6

Airports and the environment

***This section has been completely re-written and re-formatted by the World Environment Standing Committee. It serves as a model for how the other chapters of the ACI Policies and Recommended Practices will evolve in the coming years.*

6.1
Noise

ACI POLICY	ACI RECOMMENDED PRACTICE / *COMMENT*
6.1.1 Minimize or mitigate the adverse effects of aircraft noise on people.	*Noise remains the most clearly identifiable impact on local communities and the environmental issue most likely to mobilize a local community against infrastructure or capacity expansion, giving rise to operational restrictions and constraints.* ***ICAO aircraft noise certification*** *The International Civil Aviation Organization (ICAO) was established by the Chicago Convention in 1944. Annex 16 Volume 1 of this document contains standards for the assessment and certification of noise emission levels from an aircraft during take-off and landing. ICAO's noise standards are usually adopted by Member States as regulations. Effectively these standards are ICAO's main instrument for addressing aircraft noise.* *There are 3 noise certification assessment locations – landing centreline, take-off centreline and take-off sideline. Noise limits that apply to aircraft are described in Chapters 2, 3 and 4 of Annex 16 Volume 1. In most developed countries Chapter 2 aircraft were banned after 2002, so most aircraft currently flying meet Chapter 3 requirements.* *The Chapter 4 limits were approved in 2001 and are now in force for new aircraft/engine combinations certified after 1 January 2006 (and not for those already in production). Chapter 4 requires that the cumulative sum of the noise improvement on the Chapter 3 standards at the 3 measurement points must be at least 10 decibels. There is no requirement for an improvement at all 3 of the measurement points, just a minimum cumulative total of 10.*
6.1.2 ACI supports the implementation of ICAO's Balanced Approach (BA).	*ICAO's Committee on Aviation Environmental Protection (CAEP) developed the Balanced Approach to Aircraft Noise Management (BA), comprised of four elements:* *1. Reduction of noise at source;* *2. Land use planning;* *3. Noise abatement operational procedures; and* *4. Operating restrictions.* *The BA document was updated in 2007 to include "people issues" and to incorporate community engagement techniques. While equal weighting should be given to each of its four components, ACI recognizes that the BA stipulates that it should be applied on an airport-by-airport basis, allowing individual airports to apply the most appropriate elements according to local conditions. There are measures for managing aircraft noise that are not fully addressed in the BA and airports may implement many of these initiatives.* **6.1.2a** Airports should implement the Balanced Approach to Aircraft Noise Management (ICAO Document 9829, updated 2007), placing equal weighting on each of the four components and, as stipulated in the document, implementing it on an airport-by-airport basis. The process can be used to address an existing noise problem or to prevent a noise problem from developing. *Items not fully addressed in the Balanced Approach are also considered here.*

ACI POLICY	ACI RECOMMENDED PRACTICE / *COMMENT*
6.1.3 Reduction of noise at source is the most effective and lasting way to curtail aircraft noise on a permanent and global scale.	***Aircraft noise stringency standards*** *In the Balanced Approach, "reduction of noise at source" specifically refers to the aircraft noise certification stringency standards contained in Annex 16 Vol. 1. It is the element of the BA over which ICAO has sole standard setting authority, and implementation of this element should underpin the global approach to addressing noise from aviation.* *Future traffic growth should be offset by continual improvement in noise reduction technologies; although traffic and fleet projections indicate that this will not be achieved.* **6.1.3a** Airports should support ACI's efforts at CAEP to ensure that noise stringency remains on the work agenda and standards are regularly updated. This support could involve airports and regional airport associations, especially those in CAEP member States, working with their States' ICAO or CAEP representatives and other government representatives to advocate and indicate their support ACI policies, positions and working papers at ICAO.
6.1.4 Land use planning is an effective tool in minimizing the impact of aircraft noise.	**6.1.4a** Airports should work with local or regional authorities or government to ensure that only noise compatible land use is developed in areas affected by aircraft noise on land around the airports. Many airports must deal with several levels of government (local or municipal versus regional or state) and multiple jurisdictions (e.g. adjacent cities/counties). **6.1.4b** Land use activity incompatible with airport noise includes, but is not limited to, residential, schools, childcare facilities and hospitals. **6.1.4c** In many cases, airport noise contours based on average noise levels (such as Leq, Ldn, Lden, NEF or ANEF) are appropriate for determining the level of airport noise impact for land use planning purposes. An extended averaging period (e.g. 3 months or a year) can be used to allow for daily and seasonal variations in the wind and traffic flows. In some cases, it may be appropriate to use the average noise level during specific periods (e.g. night time) or the noise from specific aircraft events (e.g. Lmax, SEL, EPNL) to identify the level of airport noise impact and assess land use compatibility. **6.1.4d** Land should be protected from incompatible activity based on the best available projections of future noise levels, taking into account the growth of air traffic activity, the future composition of fleets and new infrastructure such as runways, terminals and taxiways. Traffic projections should be based on a minimum of 30 years and in some cases it would be appropriate to protect land based on airport capacity. If aircraft fleet changes create a reduction in noise contours, but traffic projections indicate that noise levels will return to similar or higher levels, encroachment of incompatible land uses should be avoided, by using calculated noise contours from an appropriate future operational scenario. **6.1.4e** In noise-affected areas where there are existing residential and other incompatible activities, land-use planning should be used to prevent the development of new incompatible activities, including any increase in the residential density. Additionally, opportunities for compatible redevelopment should be sought. **6.1.4f** The State (or regional/local authority) should be urged to legislate and apply, in close consultation with airport management and airlines, land-use planning around the airport in order to avoid sensitive buildings in the areas, which may become noise impacted. **6.1.4g** If local circumstances cannot prevent new residential and other noise sensitive land uses, local authorities should be urged to require that new buildings be built with appropriate sound insulation and ventilation or air-conditioning. Sound insulation should be designed and constructed so that appropriate internal noise levels are achieved.

ACI POLICY	ACI RECOMMENDED PRACTICE / *COMMENT*
	Graduated schemes *Many planning schemes use a graduated scheme based on projected noise contours. Criteria for Low, Medium and High levels are defined and different restrictions apply. In some New Zealand cities, for example, Low is defined between Ldn 55 and 60 dBA, Medium between Ldn 60 and 65 dBA and High greater than Ldn 65 dBA; all are based on 30 year traffic projections. In High areas, new residential is prohibited and existing residential is subject to the upgrading of sound insulation and ventilation. In Medium areas, new houses are subject to sound insulation and ventilation requirements. In Low areas new residents must be notified of the airport noise situation.*
6.1.5 Sound insulation is part of the solution for residences, classrooms and other noise sensitive buildings affected by aircraft noise.	***Sound insulation*** **6.1.5a** Sound insulation of existing or new residences and other noise sensitive buildings is designed to improve the internal noise environment for those buildings. Usually only "habitable" rooms such as bedrooms, living rooms, kitchens, dining rooms and studies are targeted. "Non-habitable" rooms such as garages, bathrooms and laundries are not treated. **6.1.5b** Typically the major noise intrusion paths include windows/skylights, external doors, roofs/ceilings, and walls. Chimneys and ventilation openings can be noise-flanking paths that require treatment. Sometimes, older buildings do not have fibrous thermal insulation and miss the acoustic benefit that it provides so it should be retrofitted. Lightweight construction of windows, roofs, ceilings and walls may require considerable upgrades. Warped or ill-fitting windows or non-sealing windows (e.g. glass louvers) may need complete replacement. **6.1.5c** Sound insulation should be regarded as only a partial solution, as it cannot address the exterior noise environment in residential areas. **6.1.5d** Depending on the local climate, alternative ventilation or air conditioning may also be needed because the sound insulation of a building envelope is only beneficial when windows and external doors are closed. In tropical climates, for example, permanently open ventilation openings would need to be closed off. **6.1.5e** The cost of sound insulation and ventilation retrofit programmes where appropriate should be passed on to airport users. The cost of sound insulation of new buildings where appropriate should be borne by the owner or developer.
6.1.6 Noise abatement procedures can be used to help reduce aircraft noise levels.	**Operational noise abatement procedures** **6.1.6a** Operational procedures to reduce noise impacts should be developed in close consultation with stakeholders, including aircraft operators, pilots, the air navigation service provider (ANSP) and community representatives. Measures can include: • Noise abatement take-off procedures such as limitations of power and flap management • Noise abatement approach procedures such as continuous descent approaches (CDA) • Preferential flight track or runway use • Concentration of flights over non-populated or non-noise sensitive areas • Dispersion of flights of populated areas or noise sharing • Flight re-scheduling • Displaced take-off and landing thresholds • Restrictions on engine run-ups and/or ground equipment use **6.1.6b** Such measures should be backed up by monitoring and enforcement procedures and sanctions should be considered for frequent violations. **6.1.6c** Such measures should be evaluated for their impact on fuel consumption and air emissions as part of consideration for implementation.

ACI POLICY	ACI RECOMMENDED PRACTICE / *COMMENT*
6.1.7 Restricting operations can reduce noise disturbance at sensitive times, usually at night.	*Restrictions can apply to the numbers and/or types of aircraft or movements (take-offs or landings), sometimes on specific runways or flight tracks. Sometimes the night time limit may be a noise contour limit, in which case more movements can occur if quieter aircraft are used.* *The blanket introduction of curfews at airports is not advocated, but these are sometimes imposed on airport by local authorities or national governments or agreed to on a voluntary basis to secure planning approval for infrastructure development.* *Night time operational restrictions including curfews may have adverse effects on other airports possibly in countries or regions. This could lead to under-utilization of infrastructure during day and have financial and social effects far beyond national borders.*
6.1.8 Noise monitoring at airports is an important process in understanding and dealing with aircraft noise impacts.	*Noise monitoring involves the use of specialized equipment including microphones and computerized/automated logging/recording devices to measure the noise levels from aircraft. The reasons for monitoring vary and can include the following:* • *Determining and tracking aircraft noise levels in residential areas* • *Compliance monitoring if individual aircraft or overall airport noise is subject to limits* • *Measuring individual aircraft noise events for the purpose of charging.* **6.1.8a** When locating a permanent or temporary monitoring site, consideration should be given to background or ambient noise sources such as roads, trains, weather, animals, and to security issues and access for regular calibration and maintenance. **6.1.8b** If a monitor is located too far from the airport, aircraft noise levels may not be sufficiently high above ambient noise conditions to register as clear, separate noise events. Crucially, the system must be able to distinguish between aircraft events and other noise events. **6.1.8c** Automated systems should to be linked to radar or other aircraft identification systems to ensure that recorded noise events are aircraft movements and that a sufficient and representative proportion of all movements are captured.
6.1.9 Interaction with communities affected by noise is an important tool in community / airport cohesion.	*A wide variety of non-acoustic factors affect community attitude to airport operations and tolerance of noise disturbance. Communication and active engagement between airports and their neighbouring communities is critical to maximizing community tolerance of noise and hence the potential for airport growth.* *Communications concerning aircraft noise and traffic movements should be clear, accurate and presented in a format understandable to a person without a technical background. However there should not be a compromise between detail and simplification. If data is simplified for general clarity, the detailed background information should also be made available for those who want to delve deeper.* *(More discussion on Communications is contained in Section 6.7)* ***Complaints*** *Many airports provide dedicated telephone lines for community complaints. Options include toll free lines, facsimile (fax) lines and Internet (or email) facilities.*

6.1.9a A complaint processing system should include the following features:

- Well-advertised complaint services and easy access to telephone lines, web sites etc
- A systematic process for complaint handling, analysis and internal and external reporting to ensure consistency and transparency
- A guaranteed standard of response, explanation, acknowledgement, and follow-up
- Regular quality performance reviews of the complaint handling system.

6.1.9b Complaints can be an indicator of the level of community disturbance due to airport activity, but should not be viewed in isolation. Other methods for gauging community response should include social surveys, public consultation and analysis of media coverage. An airport should not wait for public responses to infrastructure planning applications to determine the level of community annoyance.

6.1.10 Noise metrics provide a valuable tool for communicating with communities.

Alternative/Supplemental noise metric

Land-use planning and some regulatory limits or planning agreements are often based on calculated airport noise contours based on the noise level averaged over an extended period (e.g. Ldn, Lden, NEF or ANEF on a 3 month or 1 year period). The use of a logarithmic or decibel scale averaged over an extended period can mean that important changes in activity (e.g. extended peak traffic periods or flights changing from late night to early morning) can result in only minor changes in noise contours. Experience has shown the communities and individuals often find this information unclear or confusing and dislike being told that certain changes will have "no audible impact" or would be "acoustically imperceptible."

Many airports are finding that noise metrics based on single events are better for communicating with residential communities. Average noise level is increasingly being considered as unhelpful.

Alternative or supplemental noise metrics include the maximum noise level (Lmax), the sound exposure level (SEL) of an event, and the number of events above a certain maximum noise level (N60 or N70). Another metric being used in Australia to demonstrate noise or runway sharing schemes is called Respite, a report of periods where no aircraft are using a specific flight track or airspace.

6.1.10a In order to build trust and partnership with local communities and governments, airports should provide information on noise and flight activity in a clear and readily understandable format.

6.1.10b It can be important to provide both aggregated and detailed information on both noise levels and aircraft movements, allowing individuals to better understand the impacts of past, current and future flight activity. Programmes, such as the Transparent Noise Information Programme (TNIP) developed in Australia, can provide this.

6.1.10c The A-weighted noise level can also fail to account for low frequency noise, which can cause windows and objects to rattle. C-weighted noise levels or low frequency (eg 31 Hertz octave band) may better represent this phenomenon.

6.1.11 ACI Positions on CAEP issues

6.1.11.1 CAEP should review its stringency standards at least every second CAEP cycle (i.e. 6 years).

Standards and certification

In ACI's view the Chapter 4 noise certification requirements of Annex 16 to the Chicago Convention do not reflect state-of-the-art technologies. The vast majority of in-production aircraft already comply with the requirements, most with a considerable margin. The A380 exceeds the Chapter 4 requirements by a cumulative total of approximately 15 decibels.

ACI believes that ICAO standards should lead industry and not merely underpin existing technology.

ACI POLICY	ACI RECOMMENDED PRACTICE / *COMMENT*
6.1.11.2 Future noise stringency standards should include a minimum improvement at each of the 3 noise certification locations as well as a cumulative sum.	*New trans-sonic aircraft and new supersonic transports should meet the noise standards of other new sub-sonic aircraft.* *The new prop fan or 'open rotor' powered aircrafts should meet the noise standards of other sub-sonic jet aircrafts.*
6.1.11.3 ACI supports a single noise certification for aircraft.	*ICAO should adopt appropriate noise standards for vertical / short take-off and landing (V/STOL) aircraft, so that the overall noise level around the airport is not increased.* *ICAO Annex 16 should incorporate noise certification standards for future APU installations. International Regulation for noise certification is necessary.* *ACI supports a single noise certification for aircraft. The certificate to be carried on board should reflect its noise performance for its maximum certified take-off weight (MTOW). If operators want to change the noise value by limiting weight or by use of different types of engines, the same shall be acceptable. ACI opposes dual or multiple certification.* ***Marginally compliant chapter 3 aircraft*** *The noisiest Chapter 3 aircraft make a disproportionate contribution to the noise climate and level of noise disturbance around airports. ACI holds the position that the noisiest Chapter 3 aircraft – those that comply by a cumulative margin of less than 5 dB – should be phased-out as a next step.* *Developing nations shall be allowed to renew their fleets at their own pace, provided that renewal plans are made public and duly communicated.* *ACI supports all efforts to limit the operation of jet aircraft certified according to Chapter 2. Every effort should be made to ensure that Chapter-2 wide-bodied aircraft or those fitted with high by-pass ratio engines, which are currently exempted from phase out requirements, are reduced in number or heavily restricted after the final cut-off date.*
6.1.12 Noise-related user charges can be a strong incentive for airlines to operate quieter fleets.	*Many airports have a noise-related component associated with their landing fees. This can offer a financial reward to operators using quieter aircraft and thus an incentive not to operate noisy aircraft. Charging schemes can be based on an aircraft's certificated noise levels or on actual measured aircraft noise levels or some other system. Narita International Airport in Japan has implemented a landing charge scheme based on the ACI Noise Rating Index.* *Some airports have penalty schemes designed to ensure that aircraft stay on track and follow preferred noise routes. Penalties are often returned to communities as grants.* **6.1.12a** A noise related charging scheme should be "revenue neutral" for an airport, in that, the scheme itself should generate no net income for the airport. This can be achieved if the total of the discount or reduction in landing fees for low-noise aircraft is equal to the total of the increased landing fees for higher-noise aircraft over a given period (e.g. a year). Alternatively, all funds raised by a noise charges scheme should be used for addressing or mitigating an airport noise issue such as in a residential sound insulation programme, a community fund, or other noise programme. ***ACI Noise Rating Index*** *ACI considers that the current ICAO noise classification system is not sophisticated enough to adequately describe the different noise levels generated by various Chapter 3 and Chapter 4 certified aircraft.* *ACI recommends using the ACI Noise Rating Index (NRI) for a refinement in the classification of aircraft with respect to their noise emissions. Under such a scheme, all aircraft types are rated from A to F based their 3 certified noise levels using two rating criteria. The first is the cumulative reduction from the ICAO Chapter 3 standard, summed over the 3 certified noise levels.*

The second is the minimum of the 3 individual reductions from the Chapter 3 Standard. In this manner, the NRI recognizes aircraft that provide noise reductions at all 3 ICAO certification locations. At the time of writing (July 2008), the ACI NRI is being updated to take into account the new generation of quieter aircraft.

The ACI Noise Rating Index can be used as a basis for a noise-charging scheme and to assess the fleet make up at a particular airport for the purposes of benchmarking.

6.1.13 Ground-based noise sources must also be considered for mitigation measures.

Noise sources from ground-based airport activities can include aircraft start-up and taxiing, aircraft engine testing, auxiliary power units, ground service equipment, road traffic and plant such as power and heat or cooling generation stations.

The noise limits that apply to these sources will usually be under the jurisdiction of the local or territorial government and, depending on the land zoning rules, will usually be similar to noise limits that apply to general land-based industrial activities. Noise limits are usually applied at the residential (or other noise sensitive) locations, nearest the airport property.

Depending on the local regulations that apply to an airport, the size of the airport property, the proximity of noise sensitive receiver locations and other local factors, noise mitigation of ground based airport noise sources may include options outlined below.

6.1.13a Engine start-up and taxiing noise can sometimes be screened by bunds, acoustic fences or screens. Such measures will only be beneficial if receiver locations are close (within 50 or 100 m) to the noise source and have a direct line-of-sight to the noise source (that is, not already screened). However, some residents that choose to live near an airport may prefer to have a view of taxiways. At greater distances (>100 m), screening can be ineffective due to atmospheric effects on noise propagation. Open areas of greater that 100 m can benefit from the growth of forest to enhance noise absorption, although a single or several rows of trees will provide virtually no acoustic benefit.

6.1.13b Noise mitigation of in-situ aircraft engine run-up or ground testing usually requires a test enclosure, often U-shaped to allow access. The barrier itself needs to be of solid construction, substantially higher than the aircraft engines and to have its internal surfaces lined with an acoustically absorbent surface (which must be protected from the weather). A U-shaped semi-enclosure will typically provide 10 decibels of noise reduction in 3 directions and virtually none in the direction of the opening.

6.1.13c A fully enclosed building can provide more than a 10-decibel reduction in all directions but must be properly ventilated and acoustically lined. Restriction on engine ground running hours is a simpler solution but often overnight maintenance requires an engine run-up before the first flight in the morning.

6.1.13d Noise from an aircraft's Auxiliary Power Unit (APU) can be mitigated by providing electrical (400Hz) power and pre-conditioned air (PCA) to an aircraft parked at a terminal gate or cargo loading position.

6.1.13e Noise from Ground Service Equipment (GSE), if an issue, can be mitigated by modernizing the equipment. Acoustic barriers may also be appropriate.

6.1.13f Road traffic noise is not usually within the jurisdiction of an airport. Noise reduction (without reducing road traffic itself) can be achieved by noise barriers or bunds, porous road surfaces and roadway realignment.

ACI POLICY

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6.1.13g Noise from electricity and heating/cooling stations and their associated mechanical plant items is best treated at the design stage, rather than as a retrofit to address an existing problem. Specialist acoustical advice may be required and solutions may range from bunds and screening, enclosing a noise source to replacement or modification of old equipment.

6.2
Emissions and local air quality

ACI POLICY

ACI RECOMMENDED PRACTICE / *COMMENT*

6.2.1 Prevent, minimize or mitigate the adverse effects of aviation-related air pollution.

The management of Local Air Quality involves two major components

1. *Assessment*
2. *Response*

Assessment *involves the following steps detailed below:*

- *Local air quality regulation or standards.*
- *Measurement or monitoring*
- *Inventory of emissions sources*
- *Dispersion modelling*

6.2.2 Assessment should be based on local air quality regulation or standards.

Most states have local air quality (LAQ) standards or regulations that apply to air pollutants, including oxides of nitrogen, or NOx (i.e., NO and NO_2), carbon monoxide (CO), ozone, sulphur oxides (SO_2), particulate matter (PM), and hydrocarbons (HC). In some regions, fine PM (particulate matter) is being cited as having a major impact on public health.

These are usually in the form of acceptable concentration levels of specific pollutant species. Sometimes regulations specify assessment locations (e.g., in residential areas) and assessment periods (e.g., 1-hour or 24-hour averaging periods). States usually set their regulations for the protection of human health and well being. In the absence of national standards, international bodies such as the World Health Organization (WHO), provide guidance material.

For airports that are located in areas that fail to comply with these standards or regulations, LAQ and the management of the relevant emission sources can be a significant environmental issue.

Whether or not the airport is the dominant source of a certain pollutant, the issue can affect the ability of an airport to continue or expand its operations or to obtain local governmental permission for infrastructure expansion.

NOx is often the most important pollutant of concern for airports, predominantly due to emissions from aircraft engines during landing and take-off (LTO), but also during taxiing and idling. The proximity of major roads can also mean that motor vehicle emissions on- and off-site can be a major contributor. Other important airport emissions sources include auxiliary power units (APU), ground service equipment (GSE), air and landside vehicles, ground transportation, power production, construction and fire fighting training.

6.2.2a Airports should assess the local air quality at and around the airport and adopt measures to prevent, minimize or reduce the emissions of air pollutants from airport sources, as deemed necessary.

6.2.2b Airport LAQ management should begin with assessment of the LAQ situation. An assessment should determine if the airport is currently complying with the applicable local regulations for each pollutant species and if the projected airport activities are expected to comply.

ACI POLICY	ACI RECOMMENDED PRACTICE / *COMMENT*
6.2.3 Measurement	*Measurements of the concentrations of specific pollutant species are usually conducted as according to national regulations, methodologies, or standards. In the case where all measured levels comply with regulations and there is no issue of non-compliance, the current LAQ situation may well be acceptable. There may still be a possibility that future airport activity could cause non-compliance and this may require further investigation, as outlined below.* *If measurements indicate that LAQ standards are being exceeded, several steps are required to determine the cause of the non-compliance, if airport or non-airport sources cause or contribute to the problem, and what mitigation actions might be required.*
6.2.4 Inventory of emissions sources	*An inventory of emission sources lists and quantifies the airport and non-airport sources for each pollutant species of concern.* *Airport and airport-related sources can include aircraft LTO, aircraft taxiing, aircraft APU (auxiliary power units), aircraft engine start-up and testing facilities, ground service equipment, GPU (ground power units), airport ground vehicles (landside and airside), power and heat generation and cooling plants, de-icing, fire fighting training, passenger and staff vehicles, taxis, buses and trains.* *Non-airport sources can include any industrial and transportation sources in the vicinity. The definition of the relevant air shed or area of land to be considered may depend on the local regulations, usually taking into account the local topography, climate and geography.* *The emissions inventory will also need to consider the location and the timing of each emissions source (i.e., spatial and temporal distribution). Where is each source? When does each source emit each pollutant species?* *An inventory based on the expected airport activity at future dates should also be conducted in order to help predict and mitigate possible future LAQ issues. Projections should take into account the future aircraft fleet, future passenger and aircraft movements, infrastructure developments and the like.*
6.2.5 Dispersion modelling	*An emissions inventory determines only the mass of the pollutants emitted over a given period. LAQ is usually assessed and regulated in terms of the concentration of each pollutant in the local atmosphere.* *There can be several steps between the source of an emission and the concentration of a pollutant species in the air at a receptor or measurement location. These include dispersion due to distance, weather, topography and buildings, and chemical changes involving conversion of primary emission species into secondary pollutant species (e.g., emitted NOx can cause the production of smog or ozone.)* *Dispersion modelling is the process by which an emissions inventory is used to calculate or estimate the expected pollutant concentrations at receptor locations. This can be a complex calculation and usually requires a specific computer model to take into account the location of the source, wind and other weather factors, topography and other physical features, chemical reactions, and other factors.* *Ideally, an accurate inventory (that also includes non-airport sources) and the results of detailed dispersion modelling should correlate with pollutant concentration data obtained from measurements. The results should identify the most important emissions sources (airport and non-airport) that are causing the LAQ problem or non-compliance issue.* *For example, if excessive NOx levels have been measured, the inventory and modelling may identify that both aircraft engines during LTO and cars on a nearby motorway are the major contributors. This assessment can then be used to tailor the most appropriate mitigation solutions.*

ACI POLICY	ACI RECOMMENDED PRACTICE / *COMMENT*
6.2.6 Addressing a local air quality issue requires an Emissions Response Policy with four elements.	**Emissions response** should address all sources of emissions, as identified in the inventory and modelling. There are four main types of measures: **1. Regulatory measures:** Setting standards on emission sources or restrictions on operations (Main engine standards, APU standards, APU restrictions, etc) **2. Technical measures:** Reducing emissions by implementing technical solutions (e.g., filter traps, catalytic converters, ground power support systems, etc) **3. Operational measures:** Reducing emissions by reducing fuel consumption or changing operating times or procedures (including ATM, aircraft maintenance) **4. Economic or market-based measures:** Creating economic incentives to change to activities or equipment with lower emissions (including local emission charges and global or regional emission trading schemes). Major instruments and practices are described below
6.2.7 Mitigation of LAQ pollution is best achieved by reducing emissions at source.	**6.2.8a** When the above steps identify an existing or future LAQ problem, airports should develop and implement mitigation plans that reduce emissions at source.
6.2.8 ACI's position is that ICAO should use its authority to implement more stringent NOx standards every second CAEP cycle (i.e. every 6 years).	***ICAO Aircraft Emissions Certification*** *Annex 16 Volume 2 of the Chicago Convention contains standards for the assessment and certification of gaseous emissions from aircraft during take-off and landing, with limits on NOx (including NO and NO2), CO, HC and smoke.* *These emission standards for new aircraft-engine types are generally adopted by Member States as regulation and are ICAO's main emissions reduction instrument.* *ICAO's Committee on Aviation Environmental Protection (CAEP) is developing a new NOx stringency standard for its next meeting in 2010, that is CAEP/8. A new standard would only apply to new aircraft/engine types certified after the application date expected to be either 2012 or 2016.* ***ICAO Guidance Material on Local Air Quality*** *CAEP is publishing Guidance Material for Airport Air Quality. The initial part (Doc 9889, 2007) addresses local requirements and inventories. Further work is being conducted to complete the inventory section and to discuss pollutant measurement, dispersion modelling, mitigation, and interdependencies with other environmental issues, such as noise and greenhouse gases.* *In 2007, ICAO published Guidance on Aircraft Emissions Charges Related to Local Air Quality (Doc 9884).*
6.2.9 Reductions in aircraft taxiing, queuing and APU usage reduce LAQ emissions.	*Aircraft engines are usually the largest source of NOx and other LAQ pollutants at an airport. However, airports usually have little control over take-off and landing emissions, which can account for more than half of an airport's inventory.* **6.2.10a** Measures that reduce taxiing and queuing, such as the construction of efficient and direct taxiways, virtual queuing, holding aircraft at terminal gates and runway capacity enhancements, will contribute to reduced fuel burn and lower emissions. **6.2.10b** Providing electrical power (400Hz) and pre-conditioned air (PCA) to aircraft parked at a terminal gate or cargo loading position, allows aircraft to switch off their auxiliary power units (APU). Some airports make use of this ground-based power mandatory. **6.2.10c** Landing fee schemes that include a component based on gaseous emissions can provide an incentive for aircraft operators to use aircraft types with low emissions characteristics. ICAO has prepared Guidance Material on Charges relating to emissions that affect Local Air Quality.

ACI POLICY	ACI RECOMMENDED PRACTICE / *COMMENT*
6.2.10 Airports should review infrastructure for emissions sources where reductions can be achieved.	**6.2.11a** Airport stationary sources like boilers and power production facilities can produce significant emissions for certain pollutant species. Measures should be sought to reduce emissions from those sources, including changes in fuel (e.g., CNG), modernization of equipment, and procedures and designs to increase efficiency.
6.2.11 Airports should review ground service equipment (GSE) and ground vehicles (airside) for emissions reduction opportunities.	*Most ground service equipment (GSE) has traditionally run on diesel or gasoline and can represent in the order of 10 to 15% of an airport's NOx, CO, and PM emissions.* **6.2.12a** Ground service equipment (GSE) and other airport ground vehicles should be kept well maintained and aging equipment should be up modernized. **6.2.12b** Alternative fuels can provide significant LAQ emissions benefits compared with petrol and diesel equipment. Options include compressed natural gas (CNG), liquid petroleum gas (LPG), low emissions vehicles (LEV), hydrogen vehicles, and electric vehicles. **6.2.12c** Fuel conservation programmes including the use of hybrid cars and educating drivers on more efficient (low acceleration, soft braking) driving techniques can reduce mobile equipment emissions.
6.2.12 Airports should review ground vehicles (landside) and land transport for emissions reduction opportunities.	**6.2.13a** The LAQ assessment should indicate which modes of ground transport are significant polluters and require mitigation. Actions should target reducing the emission by reducing the activity itself, increasing efficiency and using other vehicles with produce less (or no) emissions **6.2.13b** Car emissions can be reduced by discouraging drop-off and pick-up of passengers and providing public transport/mass transit. Taxi deadheading (e.g., taxis that travel to an airport with a passenger but depart without) should be avoided. Hotel and car rental shuttles should be consolidated to reduce traffic. Engine idling of stationary vehicles should be discouraged or prohibited. **6.2.13c** "Green" vehicles – hybrid and alternatively fuelled passenger cars and taxis – can be encouraged by priority or reduced-price parking and priority taxi queues. Infrastructure for CNG, hydrogen and electrical recharge can be provided. **6.2.13d** Airports can develop themselves as inter-modal transport hubs by including local and region bus and coach facilities, and train stations for local trains, light rail, subway/metro systems, and regional/international trains. Other possibilities include dedicated fast train services between an airport and city centre, and facilities for off-airport and city centre check-in. **6.2.13e** Airport and tenant staff should also be provided with incentives to reduce car usage. This can include public transport and economic incentives to use it, car pooling schemes and facilities to assist cyclists (showers, changing rooms, bicycle racks etc).
6.2.13 Airport-wide cooperation	**6.2.14a** Airports should encourage and support (or even require) all tenants at the airport premises to cooperate and contribute with their own mitigation plans.

6.3
Greenhouse gas emissions and global climate change

ACI POLICY

6.3.1 Minimize or mitigate the adverse impact of aviation on climate change.

ACI RECOMMENDED PRACTICE / *COMMENT*

In some regions, the aviation industry has become the subject of political, NGO and public attention with regard to climate change, and this pressure is manifesting itself as opposition to airport infrastructure development proposals. If aviation as an industry does not address the physical and perceived effects of its contribution to climate change, external actions such as prevention of infrastructure expansion or regulations and taxes may be imposed.

Aviation and Climate Change

Aviation's main contribution to global climate change is through emissions from the combustion of fuel in aircraft engines.

The Stern Review Report on the Economics of Climate Change (2006) indicates that fuel combustion in aircraft contributes 1.6% of global greenhouse gas (GHG) emissions. (This statistic also appears in the document, Navigating the Numbers, Greenhouse Gas Data and International Climate Policy, WRI, 2005.)

Based on anticipated aviation traffic growth and the assumption that other industries will achieve significant cuts in GHG emissions, the Stern Review Report estimates that aviation's share as a proportion of the remaining emissions could rise to approximately 2.5% of the global total by 2050.

Aviation is likely to be responsible for a greater proportion of the total human contribution to climate change than that indicated by emissions alone. Effects of emissions at high altitude, ozone, water vapour, soot, condensations trails and cirrus clouds are unclear, and some issues are poorly understood. One approach used by the United Nations Intergovernmental Panel on Climate Change (IPCC) is to compare the climate impacts of different sources of anthropogenic emissions using the concept of radiative forcing. According to the IPCC, the best estimate of the radiative forcing in 1992 by aircraft was about 3.5% of the total radiative forcing by all anthropogenic activities, and the predicted radiative forcing by aircraft in 2050 is 3.8 times the value in 1992, or approximately 5% of the total 2050 radiative forcing (IPCC, 1999).

Airport sources / contribution

Based on the reports cited above, emissions from fuel combustion in aircraft represent 2 to 4 percent of the total global GHG inventory. Based on airport emission inventories prepared to date, emissions from non-aircraft airport-related operations represent an additional 0.1 to 0.3 percent of the global total. One of the most significant sources of emissions is related to transportation of employees and passengers to and from the airport, and they may be accounted for elsewhere in "on road" transportation emissions inventories. While the airport contribution can be relatively small, many improvements can still be made.

ACI believes that it is important to distinguish between aircraft emissions and those emissions directly associated with airports. Most discussions of the impacts of global aviation emissions refer to aircraft emissions.

The best approach for addressing aviation's climate change emissions, including those from airports, is a long-term strategy that identifies and phases in environmentally effective, economically efficient, and politically viable measures for each category of emissions. The first step is to identify emission sources and their contributions, so that emissions reductions can be implemented. CO_2 is the most common GHG, and it may serve as the best starting point for an airport GHG inventory.

As indicated previously, fuel combustion in aircraft engines is usually the largest contributor to an airport's CO_2 inventory. In practice, airports use a variety of definitions to determine the aircraft emission contribution. Some base the emissions entirely on the fuel dispensed at the airport. Others count the emissions from aircraft only while their wheels are on the ground; others include the whole (landing and take-off) LTO cycle down from and up to an altitude of 3000 feet. A regulator at one airport took the approach of assigning CO_2 emissions for the entire flights of arriving and departing aircraft. Including the LTO, taxiing, and APU use, the aircraft emissions contribution to an airport CO_2 inventory is typically in the range of 50% to 80%.

Other major sources of CO_2 at airports are fuel combustion in GSE (ground service equipment) and airside and landside motor vehicles. Airside vehicles include passenger transfer buses and service vehicles, while landside vehicles include passenger and staff transport to and from the airport.

Utility plants at airports that burn fossil fuels to produce electricity, heating and cooling can also be large sources of GHG emissions. In Europe, some airports have power generation stations that are already subject to restrictions and emissions trading under the EU's Emissions Trading Scheme.

Aviation's overall contribution to the global GHG emissions inventory is dominated by aircraft in flight and these emissions are beyond the control and influence of airports. Discussion here is limited to actions airports can take to address GHG sources within their control and influence.

ICAO

ICAO States have endorsed the development of an open emissions trading system (ETS) for aviation and in 2007 published guidance material on developing such a scheme.

In 2007, the ICAO Assembly Resolution stated that any ETS should be based on mutual consent between countries. The EU placed a reservation on this section, because it proposes an ETS that applies to all flights to, from and within the EU.

ICAO also established the Group on International Aviation and Climate Change (GIACC) to develop an Action Plan. Developments are occurring rapidly in this area.

ACI believes that, as an industry, aviation should address its climate change impacts on a global level. ICAO should establish a roadmap for long-term global action, with an Action Plan that identifies interim stages, specific measures, and sets out the policy milestones for achieving aviation's emissions objectives by 2050.

This Action Plan should identify the measures and timeframe for addressing the climate-related effects associated with non-GHG emissions, such as NOx and water vapour, and the resultant ozone, contrails, and cirrus clouds, once there is greater certainty over the scale and nature of those impacts. If, in the future, the effects of NOx and other non-Kyoto gaseous emissions are addressed by aviation, it will be important that they are also addressed by other industrial and transport sectors.

Recognizing the role of ICAO in setting standards, ACI calls upon this institution to continually devise more stringent emission standards for aircraft.

The policy measure with the least negative impact on the aviation industry will be the integration of aviation's CO2 emissions into a global emissions trading system.

Capacity constraints, taxation, or charges that do not satisfy ICAO's criteria for legitimate aeronautical charges, are not viable solutions to address aviation's contribution to climate change.

ACI POLICY	ACI RECOMMENDED PRACTICE / *COMMENT*
	6.3.1a Airports should continue to take action to minimize emissions within their direct and indirect control. **6.3.1b** Airports should support the development of infrastructure, technologies, operational practices, and design strategies in the aviation industry that will help to reduce aircraft emissions globally. *In 2007, ACI's Annual Assembly passed a resolution that encourages member airports to commit to strategies to reduce carbon emissions, with the ultimate target of becoming carbon neutral. In April 2008, more than 300 airports, and leaders of aviation industry companies and aviation organizations, signed a declaration on climate change, committing to a pathway to carbon-neutral growth and a carbon-free future.* ***Note**: This is a rapidly evolving issue. At the time of writing (July 2008) several different regions are developing guidelines on conducting airport inventories and frameworks for addressing GHG emissions. These recommended practices will be revised and reissued in the near future.*
6.3.2 Airports should inventory airport and airport-related greenhouse gas (GHG) emissions, clearly demarking responsibility or ownership and location (on and off airport).	**6.3.2a** An airport inventory of GHG emissions should identify the sources, extent (e.g. annual quantity) and ownership of emissions. The ownership is important for avoiding double counting when regional or industry-wide aggregate inventories are conducted. **6.3.2b** Airport-related sources can be categorized in 3 groups, based on the airport's level of control or influence: 1. Direct Control. The airport has full (or almost full) responsibility for the emissions. Such sources would include heating and power plants, terminal buildings, and airport vehicles. 2. Influence. The airport can only influence the emitter or the sources and does not bear direct responsibility for these emissions. These include aircraft taxiing and queuing, airline-owned GSE, taxis and hotel shuttle buses, and aircraft APU usage. 3. Little or No Influence. City or regional ground transportation infrastructure is often beyond the influence of airports. Airports can work with a city to build, for example, train lines, and may contribute financially, but final decisions are made by other authorities. *Categorization of activities is not always clear, and can vary between airports. Providing parking lots is an example. If a city is car-reliant, an airport has no choice but to provide parking, at least in the medium-term. Parking at the airport can actually reduce trips and emissions, if drivers do not make two one-way trips to drop off and pick up passengers.* **6.3.2c** An inventory should also record where emissions occurred and whether on or off the airport site. *It is important that an inventory cover all airport-related emissions sources, so that recognition can be given for actions taken by airports that reduce off-airport emissions (e.g., building a transit link or supporting bus service). However, many sources (e.g. aircraft and off-airport road transport) will be included in the inventories of other parties (e.g. the airlines and the city) and inventory process should avoid double counting or assigning the responsibility for the same emissions to two parties.*
6.3.3 Goals and action plans should be developed with the ultimate target of becoming carbon neutral.	**6.3.3a** Based on a complete inventory, an airport should set goals and develop an action plan to achieve these goals.

ACI POLICY	ACI RECOMMENDED PRACTICE / *COMMENT*
6.3.4 Reductions in aircraft taxiing, queuing and APU usage reduce GHG emissions.	*Measures that reduce fuel use or emissions from aircraft engines provide benefits for GHG emissions.* **6.3.4a** See **Section 6.2.10**
6.3.5 Airports should review ground service equipment (GSE) and ground vehicles (airside) for GHG emissions reduction opportunities.	*Most measures that reduce fuel use and LAQ emissions from ground vehicles also benefit GHG emissions.* **6.3.5a** See **Section 6.2.12**
6.3.6 Airports should review ground vehicles (landside) and land transport for GHG emissions reduction opportunities.	**6.3.6a** See **Section 6.2.13**
6.3.7 New buildings should employ best practice energy efficiency and GHG technology.	*Infrastructure design can be the single most significant factor affecting the GHG emissions associated with operating an airport. Engineering and architectural features of new terminal buildings can greatly enhance energy efficiency.* **6.3.7a** Underground thermal sinks can be used to enhance heating and cooling efficiencies. **6.3.7b** Combined cooling, heat, and power (CCHP) systems use waste heat from electricity generation to heat the terminal in winter. In summer, absorption cycle refrigeration systems can use the same heat source to generate chilled water to cool the building. **6.3.7c** Smart building technologies can be used to reduce lighting and heating or cooling in unoccupied spaces. Unoccupied escalators can be slowed or paused until people need to use them. **6.3.7d** For large interior spaces in hot climates, thermal stratification can be used to cool occupied areas at floor level while allowing unoccupied space near the ceiling to remain hot. **6.3.7e** In cold climates, new steam plume-suppressing technologies can be used to allow heating plants to be located close to terminal and control tower structures without affecting visibility. This can substantially reduce piping losses and inefficiencies.
6.3.8 Existing building should be reviewed for energy efficiency and retrofits conducted where appropriate.	**6.3.8a** A building retrofit project will usually start with an energy efficiency audit. Retrofitting and modifications can cover a wider range of building features including the following examples. Many provide significant operational cost savings, and projects can "pay off" within reasonable time frames.
6.3.9 Now and existing buildings should have best practical thermal insulation and glazing.	**6.3.9a** Installation of shading or light-filtering films on windows to reduce solar load. **6.3.9b** Modifying and modernizing heating, ventilation and air-conditioning (HVAC) systems, such as installing variable speed electric motors to reduce air flows when occupancy is low or temperatures are mild. **6.3.9.c** Installation of more efficient and long-life light bulbs for both interior and exterior lighting.

ACI POLICY	ACI RECOMMENDED PRACTICE / *COMMENT*
6.3.10 Operational procedures can also be used to improve energy efficiency.	**6.3.10a** Maintenance hangar door opening and closing procedures can be improved to reduce heat loss in winter or heat gain in summer. **6.3.10b** Lighting procedures can be improved to minimize lighting in unoccupied areas or during low occupancy.
6.3.11 Renewable energy should be used where practicable to reduce fossil fuel consumption.	**6.3.11a** Purchasing electricity from suppliers with certified renewable sources, such as hydroelectric, wind, solar, biomass, etc. **6.3.11b** Generating electricity on site with wind turbines, photovoltaic, solar cells and the like. **6.3.11c** Solar hot water heating. **6.3.11d** Using bio-fuels, hydrogen and other non-fossil fuels for ground vehicles and support equipment. **6.3.11e** Using boilers that burn wood pellets or similar forestry or recycled waste material.
6.3.12 Offsets may be purchased to reduce GHG footprint towards achieving Carbon Neutral Status, but such offsetting should not replace emissions reduction efforts.	**6.3.12a** Offsetting is a mechanism to provide funding for projects that reduce carbon emissions at an other location, in or der to compensate for carbon emissions that cannot be avoided. For example, airport authorities that want to achieve carbon neutral status would need to minimize CO2 em issions under their control. O ffsets would then need to be purchased to account for t he remaining CO2 emissions that cannot be eliminated. H owever, it should be noted that funds invested in offsetting do not in themselves improve the operation of the airport, and such funds would preferably be invested in airport carbon reduction programs. **6.3.12b** Clean Development Mechanism (CDM) projects under the Kyoto Protocol are the most rigorously reviewed offsetting projects. *Revenue diversion issues associated with offset purchases may need to be addressed in the US.*

6.4
Sustainability – System Methods

Sustainability is a general term that encompasses the concept of meeting the needs of the present without compromising the ability of future generations to meet their needs.

The three pillars of sustainability are **economic, social, and environmental**. For a n enterprise such as an airport to s ustain itself over the long-term it must maintain positive economic benefits to invest in its activities and for its stakeholders, it must develop positive impacts broadly across society both in its community and in communities affected by its activities, and it must participate in maintaining a healthy environment. Sustainability is thus a critical objective in considering all aspects in this chapter on the environment and indeed other chapters on the economics of airport construction and operation and even Safety and Security.

This section will focus primarily on environment issues not elaborated on in other sections, covering the following major considerations:

- Reduction of the use of natural resources
- Reduction of waste especially that going to land-fills
- Reusing materials including glass, aluminium and compostable waste
- Recycling of waste including demolition material and aggregate
- Reduction and avoidance of pollution causing incidents
- Rehabilitation of contaminations of land, air and water
- Enhancement of biodiversity by habitat creation

The three key environmental issues of noise, local air quality and climate change are primarily addressed in **Sections 6.1, 6.2** and **6.3**, but of course, all fall under the umbrella of striving toward a sustainable enterprise. As well as specific practices or system methods, two other aspects of sustainability, namely reporting and certification, will be addressed in **Section 6.5**.

In this document sustainable development is not distinguished from Sustainability.

Various efforts on developing frameworks for sustainability for airports are in process and this document is likely to be updated by mid-2009.

ACI POLICY	ACI RECOMMENDED PRACTICE / *COMMENT*
6.4.1 Promote sustainability by improving the environmental performance during airport development and operation.	
6.4.2 Buildings and HVAC plants should be built and operated to maximize energy efficiency and minimize non-renewable energy usage.	**6.4.2a** Use of non-renewable and polluting energy sources should be reduced while sustainable energy sources should increasingly supply airport energy needs. Energy use, energy efficiency and renewable energy sources in the context of reducing greenhouse gas emissions are also discussed in **Section 6.3.** **Building Technology** **6.4.2b** Designing and constructing a new building provides many opportunities to implement energy efficiency technologies. "Green designs", "smart" building management systems and the like are much more easily incorporated at the planning and design stages, but many can be installed as a retrofit to an existing building. **6.4.2c** The extra cost of construction or materials should be taken in to account in a "whole of life cycle" analysis, discussed later in this section. **6.4.2d** Building energy efficiency features can include the following: • Building orientation to maximize benefit of local weather and solar conditions • Insulation of roof spaces and walls, and use of thermal double glazing • Natural ventilation to reduce or avoid the need of air conditioning • Planting (e.g. deciduous trees), tinted glazing and operable window shades to minimize summer solar heat load and maximize winter heat gain • Renewable energy sources (photo-voltaic cells, wind or solar energy, etc.) • Natural lighting and other building features and materials that require little maintenance or resources for operations • Low energy lighting (e.g. light emitting diodes, compact fluorescent bulbs) both internal (terminals, offices etc) and external (runway, tarmac, roads etc) • 'Smart' building and control techniques – utilizing automatic control systems that regulate energy use according to occupation and other factors • Simplification of plumbing infrastructure requiring less pumping • Optimization of heating, hot water, and electrical infrastructures to minimize loss and degradation over the system ***Heating, Ventilation and Air Conditioning (HVAC)*** *HVAC is one of the major energy consumers at most airports. Efficiency improvement projects can have short payback periods and provide both climate change and local air quality benefits.* **6.4.2e** Many traditional and innovative technologies are available, some for new installations and some as retrofits. • Natural ventilation and offices with operable windows can be used during temperate condition. • Relaxed dress codes in offices (e.g. sweaters in winter, no neck ties or suits in summer) can permit in offices to be less heated in winter and less cooled in summer.

- Efficient lighting systems including low energy and long-life bulbs and reduced lighting in unoccupied spaces.
- Smart building technologies can be used to reduce lighting and heating or cooling in unoccupied spaces.
- Underground thermal sinks can be used to enhance heating and cooling efficiencies.
- Combined cooling, heat and power (CCHP) systems use waste heat from electricity generation to heat the terminal in winter. In summer, absorption cycle refrigeration systems can use the same heat source to generate chilled water to cool the building.
- For large interior spaces in hot climates, thermal stratification can be used to cool occupied areas at floor level and allowing unoccupied space near the ceiling to remain quite hot.
- In cold climates, new steam plume-suppressing technologies can be used to allow heating plants to be located close to terminal and control tower structures without affected visibility. This can substantially reduce piping loss inefficiencies.
- Modifying and modernizing Heating, Ventilation and Air-Conditioning (HVAC) systems, such as installing variable speed electric motors to reduce airflows with occupancy is low or temperatures are mild.
- Maintenance hangar door procedures can be reviewed to reduce heat loss in winter or heat gain in summer.

6.4.3 Water resources should be used in a sustainable manner.

The main uses of water include bathrooms and toilets, catering, laundries, cleaning, landscapes and gardens, aircraft and vehicle washing and aircraft potable water supply. Other uses might include runway de-icers, construction, and maintenance.

Sources of water include municipal supply, underground aquifers, surface water (including artificial dams) and rain water (from building roofs and hardstanding). Some airports have their own wastewater processing plants.

6.4.3a Good water management practices include the following:

- Installation of water saving devices such as waterless urinals, infrared toilet flush controls, self-closing sink taps and low flow shower heads.
- Rain water collection and grey-water recycling for non-potable uses such as toilet flushes and landscape (garden watering).
- Water recycling of vehicle wash and other lightly contaminated effluents.
- Prevention of incidental loss through leakage.

6.4.3b As with all resource management systems, the process needs to assess current usage, set goals, implement processes and assess progress.

6.4.4 Land resources include habitat, soil and groundwater and should be used and managed in a sustainable manner.

Land and Groundwater Management encompasses many environmental issues covered in other sections of this Chapter. Most fall in under the discussion on the management of the impacts of pollution, while some concern the operational procedures to prevent spillage or other damage to soil and groundwater.

6.4.4a The following potentially contaminating activities at airports should be reviewed for past and possible contamination events and dealt with as described later in this Section:

- Delivery, storage and use of fuel, oils and solvents, and vehicles containing these
- Vehicle and aircraft maintenance
- Fire fighting and training
- De-icing and anti-icing
- Accidents involving spillage of fuels, chemicals or hazardous cargoes.
- Waste disposal
- Heavy rainfall on areas where the above take place.

Wildlife habitat and biodiversity management
Airports attract a wide range of wildlife, such as birds, and domestic livestock, which represent a threat to aviation and need to be controlled. Critical safety zones for aircraft operations may extend well beyond the airport's boundary.
Land uses such as landfills, lakes, marshes, wetlands, reservoirs, recreational facilities, conservation areas etc. may attract wildlife which should be discouraged or if unavoidable, should be managed, keeping aviation safety as a priority. Legislation to suit such measures of management may be implemented, if required.

6.4.4b Airports should adopt programmes to ensure safety without compromising the preservation of wildlife habitat and biodiversity.

6.4.4c Airport boundary control is exercised by denying wildlife access through barriers, fences or other means. Habitat management including grass management should be employed to minimize attraction of wildlife into airport lands. If wildlife is present, then other measures, such as the use of bioacoustics and pyrotechnics, should be implemented.

6.4.4d While aviation safety is paramount, airport wildlife management measures shall be implemented taking into consideration the best practices for environmental protection.

6.4.4e For more detailed information see ACI's "Aerodrome Bird Hazard Prevention and Wildlife Management Handbook" (2005).

6.4.5 Fuel and air should be used in a sustainable manner.

Clean air should be viewed as a precious natural resource that must be carefully managed as much as water or fuel. While the efficient use fuel can be readily assigned a value in terms of cost savings, the efficient management of local air quality is of fundamental importance. Air quality is generally well regulated, so poor management could have other consequences for airports. As the majority of air pollutants are associated with combustion and vehicles, fuel and air are addressed together.

6.4.5a Measures to address local air quality and the efficient use of fuel are discussed in **Sections 6.3 and 6.4**.

Fuel storage and handling
Storage and distribution of fuel oil for aircraft can include above or below ground tanks, sometimes under pressure, and piping networks. Many of these activities are addressed by local regulations.

6.4.5b Leakage or loss-detection systems are crucial to monitor waste and prevent or minimize ground contamination.

6.4.4c Storage tanks should be subject to regular integrity tests and inspections including routine pressure testing. Bunds and drainage areas should be incorporated in the design of fuel handling and maintenance areas.

6.4.6 Air pollution is best managed by reduction of emissions sources.

6.4.6a Once emitted, pollutants in the atmosphere in the vicinity of airports cannot easily be removed by other than natural processes such as wind and rain. Local air quality management is invariably reliant on controlling, reducing or eliminating the sources of emissions, rather than attempting to remove air pollutants or reduce human occupation of impacted areas.

6.4.7 Airports should adopt policies and procedures to reduce, minimize or eliminate the impact of storm water discharges on receiving water bodies.

Storm water
Airport operations include a variety of industrial activities (e.g. washing, de-icing/anti-icing, maintenance, fuelling, landscaping, etc) that often require the use of a variety of chemical substances or products that when mixed with storm water can be discharged to surrounding environs.

6.4.7a Airports should consider means and methods [often referred to as Best Management Practices (BMPs)] to reduce the use of chemicals outdoors to the extent practicable, thereby reducing the potential for exposure to precipitation; consider more environmentally friendly chemicals; and/or provide treatment of impacted storm water runoff.

6.4.7b The following storm water treatment systems can be considered, as appropriate: vegetative swales, oil-water separation devices, dry-type detention basins, sediment settling basins/traps and infiltration basins. Prior to considering any type of onsite treatment system, airports should also consider potential wildlife attractants and consider appropriate procedures to mitigate this potential. Airport development and construction can also impact the surrounding environs leading to the potential for soil erosion and high levels of sedimentation in nearby water bodies. Construction contractors utilizing chemicals and fuels as part of the construction activity may also result in spills and releases to surrounding environs. These spills could enter storm water drainage systems and contaminate storm water runoff. Engineers should design improvements to minimize the potential for adverse impacts of construction and Contractors should prepare appropriate plans and be trained in appropriate controls to be incorporated into the construction project

6.4.7c The vast impervious areas associated with airports and airport developments often result in greater peak storm water discharge rates and greater volumes of storm water runoff into receiving streams or water bodies. Without control, the large impervious areas can increase flooding downstream. Airports should properly evaluate reduction and flood control measures like detention of peak storm events.

6.4.7d Programmes should be developed to reduce the sources of storm water runoff impacted by the regular operation of an airport (e.g., maintenance and fuelling) and from accidental incidents like fuel spills. Controls and measures to minimize the effects of these activities should be incorporated into the design of airport facilities. Policies, procedures, response plans, and training programmes should be developed to inform airport and tenant employees in appropriate spill handling and management. The intent of these programmes should be to prevent, prepare, respond and appropriately report spills. Developing an effective spill prevention and response program will greatly assist airport management in reducing the costs of remediation, the adverse impacts of spills on surrounding environs and improving community relations.

6.4.7e The sampling and analysis of storm water discharges can be used to assess the potential impact of discharges on water bodies on and off the airport. These data may also assist in identifying activities impacting storm water and requiring further consideration or controls. In some situations, monitoring of storm water discharges is required by legislative bodies and may be used to measure compliance with regulatory standards.

6.4.8 Airports should adopt policies and procedures to reduce, minimize or eliminate the impact of anti-icing chemicals on receiving water bodies.

De-icing and anti-icing activities

Chemicals used to deice and anti-ice (collected referred to as "deicers") aircraft and pavement may cause adverse environmental impacts if not appropriately reduced, contained, stored and treated. These impacts may include decreased dissolved oxygen levels in runoff and receiving waters, toxicity to aquatic life, increased foaming, objectionable odours, colour and/or bacterial growth.

6.4.8a To minimize the potential adverse impacts of deicers, airports should conduct evaluations and assessments to determine appropriate controls to avoid pollution and meet local regulatory requirements. Every airport is unique and solutions to minimize and control discharges are highly site specific. Airports should consider the appropriate means and methods to control deicer-laden storm water runoff through an evaluation of the variety of options (including combinations) that may exist including, but not limited to, the following:

6.4.8b Source Reduction Options

- Efficient mixture of glycol for the storm event
- Hybrid de-icing trucks (forced air/glycol mixtures)
- Minimize aircraft exposure to adverse weather (diversions, hangars, etc.)
- Weather forecasting and proactive anti-icing
- Use of pavement sensors for better detection of pavement conditions

6.4.8c Collection or Containment Options

- Glycol recovery vehicles (GRVs)
- Centralized de-icing pads
- Gate collection systems
- Runway end de-icing pads

6.4.8d Storage Options

- Underground storage tanks or containment vaults
- Aboveground storage tanks
- Retention/detention ponds

6.4.8e Treatment – Disposal Options

- Onsite treatment facilities
- Offsite treatment facilities
- Recycling systems

6.4.8f Pavement Options

- More environmentally friendly alternative pavement deicers
- More efficient mechanical removal
- Weather forecasting and proactive anti-icing

6.4.9 The adverse effects of all activities should be managed in a sustainable manner.

Solid Waste Management

Despite many different sources of waste, an airport authority is usually responsible for the management of waste. The variety of sources includes:

- *Office waste including paper and cardboard*
- *Catering waste including food and cooking oils*
- *Oils, solvents and parts from aircraft maintenance and refurbishment*
- *Scrap metal*
- *Construction waste*
- *Deplaned or in-flight waste*

6.4.9a Waste management should incorporate a waste hierarchy in the following order of decreasing priority:

- Prevent or minimize
- Reuse
- Recycle and compost
- Burn and recover energy
- Disposal or dump to landfill

6.4.9b Some airports have conducted waste analysis to determine the composition of the waste and to identify the sources of each waste stream and the areas that would best benefit from effective management.

6.4.9c Sorting is required to separate the streams of waste. Sorting at the point of collection (e.g. using multiple bins) can be the most efficient but can have problems with contamination of streams, especially with public collection points. Public collections points need to provide clear and simple procedures to ensure maximum benefit.

6.4.9d Collection from tenants and airport staff has the most potential for successful sorting as the most important waste streams can be targeted and procedures can be reviewed and developed.

6.4.9e The cost of sorting may be recoverable as some types of waste including cardboard, aluminium and other metals have a monetary value. In addition, reduction in the amount of waste going to landfills can also represent a cost saving.

6.4.9f De-planed waste can be problematic. Airline crew must be involved (usually on a voluntary basis) and disposal procedures will vary at different airports. Aluminium cans are the best potential waste stream. At most airports, waste from international flights is required to be incinerated.

6.4.9g Hazardous waste generally requires special handling and disposal, usually at significant cost.

6.4.10 Contamination of land and soil should be addressed with an appropriate strategy.

Soil contamination

6.4.10a A land or soil contamination strategy should consider the following:

- Identification of potential contamination from historical or current activity
- Risk assessment of potential exposure to contamination by humans on or near airport and ground and surface water
- Establish need for intrusive investigation (sampling and testing) to determine extent and severity of contamination
- Regulatory requirements
- Plan and prioritize remedial action
- Validation and monitoring

Historic contaminated sites

Former industrial activities, handling of chemicals and wastes, and a historic lack of understanding may have resulted in contamination of soil and ground water on airport properties. Fuel spills, leaking fuel storages facilities, abandoned landfills, fire training areas, inappropriate hazardous material/waste handling practices, or similar military activities have sometimes resulted in property being contaminated.

6.4.10b Airports should thoroughly understand their own liabilities associated with contaminated sites and implement programmes to address, assess and remediate contaminated sites that may be further impacted by an airport's activities.

6.4.10c Airports should identify potential contaminated sites on their properties and should investigate any property being acquired. Airports should refer to appropriate standards associated with environmental site assessment prior to acquisition to document current environmental condition and limit future airport liabilities.

6.4.10d Airports should thoroughly assess contaminated sites that may be impacted by future development or that may be resulting in a furtherance of chemical migration and potential harm to human health or the environment. Remediation of such contaminated sites should be undertaken when deemed appropriate or when obligated to do so by a regulatory agency.

6.4.10e ACI supports that the party responsible for contamination should pay for assessment and remediation. ACI supports research and development and exchange of information on environmentally protective, cost-effective and risk-based remediation programmes.

6.4.11 The adverse effects of fuel spill and fire fighting practice managed in a sustainable manner.

Fuel spills

6.4.11a The management of fuel spills should be covered by standard procedures often required by regulation.

6.4.11b Minor spills are usually dealt with by appropriate spill kits including containment and absorption equipment. The ready accessibility of equipment and appropriate training of employees is crucial.

6.4.11c The possibility of major spillage events, especially in the event of heavy rain, need to be taken into account in the design of the airport and its drainage systems, interceptor capacity and storm water management. Such systems usually seek to prevent the linkage between a spillage source and sensitive receptors such as soil, surface water and groundwater.

6.4.11d Remedial action options usually cover containment and soil and ground remediation. At this stage, regulators will usually be involved so approval, monitoring and validation will be required.

Fire fighting training facilities

6.4.11e To avoid pollution of soil, groundwater and storm water, fire fighting training facilities should be designed to minimize chemical and fuel release. The use of impermeable containment basins, as well as environmentally sound fuel storage and distribution system should be considered at all fire training facilities.

6.4.11f Local air quality requirements and/or regulations should be consulted and reviewed to confirm any potential restrictions on training with live fires and fuels. As consistent with regulatory requirements, lead-free hydrocarbons, natural gas or other appropriate fuels should be used to create fires.

6.4.11g The ability to use waste oils should be confirmed with appropriate regulatory agencies. Optimization of fire training should be encouraged to avoid excessive use of training exercises. Airports are encouraged to consider use of joint training facilities with other local jurisdictions.

6.5
Sustainability – Reporting and certification

ACI POLICY

ACI RECOMMENDED PRACTICE / *COMMENT*

6.5.1 Promote sustainability by improving the environmental performance during airport development and operation (same as 6.4)

6.5.2 Airports embarking on a sustainability programme should use standard Key Performance Indicators and reporting methodologies.

Key performance indicators (KPI)

KPI's are standardized means for quantifying the environmental performance of an activity. By measuring and tracking KPI's, an airport can evaluate the status of current performance, compare this with other airports and track the performance of environmental initiatives.

There are a number of pitfalls associated with KPI's including variations between methodologies at different airports nullifying the benefit of comparisons and the complexity of some indicators to address very specific issues. Blind adherence to efforts to improve a poorly selected KPI can sometime cause paradoxical adverse effects (e.g. concentrating flight tracks to reduce noise contour area causing increased community annoyance.)

The following table provides a sample of some KPI's commonly in use.

6.5.2a Noise

- Land area or number of residents with a certain noise contour (e.g. DNL 55 dBA)
- Percentage of arrival using CDA or NPR
- Number of breeches of noise limits
- Number of (night time) engine run-up tests
- Percentage of Chapter 2, 3 and 4 aircraft using airport and the contribution of each to total noise levels
- The number of noise complaints for residents

6.5.2b Local air quality

- Total (or change in) NOx emission from airport activities, as a whole and subdivided in to each airport source
- Total (or change in) other significant pollutants from airport related activities
- As above calculated per passenger, per aircraft arrival or per tonne of freight
- The number of complaints relating to odour

6.5.2c GHG and climate change

- Total (or change in) CO_2 (or CO_2 equivalent) emitted, as a whole and subdivided in to each airport source
- As above calculated per passenger, per aircraft arrival or per tonne of freight
- Annual quantity of renewable energy bought or generated, in total and as a proportion of total energy used
- Annual quantity of carbon offsets or allocations purchased

6.5.2d Building energy efficiency and water usage

- Annual energy (electricity, gas or other fuel) consumption total, per passenger and per unit building area
- Annual water consumption total and per passenger

6.5.2e Ground transportation and airport authority business travel

- Numbers of passengers and employees using each mode of transport, including public transport, walking, cycling, cars, taxis, buses etc
- Number of percentage of staff using car sharing or other single occupant vehicle alternatives
- Percentage of taxis or other ground transport using alternative or renewable fuel or that are hybrids
- Use of conference calls and video conferencing and associated reduction in travel

6.5.2f Land and soil contamination

- Land area (or percentage of airport area) under investigation, confirmed as uncontaminated and identified as problematic
- Land area (or percentage of airport area) remediated

6.5.2g Waste management

- Waste generated – total and per passenger
- Waste sent to land fill – total and per passenger
- Percentage of all waste generated recycled (including and excluding construction/demolition material)

6.5.2h Water management

- Measured pollutant levels in discharged water flows and compliance assessment
- Annual water reuse (total and per passenger)

6.5.2i Global reporting initiative (GRI)

Reporting is a key process for tracking KPI's and communicating progress in a robust and consistent manner.

A leading format for reporting on environment, social and economic issues is the Global Reporting Initiative, G3 Guidelines. (See www.globalreporting.org). The Global Reporting Initiative (GRI) has pioneered the development of the most widely used sustainability reporting framework. This framework sets out principals and indicators that organizations can use to measure and report their economic, environment and social performance – the 3 pillars of Sustainability.

Unless the concept of sustainability is fully supported by senior management, environmental issues may be better reported following the ISO 14001 Environmental Management System series (below).

Sustainability reports base on the GRI framework can be used to benchmark organizational performance with respect to laws, norms codes, performance standards and voluntary initiatives; demonstrate organizational commitment to sustainable development; and compare organizational performance over time.

The GRI guidelines help to provide the basis for an airport authority's disclosure reporting on their sustainability performance and continuous improvement. Those airports with environmental management systems will probably also be able to fulfil the requirement for reporting within the same document.

The GRI is currently exploring the opportunity to develop sector specific guidelines for airports. Tentatively scheduled to start in late 2008, the GRI will work with airports and their stakeholders to create a customized set of reporting indicators specifically for airports' use. The sector indicators will be developed in a consensus seeking process from all corners of the globe. The process will take until approximately 2010 to complete.

The guidelines are voluntary, however the reporter is "graded" based on what level of the guidelines have been applied (Application Level). There are three ways to report – self declare; third party opinion and have the GRI check the self-declaration.

Environmental management system

6.5.2j Airports should adopt an environmental management system (EMS) for a systematic approach to managing environmental issues associated with operation, development and eventual decommissioning of their infrastructure.

Airports should keep their environmental impact to a minimum, by adopting a systematic approach to address environmental impacts. The approach should include activities of all concerned parties such as operators, tenants and concessionaries and define their responsibilities and its service partners (airlines, ATC, terminal service providers)

The approach should deliver strategy, objectives, targets and action plans and these should be documented. A controlling system should be implemented for reviewing strategies, targets and programs and to aim for continuous improvements.

The prevention, minimization and mitigation of adverse environmental impacts through design of infrastructure and appropriate use of technologies and operational practices shall be supported and encouraged.

http://www.aoa.org.uk/publications/environmental_guidance_manual.asp

6.5.2k Life cycle assessment

A life cycle assessment (LCA, also known as life cycle analysis and cradle-to-grave analysis) is the investigation and valuation of the environmental impacts of a given product or service caused or necessitated by its existence.

The importance of LCA for airport environmental managers is that a project is not assessed merely on its initial cost but that the whole accumulated lifetime benefits including reduced energy consumption and other environmental benefits are factored in to the decision making process. As airport infrastructure is typically long-lived, airports' investment is significantly greater over the life-cycle of the infrastructure as compared with the initial capital investment (perhaps 70%-90%). This is an important concept in reducing long-term costs and environmental effects.

The formal procedures for LCA are part of the ISO 14000 in ISO 14040:2006 and 14044:2006.

6.5.3 Airports seeking recognition or certification for sustainability projects can use established systems such as LEED or BREEAM.

Certification

Certification is a process by which a project such as a new building or modification can obtain formal recognition that certain standards of sustainability have been met. The process will usually ensure that all issues are adequately addressed and provide an opportunity to achieve the best publicity for environmental investments.

6.5.3a LEED

The Leadership in Energy and Environmental Design (LEED) Green Building Rating System, developed by the U.S. Green Building Council (USGBC), provides a suite of standards for environmentally sensitive construction. See www.usgbc.org

The hallmark of LEED is that it is an open and transparent process where the technical criteria proposed by the LEED committees are publicly reviewed for approval by the more than 10,000 membership organizations that currently constitute the USGBC. LEED was created to accomplish the following:

- *Define "green building" by establishing a common standard of measurement*
- *Promote integrated, whole-building design practices*

- *Recognize environmental leadership in the building industry*
- *Stimulate green competition*
- *Raise consumer awareness of green building benefits*
- *Transform the building market*

Green Building Council members, representing every sector of the building industry, developed and continue to refine LEED. The rating system addresses six major areas:

- *Sustainable sites*
- *Water efficiency*
- *Energy and atmosphere*
- *Materials and resources*
- *Indoor environmental quality*
- *Innovation and design process*

There are four levels of certification – Certified, Silver, Gold and Platinum.

6.5.3b BREEAM

BREEAM is the UK Building Research Establishment's (BRE) environmental assessment method. There are 8 main areas to an assessment:

- *Energy*
- *Transport*
- *Pollution*
- *Materials*
- *Water*
- *Land Use and Ecology*
- *Health and Well Being, and*
- *Management*

Standard assessments exist for offices, industrial units, schools and homes. For other types of buildings including airport terminals, special assessments can be made. Each area as a number of criteria and are assigned credits. Ratings are made on a scale of Pass, Good, Very Good and Excellent. See www.bream.org

6.6
Environmental awareness, training, sharing information and communications

ACI POLICY	ACI RECOMMENDED PRACTICE / *COMMENT*
6.6.1 Improve environmental awareness, training and sharing of information among world airports.	**6.6.1a** Airport environmental staff and management should participate in or at least follow the progress and o utputs of the World Environment Standing Committee and ACI's regional environmental committees. Staff should also be encouraged to attend and participate in environmental training events and conferences.

6.7
Stakeholder communications and understanding

ACI POLICY	ACI RECOMMENDED PRACTICE / *COMMENT*
6.7.2 Promote understanding, cooperation and collaboration with stakeholders.	*Physical environmental issues are usually addressed by technical mitigation and engineering solutions. Physical results can usually be measured and compliance with some standard or regulation is targeted and, hopefully, achieved.* *In many cases, stakeholders (especially the communities living near an airport) may perceive that there is an environmental problem regardless of compliance with standards or de minimus impacts. Such a perceived issue is also a real environmental issue and communication with stakeholders can play a key role is addressing the issue.* *It is the groups that immediately surround an airport that will provide vocal opposition to any expansion that may be planned. However, they are not the only audience for airports. Their vocal and local opposition may have an effect on regional and national politicians and media. In addition, the environmental issue of climate change has a potential public relations impact on the industry far beyond the edge of the airport.* *For environmental issues at airports, there are a number of key stakeholder groups:* • ***Immediate community:*** *the most important stakeholders are usually the residential communities living either near the airports or under or near flight paths near the airport.* • ***Governments:*** *local and regional governments are also important, because along with residential communities, they have important influence on the ability of airports to provide infrastructure to meet the demands of the air transport system. Governments are also interested in ensuring that the air transport system provides the maximum economic and social benefit for their citizens. In some countries, governments are also airport owners and/or operators.* • ***External audiences:*** *Other important stakeholders include environmental groups, local business associations, tourism organizations and members of the aviation industry including airlines, ANSP's, aircraft manufacturers, ICAO, and the travelling public.* • ***Airport community:*** *environmental programmes often involve and impact upon businesses, airlines and government agencies operating at the airport. These are an important audience for environmental messages.* *Having a sustained and comprehensive environmental and community communications strategy is increasingly important to airports. There is a continual need to build reputation capital among stakeholders, in order to establish trust and ensure more balanced responses to future development proposals.* *A well-developed community relations strategy will also provide valuable operational assistance, both day-to-day in furthering an airport's environmental targets and programmes and also in response to emergency environmental situations such as a fuel spill.* *Being proactive with an environmental communications programme may assist the airport to avoid over-regulation by authorities that may not be aware of the environmental measures and projects already being undertaken.* *Communicating effectively will also allow a greater understanding of the issues facing an organization, and clarification of the real impact of an airport on the environment. Combating misperceptions by highlighting the actual facts is an important purpose of a communications strategy – too often rumours and gossip can become the only information source if not countered by factual and open communications from an airport.* *The most important element of a successful community relations strategy is trust.*

The audience must trust the information being presented. This trust develops over a long period and is built upon a culture of honesty and transparency. An airport should be actively engaged with its local community – the relationship cannot just be built when something is needed from them.

6.7.3 It is best to use a range of communications tools with residents affected by your airport.

Consultative or community liaison committees: *These can be established to provide a forum for interaction with the community. Often, these will include representation from the airport, major carriers, a Board of Airlines, the local or regional government and members of the community. These committees hold regular meetings where they are updated with airport news and given a chance to respond.*

A well-constructed consultation process: *If consultation needs to be undertaken with the community or affected people, the process for consultation should follow the lines of open and transparent good faith between the parties.*

Publications and community newsletters: *These are useful for keeping members of the community and other stakeholder groups informed is important. A number of airports publish community newsletters, or extend on-airport newsletters to neighbouring communities.*

Media relations: *Proactive relationships with the news media about all aspects of an airport's operations (including environmental) can provide a valuable insight to journalists.*

Environmental or sustainability report: *This should be published regularly (e.g. annually) providing a broad review of all environmental and sustainability issues at the airport including policies, goals and targets, progress in achieving these, Key Performance Indicators (KPI) and the like.*

Web site, noise hotlines and community relations telephone numbers: *the airport's website is a valuable resource centre for information for all stakeholder groups and a mechanism for feedback to the airport is important.*

Community involvement, open days and town hall meetings: *all provide important interaction opportunities with the local community and special interest groups.*

Intra-airport community relations and environmental programmes: *such as a cross-airport branded recycling scheme, car pooling programme or environmental events can help bring an airport community closer together, while highlighting important environmental goals. Work with other businesses, tenants and customers on-airport on programmes that can benefit everyone.*
Internal company communications: having a well-informed staff, many of whom may live in the surrounding area, is vital to the good operations of an airport company.

Education programmes: *schools are always looking for assistance with sports teams, events and fundraising drives. Airports provide a great learning opportunity across a number of curriculum areas and a good relationship with local schools can prove valuable, both for the schools and the airport community. Many of the students may have parents who work at the airport.*