Rhode Island Airport Corporation

Rhode Island Airport Corporation
Air Quality Monitoring Work Plan

for TF Green Airport, Warwick, RI

(Effective as of September 16, 2014)

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I. Introduction and Background

The Rhode Island Airport Corporation (RIAC) operates and maintains a long-term air quality monitoring program in the vicinity of T.F. Green Airport in Warwick as required by Rhode Island General Laws, Section 1-7-1 et seq, *The Permanent Air Quality Monitoring Act* ("the Act"). In accordance with the Act, any amendments to the Final Work Plan may be proposed by RIAC in consultation with the Rhode Island Departments of Environmental Management ("RIDEM") and Health ("RIDOH") on or before March 30, 2009, and every March 30th thereafter. RIAC has instituted the amendments included in the Final Work Plan (2009). RIAC has developed the amendments included in this *Proposed Amendments to the Air Quality Monitoring Work Plan for T.F. Green Airport* in consultation with RIDEM and RIDOH. The purpose of the amendment to the previous plan is to adjust the monitoring program to address the suitability of the monitoring devices and adaptations indicated by the data collected since 2008. There have been no changes to state and/or federal regulations that warrant adjustments to the program and there are no new monitoring technologies, methodologies or criteria changes proposed in this work plan.

The following components of the program are addressed:

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

II. Monitoring Parameters

The air quality monitoring program meets the requirements set forth in the Act. These parameters include 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 carbon (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) formaldehyde and acetaldehyde; and
- 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 acquired from the airport National Weather Service station and recorded by RIAC.

III. Number, Type and Location of the Monitors

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

The RIAC monitoring network consists 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 described below:

- **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 land uses 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.

- **North Site** (*Lydick Avenue*) – Located adjacent to the Spring Green neighborhood and the airport's northeastern property line, approximately 3/4 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 approximately 900 meters northeast of the main runway. This site is generally downwind of the airport in the summer.

- **West Site** (*Fire Station No. 8*) – Located west-northwest of the airport approximately 1/2 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 Avenue) – Located due east of the airport approximately 1/4 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.

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 RIDEM. The East Site (*Pembroke Ave.*) was established in 2008 and was not included in the RIDEM study. The East site (Pembroke Avenue) has been moved approximately 230 yards south of the initial location putting it over 200 feet closer to the runway intersection.

Figure 1: Air Monitoring Stations

The four 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 "downwind" pairs under most meteorological conditions; and 4) the sites allow comparison to the data collected during the RIDEM study. (See Appendix for site photographs and wind rose diagrams.)

Background air monitoring data (i.e., data from areas away from the airport) for $PM_{2.5}$, black carbon, VOC's, SVOC's/PAH etc., will be obtained from RIDEM stations located elsewhere in the state (i.e. Providence, E. Providence, Pawtucket and/or Providence National Air Toxics Trends Site (NATTS).

IV. Monitoring Methods

The equipment and monitoring methods used to collect and analyze air samples are summarized in Table 1. The methods and equipment are considered to be the most appropriate for the parameters established in the Act, listed in Section I, based on the following: 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 detections limits; and 3) the overall reliability and cost-effectiveness of the equipment or method. If the United States Environmental Protection Agency (USEPA) "Reference Methods" (USEPA, 1999) are established they are utilized. Where such designations do not exist, the methods are broadly accepted by the USEPA, RIDEM as appropriate for the application.

Two other terms applicable to the discussion of the monitoring methods are (1) "real-time"; and (2) "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 the 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 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 samples over a 24-hour period with the high volume sampler 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 $PM_{2.5}$.

Table 1: Air Quality Monitoring Equipment and Methods

Parameters and Target Compounds[1]	Sampling and Analysis Equipment/Methods[2]	Summary Description
Particulate Matter		
Fine PM ($PM_{2.5}$) < 2.5 microns	EPA 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[3]	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[4]	EPA Method TO-15	Time-integrated (24-hr) sample collected in canisters and based on laboratory GC/MS analysis.
1,3 butadiene[4]	EPA Method TO-15	(same as above)
Semi-Volatile Organic Compounds (SVOCs)4		
Napthalene[4]	EPA Method TO-13 (with XAD-2 resin)	(same as above)
Carbonyls[3]		
Aetaldehyde[4]	EPA Method TO-11A	Time-integrated (24-hr) sample collected on adsorbent cartridges and based on laboratory HPLC analysis.
Formaldehyde[4]	EPA Method TO-11A	(same as above)
Other		
Polycyclic Aromatic Hydrocarbons (PAH) bound to particulate matter[3].	Monitors for particle-bound PAH's.	Real-time measurements based on photoionization of particle-bound PAH.
Wind Direction and Speed	Wind vane and anemometer instrumentation	Direction and speed from National Weather Service at the airport.

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

[3] Because of the limited applications of this instrumentation, the use of water-based condensation particle counters will remain under evaluation by RIDEM.
[4] 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.

Ultra-fine PM ($PM_{0.1}$) will continue to be measured using the water-based condensation particle counter. This instrumentation is the best available equipment for real-time measurements of particulate matter.

Black carbon will continue to be measured using the aethalometers which collect PM in real time on a quartz 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 mass of black carbon according to the comparisons with other chemical analysis techniques. Presently, there is no designated EPA Reference Method for this pollutant (either real-time or time integrated), but aethalometers are commonly used to measure black carbon.

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 stainless steel sampling line and a PM filter with the flow rate controlled by a calibrated volumetric flow meter. The collected sample is then transferred to a laboratory for analysis using a chromatograph/mass spectrometer (GC/MS). This time-integrated method is consistent with USEPA Method TO-15 (*Determination of VOCs in Air Collected in Specially-Prepared Canisters and Analyzed by GC/MS).*

SVOC's will continue to 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 and 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 USEPA Method TO-13A (*Determination of Polycyclic Aromatic Hydrocarbons (PAHs) in Ambient Air Using Gas Chromatography/Mass Spectrometry).*

Carbonyls will continue to be collected using a method comprised of a prepackaged cartridge containing acidified 2,4-dinitrophenylhydrazine (DNPH). A sample pump draws the outside air through the cartridge using a stainless steel sampling line having the same 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 USEPA Method TO-11A (*Determination of Formaldehyde in Ambient Air Using Adsorbent Cartridge Followed by HPLC)*.

Particulate bound PAHs will continue to be measured using real-time monitors that work on the principle of photo-ionization. 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. Presently, there is no designated USEPA Reference Method for this pollutant (either real-time or time-integrated) but this method has previously been accepted by RIDEM.

Wind direction, wind speed, temperature, relative humidity and precipitation data will be collected at the meteorological station located at the airport and operated by the National Weather Service.

Because the 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. The $PM_{0.1}$ (water based particle counters [CPCs]) will be operated continuously 24-hours daily during the third week of every month. The CPCs will only operate one week per month. A thorough analysis of air traffic frequency demonstrates that air traffic is generally consistent throughout the month. The third week of the month was selected as it includes the Thanksgiving holiday and typically showed a slightly higher level of air traffic activity. In addition, the original CPC samplers were TSI Model 3781s. The "time-integrated" sampling of the $PM_{2.5}$ and the SVOC's will follow the conventional rotation plan used by the USEPA and RIDEM. The "rotation plan" involves taking samples once every 6 days so that each day of the week is sampled several times annually. VOC's and carbonyls are also measured with time-integrated samplers and the monitoring schedule will follow the same rotation plan. Samples for VOC and carbonyls will be taken monthly (Refer to Addendum C for specifics).

V. Monitoring Criteria

For the purpose of this *Work Plan* the term "monitoring criteria" means the standards or "benchmarks" against which the monitoring data can be compared. For PM2.5, the NAAQS are considered the most appropriate criteria. The 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 cancer and non-cancer) established by the USEPA. 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.

It is expected that these comparisons will be made by RIDEM.

VI. Quality Assurance Criteria

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 USEPA as appropriate for the application.

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

Quality assurance will be achieved in the field by trained and qualified technicians that will visit each monitoring station on an average of once 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 documented on web-based site forms with each set of collected data receiving a unique identifier and all the sample handling will be controlled following strict "chain of custody" procedures.

Other conditions related to Quality Assurance Procedures include the statistical methods for the determining the precision and accuracy of the collected data, the performance of field audit checks, and appropriate laboratory documentation are provided in the *Quality Assurance Project Plan* (QAPP) developed specifically for this monitoring program.

VII. Agency Coordination

In accordance with the Act, RIDEM and RIDOH have reviewed and commented on this *Proposed Amendments to the Air Quality Monitoring Work Plan for T. F. Green Airport*. As part of this consultation process, it is expected that these agencies will continually provide RIAC with peer consultation review, scientific knowledge and specialized expertise as necessary and relevant to this air quality monitoring program. It is also RIAC's intent to coordinate with RIDEM/RIDOH on a regular (but unscheduled) basis in furtherance of the air monitoring program and whenever the need arises.

VIII. 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 of the air quality monitoring program. RIAC has searched for funding sources and will continue to do so in the hopes that sources may become available.

EFFECTIVE DATE

The foregoing "Air Quality Monitoring Work Plan", is hereby amended, adopted and filed with the Secretary of State this 15th day of September, 2014, to become effective on September 16, 2014 in accordance with the provisions of Chapters 42-35 of the General Laws of Rhode Island, 1956.

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Notice Given On: September 15, 2014
Filing Date: September 15, 2014
Effective Date: September 16, 2014

Addendum A: Air Monitoring Station Summary

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

Site Location	North	South	West	East
Site Name	Lydick Ave.	Fieldview Dr.	Fire Station	Pembroke Ave.
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 Road 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-southwest of the airport approximately ½ mile (2,250 ft.) from the end of Runway 16.	Due east of the airport approximately ¼ of a mile 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 RIDEM elsewhere in the state. These data will be supplemented by measurements of SVOC's, PM0.1 and particle bound PAH's by RIAC at one of these RIDEM 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
SVOCs – semi-volatile organic compounds including (but not limited to) Naphthalene
VOCs – volatile organic compounds including (but not limited to) benzene and 1,3 butadiene

Addendum B: Site Photos

Figure B1: Pictures of the Lydick site in the four cardinal directions.

Facing North

Facing East

Facing West

Facing South

Figure B2: Pictures of the Pembroke site in the four cardinal directions.

Facing North

Facing East

Facing West

Facing South

Figure B3: Pictures of the Field View site in the four cardinal directions.

Facing North

Facing East

Facing West

Facing South

Figure B4: Pictures of the Fire Station site in the four cardinal directions.

Facing North

Facing East

Facing West

Facing South

Addendum C: Sampling Schedule

TF GREEN SAMPLING SCHEDULE FOR 2014

Full sampling suite: PUFS, SUMMAs, SepPaks, $PM_{2.5}$
PUFS, PM2.5
Duplicates for CAN, CART; Blanks for CART, $PM_{2.5}$
Give can to RIDOH, then ship to ALS; Duplicate and blank cartridge to RIDOH
Week-long run of ultrafine particulate samplers

2014

January

Su	Mo	Tu	We	Th	Fr	Sa	Duplicates, Blanks
			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	Fieldview PB to RIDOH
26	27	28	29	30	31		

Febuary

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

March

Su	Mo	Tu	We	Th	Fr	Sa	Duplicates, Blanks
						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	Fire Station
30	31						

April

Su	Mo	Tu	We	Th	Fr	Sa	Duplicates, Blanks
		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	Lydick Dups, FS to RIDOH
27	28	29	30				

May

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

June

Su	Mo	Tu	We	Th	Fr	Sa	Duplicates, Blanks
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	Pembroke
29	30						

2014

July

Su	Mo	Tu	We	Th	Fr	Sa	Duplicates, Blanks
		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	Fire Station, LD to RIDOH
27	28	29	30	31			

August

Su	Mo	Tu	We	Th	Fr	Sa	Duplicates, Blanks
					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	Lydick
31							

September

Su	Mo	Tu	We	Th	Fr	Sa	Duplicates, Blanks
	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	Fieldview
28	29	30					

October

Su	Mo	Tu	We	Th	Fr	Sa	Duplicates, Blanks
			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	PB Dup, FV to RIDOH
26	27	28	29	30	31		

November

Su	Mo	Tu	We	Th	Fr	Sa	Duplicates, Blanks
						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	Fire Station
30							

December

Su	Mo	Tu	We	Th	Fr	Sa	Duplicates, Blanks
	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	Lydick
28	29	30	31				