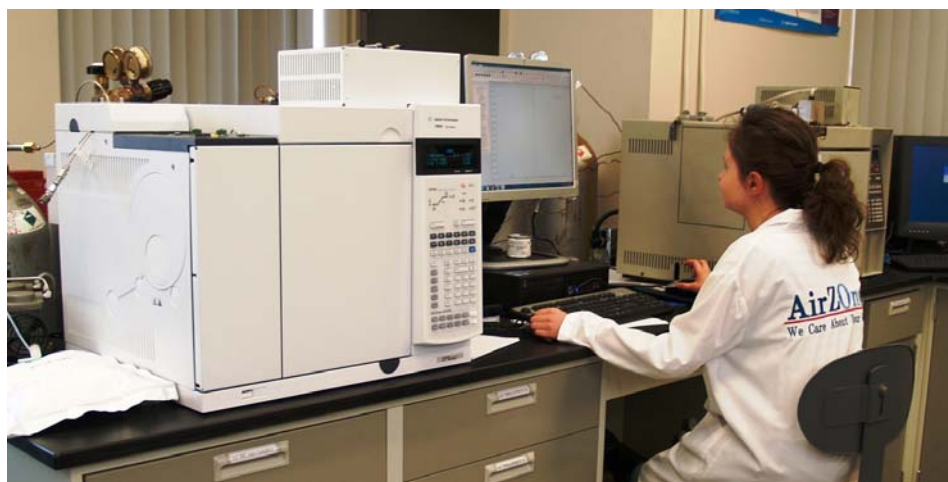# AirZOne
Comprehensive Air Quality Services

AIRZONE AIR QUALITY ENVIRONMENTAL ASSESSMENT EXPERIENCE

Airzone One Ltd. has provided comprehensive air quality services to a variety of organizations in current and predecessor companies since 1979. Airzone's services include:

❖ **Ambient monitoring, modelling and permitting** (including deployment of continuous air monitors).

❖ **Laboratory analysis**, including deployment of analytical instruments at client sites to provide fast response analysis.

❖ **Indoor air quality and occupational hygiene ass**essments (employee exposures to noise, physical & chemical agents, designated substances such as crystalline silica and mould).

In-house Laboratory Analysis of Samples Ensures Quick Turn-around - Airzone's laboratory is accredited by the Canadian Association for Laboratory Accreditation (CALA) under ISO 17025:2005. This protocol defines a comprehensive QA/QC program including auditing of methods and participation in CALA-mandated proficiency testing programs. CALA accreditation requires the use of qualified, certified suppliers for external services. Our specific accreditation is for airborne total PCBs, total PCBs in soils, airborne PAH, Airborne Particles (TSP, PM10 and PM2.5) and VOCs.

We regularly team with engineering consulting companies when there is a requirement for specialist air quality services. This often arises for Environmental Assessments (Class or otherwise); to assist you we provide an example listing of recent experience in air quality assessments for various projects often subject to EAs; more examples in each category are available upon request.

ELECTRICITY GENERATION

i. **TransCanada (Oakville)** – TransCanada proposed a gas-fired peaking generator plant to be built in Oakville, Ontario. An air emissions impact assessment was conducted by the proponent's consultants (SENES). Airzone was retained by the Town of Oakville to review the air emissions assessment. A number of issues were identified but the proposed plant was withdrawn by the Ontario government before the review stage proceeded further.

ii. **Kosovo Lignite Plant** – Airzone has been retained by the World Bank to review air emissions impact assessments of a proposed lignite-fuelled power plant; initial reviews have and will be conducted of an associated monitoring network and also of preliminary modelling effort by a USAID contractor using the SCIPUFF model. (SCIPUFF is similar to CALPUFF in most respects, but has a more complex chemical transformation module).

iii.   **Barbados WTE facility** - Airzone has completed an EIA, with regards to air emissions, for R.J. Burnside International, for a proposed Waste-To-Energy (WTE) facility in Barbados. The EIA involved the review of international standards for the WTE plant emissions, and, ambient air concentration standards for the contaminants of concern.

The air emission assessment was based on assumptions about plant layout and operations (e.g., incineration technology, plant location, building configuration, exhaust characteristics and incineration throughput rate, etc.) in lieu of specific design statements since contracts were not yet finalized for design and build. Emissions estimates (contaminants of concern and emission rates) were based on internationally-recognized emission limits supplemented, by US Environmental Protection Agency (EPA) emission factors. Emissions from ancillary operations (trucks movements on-site for waste deliveries) were also included.
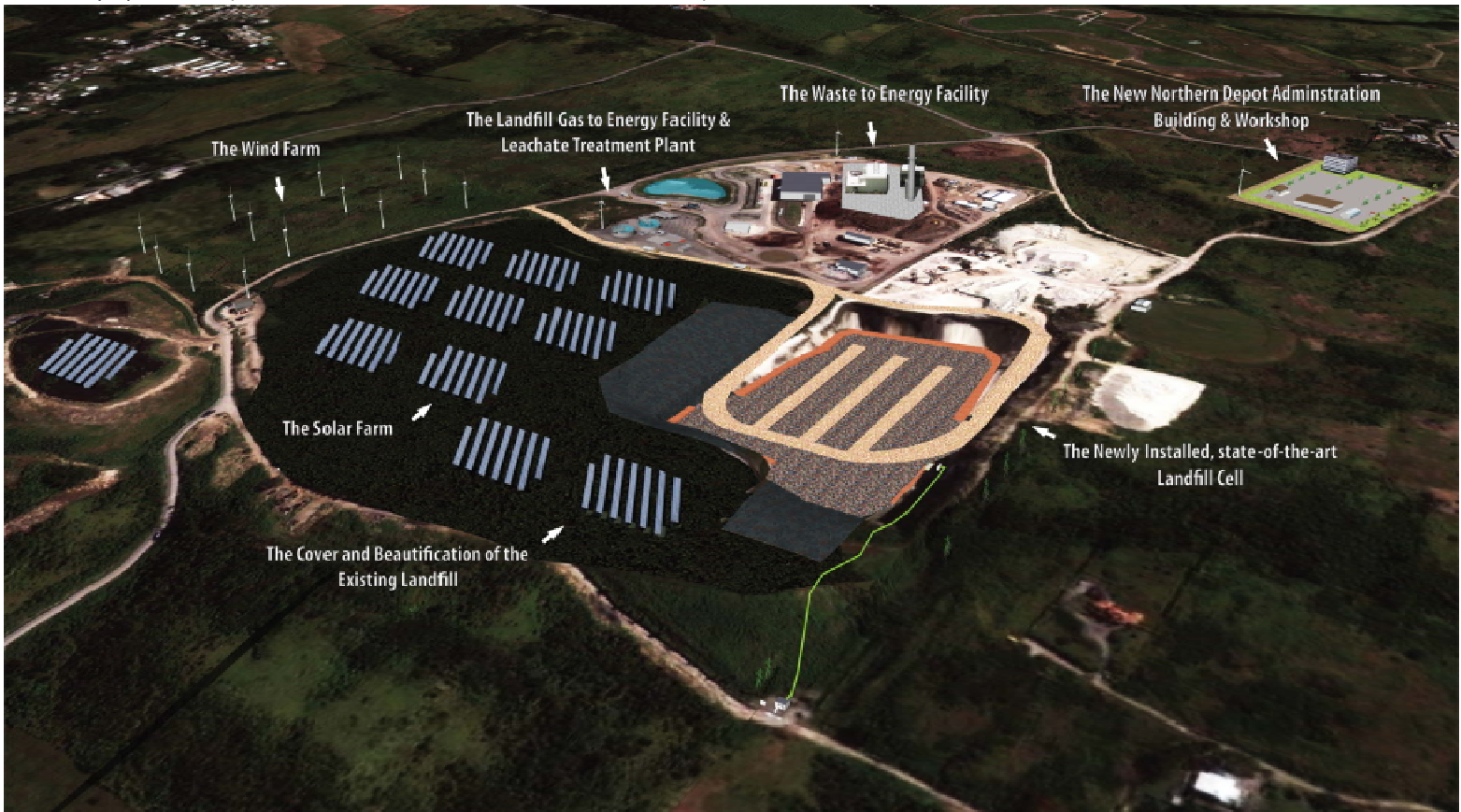
Major industrial sources within the area of the proposed incinerator impact area were also considered to assess the local cumulative impact of the WTE facility. The assessment of major local industrial facilities involved touring each site during operational times to assess possible air emissions.

The dispersion environment was complex due to the possible combination of land/sea breezes and complex terrain within a short distance of proposed site. Therefore, the CALPUFF model was chosen for its ability to explicitly deal with coastline meteorological effects; effects that could be significant given the locale and possible exhaust stack height. Moreover, CALPUFF was able to evaluate inorganic secondary particulate matter formation from NO_x and SO_2 emissions, which are potentially significant emissions from the WTE facility.

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MINING

i.   **Syncrude Mildred Lake Mine and Upgrader** Expansion – EIA for this Athabasca Oil Sands project submitted in 1998, including air assessment of primary gaseous and particulate emissions, secondary formation of ozone, deposition of acidifying emissions and deposition of metals and PAH emissions.

ii.   Sub-contracted to MDH Engineering Solutions (Saskatoon) to provide air dispersion modelling of impacts of proposed Fortune Minerals Ltd. Saskatchewan Metals Processing Plant, outside Saskatoon.
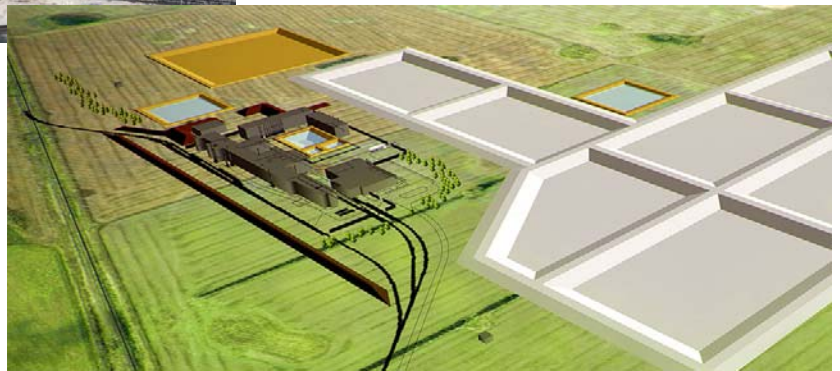
iii.   **Mount Nemo Quarry EIA Review** – This project involved the assessment of vehicle emissions and process operations related to a proposed aggregate pit extension. We reviewed AP-42 and exhaust emission estimation techniques conducted by other consultants, and their use of US EPA AERMOD dispersion model; background levels and cumulative impacts. We undertook our own calculations of process and vehicle emissions (road dust and vehicle exhaust, e.g., Guelph Line, Walkers Line, 407) and also, independently, fed those estimates into the US EPA AERMOD model to verify the other consultant's results. Results were presented before a Joint Review Tribunal hearing.

iv.   **Proposed Capital Paving Quarry** - Airzone carried out peer review and sensitivity analysis of air emissions of proposed quarry using dispersion modelling. Work included adjusting model inputs to determine influence on model outputs and uncertainty, including focus on dry deposition of PM. Results were presented as a witness statement before an Ontario Municipal Board hearing.

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WASTE WATER TREATMENT PLANTS

i. **Duffin Creek Water Pollution Control Plant** - Airzone collaborated with an odour monitoring program at a water pollution control plant. Airzone provided reduced sulphur compound (RSC) analysis on-site, providing rapid reporting of airborne concentrations in order to arrange mitigation options for certain areas of the waste water treatment process related to odour complaints. The rapid on-site analysis minimizes RSC degradation, allows assessment of the sample validity and provides an opportunity to re-sample if needed.

ii. **Peer Review of the XXXXX Wastewater Treatment Plant Odour Monitoring Program** – Airzone was chosen to review the odour monitoring program in anticipation of plant expansion and urban encroachment. Odour and odorant emissions data is being correlated with processing data to identify key emitting sources and to mitigate odour impacts.

iii. **Privately Operated Waste Water Treatment Facility** - This project involved the assessment of potential emissions from a proposed waste water treatment facility. The US EPA WATER9 (v.3) wastewater treatment emissions model was used to estimate emissions from each process within the facility. Use of this model requires a detailed understanding of all waste water treatment steps within the facility and accounts for multiple operating scenarios and waste streams. Emission impacts were modeled using the AERMOD dispersion model.

ROADS/TRANSPORTATION (MUNICIPAL/PROVINCIAL)

i. **Airzone are a MTO-RAQS** qualified consultant for air quality assessments.

ii. **Expanded Cruise Berthing Facility in George Town, Cayman Islands, EIA** – Involved the review of port operations before, during and after construction of a proposed expansion to the existing cruise ship berthing facility. Emissions (SO_2, NO_2, dust and greenhouse gases) from approaching and stationary docked marine vessels were assessed using

emission factors. On-road vehicle emissions within the study area of the proposed terminal were considered for three scenarios. Vehicle emissions from roads were assessed using AP-42 emission factors and the US EPA international IVE model. The assessment of

vehicle exhaust emissions required the investigation and application of engine and emission control technologies specific to the Caribbean island, as well as the properties of the fuel sold on the island. We have also aided in the preparation of a construction mitigation plan based upon best practises for the construction industry.

iii.   **Exposure Assessment Of Canadians To Substances Associated With Exhaust, Evaporative And Refuelling Emissions Of Vehicles Fuelled With Conventional And Ethanol Blended Gasoline. Report to Health Canada** – This project involved the assessment of vehicle emissions fuelled by regular gasoline versus ethanol blended gasoline. We assessed ambient measurement data for various micro-environments and factored by alternate emissions data to provide exposure concentrations for the Canadian population. Results were used to derive a probabilistic risk assessment for exposure to vehicle emissions from E10 fuels and compared to impacts from regular fuels. This work also required a consideration and review of vehicle and engine technologies and their effect on emissions using alternative fuels, as well as emission control technologies.

iv.   Review of MTO submission to Environment Canada regarding preliminary impacts of emissions from proposed Hwy 427 extension on measurement programs at CARE, a long term regional background site. We reviewed and critiqued vehicle emissions estimates and dispersion modelling results submitted by MTO. We undertook our own vehicle emissions calculations (AP-42 & MOBILE6C) and dispersion modelling (ISC3) to verify MTO results. The calculations of vehicle exhaust emissions required the investigation of engine and emission control technologies specific to Canadian conditions, as well as the properties of the fuels in the area.

LANDFILLS

i. **Mangrove Pond Landfill EIA (Caribbean)** – The assessment for affected receptors included explicit modelling of adjacent, non-subject, facilities and determination of regional background through monitoring. Regional background (baseline) monitoring was for particulate matter (PM), ozone, nitrogen oxides (NO_x), sulfur dioxide (SO_2) and volatile organic compounds (VOCs). The work included emissions assessment and dispersion modelling for the adjacent Solid Waste Management Centre and adjacent limestone quarry and aggregate processing facility, as well as the assessment of vehicular emissions (both on-site and operating highways and high-order municipal roads). Subject and non-subject facility operational emissions were assessed using US EPA AP-42 emission factors. US EPA AP-42 and MOBILE6.2 emission estimation techniques were used for vehicle emissions. The emission estimates served as inputs to the US EPA AEMOD dispersion model, and background levels of vehicle pollutants were added to assess cumulative impacts.

ii. **Peer review of ToR for proposed Landfill in SW Ontario** - Airzone was retained by a southern Ontario municipality to review the Terms of Reference for an Environmental Assessment for a garbage dump being proposed close to their municipal boundary. The proposed air quality impacts assessment methods were reviewed by Airzone staff; the methods included proposals for the assessments of general odour, as well as individual odorants. Airzone staff raised numerous issues with the proposed methods including addition of baseline levels of "like" agricultural odours pre-existing in the surrounding rural community.

OTHER RELATED EXPERIENCES

DEVELOPMENT OF AIR QUALITY REGULATIONS

Airzone has experience with developing air quality regulations. Chief among them is the development of air quality regulations and guidance for the permitting of $PM_{2.5}$ emissions within the Town of Oakville (Oakville Health Protection Air Quality By-Law; HPAQB). Existing or proposed facilities that cause, or may cause, a "major emission" are subject to this approval process, which may also involve a modelled assessment of health impacts from the major emission.

The work involved in developing the bylaw and permit application guidance involved:

❖ Emission inventory development to identify existing and potential sources of $PM_{2.5}$ and precursor compounds.

❖ Reviewing regulatory controls on facilities that have sources of major emissions.

❖ Collecting monitoring and other data to inform decisions to reduce the health risk from these air pollutants.

❖ Review of appropriate models that account for complex (lakeshore) flows and secondary PM formation (CALPUFF was eventually chosen).

❖ Detailed review of CALMET basis and algorithms, collection of MM5 and measured meteorological data within modelling domain, input into CALMET with appropriate setting of processing switches, to develop a regulatory meteorological dataset for all applicants to use.

❖ Detailed review of CALPUFF chemistry and dispersion mechanisms, background chemistry, as well as various application issues that may arise (e.g., issues of changes in adjacent, non-subject, buildings altering in shape and affecting downwash), including selection of the appropriate model version.

❖ Review of chemistry modules within CALPUFF to account for local emissions of ammonia and its contribution to secondary aerosol formation and proposed additions to the modules based on known chemistry.

❖ Development of Town default settings for CALPUFF modelling implementation.

❖ Develop guidance document for Town outlining to proponents, in detail, the proper use of CALPUFF including development of a hypothetical example application.

The project also involved development of an application, to the Environmental Commissioner's Office of Ontario, to request that the MOE develop regulations for local impacts of $PM_{2.5}$ emissions. This involved reviewing various technical and policy aspects of air quality management for $PM_{2.5}$. The Ontario MOE does not consider $PM_{2.5}$ in its air permitting decisions. Through this process, and in development of the Oakville modelling guidelines, Airzone staff gained particular experience in dealing with varied stakeholders in development of air permitting regulations and guidance in relation to fine particulate matter along with experience in public policy discussions in lead-up to development of the Oakville bylaw and guidance.

REGULATORY APPLICATION OF AIR DISPERSION MODELS

Airzone staff has used dispersion models for regulatory approval ranging from simple models such as Ontario Reg. 346 and the U.S. EPA SCREEN3 model, as well as more complex assessments using U.S. EPA ISC3 and AERMOD models. We have conducted over 250 regulatory dispersion modelling studies, with more than 50 of those studies using the AERMOD model.

CUSTOM AIR DISPERSION MODEL DEVELOPMENT FOR POLLEN DISPERSION

Airzone developed the source code and executable files for modelling pollen dispersion from genetically modified crops; the model was based on a Langevin Markov-chain algorithm. The model was tested using field release of pollen particles in a pine forest environment and pollen collection to verify dispersion characteristics. The model was applied to different dispersion datasets across the country. A regulatory version of the model was developed for Canadian Food Inspection Agency who funded the developmental work. The model was applied to the agricultural seed industry and the forestry industry. Such experience is valuable in assessing primary biogenic emissions (pollen and spores) and their relevance in total PM_{10} and $PM_{2.5}$ atmospheric budgets.

DRY DEPOSITION MODELLING/MONITORING

i. **Environment Canada retained Airzone to assist in parameterization of regional**-scale dry deposition to support the derivation of atmospheric dry deposition models for Environment Canada's implementation of the North American Dry Deposition Model (NARDM). NARDM is used to assess atmospheric dry deposition fluxes of acidic airborne species to Canadian ecosystems. This work involved parameterizing deposition velocities for all major Canadian terrain types and various acidic species, and gathering input data from the literature. NARDM sensitivity tests allowed identification of key input parameters from measurements at various CAPMoN (Canadian Acid Precipitation Monitoring Network) sites across Eastern Canada.
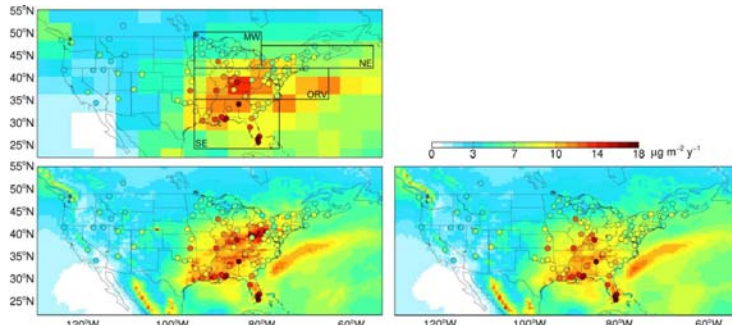
ii. **Airzone has been retained by the World Bank to assist in establishing a deposition monitoring network for airborne substances in Equatorial Africa (EADN).** The objective is to provide a state-of-the-art platform to investigate deposition of nutrients onto the African Great Lakes and other water bodies as well as the effect on other areas of the continent's agricultural zones. The underpinning of the conceptual approach for the network is the use of the inferential method for atmospheric deposition of particles, particle-bound nutrients and reactive gases, and relies on direct measurement of airborne substances as well as collection of precipitation in wet-only collection

systems. Concurrent measurement of meteorological parameters will allow use of dispersion models (Lagrangian, Eulerian or Statistical) to determine dispersion and dry deposition of the target substances. Airzone developed draft manuals for establishment of the EADN, Program Manual for Monitoring Atmospheric Deposition of Nutrients and Other Contaminants in the Equatorial Region of Africa. We are now assisting with implementation of the network. This work also includes flux chamber emission measurements in Uganda for agricultural pesticides. The work is funded by UNEP and is being implemented in cooperation with the University of Nairobi.

AIR QUALITY MONITORING

Monitoring is often required as part of an EA to establish current background (baseline) air quality levels. Airzone has extensive experience and expertise in air quality monitoring. In addition to the examples given above we present two examples below.

i.   **Soil remediation air monitoring (various sites)** - Of relevance is our experience with monitoring for airborne PCBs, VOCs, TSP/PM$_{10}$ and continuous TSP (particulate matter) at Mid-Canada Line radar sites during remediation activities (Fort Albany, Fox Lake and Ramore near James Bay (MNR) and Saglek in Labrador (DND)) as well as many private sector clients. At Polar Bear Provincial Park remediation site we utilized real-time monitoring of TVOCs with a PID and alarm system.

In addition, we have worked on several construction projects related to emissions and monitoring either directly or as sub-contractors to other engineering firms. Many of these projects involved continuous sampling of airborne particles, VOCs and other substances and set-up of alarm and warning systems for on-site contractors as well as remote polling of data at frequent intervals as shown below.


Figure 1. Continuous monitoring and alert system next to a soil remediation site. The warning system in the photograph had visual and audible alarms to alert the on-site manager to take mitigative action if airborne dust concentrations exceeded pre-established levels. We have implemented three such multi-site systems over the last 4 years.

A similar sampler deployment was implemented for two major transportation construction projects in Toronto, as shown below. We have established similar such monitoring systems at up to six constructions sites simultaneously, handled warning levels, data downloads, QA/QC, client reporting and mitigation recommendations.

Figure 2. **Continuous monitoring and alert system next to a construction site in Toronto. Three samplers are used to monitor TSP, PM$_{10}$ and PM$_{2.5}$ continuously. In this project data were transmitted wirelessly, from remote locations periodically via modem to give electronic warnings instantaneously by email to computer/hand-held devices (e.g., blackberries, smart-phones). Warning levels can be set to any levels specified.**

ii. **Arctic Monitoring** - We have established a network of Arctic sites (Canada, Alaska & Russia) to monitor airborne Persistent Organic Pollutants (POPs; PM_{10}-bound and vapour phase organochlorines pesticides, polyaromatic hydrocarbons and polychlorinated biphenyls) for the last 20 years for Environment Canada and DIAND (Dept of Indian Affairs and Northern Development).
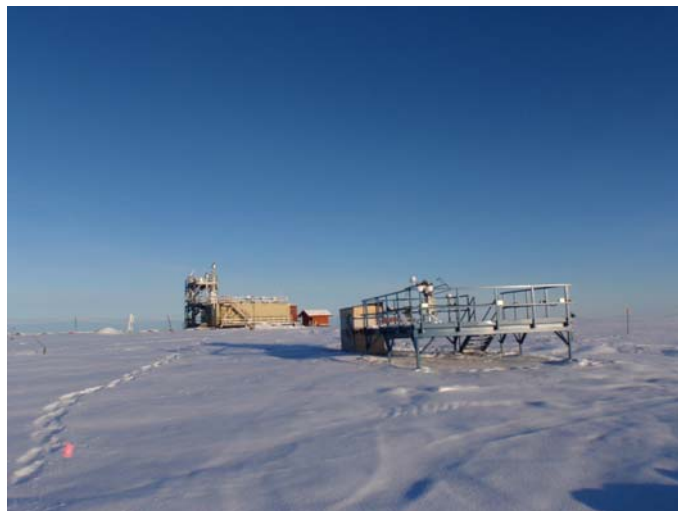
ORGANIC VAPOR MONITOR 3500	ETHYLENE OXIDE MONITOR 3550	FORMALDEHYDE MONITOR 3720	ORGANIC VAPOR MONITOR 3520 WITH BACK-UP SECTION

iii. **Passive Sampling Technologies** – Airzone has developed an refined the use of passive air sampling; a technique that requires no power and bulky equipment. This renders air sampling much easier and cheaper.

Passive monitoring has been used to great effect in soil vapour extraction, monitoring and intrusion issues where contaminated groundwater passes under or close to residential homes. Airzone was contracted in a major VI project where the Ontario MOE supported Thermal Desorption (TD) tube or EPA canister-based methods and initially resisted the use of passive methods. We demonstrated, at our own cost, that passive monitoring achieved adequate sensitivity, better capacity (measured a broader range of airborne concentrations) and better precision than the TD or canister methods. After almost 10 years of routine comparison sampling with the MOE and canister methods at randomly selected sites, the MOE has indicated that "the comparison amongst the methods has been excellent". Moreover, with the Airzone passive method, the indoor monitoring program was readily accepted by residents since the monitors are small, unobtrusive, make no noise, require no power and are easily deployed. Moreover, results can be provided quickly because of the method's efficiency. The cost advantage achievable with the passive method compared to other methods is significant. This allows a more detailed level of monitoring than in other contaminated site assessments, freeing resources to address mitigation rather than costly analysis. The routine fast turnaround of results, typically within 2 to 3 business days, allows quick identification of problem areas and is important in alleviating residents' uncertainty. Consistent, similar quick turnaround with the other recommended methods will incur significant extra costs especially in large sampling campaigns.

The use of passive air sampling has grown significantly for ambient and indoor air monitoring applications. Some example of PSDs use in indoor and outdoor VOC monitoring (including TCE and other chlorinated solvents) and monitoring of other airborne substances include:

Figure 3. Deployment of passive sampler at a contaminated soil site.

❖ National VOC exposure survey for Health Canada, 1992-1993, (3M OVM 3500 PSDs) undertaken by Airzone predecessor.

❖ Multimedia (air, water & food) exposure studies, 1994-1996, (3M OVM 3500 PSDs) undertaken by Airzone predecessor.

❖ Vehicle exposure studies in urban areas for VOCs, Aldehydes, PAH and inorganic gases (Winnipeg, Medicine Hat, Windsor, Ottawa & Stockholm [Sweden]), 1988-1997, (3M OVM 3500 PSDs & other PSDs) undertaken by Airzone predecessor.

❖ Alberta Cattle Health study - monitoring of ambient air VOCs (30-day exposures with 3M OVM 3500 PSDs) and airborne particles (1.0 microns), PAH and metallic elements using purpose-designed solar powered active samplers at 200 sites monthly for 18 months (2001 to 2004) undertaken by Airzone.

❖ US Forestry Service (inorganic gases) continuous – (Ogawa Passive Samplers) undertaken by US Forestry Service

❖ Ambient air studies in Europe for VOCs & inorganic compounds – (Radiello Passive Samplers)

    ❖ MACBETH (Monitoring Benzene in European Towns and Homes),

    ❖ RESOLUTION (high spatial resolution atmospheric monitoring to verify emissions reduction of ozone precursors foreseen by Auto-Oil program),

    ❖ LIFE99ENV/IT/081, LIFE 00 ENV/IT/000005 & ARTEMIDE (High temporal resolution monitoring of VOC's).

❖ US & in California - (Radiello PSDs) for VOCs

❖ Cambridge VI study - since 2005, 3M OVM 3500 PSDs for IAQ and Active Charcoal tube sampling for SVE & SSDS, undertake by Airzone.

❖ Borders Study of VOCs, (8 Campaigns monitoring airborne VOCs in Border cities in Canada) for Env. Can. and Health Canada, 2008-2013, undertaken by Airzone.