet from Taxiway S and 900 feet from the end of Runway 5.	West-northwest of the airport approximately ½ mile (2,250 ft.) from the end or Runway 16.	Due east of the airport approximately ¼ mile (1,425 ft.) from the intersection of Runways 5/23 and 16/34.
Monitoring Parameters	– $PM_{2.5}$ – $PM_{0.1}$ – Black carbon – VOCs – SVOCs – Carbonyls – PAHs on PM	– $PM_{2.5}$ – $PM_{0.1}$ – Black carbon – VOCs – SVOCs – Carbonyls – PAHs on PM	– $PM_{2.5}$ – $PM_{0.1}$ – Black carbon – VOCs – SVOCs – Carbonyls – PAHs on PM	– $PM_{2.5}$ – $PM_{0.1}$ – Black carbon – VOCs – SVOCs – Carbonyls – PAHs on PM

[1] This table contains the list of monitoring stations to be operated by RIAC.

[2] Background air monitoring data will be obtained from monitoring stations operated by RI DEM elsewhere in the state. These data will be supplemented by measurements of SVOC's, $PM_{0.1}$ and particle-bound PAHs' by RIAC at one of these RI DEM monitoring stations.

Carbonyls – including (but not limited to) formaldehyde and acetaldehyde

PAHs – polycyclic aromatic hydrocarbons, including (but not limited to) PM bound to semi-volatile organic compounds

PM – particulate matter; 2.5 microns and 0.1 microns in diameter

RIAC – Rhode Island Airport Corporation

SVOCs – semi-volatile organic compounds, include (but not limited to) naphthalene

VOCs – volatile organic compounds, including (but not limited to) benzene, 1,3 butadiene

Source: KB Environmental Sciences, Inc.

North Air Monitoring Station
Lydick Avenue

Site View

Looking North

Looking East

Looking South

Looking West

South Air Monitoring Station
Fieldview Drive

Site View

Looking North

Looking East

Looking South

Looking West

West Air Monitoring Station
Fire Station

Site View

Looking North

Looking East

Looking South

Looking West

East Air Monitoring Station
East Pembroke Avenue

Site View

Looking North

Looking East

Looking South

Looking West

Table A2: Air Quality Monitoring Program Rotating Sampling Schedule for Time-Integrated Parameters

January 2008

Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

February 2008

Su	Mo	Tu	We	Th	Fr	Sa
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	

March 2008

Su	Mo	Tu	We	Th	Fr	Sa
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

April 2008

Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

May 2008

Su	Mo	Tu	We	Th	Fr	Sa
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

June 2008

Su	Mo	Tu	We	Th	Fr	Sa
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

July 2008

Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

August 2008

Su	Mo	Tu	We	Th	Fr	Sa
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

September 2008

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

October 2008

Su	Mo	Tu	We	Th	Fr	Sa
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

November 2008

Su	Mo	Tu	We	Th	Fr	Sa
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

December 2008

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

Highlighted dates designate possible sampling days (according to David Luch, U. S. EPA, July 19, 2007. The “rotation” plan involves taking samples once every 6 or 12 days so that each day of the week is sampled several times annually.

RI DEM Comment Letter

RHODE ISLAND
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
235 Promenade Street, Providence, RI 02908-5767 TDD 401-222-4462

21 August 2007

Brenda L Pope, CHMM, REM
Vice President, Environmental Management Systems
Rhode Island Airport Corporation
2000 Post Road
Warwick, RI 02886-1533

Dear Ms. Pope:

The Rhode Island Department of Environmental Management, Office of Air Resources (RI DEM) has reviewed the draft "Air Quality Monitoring Work Plan for the T. F. Green Airport," which was received by RI DEM on 1 August 2007. This document was submitted by the Rhode Island Airport Corporation (RIAC) in accordance with requirements in Section 1-7-1 of the Rhode Island General Laws (RIGL). The following are RI DEM's comments about the scope of work outlined in the draft work plan:

1. The planned implementation date, 30 December 2007, the list of parameters to be monitored and the planned location of monitoring sites are appropriate and consistent with RIGL 1-7-1.

2. In the last paragraph of Section III of the draft work plan, RIAC states that, "because ambient levels of SVOC's, $PM_{0.1}$ and particle-bound PAHs' are not measured in any other part of the state, measurements of these parameters will be made by RIAC at one of the existing RI DEM stations." Note that RI DEM will begin monitoring for semivolatiles/polycyclic aromatic hydrocarbons (SVOCs/PAHs) using EPA Method TO-13A at the Providence National Air Toxics Trends Site (NATTS), on 6 January 2008. TO-13A monitoring will be conducted at the Providence site, as well as at the other NATTS sites in the country, for 24-hour periods every sixth day beginning on that date.

3. RIAC is proposing to collect intermittent filter-based $PM_{2.5}$ samples using Federal Reference Method (FRM) equipment. RI DEM agrees that a FRM or Federal Equivalent Method (FEM) should be used to measure this parameter, so that data collected can be compared to the National Ambient Air Quality Standard (NAAQS) for $PM_{2.5}$. At the present time, the filter-based FRM is the only method that has been approved by the EPA for that purpose. However, the EPA is currently evaluating several types of continuous $PM_{2.5}$ monitors and is expected to designate one or more of those monitors as FEM in the near future. RIAC may

want to consider the using continuous monitors when they are approved, because operation of those monitors may be less expensive than sampling and analysis using the filter-based method and because continuous monitors generate considerably more information than intermittent FRMs.

4. Nephelometers are commonly used for measuring $PM_{2.5}$ and are not the preferred instrumentation for measuring particulate matter in the ultrafine range ($PM_{0.1}$). RI DEM suggests the use of condensation particle counters for measuring $PM_{0.1}$.

5. The use of EPA Method TO-13A for measuring semivolatiles is appropriate. However, since naphthalene is specifically identified in RIGL 1-7-1 as a target compound, the resin XAD-2 should be used in addition to or instead of PUF as a sorbent material. Note that the EPA documentation for Method TO-13A[1] specifies the following:

> 6.1.3 Naphthalene, acenaphthylene, and acenaphthene possess relatively high vapor pressures and may not be efficiently trapped by this method when using PUF as the sorbent. The sampling efficiency for naphthalene has been determined to be about 35 percent for PUF. The user is encouraged to use XAD-2 if these analytes are part of the target compound list.

6. While RI DEM supports the employment of a continuous monitor to measure particulate-bound PAHs, please note that the TO-13A method, which utilizes a filter and sorbent material in series, captures and measures PAHs in both the particulate and gaseous phase. The EPA documentation for that method specifies the following:

> 6.1.1 PAHs span a broad spectrum of vapor pressures..... Those with vapor pressures above approximately 10^{-8} kPa will be present in the ambient air substantially distributed between the gas and particulate phases. This method will permit the collection of both phases.

Note however, that Method TO-13A does not allow the user to quantify particulate and vapor phase PAHs, as they exist in the atmosphere, separately, but rather provides a total of the PAHs in both phases. According to the documentation:

> 6.1.2 Particulate-phase PAHs will tend to be lost from the particle filter during sampling due to volatilization. Therefore, separate analysis of the filter will not reflect the concentrations of the PAHs originally associated with particles, nor will analysis of the sorbent provide an accurate measure of the gas phase. Consequently, this method calls for *extraction of the filter and sorbent together* to permit accurate measurement of total PAH air concentrations.

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[1] USEPA, Center for Environmental Research Information, Compendium of Methods for the Determination of Toxic Compounds in Ambient Air, Compendium Method TO-13A, "Determination of Polycyclic Aromatic Hydrocarbons (PAHs) in Ambient Air Using Gas Chromatography/Mass Spectrometry (GC/MS)", January 1999. http://www.epa.gov/ttn/amtic/files/ambient/airtox/to-13arr.pdf

7. The methodology specified to measure black carbon (aethalometers), VOCs (EPA Method TO-15) and carbonyls (TO-11A) is appropriate.

8. The last paragraph of Section IV of the draft work plan states that the $PM_{0.1}$ and black carbon real-time monitors will be operated 24 hours per day, 7 days per week, but that the real-time instrumentation used to measure particulate-bound PAHs will be operated only when the intermittent monitors are operational. RI DEM strongly urges RIAC to operate all real-time instruments continuously; to not do so would result in the potential to miss important information on days that the intermittent equipment is not being operated. In particular, RI DEM is interested in the correlation between the particulate-bound PAH levels and concurrent levels of $PM_{0.1}$ and black carbon.

9. The last paragraph of Section IV also states that the monitoring schedule for time-integrated samples "will follow the conventional 'rotation' plan used by US EPA and RI DEM." A footnote to that statement says that "the 'rotation' plan involves taking samples once every 6 or 12 days..." RI DEM takes year-round intermittent samples for VOC, SVOC and carbonyl on a one in six day schedule. FRM $PM_{2.5}$ samples are collected daily at two sites and on a one in three day schedule at the other sites in the State. RI DEM believes that RIAC sampling schedule for those pollutants should not be less frequent than one in six days.

10. The annual average NAAQS for $PM_{2.5}$ cited in Section V of the draft work plan is incorrect. The current annual average NAAQS for that pollutant is 15 $\mu g/m^3$. The 24-hour NAAQS for $PM_{2.5}$ is correctly identified as 35 $\mu g/m^3$.

11. RI DEM and the RI Department of Health will assist with the interpretation of data collected, as stated in Section V of the draft work plan.

12. Good quality assurance/quality control is essential for producing meaningful results. RI DEM will carefully scrutinize the Quality Assurance Project Plan (QAPP) developed by the contractor to ensure that the procedures identified, including the operation of co-located equipment, are consistent with EPA specifications. RIAC may wish to review QAPPs developed by the RI DEM and the RI Department of Health Air Pollution Laboratory for similar projects, as well as EPA guidance documents, when developing those procedures. Members of the public may also be interested in reviewing the QAPP.

13. It is important that the sampling methodology employed in the study be sensitive enough to be able to measure levels of the target air toxics that may be associated with health effects. RIAC should work with RI DEM and the Rhode Island Department of Health Office of Environmental Health Risk Assessment to determine health significant concentrations. The QAPP should demonstrate that the methodologies chosen can accurately measure concentrations in that range or concentrations generally present in the ambient environment.

14. The implementation schedule and agency coordination discussions in the draft work plan are consistent with the requirements of RIGL 1-7-1.

If you have any questions about any of the above comments, please contact me at (401) 222-4700, ext. 7012.

Very truly yours,

Barbara Morin, Supervising Environmental Scientist
Office of Air Resources

Response to RI DEM Comments on the Air Quality Monitoring Work Plan for T.F. Green Airport[4]

1. Comment noted. No response necessary.

2. Comment noted. No response necessary.

3. Comment noted. No response necessary.

4. Comment noted. Condensation Particle Counters will be used to monitor untra-fine particles.

5. Comment noted and the EPA Method 13A will include the resin XAD-2 in addition to, or instead of, the PUF sorbent material.

6. Particle-bound PAH's will be monitored continuously.

7. Comment noted. No response necessary.

8. See response to Comment No. 6.

9. Time-integrated samples will be taken on the once-every-six-day schedule.

10. The value for the annual NAAQS for $PM_{2.5}$ has been corrected.

11. Comment noted. No response necessary.

12. The QAPP's will be reviewed by RI DEM and made available to the public.

13. Ongoing coordination between RIAC, RI DEM and RI DOH is underway and the QAPP's will identify the detectable limits of each monitoring method used.

14. Comment noted. No response necessary.

[4] Rhode Island Department of Environmental Management, Barbara Morin, correspondence to Rhode Island Airport Corporation (RIAC), Brenda Pope, August 21, 2007.

RI DOH Comment

Copy of Electronic Communication

-----Original Message-----
From: Robert Vanderslice [mailto:Robert.Vanderslice@health.ri.gov]
Sent: Thursday, September 06, 2007 10:52 AM
To: Brenda Pope
Subject: Re: RIAC Permanent Air Quality Monitoring Work plan

Brenda,

Thanks for the reminder.

I have no comments on the Permanent Air Quality Monitoring work plan of July 2007.

Robert Vanderslice, PhD
Healthy Environment Team Lead
RI Department of Health

>>> "Brenda Pope" <BPope@pvdairport.com> 9/5/2007 12:59 PM >>>
Hey Bob,

I just wanted to confirm our conversation from last week regarding the above noted subject. The Rhode Island Airport Corporation (RIAC) provided a copy of the Permanent Air Quality Monitoring work plan for your review in July 2007. The Rhode Island Department of Environmental Management has recently provided comments to RIAC on the plan. Per your comment last week the Rhode Island Department of Health has no additional comments on the work plan.

Please let me know whether this is correct. Thanks Bob.

Brenda L. Pope, CHMM,REM
Vice President of Environmental Management Systems Rhode Island Airport Corporation 2000 Post Road Warwick, RI 02886 401-737-4000 ext. 417
401-732-8204 (fax)

Comment noted. No response necessary.

Public Comment Letter

October 17, 2007

Ms. Beth Tetreault, Rules Coordinator
Rhode Island Airport Corporation
Via email: btetreault@pvdairport.com

Re: Public Comments
Air Quality Monitoring Work Plan for T.F. Green Airport

Dear Ms. Tetreault:

Thank you for accepting my comments regarding the "Air Quality Monitoring Work Plan for T.F. Green Airport", prepared by KB Environmental Sciences, Inc. and dated September 7, 2007. In accordance with our conversation, public comments will be accepted until midnight October 17, 2007 at your email address.

My comments are the following:

Cover: Should be "Draft" and not "Final Draft".

Executive Summary and II. Monitoring Parameters: In addition to RIAC recording wind direction and wind speed and other meteorological parameters as cited, my comment is to include the recording of airport ground activity, changes in ground activity, and directions of runway landing and takeoff. For example, regarding airport ground activities, report construction activities, maintenance activities such as application of cleaners to runways, use of different parking areas and vehicular access, etc. Include in data report, a record of all commercial flights as well as FAA aircraft registration numbers (ANOMS or other appropriate method) for purpose to provide information regarding airplane engines. Omission of this data would result in information needed for the analysis phase.

Executive Summary and II. Monitoring Parameters: Provide map of airport along with data reports to be prepared, showing air quality monitoring stations, airport buildings (and provide activities ongoing in each building) and runways (showing taxiing areas). Provide map of flight paths with applicable dates. Install realtime video recording of arriving and departing flights on prevailing runway during summer months. Omission of this data would result in information needed for the analysis phase.

Executive Summary and III. Number, Type and Location of the Monitors: The determination of "background" conditions is not part of the scope of the work plan per the Act and should be deleted. The scope of work plan specified in the Act is to collect data and not compare airport air

quality data with other monitoring stations in the state which are affected by other sources to make comparisons to possibly diminish the significance of collected airport air quality data.

III. Number, Type and Location of the Monitors: "…four (4) separate monitoring sites should be changed to a "minimum" of four monitoring to comply with the Act.
The Work Plan only addresses the minimum required stations. Ad hoc mobile detection unit to collect air quality parameters as deemed necessary by the PAC, RIDEM or RI HEALTH.
The location of monitoring stations should be determined by the PAC and with options to add additional stations, in particular with the centerline of major use runways in such a manner to measure the dispersion gradient of all compounds required to be tested. Not doing so would leave a major deficiency in the testing program.

There is no mention on the format for reporting the data, which should be presented in format for technical analysis and for information to the general public. Data should be stored in Microsoft Access data base or other database acceptable to RIDEM.

Again, thank you accepting my comments and I look forward to receiving responses to my comments and viewing responses to other comments RIAC may have received.

Sincerely,

Michelle Komar
80 Audubon Road
Warwick, RI 02888

Response to Public Comments on the Air Quality Monitoring Work Plan for T.F. Green Airport[5]

In accordance with *The Permanent Air Quality Monitoring Act*[6], the *Draft Air Quality Monitoring Work Plan for T.F. Green Airport*[7] has been made available for review and comment by the general public.[8] One comment letter was received.[9] These comments (shown below in **bold** type) are followed by the responses. Wherever necessary, the *Draft Work Plan* has been updated and amended to reflect these comments.

1. **Cover: Should be "Draft" and not "Final Draft".**

   In accordance with the *Act*, the *Work Plan* cover shall contain the term "*Final*", from this point forward.

2. **Executive Summary and II. Monitoring Parameters: In addition to RIAC recording wind direction and wind speed and other meteorological parameters as cited, my comment is to include the recording of airport ground activity, changes in ground activity, and directions of runway landing and takeoff. For example, regarding airport ground activities, report construction activities, maintenance activities such as application of cleaners to runways, use of different parking areas and vehicular access, etc. Include in data report, a record of all commercial flights as well as FAA aircraft registration numbers (ANOMS or other appropriate method) for purpose to provide information regarding airplane engines. Omission of this data would result in information needed for the analysis phase.**

   As part of the Long-Term Air Quality Monitoring Program, RIAC will collect wind direction and wind speed which is available from the meteorological station located at the airport. The number of aircraft operations (i.e., take-offs and landings) by runway and aircraft type, can similarly be obtained from FAA records as well as the RIAC web site.

   Construction and maintenance activities at the airport are almost constantly underway, in some form or another. Upon specific requests and to the extent the location, duration and magnitude of these activities could have an influence on air quality conditions at the monitoring stations, they will be noted. Similar information associated with the utilization of different parking areas and vehicle access routes can also be evaluated, upon specific requests and on a case-by-case basis.

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[5] Prepared October 25, 2008 by RIAC in coordination with RI DEM and RI DOH.
[6] State of Rhode Island, 2007, Section 1-7-1 of the State of Rhode Island General Law (*The Permanent Air Quality Monitoring Act)*, signed into law July 3, 2007.
[7] *Air Quality Monitoring Work Plan for T.F. Green Airport*, Prepared in Support of the State of Rhode Island Permanent Air Quality Monitoring Act, Prepared for the Rhode Island Airport Corporation (RIAC), Prepared by KB Environmental Sciences, Inc. September 7, 2007.
[8] Public notice of availability in newspaper September 17, 2007.
[9] Email correspondence to Ms. Beth Tetreault, RIAC from Michelle Komar,, Public Comments – Air Quality Monitoring Work Plan for T.F. Green airport, October 17, 2007.

Aircraft registration numbers are available from FAA records, although it is not RIAC's intent to provide these data.

3. **Executive Summary and II. Monitoring Parameters: Provide map of airport along with data reports to be prepared, showing air quality monitoring stations, airport buildings (and provide activities ongoing in each building) and runways (showing taxiing areas). Provide map of flight paths with applicable dates. Install realtime video recording of arriving and departing flights on prevailing runway during summer months. Omission of this data would result in information needed for the analysis phase.**

   An aerial photograph of the airport which includes the air monitoring site locations, airport buildings, runways and taxiways is provided as Figure 1 (*Air Monitoring Stations*) of the *Draft Work Plan*.

   A map of flight paths at T.F. Green is not readily available.

   The installation of real time video recordings of arriving and departing flights is not called for in the *Act* and not considered to be part of the scope.

4. **Executive Summary and III. Number, Type and Location of the Monitors: The determination of "background" conditions is not part of the scope of the work plan per the Act and should be deleted. The scope of work plan specified in the Act is to collect data and not compare airport air quality data with other monitoring stations in the state which are affected by other sources to make comparisons to possibly diminish the significance of collected airport air quality data.**

   The over-riding intent of the *Act*, and therefore the *Draft Work Plan*, are to help ascertain the impact of airport operations on local air quality conditions. Because the air quality around the airport is likely affected by a variety of other non-airport sources (i.e., motor vehicles, industrial/manufacturing activities, and natural sources) it is necessary to measure ambient conditions located outside the airport's potential area of influence. These "background" measurements are designed to aid in this determination and will be obtained through collaborative efforts between RIAC and RI DEM.

5. **III. Number, Type and Location of the Monitors: "…four (4) separate monitoring sites should be changed to a "minimum" of four monitoring to comply with the Act.**

   The *Draft Work Plan* text has been changed to reflect this recommendation.

6. **The Work Plan only addresses the minimum required stations. Ad hoc mobile detection unit to collect air quality parameters as deemed necessary by the PAC, RIDEM or RI HEALTH.**

   In accordance with the *Act*, the four permanent air monitoring stations are located north, east, south and west of the airport and will cover the range of seasonal upwind, down-wind and

cross-wind conditions. In addition, an ongoing research project sponsored by the FAA at T.F. Green involves portable monitoring equipment and these data will be available in the future.[10] A separate mobile detection unit is not called for in the *Act*, and is therefore not included in the long-term program at the airport.

7. **The location of monitoring stations should be determined by the PAC and with options to add additional stations, in particular with the centerline of major use runways in such a manner to measure the dispersion gradient of all compounds required to be tested. Not doing so would leave a major deficiency in the testing program.**

   The locations of the monitoring stations north, east, south and west of the airport has been dictated by the Act and coordinated with both the RI DEM and RI DOH. (See also Response to Comment No. 6, above.)

8. **There is no mention on the format for reporting the data, which should be presented in format for technical analysis and for information to the general public. Data should be stored in Microsoft Access data base or other database acceptable to RIDEM.**

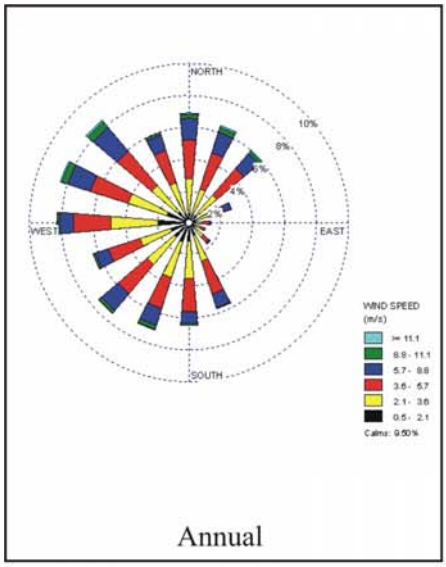
   The format for reporting the collected data will vary depending on the type of pollutant and monitoring period. For example, measurement of ambient levels of Black Carbon will be taken every 1 to 5 minutes, 24 hours a day, while measurements of $PM_{2.5}$ will be taken over 24-hour periods, every 6 days. Moreover, for some pollutants (i.e., $PM_{2.5}$), comparisons to regulatory standards are possible while for others (i.e., $PM_{0.1}$) no such thresholds exist. Other potentially meaningful trends and observations will also not likely emerge until a few months of data have been collected. It is for these reasons that advanced discussions of the precise formats for reporting the data are reserved until later, but will be coordinated with the RI DEP and RI DOH. In the interim, RI DEM has indicated what form they will receive the data (i.e., hard and electronic (Excel) copies).

End of Responses

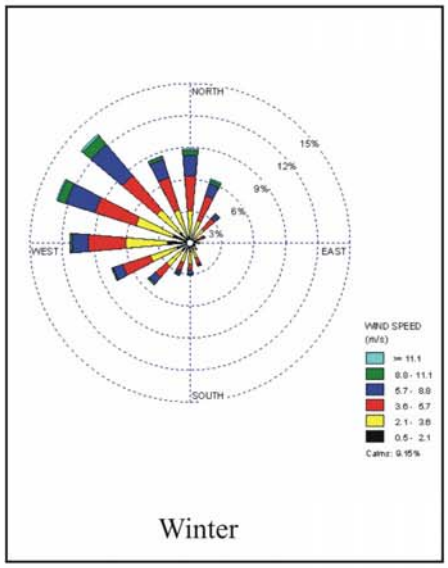
[10] PARTNER Research on Air Quality and Health Impacts due to Aviation-Related Air Pollutants

Annual and Seasonal
Wind Roses for
T.F. Green Airport

Based on data from 2001 to 2005 (arrows point in the direction that the wind is coming from and the width of the arrow is a function of frequency).



Annual



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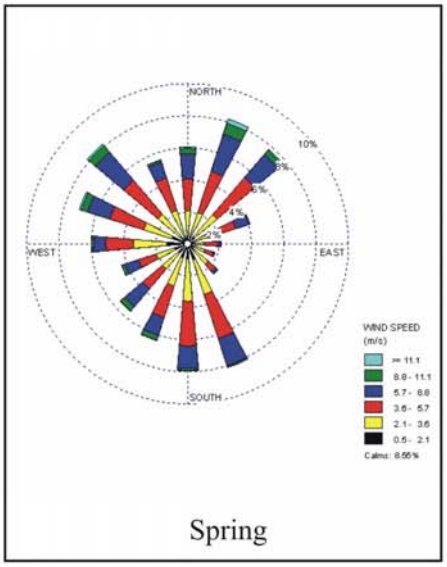

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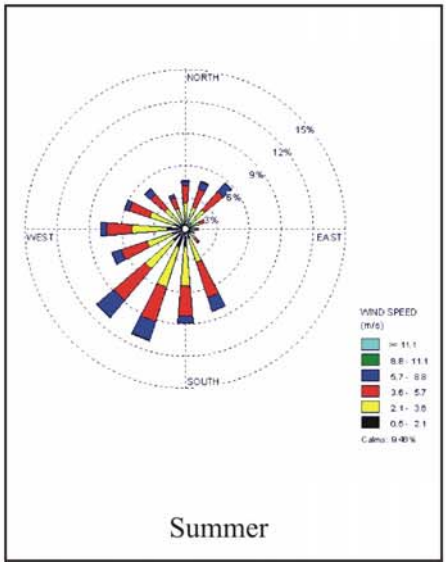

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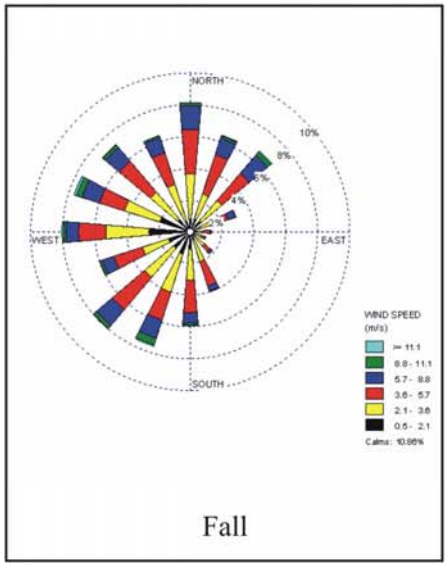

Fall