**Subject:** FW: Transport Canada Regulations on Aerodrome land use planning
**Attachments:** tp1247e (Transport Canada Land Use).pdf

**From:** Derek Dougherty [redacted]
**Sent:** Friday, March 14, 2025 1:22 PM
**To:** cityclerk <cityclerk@princegeorge.ca>
**Cc:** Sabrina Angus [redacted]
**Subject:** Transport Canada Regulations on Aerodrome land use planning

You don't often get email from derek.dougherty@mnp.ca. Learn why this is important

Good afternoon, with regards to the proposed OCP amendments and previously sent information, I am forwarding on some technical materials from Transport Canada that support that land use consultation in and around the YXS lands. It is very important that language sufficient to bolster this relationship remain in the OCP, as it has in the past.

This publication describes not only the operational characteristics of aerodromes but also different types of land uses outside the aerodrome property boundary and recommends, where applicable, guidelines for those land uses in the vicinity of aerodromes. In addition, the source documents have been linked to further explain the technical aeronautical requirements.

I would also point out that several other OCPs (Richmond and Sydney to name a few) also contain very clear language on requiring consultation and cooperation with their respective airport.

Respectfully submitted,

Derek D. Dougherty
Board Chair,
Prince George Airport Authority

4141 Airport Road

TP1247E
2013/14

Transport Canada Transports Canada

# AVIATION
## Land Use In The Vicinity of Aerodromes

Ninth Edition

Canada

**Abstract**

This publication describes not only the operational characteristics of aerodromes but also different types of land uses outside the aerodrome property boundary and recommends, where applicable, guidelines for those land uses in the vicinity of aerodromes. In addition, the source documents have been linked to further explain the technical aeronautical requirements.

This publication was prepared by the Flight Standards division of the Standards Branch of the Civil Aviation Directorate of Transport Canada. Enquiries relating to the document's content and suggested amendments should be directed to:

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## Part I -- Introduction

This publication is designed to assist planners and legislators at all levels of government in becoming familiar with issues related to land use in the vicinity of aerodromes.

Municipal planners and developers must understand that how land is used around an aerodrome will have an impact on the aerodrome's operations. The land use around aerodromes can have significant impacts on safety at the aerodrome and can negatively impact the operational viability of the aerodrome to the detriment of the local community that depends upon it.

The compatible land use planning concept is an outgrowth of the focus of attention on the environmental relationship between aerodromes and their community neighbours. This planning concept is relatively simple and the results can be impressive, but the implementation requires careful study and co-ordinated planning.

Some community/aerodrome situations have reached the point where the effect of land use planning guidelines may be minimal. However, there are still instances where the use of these guidelines will result in more compatible aerodrome and community development. Implementation of this guidance may result in provincial/municipal legislation or bylaws for compatible land uses, easements or land zoning.

As new and non-traditional uses of land become more prevalent (e.g. windfarms), the public and aviation stakeholders have advanced concerns to Transport Canada over items that may be viewed as impediments to access or as safety items. The ninth edition of TP 1247 has been revised to address these issues.

Where units of measure are quoted in this document, the metric numbers are to be heeded as the equivalent imperial units are approximations only.

For the purposes of this document, where the word *aerodrome* is used, it includes certified aerodromes, non-certified aerodromes, heliports and water aerodromes; where the word *airport* is used, it specifically means certified aerodromes.

Enquiries relating to the application of these guidelines should be directed to the appropriate Regional Director Civil Aviation. Addresses for the Regional Civil Aviation officials are listed in Appendix A.

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**Transport Canada Land Use Role**

From a regulatory perspective, the authority for the designation of and control of the use of lands located outside of aerodrome property rests with provincial/municipal levels of government. The only exception to this fact, in the aviation case, occurs where an airport zoning regulation, made pursuant to the Aeronautics Act, is in force.

The Minister of Transport may exercise authority only over lands that are included in an Airport Zoning Regulation made pursuant to the Act. An Airport Zoning Regulation contains restrictive clauses that describe the activities and uses that are restricted or prohibited and contains a legal description of the lands to which it applies.

Restrictions and or prohibitions contained in a zoning regulation may range from limiting the height of structures to prohibiting specified land uses or to prohibiting facilities that may interfere with signals or communications to/from aircraft.

Airport zoning regulations cannot be made for non-certified aerodromes.

Individual zoning regulations are included in a listing of regulations made pursuant to the Aeronautics Act and may be found at the following internet address:

**http://www.tc.gc.ca/eng/acts-regulations/acts-1985ca-2.htm**

## Definitions

The following definitions are provided for the purposes of this document only;

**Airport:** An aerodrome for which, under Part III of the *Canadian Aviation Regulations*, an airport certificate has been issued by the Minister.

**Aerodrome:** Any area of land, water (including the frozen surface thereof) or other supporting surface used or designed, prepared, equipped or set apart for use either in whole or in part for the arrival, departure, movement or servicing of aircraft and includes any buildings, installations and equipment situated thereon or associated therewith.

***Note:*** *This definition of "Aerodrome" includes water aerodrome and heliports.*

**Aerodrome Reference Point:** The designated point or points on an aerodrome normally located near the geometric centre of the runway complex that:

(a) establishes the geographical location of an aerodrome for charting purposes, and
(b) establishes the locus of the radius or radii of the outer surface as defined in a Zoning Regulation.

**Graded Area:** An area surrounding the runway which is graded to a specified standard to minimize hazards to aircraft which may accidentally run off the runway surface.

**Heliport:** An aerodrome or a defined area on a structure intended to be used wholly or in part for the arrival, departure and surface movement of helicopters.

**Obstacle Limitation Surface:** A surface that establishes the limit to which objects may project into the airspace associated with an aerodrome consisting of the following; a takeoff surface, an approach surface, a transitional surface and an outer surface.

**Runway Strip:** A defined area including the runway, and stopway if provided, intended to reduce the risk of damage to aircraft running off a runway and to protect aircraft flying over it during takeoff or landing operations.

**Water Aerodrome:** means an aerodrome that uses an area of water, excluding the frozen surface of that area, for the arrival, departure, movement or servicing of aircraft.

## 1.1 General

This part will give the reader some insight into those aerodrome operational factors which can affect land uses outside the aerodrome property boundary. Each factor is considered separately and in enough detail to allow general planning conclusions to be drawn. It is important that any particular land use under consideration be judged from the point of view of all relevant factors. The referenced Manual for Part I is: Aerodrome Standards and Recommended Practices (TP 312E).

Obstacle Limitation Surfaces are established to ensure the required level of safety. These surfaces normally extend beyond the boundary of the aerodrome and therefore benefit from protection by the enactment of an Airport Zoning Regulation which will prohibit the erection of structures which would violate any of the defined plane surfaces.

Where enacted, zoning regulations apply to all the lands, including public road allowances, adjacent to or in the vicinity of an airport; the specific lands are described in the Schedule of the relevant airport zoning regulation. Lands within an airport boundary are therefore not included in an airport zoning regulation; however, all structures within an airport boundary must comply with obstacle limitation surface requirements, as stated in TP312 Aerodrome Standards and Recommended Practices.

For those airports at which an Airport Zoning Regulation has been enacted under the Aeronautics Act, details of the registered zoning plans are available from the Land Registry Office for the district within which the airport is located.

**Note: It is of the utmost importance to be aware that the proximity of obstacles, for example, wind turbines, telecommunications towers, antennae, smoke stacks, etc., may have an impact on the current and future usability of an aerodrome. Therefore, it is critical that planning and coordination of the siting of obstacles should be conducted in conjunction with an aerodrome operator at the earliest possible opportunity.**

## 1.2 Slopes and Surfaces

There are three types of surfaces in place at an aerodrome that should be protected to avoid penetration by objects or structures. Protection of these surfaces is done by limiting the height of structures, including appurtenances or objects on the ground, to heights that are less than that of the slope surface thereby avoiding penetration of that surface.

Airports that have an Airport Zoning Regulation have these surfaces protected by law and these zoning regulations apply to land that is located outside the property boundary of the airport. At aerodromes that do not have an Airport Zoning Regulation, the cooperation of adjacent communities is sought to obtain provincial/municipal zoning protection against development that would compromise the operational airspace, as defined by the description of these surfaces, around the aerodrome facility.

Where the facility is an airport, objects penetrating any of these surfaces may affect the operations of the airport and the certification status of the airport. Where the facility is a non-certified aerodrome, penetration of these surfaces may affect the operations at the aerodrome. Where the facility is a non-certified aerodrome, the standards in TP312 Aerodrome Standards and Recommended Practices can be used but are not enforceable; however, the operational integrity of the non-certified aerodrome is enhanced if the designation of the use of land adjacent to the facility is done in line with technical portions of the standards.

The three types of surfaces in place at an aerodrome are the outer surface, the takeoff /approach slope surface and the transitional surface as shown in Figure 1.

A complete description of the standards related to these surfaces may be accessed at the following website:

http://www.tc.gc.ca/eng/civilaviation/publications/tp312-menu-4765.htm

The following figure will assist the reader in developing a visual picture of the surfaces discussed above.

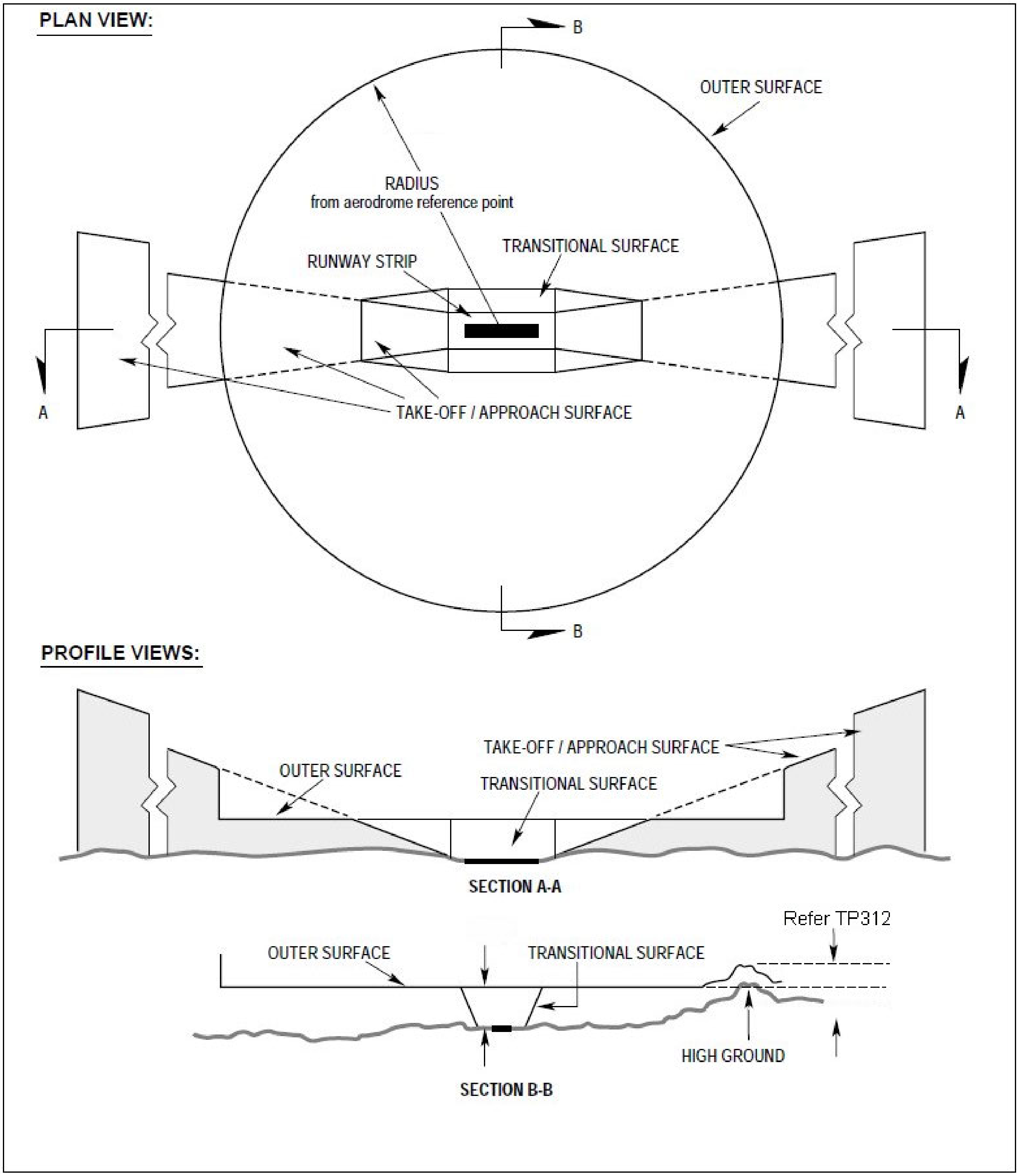


**Figure 1: Obstacle Limitation Surfaces**

### 1.3 Outer Surface

An outer surface shall be established where required for the protection of aircraft conducting a circling procedure or manoeuvring in the vicinity of an aerodrome. The outer surface establishes the height above which it may be necessary to rake one or more of the following actions:

(a) restrict the erection of new structures which would constitute an obstruction; or
(b) remove or mark obstacles to ensure a satisfactory level of safety and regularity for aircraft manoeuvring visually in the vicinity of the airport before commencing the final approach phase (See Figure 2).

#### 1.3.1 Dimensions of Outer Surface

Where an outer surface is established, it shall be as follows:

(a) a common plane established at a constant elevation of 45 m above the assigned elevation of the aerodrome reference point; and
(b) when the common plane described in paragraph (a) is less than 9 m above the surface of the ground, an imaginary surface shall be established at 9 m above the surface of the ground (See Figures 2 and 3).

***Note:*** *When the outer surface elevation cannot be held to 45 m, a semi-circular outer surface may be established permitting a circling procedure on one side of the runway. If this compromise solution is not possible, circling as part of an instrument approach procedure should not be recognized, thus eliminating the need for an outer surface.*

The outer surface measured from the designated aerodrome reference point or points, shall extend to a horizontal distance of at least:

(a) 4000 m is recommended where the code number is 1, 2 or 3.
(b) to be determined by an aeronautical study where the code number is 4, but never less than 4000 m.

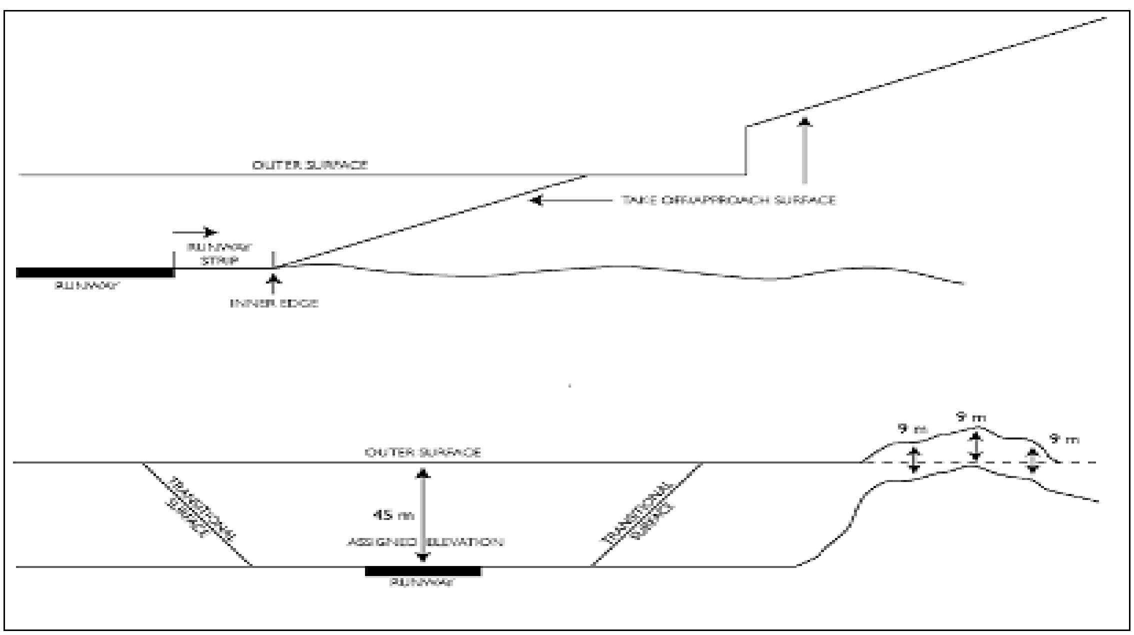


**Figure 2 – Obstacle Limitation Surface – Side View**

### 1.4 Take-Off/Approach Areas and Surfaces

#### 1.4.1 Delimination

They are established for each runway direction intended to be used for the take-off and landing of aircraft.

(a) An inner edge, perpendicular to the runway, begins at the end of the runway strip (normally 60 m from the runway threshold). The length of the inner edge is dependent on the strip width.
(b) Two sides originate at the ends of the inner edge and diverge uniformly at either 10% or 15% from the extended runway centre line (Note: See divergence minima information in paragraph 1.4.2).
(c) Final Width will be the product of the divergence and length of the area, and will be parallel to the inner edge.

#### 1.4.2 Dimensions of the Takeoff/Approach Areas and Surfaces

The dimensions of the takeoff/approach areas and surfaces shall be:

(a)

| **Precision Approach Runway - Category I and II** | |
|---|---|
| Length of inner edge | As per strip width |
| Divergence (min) | 15% |
| Length (min.) | 15 000 m |
| *Slope (max.) | Cat. II Runways, 2% where the code number is 3 or 4.<br>Cat. I Runways, 2% where the code number is 3 or 4.<br>Cat. I Runways, 2.5% where the code number is 1 or 2. |

* Where applicable, for new runways at major aerodromes the slope should be 1.66% for the first 3000 m and 2% thereafter for a total length of 15 000 m.

For the purposes of registered zoning, the takeoff approach surfaces of Code 3 and 4 Precision Approach Runways shall be defined by using slopes appropriate for a glide path extending for a maximum of 6 KM. If local terrain precludes the use of a glide path, then the lowest usable glide slope should be selected.

(b)

| **Non-Precision Approach Runway** | | | | |
|---|---|---|---|---|
| Code Number | 1 | 2 | 3 | 4 |
| Length of inner edge | As per strip width | | | |
| Divergence (min.) | 10% | 10% | 15% | 15% |
| Length (min.) | 2 500m | 2 500m | 3 000m | 3 000m |
| * Slope (max.) | 3.33% | 3.33% | 2.5% | 2.5% |

* Where practicable, the slope should be 2%.

(c)

| **Non-Instrument Runways** | | | | |
|---|---|---|---|---|
| Code Number | 1 | 2 | 3 | 4 |
| Length of inner edge | As per strip width | | | |
| Divergence (min.) | 10% | 10% | 10% | 10% |
| Length (min.) | 2 500m | 2 500m | 3 000m | 3 000m |
| Slope (max.) | 5% | 4% | 2.5% | 2.5% |

***Note:*** *The lengths given in (a), (b) and (c) above, are measured horizontally, unless otherwise specified. Regardless of the slope specifications in (a), (b) and (c) above, all objects considered by the certifying authority to be hazardous shall be marked and/or lighted.*

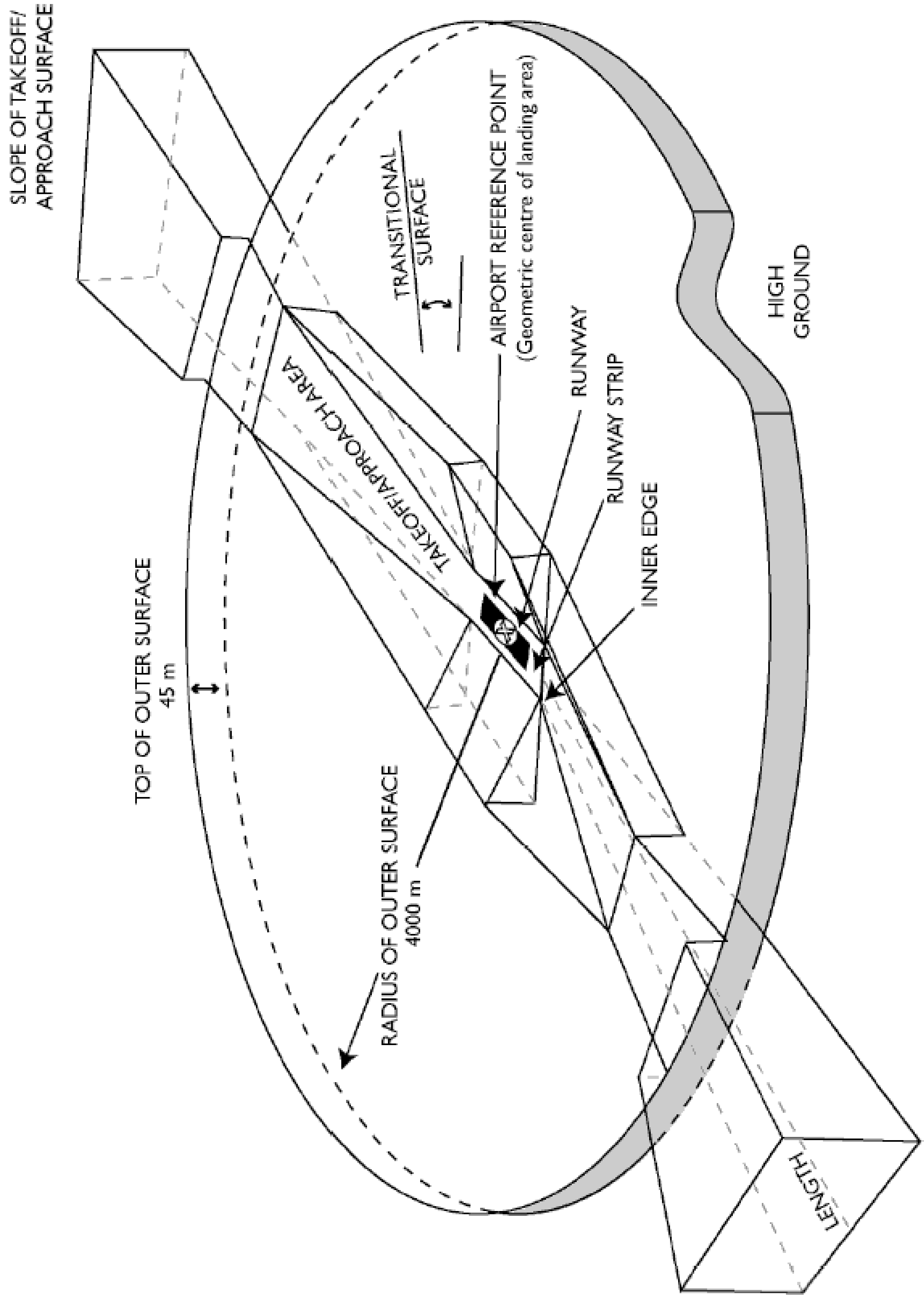


**Figure 3 – Obstacle Limitation Surfaces**

### 1.5 Transitional Surface

#### 1.5.1 Delimination

Transitional surface is a complex surface along the sides of the runway strip and pan of the approach surface that slopes up to the outer surface. Its purpose is to ensure the safety of aircraft at low altitudes displaced from the runway centre line in the approach or missed approach phase. The slope of a transitional surface measured in the vertical, perpendicular to the runway shall be:

- 14.3% for an Instrument runway and non-Instrument runways, Code 3 and 4
- 20.0% for non-Instrument runways, Code 1 and 2

Where topographical or natural obstructions make it economically unreasonable and in the opinion of the Certifying Authority, an equivalent level of safety will be achieved, the transitional surfaces for runways where the code number is 1 or 2, used in Visual Meteorological Conditions (VMC) may be steepened or eliminated provided the strip width is widened in accordance with the following:

| **Strip Width** | | | |
|---|---|---|---|
| Code Number | 90 m | 120 m | 150 m |
| 1. Transitional Surface | 33% | Vertical | Vertical |
| 2. Transitional Surface | 33% | 50% | Vertical |

***Note:*** *This is intended to provide relief for small aerodromes in mountainous regions, used in VMC, where river valleys, etc. are the only sites, available. At other locations an aeronautical study and Headquarters' approval is required before applying the above criteria.*

### 1.6 Width of Strip

#### 1.6.1 Dimensions of the Runway Strips

1. **Width of Strip - Instrument Runways**

   The runway strip shall extend the following distances each side of the centre line of the runway.

   **Precision Approach Runway**:

   1. 150 m where the code number is 3 or 4,
   2. 75 m where the code number is 1 or 2.

   **Non-Precision Approach Runway**:

   3. 150 m where the code number is 4,
   4. 75 m where the code number is 3,
   5. 45 m where the code number is 1 or 2.

2. **Width of Strip - Non-instrument Runways**

   Runway strips containing a non-instrument approach runway shall extend each side of the centre line as follows:

   1. 75 m where the code number is 4,
   2. 45 m where the code number is 3,
   3. 30 m where the code number is 1 or 2.

## Part II -- Telecommunications and Electronic Systems

### 2.1 General

The guidance contained in this part is aimed at protecting navigational aids, radars and telecommunications systems which include systems for civil, military, and environmental applications. Transport Canada approval of the location and/or construction of structures and facilities considered incompatible would only be required for structures located on lands to which an airport zoning regulation applies.

Local land use planners and those wishing to erect structures are encouraged to contact regional Transport Canada Civil Aviation offices for assistance in locating any nearby aerodromes and NavCanada for assistance in locating any potentially impacted radars, navigation aids or telecommunications facilities. Local planners and those wishing to erect structures are encouraged to consult with identified airport and aerodrome operators and NavCanada. NavCanada can be contacted at 1-866-577-0247 or by email at landuse@navcanada.ca.

The information contained in this part represents the criteria normally applicable for the protection of navigational aids, radars and telecommunications systems. More specific guidance on structures conforming to these values should be available from the owner of the radar, navigational aid or telecommunications system.

Planners should also be aware that, where airport zoning regulations are in effect, specific structures which contravene the values contained within said zoning regulations may sometimes be acceptable, provided that the applicant demonstrates by a technical analysis that such approvals will not cause harmful interference.

Consultation with the radar, navigational aid or telecommunication system owner should take place at an early stage in the project in order to avoid costly redesign or undue pressure when seeking building and site approvals. It is recommended that consultation take place at the building concept stage, before site approval is sought.

The radar, navigational aid or telecommunication system owner should ensure that full coordination takes place with aerodrome and local authorities where there is any air navigation system change that may impact local communities.

***Note:*** *The development and promulgation of the requirements for the protection of radar, navigational aid or telecommunication systems are the responsibility of the facility owner.*

### 2.2 Radar Systems

The radar coverage volume for all types of radar systems can be reduced by a structure blocking the transmit or receive signal path. The severity of this blockage is proportional to the size of the structure and varies according to its location.

The size and construction material of buildings and other structures can be controlled to ensure that the radar coverage volume is maintained and that the number of false targets detected is not increased.

False targets are usually a problem only with Air Traffic Control (ATC) Radar Systems (including military and weather radar systems). They are created by transmitted or received signals being reflected from structures. The magnitude of the reflection is proportional to the size of the structure and the electrical behaviour of the material used. Non-metallic materials can reduce the magnitude of the reflection.

The protection criteria presented in this section are provided for general guidance purposes only. For more precise criteria suitable to the location/structure being proposed, proponents should contact local aerodrome operators and/or the radar/navigation aid/communication systems owner.

### 2.2.1 Air Traffic Control (ATC), Air Defence or Military Radars

(a) Primary Surveillance Radar (PSR)

- (i) within 300 m of the radar site, no building or other structure should exceed a height of 5 m below the geodetic height of the antenna platform. The preference is to have no structure at all or to have trees surrounding the site.
- (ii) from 300 to 1,000 m from the radar site, the upper limit on the height of a structure is increased at a rate of approximately 0.007 m per metre. Thus, at a distance of 1,000 m from the site, the structure can be as high as the geodetic height of the antenna tower platform.
- (iii) beyond 1,000 m from the radar site, no site protection requirement is specified; however, it is preferable not to have any large structure exceeding 0.25° above the radar horizon. Large structures are defined as having an azimuth of more than 0.43°. The consequences of building such structures should be brought to the attention of the local land use authority responsible for approving the proposal for construction.

(b) Secondary Surveillance Radar (SSR)

The provisions given above for a Primary Radar System apply as well for an ATC Secondary Surveillance Radar System. In addition, all buildings or other structures within 1,000 m of the radar should be constructed with non-metallic materials having a low reflectivity at frequencies from 1.0 to 1.1 GHz.

(c) Precision Approach Radar (PAR)

Within 900 m of the approach area to a runway served by a Precision Approach Radar System, no reflecting objects (trees, buildings or other structures) are allowable.

(d) Airport Surface Detection Equipment Radar (ASDE)

No structure should be built that blocks the line-of-sight from the ASDE radar antenna to any runway, taxiway, intersection, etc., unless it is approved by the owner of the equipment. Any exception would have to demonstrate that the blockage would be operationally insignificant.

### 2.2.2 Weather Radar

No structures exceeding the height of the radar antenna should be built within a radius of 300 m of weather radars. Environment Canada is the entity responsible for siting weather radars in Canada. The owner or proponent of the structure is responsible for any coordination with Environment Canada.

## 2.3 VHF/UHF Radio Communication Systems

Metallic structures may cause reflection of communication signals. In cases where such structures are proposed to be constructed within 300 m of a VHF/UHF transmitter/receiver installation, consultation with the owner of the communications systems is recommended.

The protection criteria presented in this section are provided for general guidance purposes only. For more precise criteria suitable to the location/structure being proposed, proponents should contact local aerodrome operators and/or the radar/navigation aid/communication systems owner.

## 2.4 Navigational Aids

### 2.4.1 General

Although several different standardized types of navigational aids are used to support air navigation, they share the common characteristic that the navigation guidance is derived partially as a function of the direction from which the navigation signals are received. Any structure that causes unwanted reflections of guidance signals will cause some of those signals to be received from a different direction, altering the navigation guidance in a potentially hazardous way. For this reason, it is important to screen and assess any developments in the vicinity of navigational aids.

The protection criteria presented in this section are provided for general guidance purposes only. For more precise criteria suitable to the location/structure being proposed, proponents should contact local aerodrome operators and/or the navigational aid owner.

### 2.4.2 Non-Directional Beacons (NDB)

The following types of structures should be assessed prior to construction to determine the potential impact on navigation signals from an NDB:

(a) All proposed structures within 200 m of an NDB antenna; and
(b) All proposed steel towers, power lines, metal buildings, etc., within 1,000 m of an NDB antenna, for which the subtended vertical angle measured from the base of the NDB antenna structure exceeds 3°.

### 2.4.3 VHF Direction Finding Systems (VHF/DF)

Siting requirements for VHF/DF are of major importance. In particular, the equipment requires that:

(a) within 45 m of the antenna: ground to be level ±1º and surface roughness ±30 cm
(b) within 90 m of the antenna: ground to be clear of trees, masts, metal fences and vehicles.
(c) within 180 m of the antenna: ground to be clear of buildings, car parks and small metal structures.
(d) within 365 m of the antenna: ground to be clear of built-up areas, hangars, railways and other metallic structures.

In general, a clear line-of-sight should be maintained between the antenna system and local flying aircraft.

The VHF/DF antenna should be separated from any VHF air/ground communication (transmitting) antenna to the greatest extent practical, but by at least 2 km, and be separated from any antenna transmitting a high power broadcast by at least 8 km.

### 2.4.4 VHF Omni-Directional Range (VOR)

For standard VOR facilities, the following constraints should be applied to maintain the required accuracy of navigation signals:

(a) Within 300 m radius of the VOR antenna array, the area should be clear of trees, fences, wire lines, structures, machinery or buildings;
(b) Within 600 m radius of the VOR antenna array, structures and buildings having large metal content, wire lines and fences should not subtend a vertical angle of more than 1.2° or extend above the horizontal plane as measured from the array centre, except that the subtended vertical angle may be increased by 50% for fences or lines which are essentially radial or which subtend an angle of not more than 0.2° measured in the horizontal plane;
(c) Within 600 m radius of the VOR antenna array, wooden structures or buildings with negligible metallic content should not subtend a vertical angle of more than 2.5°; and
(d) Outside of 600 m radius of the VOR antenna, proposed large continuous metallic objects such as overhead power lines, masts, water towers or large metal-clad buildings which will penetrate beyond above the horizontal plane as measured from the array centre, or which will subtend a vertical angle of more than 1.2°, should be assessed prior to construction to determine the potential impact on VOR navigation signals.

The above criteria for standard VOR also apply to Doppler-type VOR facilities, except that the radius of 300 m may be reduced to 150 m, and the radius of 600 m may be reduced to 300 m.

### 2.4.5 Distance Measuring Equipment (DME)

DME may be installed as a stand-alone facility, or may be collocated with a VOR or ILS facility.

The following types of structures should be assessed prior to construction to determine the potential impact on navigation signals from a DME:

(a) All proposed structures within 150 m of a DME antenna; and
(b) All proposed steel towers, power lines, metal buildings, etc., within 3,000 m of a DME antenna, for which the subtended angle of elevation measured from the base of the DME antenna structure exceeds 1°.

**2.4.6 Tactical Air Navigation System (TACAN and VORTAC)**

TACAN is a military navigational aid whose functions are similar to those of a combined VOR and DME. TACAN may be installed as a stand-alone facility, or may be co-located with a VOR (VORTAC). Criteria outlined above for VOR and DME are applicable to TACAN.

**2.4.7 Instrument Landing Systems (ILS)**

An ILS supporting operations to a given runway generally consists of two complementary components: a localizer transmitter installed near the stop end of the runway and a glide path transmitter installed alongside the runway roughly 300 m from the beginning of the runway.

ILS supports all-weather precision approach and landing operations. To maintain the safety of landing aircraft, it is critical that the accuracy of ILS navigation signals not be compromised by unwanted reflections or interference.

The most significant sources of interference for ILS facilities are metallic objects having appreciable horizontal dimensions such as structural steel towers, metal-clad buildings and power/telephone transmission lines. These objects may reflect the ILS signals in unwanted directions, distorting the information provided to aircraft. Planners involved in siting and approval of these sources of interference should contact the ILS facility owner. For planning purposes, all runways should be considered to be equipped with an ILS at each end.

Any proposed structure on or in the vicinity of an aerodrome should be subjected to a detailed assessment for possible interference to ILS facilities unless it falls outside the Building Restricted Area (BRA) surfaces for ILS as defined in the document, European Guidance Material on Managing Building Restricted Areas[1]. (Buildings within the ILS building restricted area are often acceptable after a detailed assessment. In some cases, measures such as appropriate orientation of the building, shape of reflecting surfaces, etc. can significantly reduce the impact on ILS navigation signals.)

Some ILS localizers provide “back course” approach navigation guidance to the reciprocal end of the runway. For these localizers, the applicable restrictions apply in both directions from the antenna array.

High voltage power lines and substations radiate Electromagnetic Noise (EMN). In addition, EMN radiated by Industrial-Scientific-Medical (ISM) apparatus may inhibit reliable reception of ILS signals. Power lines and substations should be designed, constructed and maintained using state of the art techniques to minimize radiated EMN in the ILS frequency bands. In general, the following should be avoided:

(a) power lines with voltages greater than 100 kV that are closer than 1.8 km from the runway centre line and closer than 3.2 km from the ends of the runway;
(b) AC electrical substations for voltages greater than 100 kV that are closer than 3.2 km from the centre line of the runway and closer than 16 km from the ends of the runway;
(c) ISM apparatus operating within the rectangular area extending 1.5 km on either side of the centre line of the runway to the outer markers.

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[1] International Civil Aviation Organization (ICAO) European and North Atlantic Office:
ICAO EUR DOC 015, European Guidance Material on Managing Building Restricted Areas, Second Edition (2009)

## Part III -- Bird Hazards and Wildlife

### 3.1 General

In its many civil aviation responsibilities, Transport Canada remains focused sharply on the safety of air travelers. This focus has led the department to examine numerous potential hazards, including those found on and in areas around Canadian aerodromes.

Working with industry experts, and based on extensive international scientific research, Transport Canada has confirmed that these hazards include many forms of wildlife, from birds and deer which are often struck by aircraft, to smaller prey animals that attract more hazardous species. Wildlife of all types can be hazardous to aircraft because they can cause structural or engine damage. The hazard is greatest at and in the vicinity of aerodromes due to the concentration of aircraft activity close to the ground, where the majority of wildlife lives. In addition, aircraft involved in takeoffs or landings are at low altitudes and in a critical phase of flight where any disruptions to the operation could be catastrophic.

The presence of birds at or near aerodromes presents particular hazards. Aerodromes are naturally attractive areas to many species of birds because the wide open, short grass areas provide the basic elements of security from predators and humans, a place to nest and loaf (just generally sit about) and access to food and water sources. Wildlife Management programs at aerodromes effectively reduce this natural attraction of birds to aerodrome lands, primarily through major habitat management and manipulation projects, as well as through day to day vigilance and the use of bird scaring techniques. While these on aerodrome activities are effective, they can be neutralized by the presence of attractive land use or activities outside the aerodrome boundary. Hazardous bird species will be persistent in their attempts to use the aerodrome as a convenient stop over and resting place before or after feeding at a nearby location. It is therefore important that land in the surrounding area be used in a manner that is compatible with the wildlife control measures in use on the aerodrome, to minimize the attraction to birds and other potentially hazardous species.

Wildlife respects no boundaries, physical or regulatory, and often congregates in and passes through air-traffic corridors, such as take-off, departure, approach and landing areas. The result is risk to aircraft and air travelers that can be minimized when aerodrome area stakeholders work together and systematically integrate their efforts to:

- identify wildlife hazards and risks;
- plan, coordinate and implement management and mitigation measures; and
- measure results.

These activities can prevent lands in the vicinity from being used or developed in a manner that is incompatible with the safe operation of aircraft due to hazardous wildlife activity.

The following information provides guidance on the acceptability of different land use practices in the vicinity of aerodromes. General land use practices have been evaluated on their relative attractiveness to traditionally hazardous bird species.

***Note:*** *Where land in the vicinity of aerodromes is targeted for development, local land use authorities should consult a wildlife/bird hazard specialist to identify and address any issues relative to attractant and habitat concerns prior to approval of the development.*

### 3.2 Hazardous Land-use Acceptability

Not all potentially hazardous activities possess the same level of potential risk and cannot be treated equally when planning land uses in the vicinity of an aerodrome. The acceptability of land use activities can be classified using specific zones created around the aerodrome property, as defined in *Safety Above All* - http://www.tc.gc.ca/eng/civilaviation/publications/tp8240-awmb38-appendix-a-5031.htm.

**Primary Hazard Zones** generally enclose airspace in which aircraft are at or below altitudes of 1500 feet AGL (above ground level). These are the altitudes most populated by hazardous birds, and at which collisions with birds have the potential to result in the greatest damage.

**Secondary Hazard Zones** (4km beyond the Primary Hazard Zone) are buffers that account for:

- variables in pilot behaviour and technique;
- variations in departure and arrival paths that are influenced by environmental conditions, ATC (air traffic control) requirements, IFR versus VFR flight, etc.; and
- unpredictability of bird behaviour, and variations in bird movements around specific land uses.

**Special Hazard Zones**, though often distant from aerodromes, may regularly attract potentially hazardous species across primary or secondary zones.

**Table 1. Hazardous land-use acceptability by hazard zone**

| LEVEL OF RISK | LAND USE | LAND-USE ACCEPTABILITY BY ZONE | | |
|---|---|---|---|---|
| | | Primary | Secondary | Special |
| Potentially High | Putrescible waste landfills | No | No | No |
| | Food waste hog farms | No | No | No |
| | Fish processing/packing plants | No | No | No |
| | Horse racetracks | No | No | No |
| | Wildlife refuges | No | No | No |
| | Waterfowl feeding stations | No | No | No |
| Potentially Moderate | Open or partially enclosed waste transfer stations | No | No | Yes |
| | Cattle paddocks | No | No | Yes |
| | Poultry factory farms | No | No | Yes |
| | Sewage lagoons | No | No | Yes |
| | Marinas/fishing boats/fish cleaning facilities | No | No | Yes |
| | Golf courses | No | No | Yes |
| | Municipal parks | No | No | Yes |
| | Picnic areas | No | No | Yes |
| Potentially Low | Dry waste landfills | No | Yes | Yes |
| | Enclosed waste transfer facility | No | Yes | Yes |
| | Wet/dry recycling facility | No | Yes | Yes |
| | Marshes, swamps & mudflats | No | Yes | Yes |
| | Stormwater management ponds | No | Yes | Yes |
| | Plowing/cultivating/haying | No | Yes | Yes |
| | Commercial shopping mall/plazas | No | Yes | Yes |
| | Fast food restaurants | No | Yes | Yes |
| | Outdoor restaurants | No | Yes | Yes |
| | School yards | No | Yes | Yes |
| | Community & recreation centers | No | Yes | Yes |
| Potentially Limited | Vegetative compost facilities | Yes | Yes | Yes |
| | Natural habitats | Yes | Yes | Yes |
| | Inactive agricultural fields | Yes | Yes | Yes |
| | Inactive hay fields | Yes | Yes | Yes |
| | Rural ornamental & farm ponds | Yes | Yes | Yes |
| | Residential areas | Yes | Yes | Yes |

Land-use acceptability is site sensitive, and can be determined only through detailed assessments of each aerodrome and its surroundings. The table indicates general land-use suitability in primary, secondary and special hazard zones.

Although the table lists discreet categories, land-use suitability is dynamic and subject to change based on a variety of factors, including seasonal considerations and the range of activities that may be associated with a specific site. For example, agricultural fields can be classified as posing limited risk as long as they remain inactive. The moment cultivation begins; the degree of risk escalates, since the turning of soil, seeding, etc., increase the attraction to wildlife.

Risk may also escalate incrementally due to concentrations of land uses. For example, a golf course's attractiveness to birds may increase if the facility is bordered by a storm water management pond, marsh or agricultural operation.

Finally, it's important to note that risks associated with many land uses can be reduced through appropriate mitigation and monitoring. The acceptability of a commercial shopping plaza in a primary hazard zone, for example, would depend on the effectiveness of facility design-or the property owner's active, calculated interventions-to minimize the operation's attractiveness to potentially hazardous bird species.

For remedial actions please consult the Wildlife Control Procedures Manual (TP 11500) available at the following website:

http://www.tc.gc.ca/eng/civilaviation/publications/tp11500-menu-1630.htm

The information contained here provides a brief explanation and appreciation of the compatibility issues between aerodromes and wildlife. Land use planners are invited to obtain more details by accessing the following website:

http://www.tc.gc.ca/eng/civilaviation/publications/tp8240-awmb38-appendix-a-5031.htm

## Part IV -- Aircraft Noise

### 4.1 General

An assessment of the annoyance resulting from exposure to aircraft noise is often essential to both aviation planners and those responsible for directing the nature of development of lands adjacent to aerodromes. This section will discuss noise measurement, annoyance prediction, the Noise Exposure Forecast and the Noise Exposure Projection. It also contains an assessment of various land uses in terms of their compatibility with aircraft noise.

#### 4.1.1 Noise Measurement

The sound pressure level created by an aircraft (or any other noise source) can be measured by means of a sound level meter. The microphone of the sound level meter senses the pressure fluctuations over a short period of time. The sound pressure is the root mean square value of the difference between atmospheric pressure and the instantaneous pressure of the sound, the mean being read over several periodic cycles. For mathematical convenience, the logarithmic parameter called sound pressure level (SPL) is used. The unit of sound (noise) measurement is the decibel (dB).

A particular sound signal may comprise several different frequencies to which the human ear may respond in various ways. In order that noise measurements may relate more closely to loudness as judged by the average person, sound level meters are equipped with weighting networks which make use of information related to the frequency response characteristics of the human ear. Some sound level meters have the capability of reading on A, B, C, and D weighting scales, and decibel values are correspondingly indicated as dB(A), dB(B), dB(C) or dB(D), according to the weighting network used. However, the dB(A) is the most common.

The noise metric known as Perceived Noise Level (PNL), measured in the unit PNdB, provides a frequency weighting system which attempts to more closely approximate the subjective reaction of the human ear to an aircraft noise stimulus. Although weighting networks are available which provide a means of directly measuring approximate PNL values, i.e., dB(D), true PNL values are determined by the analysis and treatment of sound pressure levels in various 1/3 octave bands.

A more sophisticated noise metric, the Effective Perceived Noise Level (EPNL), expressed in the unit EPNdB, was developed specifically for use in the measurement of aircraft noise. The EPNdB is the metric that forms the basis of noise certification of aircraft. This metric is basically similar to the PNL except that corrections have been applied to account for the effects of discrete tones and the duration of the noise event, i.e., factors which contribute to the annoyance of the listener.

#### 4.1.2 Predicting Annoyance

In addition to the annoying characteristics of an individual noise signal, overall subjective reaction to noise is dependent on the number of times the disturbance occurs as well as the daily distribution of these events. These factors must be included in any noise forecasting system if it is to be applicable to the communities located in the vicinity of aerodromes. The Noise Exposure Forecast (NEF) system made available by Transport Canada takes into consideration all of these factors.

The NEF system provides for the summation of noise from all aircraft types operating at an aerodrome based on actual or forecast aircraft movements by runways and the time of day or night the events occur. The large number of mathematical calculations necessary for the construction of NEF contours requires the use of computer techniques for the practical application of this system.

#### 4.1.3 The Noise Exposure Forecast System (NEF)

The Effective Perceived Noise Level is the basis for estimating noise annoyance in the Noise Exposure Forecast system.

The data required for determining NEF contours consist of EPNL versus distance information for various aircraft types, along with generalized aircraft performance data. In calculating NEF at a specific location, the EPNL contribution from each aircraft operating from each runway is assessed by considering the distance from the point in question to the aircraft, and then obtaining EPNL values from the appropriate EPNL versus distance curve. The noise contributions from all aircraft types operating on all runways are summed on an anti-logarithmic basis to obtain the total noise exposure at that one location. Thus, the determination of NEF contours is strictly a numerical calculation procedure. As stated previously, due to the large number of mathematical calculations involved, computer techniques provide the only practical means of constructing NEF contours.[2]

### 4.2 Production of Noise Contours - Aerodromes That Are Neither Owned Nor Operated and Managed by Transport Canada

The preparation and approval of noise contours for aerodromes that are neither owned, nor operated and managed by the Federal Government is not a responsibility of Transport Canada. Transport Canada will conduct a technical review of an NEF, NEP or Planning Contour if requested by the sponsoring aerodrome operator or airport authority provided that:

(a) the Aerodrome owner or operator initiates this action;
(b) the Aerodrome owner or operator supplies or approves a projection of aircraft traffic, both as to type and numbers; and
(c) the Aerodrome owner or operator uses the noise impact prediction methods, procedures and recommended practices relating to aircraft operations as established by Transport Canada.

[2] Kingston, Beaton and Rohr, A Description of the CNR and NEF Systems for Estimating Aircraft Noise Annoyance (R-71-20), Department of Transport, 1971

### 4.3 Noise Exposure Contours

There are three types of noise exposure contours produced depending on the time element involved. These are Noise Exposure Forecasts (NEFs), Noise Exposure Projections (NEPs) and Planning Contours. Transport Canada may provide, upon request from a sponsoring aerodrome operator or airport authority, a technical review of any contours calculated to determine if the NEF computer model has performed accurately and has been applied correctly.

#### 4.3.1 Noise Exposure Forecast (NEF)

The Noise Exposure Forecast (NEF) is produced to encourage compatible land use planning in the vicinity of aerodromes. Traffic volume and aircraft type and mix used in calculating the noise contours are normally forecast for a period of between five and ten years into the future (See NOTE). Runway geometry should be the current layout plus any changes forecast to be completed prior to the end of the forecast period. Noise contours (NEFs, NEPs and Planning Contours) are the property of the sponsoring aerodrome operator or airport authority which may be make them available to provincial and local governments. The use of the contours will enable planners to define compatible land use in the vicinity of aerodromes.

***Note:*** *Transport Canada does not retain copies of NEFs and NEPs submitted to it for technical review. Upon completion of the review, all materials submitted are returned to the sponsoring aerodrome operator or airport authority. These materials are the property of the sponsoring aerodrome operator or airport authority.*

Transport Canada does not support or advocate incompatible land use (especially residential housing) in areas affected by aircraft noise. These areas may begin as low as NEF 25. At NEF 30, speech interference and annoyance caused by aircraft noise are, on average, established and growing. By NEF 35 these effects are very significant. New residential development is therefore not compatible with NEF 30 and above, and recommends that it not be undertaken.

#### 4.3.2 Noise Exposure Projection (NEP)

It is recognized that much land use planning involves projections beyond five years into the future, when aircraft fleet mixes and runway configurations are most likely to be different from the known conditions of today. To provide provincial and municipal authorities with long range guidance in land use planning, Transport Canada introduced the Noise Exposure Projection (NEP). The NEP is based on a projection (not a forecast) of aircraft movements for more than 10 years into the future, and includes aircraft types and runway configurations that may materialize within this period. NEPs may be made available in the same manner as NEFs.

#### 4.3.3 Planning Contour

The third type of noise contour is the Planning Contour which is produced to investigate planning alternatives and should be labelled as such. In the same manner as NEFs and NEPs, these contours are the property of the sponsoring aerodrome operator or airport authority.

### 4.4 Production of Noise Contours: DND Aerodromes

Production of noise contours for aerodromes used solely by the Department of National Defence (DND) is the responsibility of DND as to data input and production. Production of Noise contours for DND owned joint use aerodromes with a civilian airport authority is the responsibility of DND as to data input and production. When requested, these contours will be published subject to Commander, Canadian Air Division (1CAD)'s approval of the accuracy of the contours.

### 4.5 Noise Contour Maps

It may be necessary for computer-produced contour lines to be mechanically smoothed to remove irregularities that arise in the plotting process. This should be done particularly in areas of sharp corners or tips. The convention used for depicting the NEF and NEP 40, 35 and 30 contours on maps is a solid line. The printing and any subsequent distribution of contour maps is not the responsibility of Transport Canada. These functions may be undertaken by the sponsoring aerodrome operator or airport authority as they are the property of the aerodrome.

### 4.6 Community Response to Noise

During developmental work on preliminary noise rating systems, it was established that community response to aircraft noise correlated well with the noise contours then in use. Case histories of noise complaints at twenty-one aerodromes were analyzed as to severity, frequency of complaint, and distribution around the aerodromes to establish a relationship with known noise values. The results of this work, which may be found in Table 1 (see below) have been used for relating land use recommendations to NEF contour levels.

The analysis of the effect of aircraft noise on various working and living environments is a complex matter. For each case where there is a note in the Land Use Tables (Table 2) (see below) it is desirable that a noise climate analysis or a noise reduction requirement analysis be undertaken, since each note indicates a particular specialized problem. Many of the factors that would be considered in such analyses are subject to changing technology. Also, the attitudes of those exposed to the noise environment are subjective and varied. Since these factors evolve, authorities undertaking analyses of noise climates and noise reduction requirements in buildings should consult using most recent information with agencies conducting these reviews. The National Research Council has undertaken work in this area and validated the results of the NEF System and interpretation of noise exposure areas in 1996.

#### 4.6.1 New Aerodromes and Community Response to Noise

For the purposes of this section, "*New Aerodrome*" means any land designated by the Governor in Council as an "*Airport Site*" under the Aeronautics Act after January 1, 2001.

Where an aerodrome is already surrounded by residential or other noise sensitive land uses, the intent of land use planning guidelines is to prevent any increases in incompatible land use. As urbanization increases, any new aerodrome would, by necessity, be planned for and built in non-urban areas. Therefore, where a new aerodrome is planned on land designated as an airport site, an opportunity exists to establish appropriate land use planning guidelines that recognize the unique noise environment of a non-urban area and preserve the balance between the integrity of the future aerodrome and the quality of life of the community that it will serve.

The encroachment of incompatible, sensitive land uses is clearly a vital factor in planning and establishing appropriate protection criteria for new aerodromes. The best and often only opportunity to establish a sufficient buffer zone to control noise sensitive development around a new aerodrome is in the initial planning stage of that new aerodrome. This opportunity diminishes quickly as the aerodrome develops and community land use patterns become established.

In addition to the traditional approach of defining land use planning guidelines, pertinent factors considered in a study of land use guidelines for new aerodromes included not only individual activity interference (speech and sleep) criteria, but also habituation to noise, the type of environment (non-urban versus urban environment), community attitudes toward the noise source, the extent of prior exposure to the noise source, and the type of flight operations causing the noise.

For new aerodromes, Transport Canada recommends that no new noise sensitive land uses be permitted above 25 NEF/NEP. Noise sensitive land uses include residential, schools, day care centres, nursing homes and hospitals. This approach is the single most practical for reasons of ease of implementation and administration since below this threshold, all noise-sensitive land uses would be permitted without restrictions or limitations. The guidelines for all other land uses remain unchanged from Table 2. This buffer would also offer protection against the long term uncertainties inherent in planning for a new aerodrome.

To implement this NEF 25 criterion, NEF and NEP maps for new aerodromes must depict the 25 contour as a solid line in addition to the noise contour requirements set out in Section 4.5.

### 4.7 Recommended Noise Control Action

For a specific noise problem, Table 3 (see below) may be used to select different actions.

### 4.8 Recommended Practices

NEF/NEP contours should be used in conjunction with these guidelines to encourage compatible land use in the vicinity of aerodromes. Therefore, it is recommended that contours be distributed by aerodrome operators or airport authorities to the officials and organizations responsible for land use and municipal zoning of the affected land. This would normally include both provincial and municipal planners, and zoning boards.

**Table 1 - Community Response Prediction**

| Response Area | Response Prediction * |
|---|---|
| 1 (over 40 NEF) | Repeated and vigorous individual complaints are likely. Concerted group and legal action might be expected. |
| 2 (35-40 NEF) | Individual complaints may be vigorous. Possible group action and appeals to authorities. |
| 3 (30-35 NEF) | Sporadic to repeated individual complaints. Group action is possible. |
| 4 (below 30 NEF) | Sporadic complaints may occur. Noise may interfere occasionally with certain activities of the resident. |
| * It should be noted that the above community response predictions are generalizations based upon experience resulting from the evolutionary development of various noise exposure units used by other countries. For specific locations, the above response areas may vary somewhat in accordance with existing ambient or background noise levels and prevailing social, economic and political conditions. | |

**Table 2 - Land Use Tables - Aircraft Noise Considerations Only**

This land use tabulation should not be considered as an exhaustive listing, but merely as examples of how various land uses would be assessed in the Noise Exposure Forecast zones in terms of community response predictions.

| | |
|---|---|
| NO | Indicates that new construction or development of this nature should not be undertaken. |
| NO | Indicates that new construction or development of this nature should not be undertaken. See Explanatory Note B. |
| A | This particular land use may be acceptable in accordance with the appropriate note and subject to the limitations indicated therein. |
| YES | The indicated land use is not considered to be adversely affected by aircraft noise and no special noise insulation should be required for new construction or development of this nature. |

**The land uses contained in the following tables are included for compatibility purposes from a noise perspective only. Caution should be exercised as some of the recommended uses may not be optimal from a safety perspective (i.e bird and wildlife habitat)**

**Table 2A - Residential**

| **Noise Exposure Forecast Values** | > 40 | 40-35 | 35-30 | < 30 |
|---|---|---|---|---|
| **Response Areas** | 1 | 2 | 3 | 4 |
| Detached, Semi-Detached | NO | NO | NO | A |
| Town Houses, Garden Homes | NO | NO | NO | A |
| Apartments | NO | NO | NO | A |

**Table 2B- Recreational - Outdoor**

| Noise Exposure Forecast Values | >40 | 40-35 | 35-30 | < 30 |
|---|---|---|---|---|
| **Response Areas** | 1 | 2 | 3 | 4 |
| Athletic Fields | NO | J | K | YES |
| Stadiums | NO | NO | K | YES |
| Theatres - Outdoor | NO | NO | NO | H |
| Racetracks - Horses | NO | K | K | YES |
| Racetracks - Autos | YES | YES | YES | YES |
| Fairgrounds | K | K | YES | YES |
| Golf Courses | YES | YES | YES | YES |
| Beaches and Pools | YES | YES | YES | YES |
| Tennis Courts | NO | K | YES | YES |
| Playgrounds | K | K | YES | YES |
| Marinas | YES | YES | YES | YES |
| Camping Grounds | NO | NO | NO | NO |
| Park and Picnic Areas | NO | K | YES | YES |

**Table 2C - Commercial**

| Noise Exposure Forecast Values | >40 | 40-35 | 35-30 | < 30 |
|---|---|---|---|---|
| **Response Areas** | 1 | 2 | 3 | 4 |
| Offices | F | E | D | YES |
| Retail Sales | F | D | YES | YES |
| Restaurants | F | D | D | YES |
| Indoor Theatres | NO | G | D | YES |
| Hotels and Motels | NO | F | G | YES |
| Parking Lots | YES | YES | YES | YES |
| Gasoline Stations | YES | YES | YES | YES |
| Warehouses | YES | YES | YES | YES |
| Outdoor Sales | E | K | YES | YES |

**Table 2D - Public**

| Noise Exposure Forecast Values | >40 | 40-35 | 35-30 | < 30 |
|---|---|---|---|---|
| **Response Areas** | 1 | 2 | 3 | 4 |
| Schools | NO | NO | D | C |
| Churches | NO | NO | D | C |
| Hospitals | NO | NO | D | C |
| Nursing Homes | NO | NO | D | C |
| Auditoriums | NO | NO | D | C |
| Libraries | NO | NO | D | C |
| Community Centres | NO | NO | D | C |
| Cemeteries | N | N | N | N |

**Table 2E - Municipal Utilities**

| Noise Exposure Forecast Values | >40 | 40-35 | 35-30 | < 30 |
|---|---|---|---|---|
| **Response Areas** | 1 | 2 | 3 | 4 |
| Electric Generating Plants | YES | YES | YES | YES |
| Gas & Oil Storage | YES | YES | YES | YES |
| Garbage Disposal | YES | YES | YES | YES |
| Sewage Treatment | YES | YES | YES | YES |
| Water Treatment | YES | YES | YES | YES |
| Water Storage | YES | YES | YES | YES |

**Table 2F - Industrial**

| Noise Exposure Forecast Values | >40 | 40-35 | 35-30 | < 30 |
|---|---|---|---|---|
| **Response Areas** | 1 | 2 | 3 | 4 |
| Factories | I | I | YES | YES |
| Machine Shops | I | I | YES | YES |
| Rail Yards | YES | YES | YES | YES |
| Ship Yards | YES | YES | YES | YES |
| Cement Plants | I | I | YES | YES |
| Quarries | YES | YES | YES | YES |
| Refineries | I | I | YES | YES |
| Laboratories | NO | D | YES | YES |
| Lumber Yards | YES | YES | YES | YES |
| Saw Mills | I | I | YES | YES |

**Table 2G - Transportation**

| Noise Exposure Forecast Values | >40 | 40-35 | 35-30 | < 30 |
|---|---|---|---|---|
| **Response Areas** | 1 | 2 | 3 | 4 |
| Highways | YES | YES | YES | YES |
| Railroads | YES | YES | YES | YES |
| Shipping Terminals | YES | YES | YES | YES |
| Passenger Terminals | D | YES | YES | YES |

**Table 2H - Agriculture**

| Noise Exposure Forecast Values | >40 | 40-35 | 35-30 | < 30 |
|---|---|---|---|---|
| **Response Areas** | 1 | 2 | 3 | 4 |
| Crop Farms | YES | YES | YES | YES |
| Market Gardens | YES | YES | YES | YES |
| Plant Nurseries | YES | YES | YES | YES |
| Tree Farms | D | YES | YES | YES |
| Livestock Pastures | M | YES | YES | YES |
| Poultry Farms | L | L | YES | YES |
| Stockyards | M | YES | YES | YES |
| Dairy Farms | M | YES | YES | YES |
| Feed Lots | M | YES | YES | YES |
| Fur Farms | K | K | K | K |

**Explanatory Notes for Table 2**

The location of the lines between noise zones cannot be fixed exactly. It will therefore be necessary for the responsible public authority to make an appropriate interpretation of what regulations are to apply at a specific location.

In cases where reference is made to a detailed on-site noise analysis, or to peak noise levels, it will be appreciated that the notes are intended to apply specifically at existing aerodromes, where a field assessment is possible. For planning with respect to new aerodromes, such zones should be considered cautionary. Before reaching a final decision with respect to permitting the particular land-use in question, the authority may wish to consider local topographic effects and ambient noise levels, in conjunction with generalized peak noise level "footprints" for the predominant aircraft types to be using the newaerodrome.

| | |
|---|---|
| A | Annoyance caused by aircraft noise may begin as low as NEF 25. It is recommended that developers be made aware of this fact and that they undertake to so inform all prospective tenants or purchasers of residential units. In addition, it is suggested that development should not proceed until the responsible authority is satisfied that acoustic insulation features, if required, have been considered in the building design. [2] |
| B | (b) This Note applies to NEF 30 to 35 only. New residential construction or development should not be undertaken. If the responsible authority chooses to proceed contrary to Transport Canada's recommendation, residential construction or development between NEF 30 and 35 should not be permitted to proceed until the responsible authority is satisfied that:<br>(1) appropriate acoustic insulation features have been considered in the building and<br>(2) a noise impact assessment study has been completed and shows that this construction or development is not incompatible with aircraft noise.<br>Notwithstanding point 2, the developer should still be required to inform all prospective tenants or purchasers of residential units that speech interference and annoyance caused by aircraft noise are, on average, established and growing at NEF 30 and are very significant by NEF 35. |
| C | These facilities should not be located close to the 30-NEF contour unless the restrictions outlined in Note D below are applied. |
| D | These uses should not be approved unless a detailed noise analysis is conducted and the required noise insulation features are considered by the architectural consultant responsible for the building design. |
| E | When associated with a permitted land use, an office may be located in this zone provided that all relevant actors are considered and a detailed noise analysis is conducted to establish the noise reduction features required to provide an indoor environment suited to the specific office function. |
| F | It is recommended that this specific land use should be permitted only if related directly to aviation-oriented activities or services. Conventional construction will generally be inadequate and special noise insulation features should be included in the building design. |
| G | Generally, these facilities should not be permitted in this zone. However, where it can be demonstrated that such a land use is highly desirable in a specific instance, construction may be permitted to proceed provided that a detailed noise analysis is conducted and the required noise insulation features are included in the building design. |
| H | Facilities of this nature should not be located close to the NEF 30 contour unless a detailed noise analysis has been conducted. |
| I | Many of these uses would be acceptable in all NEF zones. However, consideration should be given to internally generated noise levels, and acceptable noise levels in the working area. |
| J | Undesirable if there is spectator involvement. |
| K | It is recommended that serious consideration be given to an analysis of peak noise levels and the effects of these levels on the specific land use under consideration. |

| | |
|---|---|
| L | The construction of covered enclosures should be undertaken if this use is to be newly introduced to the noise environment. (See Note M below). |
| M | Research has shown that animals condition themselves to high noise levels. However, it is recommended that peak noise levels be assessed before this use is allowed. |
| N | This appears to be a compatible land use in all NEF zones. |

**Table 3 - Recommended Matrix of Noise Control Actions**

| | | If you have this problem | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Consider these actions | Noise from taxiing | Departure | Approach | Landing roll | Training flights | Maintenance | Ground equipment |
| Aerodrome plan | Changes in runway location, length or strength | ■ | ■ | ■ | ■ | ■ | | |
| | Displaced thresholds | | | ■ | | ■ | | |
| | High-speed exit taxiways | ■ | | | ■ | | | |
| | Relocated terminals | ■ | | | | | ■ | ■ |
| | Isolating maintenance runups or use of test stand noise suppressors and barriers | ■ | | | | | ■ | ■ |
| Aerodrome and airspace use | * Preferential or rotational runway use | ■ | ■ | ■ | ■ | ■ | | |
| | * Preferential flight track use or modification to approach and departure procedures | | ■ | ■ | | ■ | | |
| | * Restrictions on ground movement of aircraft | ■ | | | | | | |
| | Restrictions on engine runups or use of ground equipment | | | | | | ■ | ■ |
| | Limitations on number or types of operations or types of aircraft | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| | US restrictions, rescheduling move flights to another aerodrome | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| | Raise glide slope angle or intercept. | | | ■ | | ■ | | |
| Aircraft operation | Power and flap management | | ■ | ■ | | ■ | | |
| | Limited use of reverse thrust | | | | ■ | | | |
| Land use | Land or easement acquisition | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| | Joint development of aerodrome property | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| | Compatible use zoning | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| | Building code provisions and sound insulation of buildings | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| | Real property noise notices | | ■ | ■ | ■ | ■ | ■ | ■ |
| | Purchase assurance | | ■ | ■ | ■ | ■ | ■ | ■ |
| Noise program management | Noise related landing fees | ■ | ■ | ■ | ■ | ■ | | |
| | Noise monitoring | | ■ | ■ | | ■ | ■ | |
| | Establish citizen complaint mechanism | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| | Establish community participation program | ■ | ■ | ■ | ■ | ■ | ■ | ■ |

** These are examples of restrictions that involve TC Aviation's responsibility for safe implementation.*

## PART V -- Restrictions to Visibility

Restrictions to visibility at an aerodrome which can seriously limit aircraft operations may be caused by factors other than deteriorating weather conditions. These phenomena are briefly discussed in this Part.

Some industrial/manufacturing/power generation processes may generate smoke, dust or steam in sufficient volume to potentially affect visibility at or near aerodromes under certain wind conditions and temperature inversions. Examples of the types of industries which may be prominent in this regard are pulp mills, steel mills, quarries, municipal or other incinerators, cement plants, sawmills (slash and sawdust burners), power generating plants and refineries.

During the planning stages for new industrial complexes that will generate smoke, dust or steam, it is recommended that individual facility plans include an analysis to deal with potential emission dispersion problems. The results of the analysis should be considered before approving such land uses near an aerodrome. Prospective industrial sites near an aerodrome should be assessed on an individual basis due to the many local factors involved. Sufficient evidence is available from aerodromes across the country to suggest that such industries generating emissions may cause visibility problems near aerodromes that could pose a potential safety problem.

## PART VI -- Wind Turbines and Wind Farms

### 6.0 General

Due to concerns regarding climate change, governments are encouraging the installation of renewable energy sources such as wind turbines for the generation of electricity. Although a wind turbine can be considered as just another object that is deemed an obstacle and thus in need marking and lighting, there are additional issues that should be addressed through consultation in the early stages of planning.

### 6.1 Wind turbine marking and lighting

Industrial wind turbines are typically more than 90m in height and thus in need of marking and lighting in accordance with Transport Canada's Standard 621. (http://www.tc.gc.ca/eng/civilaviation/regserv/cars/part6-standard-standard621-3868.htm)

In as much as the wind turbine presents a substantial silhouette, the marking is that of the surface painting in either a white or off-white colour. In Canada, special paint bands for the blade ends is not required for reason that the blades are rotating and the display would not be as effective as that of a fixed object. The lighting is a red medium intensity flashing beacon of 2000 candela nominal output located on the nacelle. Light units are not mounted on the blades because the technical impracticality of such installation. In order to reduce the amount of lighting, the required lights are installed at intervals in the order of 900m such that not all wind turbines of a wind farm need lighting. The lights are provided with means to make them flash in unison.

The wind farm proponent should complete the Aeronautical Assessment Form for Obstruction Marking and Lighting and submit to the local regional office of Transport Canada. This form instructs contact with adjacent aerodromes and information on the planned wind farm.

### 6.2 Wind turbines and airport radar

Wind turbines can interfere with radar tracking of airplanes. Although the rotational speed of the blades is relatively slow at 10 to 20 rpm, the blade tip can have an angular speed reaching more than 180km/hr. The tip speed is then sufficient to mimic aircraft. The result is shadowing of aircraft, false returns and general cluttering of the radar screen. The wind farm proponent should, therefore, consult with NavCanada on the issue and to develop means of mitigation.

NavCanada can be contacted at ... 1-866-577-0247

or

by email at ... landuse@navcanada.ca

### 6.3 Navigation aids and communication systems

Similarly wind turbines of a wind farm may have adverse impact on navigation aids and communication systems. Consultation should be again made with NavCanada.

VOR is susceptible to reflection interference from wind turbines; due to the height of wind turbines, they can cause interference to the VOR even if they are far away. Developments of several wind turbines together have a cumulative effect on the VOR signal accuracy. Proposed wind turbine developments must be assessed if within 15 km from the VOR facility. Wind turbines that are less than 52 m in height can be treated like other structures. In most cases, a single wind turbine is acceptable at a distance greater than 5 km from the VOR facility, and developments of less than six wind turbines are acceptable at distances greater than 10 km from the VOR facility. However if VOR performance is already marginal this may not be acceptable.

**6.4 Weather Radar**

Wind farms can also shadow weather affects or return false information to weather radars. The proponent of a wind farm should contact Environment Canada at (416) 739-4103 or (416) 464-2798.

**6.5 Parachute Landing Areas (PLA)**

Wind turbines pose a special risk to parachutists, regardless of size, although those over 15m can additionally present a hazard to aircraft used in the activity of parachuting. Consultation with stakeholders is necessary as the existence of wind turbines near the PLA may result in restrictions being placed upon any parachute activity.

**6.6 Light Pollution.**

Lighting is provided for wind turbines within a wind farm for purpose of warning to aircraft. Extraneous lighting such as that for support buildings should be minimized. Refer to the Royal Astronomical Society of Canada "Light-Pollution Abatement (LPA) Program".

http://www.rasc.ca/lpa

**Note: It is of the utmost importance to be aware that the proximity of obstacles, for example, wind turbines, telecommunications towers, antennae, smoke stacks, etc., may potentially have an impact on the current and future usability of an aerodrome. Therefore, it is critical that planning and coordination of the siting of obstacles should be conducted in conjunction with an aerodrome operator at the earliest possible opportunity.**

## PART VII -- Exhaust Plumes

The purpose of this section is to provide guidance to aerodrome operators and persons involved in the design, construction and operation of facilities with exhaust plumes about the information required to assess the potential hazard from a plume.

The hazard is that both to the aircraft itself in flight and the impact of exhaust upon visibility for landing/takeoff.

Exhaust plumes, of both visible and invisible emissions may pose a hazard to aviation operations. Exhaust plumes can originate from any number of sources; chimneys; elevated smoke stacks at power generating stations; smelters; combustion sources; a flare created by an instantaneous release from pressurised gas systems all create exhaust plumes of one degree or another. High temperature exhaust plumes may cause significant air disturbances such as turbulence and vertical shear. Other identified potential hazards include, but are not necessarily limited to, reduced visibility, oxygen depletion, engine particulate contamination, exposure to gaseous oxides, and/or icing. These hazards are most critical during low altitude flight, especially during takeoff and landing.

In the case of a solid object, Standard 621 provides for marking and/or lighting so that the object's shape is delineated and made visible to pilots. This, however, is not feasible for an exhaust plume and there is a need to assess the hazards to aviation because the vertical velocity from gas efflux that may cause airframe damage and/or affect the handling characteristics of an aircraft in flight, as well as visibility reduction. TCCA may be obliged to consider alternative measures to make sure that pilots are unlikely to encounter the affects of exhaust plumes.

Away from aerodromes, exhaust plumes may also pose a hazard to low level flying operations such as that of specialist flying activities for crop dusting, pipeline inspection, power line inspections, fire-fighting, etc., search and rescue operations and military low-level manoeuvres. The risk posed by an exhaust plume to an aircraft during low level flight can be managed or reduced if information is available to pilots so that they can avoid the area of likely air disturbance.

The proponent of a facility that creates an exhaust plume should provide details of the facility to Transport Canada Civil Aviation (TCCA) so that potential hazards to aircraft safety can be assessed. In determining the need for a Restricted Area, TCCA will consider the severity and frequency of the risk posed to an aircraft which might fly through the plume.

## PART VIII -- Solar Array Installations

The geometry of aerodromes is such that there are relatively large open areas which give opportunity for installation of solar energy projects. These projects, however, need to be evaluated in relation to possible problems that such installation may pose.

For example, the following concerns could pose problems:

- Glare to pilots of aircraft approaching to or departing from the aerodrome or glare to ATC (Air Traffic Control) staff.
- Interference with electronic navigational aids.
- Penetration through transitional or approach/departure surfaces.
- Thermal plumes from the central tower of concentrated solar power installations.

There is a variety of solar plants used for production of electrical energy: photovoltaic (PV) panel arrays and concentrator solar power (CSP) systems. The former converts solar energy directly to electricity by a photovoltaic effect whereas the latter involves the heating of a fluid (e.g. molten salt) that activates a turbine coupled to a convention electric generator.

All solar plants involve reflection. In the case of concentrator systems, the reflection necessary to the system and is controlled by purpose so as to focus solar energy upon a central absorbing tube or tower. Because the light is focused, the possibility of glare to ATC and pilots is minimal, but should still be assessed in the preliminary design.

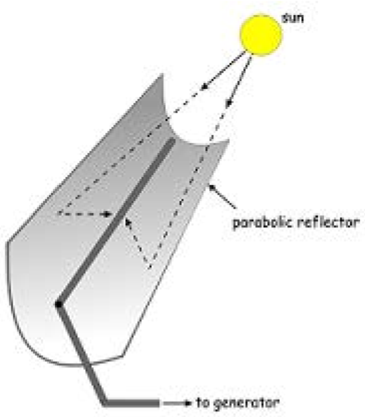


**Figure 1. Parabolic trough reflector**

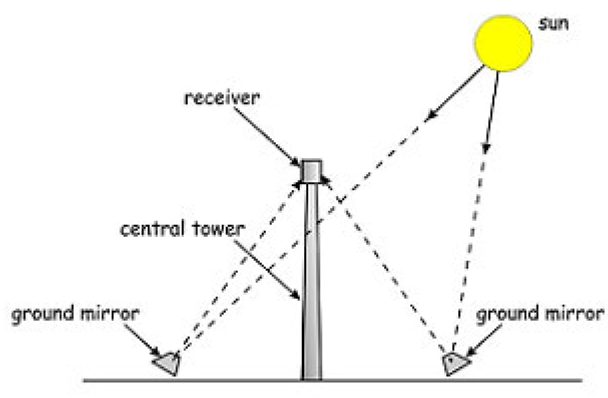


**Figure 2. Central tower Concentrator**

In the case of photovoltaic panels, electrical energy is produced directly and reflection is a loss factor. For this reason, the panels are designed to have as minimum reflectance as possible. The panels may be installed in a fixed position facing in a generally southern direction or provided with means to follow the sun as it moves across the sky.

**Figure 3. Photovoltaic Panel**

Also, when viewed from a distance, the sun reflectance tends to be smeared across the array as might be the case for a body of water. Thus the impact for glare to the pilot is inherently minimized. But again this is not a certainty and glare to the pilot should be assessed in the preliminary design. In the case of panels that are automatically rotated with sun movement, a remedy may be to stop the rotation prior to the point at which glare can occur.

The analysis of glare should involve a review of the position of the aircraft for both landing and take-off as well as when performing a circling approach.

**Figure 4. Mehringer Höhe Solar Park I, Germany - www.juwi.com**

Although for purpose improving efficiency, solar panels are usually provided with a top layer of anti-reflective coating intended to reduce reflectance, this does not mean that there is no reflected light. When viewed from a relatively short distance the affect can be significant, especially when the observer is not moving as would be the case of ATC personnel in the control tower. The designer should review the positioning and orientation of the panels in relation to the control tower to ensure that adverse reflection will not be produced. Figure 4 illustrates the occurrence of reflectance as the sun angle is optimized.

**Figure 5. Reflection off solar panel**

# Appendix A - Regional Offices of Transport Canada – Civil Aviation

Regional Director, Civil Aviation (TA) – Pacific
Transport Canada
800 Burrard Street
Vancouver, British Columbia
V6Z 2J8
[Telephone: 1-604-666-8317]

Regional Director, Civil Aviation (PA) - Ontario
Transport Canada
4900 Yonge Street
North York, Ontario
M2N 6A5
[Telephone: 1-416-952-0167]

Regional Director, Civil Aviation (NA) - Québec
Transport Canada
Regional Administration Building
700 Leigh-Capreol Place
Dorval, Quebec
H4Y 1G7
[Telephone: 1-514-633-3159]

Regional Director, Civil Aviation (RA) – Prairie and Northern
Transport Canada
344 Edmonton Street
Winnipeg, Manitoba
R3B 2L4
[Telephone: 1-204-983-4373]

Regional Director, Civil Aviation (MA) - Atlantic
Transport Canada
95 Foundry Street
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