GHANA

CIVIL AVIATION AUTHORITY

**ADVISORY CIRCULAR**

**AC 14-006**

# AERODROME SITE SELECTION GUIDE

## GENERAL

Ghana Civil Aviation Authority (GCAA) Advisory Circulars from Aerodrome Safety and Standards (ASAS) contain information about standards, practices and procedures that the Authority has found to be an Acceptable Means of Compliance (AMC) with the associated Directives.

An AMC is not intended to be the only means of compliance with a Directive, and consideration will be given to other methods of compliance that may be presented to the Authority.

## PURPOSE

This Advisory Circular (AC) provides information and guidance to prospective aerodrome operators on aerodrome site selection processes.

## REFERENCE

The Advisory Circular relates specifically to Parts 25, 26, 27 and 32 of the GCADs.

## STATUS OF THIS AC

This is the first AC to be issued on this subject.

## FOREWARD

This document provides guidance to prospective Aerodrome owners, consultants and constructors on processes and factors to be considered when selecting a site for an aerodrome construction. □

# APPROVAL

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| Issue No: 01 | Approved by:<br>Director-General | Nov. 2018 |

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# 1. INTRODUCTION

To construct a new airport or a new runway, certain factors would need to be considered, including discussion of the factors, which influence its location. The weight and degree of concern given to each of the following factors depend, in part, on: the airport reference code, the meteorological conditions; the surrounding environment; topography; and the volume of air traffic expected at the airport.

Factors to be considered when selecting suitable site(s) for the establishment of aerodrome include but are not limited to the following:

- The size and performance characteristics of the airplanes that will use the runways
- Wind and Runway Orientation
- Terrain and soil considerations
- Natural and man-made obstructions
- Airspace Availability
- Environmental considerations
- Noise level impacts
- Land availability
- Ghana Civil Aviation Directives and Directives
- Community needs
- Airport access
- Total costs
- Engineering factors which may affect site development

## 1.1. CONSISTENCY WITH AREA-WIDE PLANNING

The site selected should fit well into regional and local land use and transportation plans, thereby forming an integral part of the national network of airports.

## 1.2. AIRPORT USE

The selection of site depends upon the intended use of an airport. The airport may be used for civilian or for military operations. Airports may be needed for international or domestic operations. They may be public or private.

## 1.3. PROXIMITY TO COMMUNITY

The closeness of the Airport to the town or city it is to serve is also a necessary consideration. In considering proximity, the ease of access to community to the airport and the existence of other utilities such as power & water must also be considered. The impact of airport operations on the surrounding communities must be checked.

### 1.3.1. Ground Accessibility

The site should be so selected that it is readily accessible to the users. The airline passenger is more concerned with his door-to-door time rather than the actual time in air travel. The time to reach the airport is therefore an important consideration especially for short haul operations.

## 1.4. AERODROME REFERENCE CODE

The Aerodrome Reference Code (ARC) is used as design reference. This dictates dimensions of airports element, based on the size, performance characteristics and operational requirements of critical aircraft the aerodrome is intended to serve. Selection criteria at any stage of the design are based on the approach speeds and associated parameters and geometry of the aircraft.

*Aerodrome physical characteristics include the lateral and longitudinal dimensions of runways, strips, safety areas and their slopes or grade which must conform to design standards required by of GCAD for the critical or design aircraft.*

## 1.5. METEOROLOGICAL FACTORS

### 1.5.1. Wind Conditions and Runway Orientation

The Runway is should be so oriented such that landing and take-off is done by heading into the wind. Wind data should be collected over a minimum period of about five years prior to site selection.

### 1.5.2. Usability Factor

*Consistency with prevailing wind direction; wind speeds and allowable cross wind factors. Analysis of wind distribution to ensure runway orientation is in the direction of the prevailing wind.*

Runway location and orientation are paramount to airport safety, efficiency, economics, and environmental impacts. Consideration of local weather patterns is a major factor in determining an airport's layout. The weather patterns of an area, especially the prevailing winds, are a major factor in determining runway headings. The runway, to the extent other factors permit, should be oriented in the direction of the prevailing wind.

Wind is one of the most highly variable meteorological elements, both in speed and direction. Prevailing winds are defined as the direction from which the winds blow most frequently. It is influenced by a wide range of factors, from large scale pressure patterns, to the time of day and the nature of the surrounding terrain. Because the wind is highly variable it is often studied by means of frequency analyses, provided here in the form of *wind roses*, rather than as simple averages.

The wind direction is specified relative to true (geographic) north, and it is the ***direction from which the wind is blowing***. The direction can be specified either as the number of degrees clockwise from true north, or as one of the 8 or 16 compass points. Wind speeds are 10-minute average wind speeds unless specifically labelled as gusts, in which case they are an almost instantaneous reading. For nautical and aviation use, the wind speed is expressed in knots.

Wind analysis considers the wind velocity and direction as related to the existing and forecasted operations during visual and instrument meteorological conditions. It may also consider wind by time of day. Wind Rose Analysis is used to determine optimal placement of runways and it indicates probability of safe landings. Winds are always reported as “from” with respect to the North in ATC transmissions. Appendix II, section 3 provides information on wind data analysis for airport planning and design.

The runway orientation should be such that, 95% of the time, the runway can be used by the airplane the aerodrome is intended to serve. This is termed “usability factor” of the aerodrome and should not be less than 95%. When a runway orientation provides less than 95% wind coverage for any aircraft forecasted to use the airport on a regular basis, a second (crosswind) runway is recommended.

Remember that airplanes take off and land into the wind. For instance, at a given airport the prevailing winds blow in from the west 65% of the year, while 30% of the year the wind blows in from the east, and the remaining 5% coming from the northwest. It would be best then to orient the runway W (27) and E (9). That would mean that approximately 95% of the year airplanes would be landing and taking off into the wind.

Information on wind data considers the wind velocity and direction, as well as time of day. Wind rose analysis is used to determine optimal placement of runways.

Each aircraft has a uniquely stated maximum demonstrated crosswind component, usually specified in the flight manual (derived from flight test experiments). The challenge for the designer is to accommodate all of the aircraft using the facility in a reliable and reasonable manner. *If wind coverage of 95% for 10.5-knot wind can be achieved no cross wind runway is needed.*

*The 95 percent wind coverage is computed on the basis of the crosswind not exceeding:*

| **ICAO Crosswind Design Criteria** | | **FAA Crosswind Design Criteria** | |
|---|---|---|---|
| **Aerodrome Reference Field Length** | **Runway Reference Field Length (m)** | **Airport Reference Code** | **Design Crosswind Value (knots)** |
| < 1,200 | 10 knots (19 km/h) | A-I and B-I, | 10.5 knots |
| 1,200 - 1,500 | 13 knots (24 km/h) | A-II and B-II | 13 knots for |
| > 1,500 | 20 knots (37 km/h) | A-III, B-III, and C-I through D-III | 16 knots |
| | | A-IV through D-VI | 20 knots |

### 1.5.3. Data Sources & Assembly

Wind data should be collected from a **reliable source**. The source of data to be used for the calculation of the usability factor should be stated.

The latest and best wind information should always be used to carry out a wind analysis. A record which covers the last 10 consecutive years of wind observations is preferred. Records of lesser duration may be acceptable on a case-by-case basis.

State if wind distribution statistics that does not extend over a period of 10 years. In some instances, it may be highly desirable to obtain and assemble wind information for periods of particular significance; e.g., seasonal variations, instrument weather conditions, daytime versus nighttime, and regularly occurring gusts.

Often wind data for a new location has not been recorded. In such instances it is permissible to develop composite wind data using wind information obtained from two or more nearby recording stations. However, care should be taken in using weather record from these nearby stations due to local weather effects. Composite data are usually acceptable if the terrain between the stations and the site is level or only slightly rolling. If the surrounding area is fairly level, the records of these stations should indicate the winds at the site of the proposed aerodrome. If the terrain is hilly or mountainous, composite data may only have marginal validity since the wind pattern is often affected by the topography, and it is dangerous to utilize the records of stations some distance from the site.

In extreme cases it may be necessary to obtain a minimum of 1 year of onsite wind observations. These meagre records should be augmented with personal observations (wind-bent trees, interviews with the local populace, etc.) to ascertain if a discernible wind pattern can be established. Airport development should not proceed until adequate wind data are acquired.

*Note: A study of the topography of the region and consultation with local residents may prove useful but wind study of the site should be initiated. Such a study would involve the installation of wind gauges and the keeping of wind records. Guidance material on the preparation and analysis of wind data for aerodrome planning purposes is given in the* ***Airport Planning Manual (Doc 9184) Part 1 — Master Planning.***

**(a) Visibility Conditions**

*Weather patterns dictate types of runway approaches. Visibility minimums and planned runway operations. Evaluate the most demanding meteorological conditions in which airplanes will operate).*

Poor visibility lowers the traffic capacity of the airport. The site selected should therefore be free from visibility reducing conditions such as fog smoke and haze. Fog generally settles in the area where wind blows minimum in a valley.

(i) Check for planned aerodrome usage and meteorological conditions

- *All meteorological conditions;*
- *Only in visual meteorological conditions;*
- *Day and night; or*
- *Only by day.*

**(i). <u>Ascertain the occurrence of localized fogs</u>**

Weather, in particular wind characteristics under poor visibility conditions are often quite different from those experienced under good visibility conditions. A study should be made of the wind conditions occurring with poor visibility and/or low cloud base at the aerodrome, including the frequency of occurrence and the accompanying wind direction and speed)

## 2. OBSTRUCTIONS TO AIR NAVIGATION

When aircraft is landing or taking off it loses or gains altitude very slowly as compared to the forward speed. For this reason long clearance areas are provided on either side of runway known as approach areas over which the aircraft can safely gain or lose altitude.

Man-made obstructions like multi-storied high rises, transmissions towers and bridges can and do influence runway orientation.

Sound obstacle clearance for both natural (terrain) and man-made obstructions are required. Aerodrome Planners should therefore:

- Check whether aerodrome and its surroundings are in compliance with the obstacle limitation surfaces; check for clear approaches and departure paths (i.e. free of obstacles like power lines and masts)

- Check for fix obstacles may require runway displacement (e.g. public roads, terrain)

- Check for objects that may affect circling altitudes or may cause significant constraints to missed approach procedures

- Look for other objects such as buildings in the air operations area (landside) may cause disturbance to wind flow.

***Note:*** *An obstruction survey should identify those objects which may affect airplane operations. Approaches free of obstructions are desirable and encouraged, but as a minimum, locate and orient runways to ensure that the approach areas associated with the ultimate development of the airport are clear of hazards to air navigation.*

*See Appendix 4 of CGAA publication, “Airport Master Plans and Airport Layout Plan Set – Preparation and Submittal Guidelines ASAS TP 03”.*

## 3. SITE TOPOGRAPHY AND WIND PATTERN

*Considerations should be given to Terrain and wind flow. Obstructions to wind flow, mountain wave, convective currents,*

### 3.1. CONVECTIVE CURRENTS

Convective currents are common cause of turbulence, especially at low altitudes. These currents are localized vertical air movements, both ascending and descending. For every rising current, there is a compensating downward current. The downward currents frequently occur over broader areas than do the upward currents, and therefore, they have a slower vertical speed than do the rising currents.

Convective currents are most active on warm afternoons when winds are light. Heated air at the surface creates a shallow, unstable layer, and the warm air is forced upward. Convection increases in strength and to greater heights as surface heating increases. Barren surfaces such as sandy or rocky wastelands and ploughed fields become hotter than open water or ground covered by vegetation. Thus, air at and near the surface heats unevenly. Because of uneven heating, the strength of convective currents can vary considerably within short distances.

When cold air moves over a warm surface, it becomes unstable in lower levels. Convective currents extend several thousand feet above the surface resulting in rough, choppy turbulence when flying in the cold air. This condition often occurs in any season after the passage of a cold front.

Figure 1 illustrates the effect of low level convective turbulence on aircraft approaching to land. Turbulence on approach can cause abrupt changes in airspeed and may even result in a stall at a dangerously low altitude.

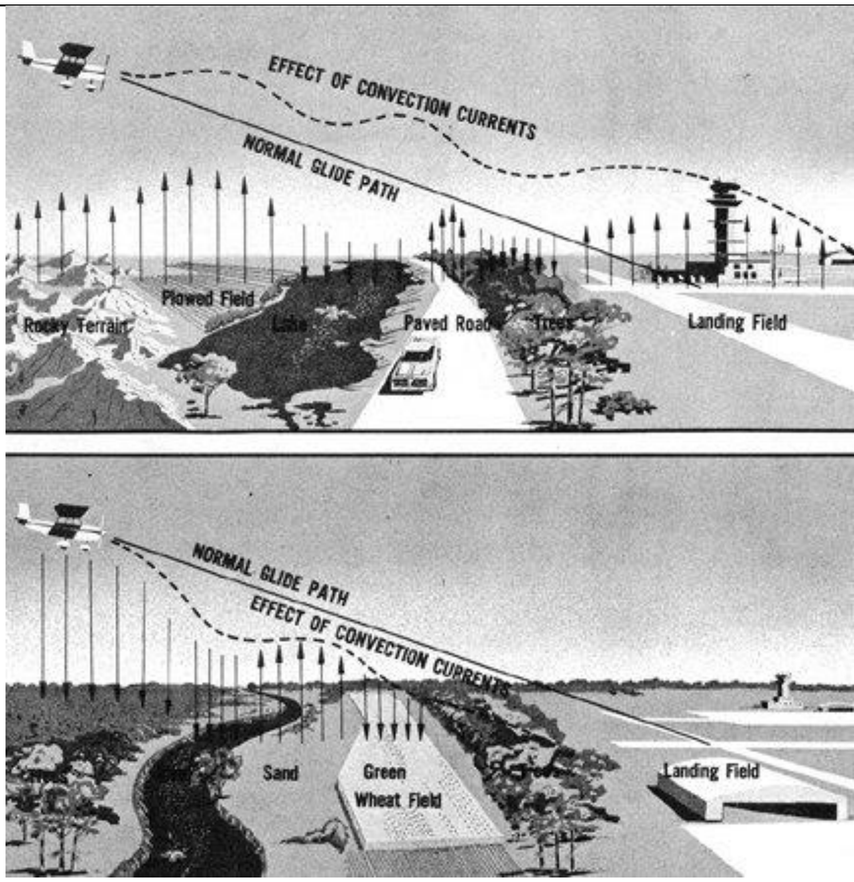


Figure 1 - Effect of convective currents on final approach. Predominantly upward currents (top) tend to cause the aircraft to overshoot. Predominantly downward currents (bottom) tend to cause the craft to undershoot.

### 3.2. OBSTRUCTIONS TO WIND FLOW

Obstructions such as buildings, trees, and rough terrain disrupt smooth wind flow into a complex snarl of eddies as diagrammed in figure 2. An aircraft flying through these eddies experiences turbulence. This turbulence we classify as "mechanical" since it results from mechanical disruption of the ambient wind flow.

The degree of mechanical turbulence depends on wind speed and roughness of the obstructions. The higher the speed and/or the rougher the surface, the greater is the turbulence. The wind carries the turbulent eddies downstream - how far depends on wind speed and stability of the air. Unstable air allows larger eddies to form than those that form in stable air; but the instability breaks up the eddies quickly, while in stable air they dissipate slowly.

Mechanical turbulence can also cause cloudiness near the top of the mechanically disturbed layer. However, the type of cloudiness tells you whether it is from mechanical or convective mixing. Mechanical mixing produces stratocumulus clouds in rows or bands, while convective clouds form a random pattern.

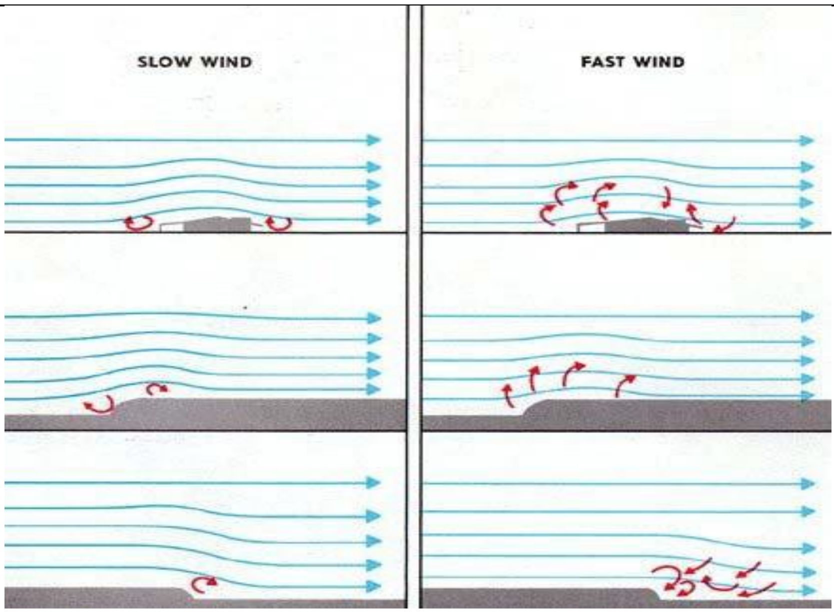


Figure 2 - Eddy currents formed by wind blowing over uneven ground or over obstructions.

The airport area is especially vulnerable to mechanical turbulence, which invariably causes gusty surface winds. Essentially, the building generated turbulence wind shear/turbulence issue becomes safety critical when a significant obstacle, such as a building is located in the path to an operational runway. The wind flow will be diverted around and over the buildings causing the cross-wind speed to vary along the runway. When an aircraft is in a low level approach or a climb, airspeed fluctuates in the gusts, and the aircraft may even stall. When landing with a gusty crosswind as illustrated in fig. 3, there may be mechanical turbulence and control problems caused by airport structures upwind. Surface gusts also create taxi problems.

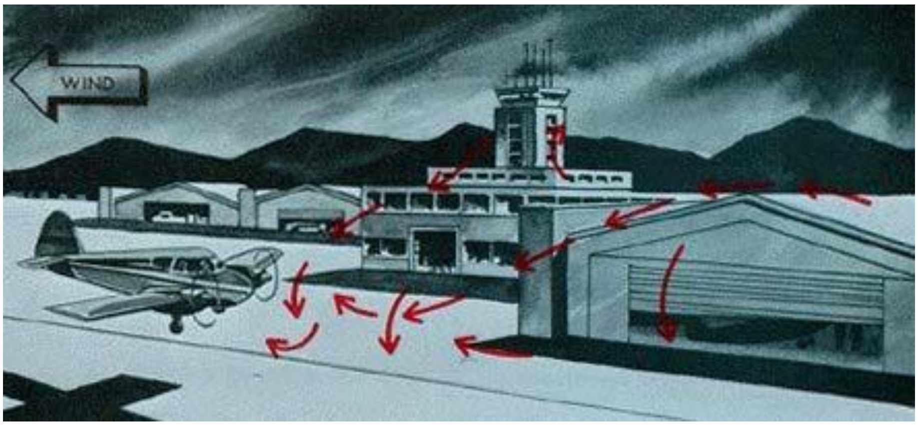


Figure 3 - Turbulent air in the landing area.

Such horizontal wind shear, which is usually localized and turbulent, poses risk to light aircraft in particular but has also been a factor in safety incidents involving large jet aircraft.

Research conducted by the Aeronautical Research Laboratory of the Netherlands (NLR) indicates that this safety risk is highest for buildings between the runway and 200ft above runway. This research was conducted in response to safety incidents at Amsterdam airport caused by building induced wind effects.

Buildings that could pose a safety risk are those located within;

- 200m perpendicular to the runway centerline; or
- 900m from runway threshold
- 500m from runway threshold ‘into’ the runway.

Building-generated vortices are created when airflows start to spin after strong wind flow encounters a building at particular angles.

Effect that buildings have on the prevailing wind flow depends on number of factors, the most important being:

- The speed of the wind and upstream turbulence;
- Orientation of wind relative to the building;
- The scale of the building in relation to the runway dimensions;
- Location of the building in relation to safe-critical zones such as touch-down zones, and
- Bulk, form and complexity of the building

Although buildings near runways (such as offices, warehouse type buildings and hangars) are height-restricted to comply with the ‘Obstacle Limitation Surfaces’, they can potentially constitute obstacles of significant size relative to the prevailing surface wind flow.

Research from the NLR indicates that the prescribed OLS at airports has the effects of mitigating the risk of building-generated turbulence for aircraft between 200ft and 100ft above ground level. It should be noted, however, that OLS protection is inadequate to address the risk of building-generated wind effects below 200ft.

Mechanical turbulence can affect low-level cross-country flight about anywhere. Mountains can generate turbulence to altitudes much higher than the mountains themselves.

When flying over rolling hills, you may experience mechanical turbulence. Generally, such turbulence is not hazardous, but it may be annoying or uncomfortable. A climb to higher altitude should reduce the turbulence.

When flying over rugged hills or mountains, however, you may have some real turbulence problems. Where and to what extent depend largely on wind speed and stability.

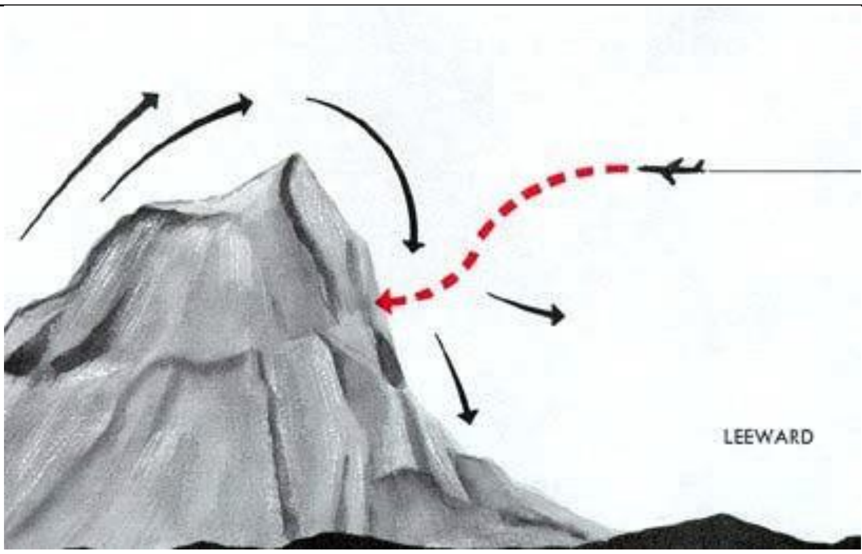


Figure 4 -Wind flow in mountain areas. Dangerous downdrafts may be encountered on the lee side.

If the air crossing the mountains is unstable, turbulence on the windward side is almost certain. If sufficient moisture is present, convective clouds form intensifying the turbulence. Convective clouds over a mountain or along a ridge are a sure sign of unstable air and turbulence on the windward side and over the mountain crest.

As the unstable air crosses the barrier, it spills down the leeward slope often as a violent downdraft. Sometimes the downward speed exceeds the maximum climb rate for the aircraft and may drive the aircraft into the mountainside as shown in figure 4. In the process of crossing the mountains, mixing reduces the instability to some extent. Therefore, hazardous turbulence in unstable air generally does not extend a great distance downwind from the barrier.

### 3.3. MOUNTAIN WAVE

Land at a greater elevation surrounding an airport such as mountains also have a profound effect on winds. In the daytime, air next to a mountain slope is heated by contact with the ground as it receives radiation from the sun. This air usually becomes warmer than the air farther up the slope. Colder, denser air in the area settles downward and forces the warmer air near the ground up the mountain slope. This wind is called a "valley wind" because the air is flowing up and out of the valley. At night, the air in contact with the mountain slope is cooled by terrestrial radiation and becomes heavier than the surrounding air. It sinks along the slope producing the "mountain wind" which flows like water down the mountain slope. Mountain winds are usually stronger than valley winds. The wind pattern on the leeward side of a mountain contains dangerous downdrafts or "rotor waves". An aircraft flying through such wind would encounter hazardous turbulence that would push the airplane towards the ground. These are all considered when orienting runways in an area near mountains.

The terrain often influences development of the runways in the mountains. Mountains can rise abruptly from the airport elevation of 7,815 feet to above 14,000 feet on three sides of an airport.

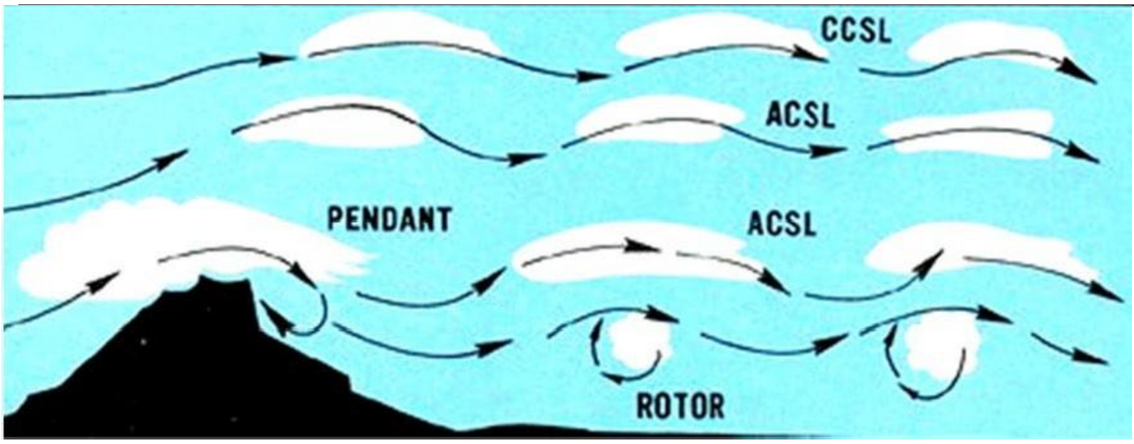


Figure 5 - Schematic cross section of a mountain wave. Note the standing wave pattern downwind from the mountain. Note also the rotary circulation below the wave crests. When the air contains sufficient moisture, characteristic clouds form.

The wave pattern may extend 100 miles or more downwind from the barrier.

Wave crests extend well above the highest mountains, sometimes into the lower stratosphere. Under each wave crest is a rotary circulation also diagrammed in figure 5. The "rotor" forms below the elevation of the mountain peaks. Turbulence can be violent in the overturning rotor. Updrafts and down drafts in the waves can also create violent turbulence.

Figure 5 further illustrates clouds often associated with a mountain wave. When moisture is sufficient to produce clouds on the windward side, they are stratified. They form in the updraft and dissipate in the downdraft, so they do not move as the wind blows through them. The rotor may also be marked by a "rotor" cloud. It should be noted that, clouds are not always present to mark the mountain wave. Sometimes, the air is too dry. Always anticipate possible mountain wave turbulence when strong winds of 40 knots or greater blow across a mountain or ridge and the air is stable.

Some useful information on convective currents and obstructions to wind flow can be found at http://www.aviationweather.ws, chapter 9 - Turbulence.

# 4. SITE TOPOGRAPHY AND SOIL CONSIDERATIONS

*The runway orientation and surrounding topography must offer **flexibility to accommodate any future expansion** of the runway infrastructure.*

## 4.1. GRADING AND DRAINAGE CHARACTERISTICS

Grading and drainage play an important role in the construction and maintenance of airport, which in turn influences the site selection. The general site grading of the runway area may affect the amount of earthworks/grading and drainage work required to construct a runway. This includes natural features like ground contours, trees, streams etc.

The original ground profile of a site together with any grading operations determines the shape of an airport area and the general pattern of the drainage system. A raised ground, a hilltop, but fairly level is usually considered to be an ideal site for an airport.

Availability of uniform topography is important as good topography may not require massive earthworks to meet slope requirements and may increase cost of airport development.

The possibility/threat of site flooding, especially, at the valley sites should be investigated. Sites with high water tables which may require costly subsoil drainage should be avoided.

***Note:** In determining runway orientation, consider the costs of both the initial work and ultimate airport development.*

## 4.2. SOIL CHARACTERISTICS

Soil strength is an important factor in airport planning. The ground on which the airport is to be built must have a stable stratum of earth upon which building foundations can be anchored. The soil must be capable of supporting heavy loads without shifting or sinking. If the airport's runways are to be used by heavy aircraft (airplanes with a gross weight 300,000 pounds and heavier) the underlying soil and/or bedrock must be able to support the weight of the runway plus the aircraft's weight.

Many airport runways have several feet of reinforced concrete to support the airplanes without cracking. Weak in-situ soils require heavy financial decisions at the design stage. It also requires much attention in terms of pavement maintenance.

It is also very important to assess the drainage characteristics of the underlying soils.

## 5. AVAILABILITY OF LAND

Provisions for land, large enough site for airport on development works.

- Assess availability of land area and the possibility of installing suitable non-visual and visual aids for approach-to-land or other aerodrome facilities.
- Assess availability of land to accommodate provisions for Strip, Shoulders, RESA and other safety areas.
- Availability of land for future airport expansion required to meet traffic demands

Airport projects are land intensive. The amount of land needed for and airport or heliport must also include the areas surrounding the actual landing area which must meet requirements for the removal of obstructions. These requirements include land to the sides of the sides of the landing area as well as the areas used as approach and departure paths. Land must be available for future expansion needs and for the installation of navigational equipment. Installation of communication, navigational and surveillance equipment that support aviation activities require clearances for the protection of signals and prevention of electromagnetic interference. These requirements must be added to the amount of land that is necessary to construct the actual runway or helipad. The Aviation Inspector will assess the land requirements and determine if the type facility planned can be constructed at the proposed location. For further details, refer to “Guidance for Aerodrome Safeguarding and Protection of Communication, Navigation and Surveillance Equipment”.

Considering that the air traffic volume will continue to increase in future a number of runways may have to be provided for an increased traffic.

Ability of land to accommodate the basic airport layout (aircraft apron, terminal building, and hangar)

## 6. AIRSPACE AVAILABILITY & TRAFFIC PATTERNS

Proximity to other airport is another important factor for consideration. The site should be selected at a considerable distance from the existing airports so that the aircraft landing in one airport does not interfere with the movement of aircraft at other airport.

Consider existing and planned instrument approach procedures, missed approach procedures, departure procedures, control zones, special use airspace (SUA) including military training areas (MTA), restricted airspace, GPS overlays and traffic patterns influence airport layouts and locations.

Check availability of usable airspace. Traffic patterns and airspace associated with the proposed airstrip shall be checked to ensure that it does not **overlap with any adjacent airport**. (Note: VFR airport within 5nm or IFR airport within 20nm)

Check if aerodrome does not ***underlie existing or proposed instrument approach procedures*** to ensure that adequate vertical separation requirements are met.

The required separation between the airports mainly depends upon the volume of air traffic.

Evaluate if topography/airspace around the aerodrome will be able to accommodate the anticipated **Traffic density** at the aerodrome regarding category and volume of aircraft planned for the airstrip including missed approaches, especially, plan for number and category of aircraft to be accommodated in a holding pattern.

***Note****: GCAA needs to be contacted for assistance on airspace matter; the possible constraints on navigable airspace and volume and mix of operations).*

### 6.1. SAFETY OF FLIGHT

Other ***airports or landing sites within 5nm*** of the proposed airstrip must be noted for *lateral separations*.

Determine ***feasibility of instrument approach procedures in the surrounding terrain must be checked***. Approaches and Departure paths should be free of obstacles. Check for ***terrain or obstacles*** in the approach paths that ***require displacement of threshold***. Determine terrain or obstacle that may pose threat to flights in missed approach procedures

Document all ***obstructions located within 3nm*** of the aerodrome and determine ***controlling obstacle*** in the vicinity of the airstrip

**Note :** *For instrument runway, pay attention to areas over which aeroplanes will be required to fly when following instrument approach and missed approach procedures, so as to ensure that obstacles in these areas or other factors will not restrict the operation of the aeroplanes for which the runway*

There is the need for Wildlife Hazard Considerations. In orienting runways, consider the relative locations of bird sanctuaries, sanitary landfills, or other areas that may attract large numbers of birds or wildlife. Where bird hazards exist, bird control procedures to minimize such hazards must be developed and implemented.

## 7. SAFETY OF PERSONS ON GROUND

*Consider chances of people congregating in the approach and departure areas of the airstrip.*

Check if human settlements are not within accident potential zones and under the proposed traffic pattern.

Apart from noise reasons, approach and departure areas should be such that aircraft are not directed over populated areas to avoid threats to safety of people on ground.

Assess current and future land use; the orientation and layout of the runway protect as far as possible the particularly sensitive areas such as residential development, schools, churches, and hospital zones from the discomfort caused by aircraft noise.

All facilities including heliports must provide and maintain an obstruction free approach and departure path for aircraft. These paths to and from the landing area are trapezoidal in shape and slope at various ratios depending on the type of approaches to be conducted at the landing facility. For dimensions and slope ratios, refer to Appendix 4 of the GCAA publication “ASAS TP - 03 Airport Master Plan and Airport Layout Plan Set (Preparation and Submittal Guidelines)”.Land uses for airports and its environs must be compatible and coordinated. This leads to the development of Airport land Use Plans which are developed as part of Airport Master Plan or Community Zoning.

## 8. AIRPORT TRAFFIC CONTROL TOWER VISIBILITY

Consider *Airport Traffic Control Tower Visibility***.** The location and orientation of runways and taxiways must be such that the existing (or future) airport traffic control tower (ATCT) has a clear line of sight to: all traffic patterns; the final approaches to all runways; all runway structural pavements; and, other operational surfaces controlled by ATC. A clear line of sight to taxilane centerlines is desirable. Operational surfaces not having a clear unobstructed line of sight from the ATCT are designated by ATC as uncontrolled or no movement areas through a local agreement with the airport owner.

## 9. ENVIRONMENTAL CONSIDERATIONS

*Ensure minimum disruption to environments. Noise level impacts, Air & Water Quality, Traffic Congestion, Vegetation & Animals. Consider effect on adjacent land use. Airports are not to interfere with future city/town development. Consideration should be given to off-airport land uses & Airport Compatibility Plans*

Actions such as modifying air routes and increasing air traffic will require Environmental Assessment.

Environmental factors such as the effect of the runway alignment on wildlife, the general ecology of the area and noise-sensitive areas of the community must be considered.

The following environmental factors should be considered carefully:

- Land – Actions that potentially affect physical terrain
- Air – Actions that create potential impacts on the quality of air (i.e. air pollution)
- Water – Actions that establish possible sources of pollution to the water supply (Water pollution)
- Ecological impacts – Actions that might impact animals and natural habitats of endangered species or other protected animals (i.e. effect on flora and Fiona)
- People – Actions that could potentially impact communities and neighborhoods, especially noise, traffic congestion

## 9.1. ECOLOGICAL IMPACTS

Consider need for **conservation of threatened and endangered plants and animals and habitat** in which they are found. Consider impact of operations on a list of endangered species and coordinate efforts with wildlife services.

## 9.2. WATER POLLUTION

Controlling water pollution from airports has been well-mastered by planners. Airports can be major contributors to water pollution if suitable treatment facilities are not provided for the various types of airport wastes. These wastes include domestic sewage, industrial wastes such as oil and fuel spills and high temperature water degradation that stems from the heat of various power plants in nearly constant use at an airport.

## 9.3. NOISE NUISANCE

One of the severe problems is that of **aircraft noise** in and around an airport. Noise in the vicinity of airports generated from aircraft operations has an adverse impact on a community's quality of life.

Noise may decrease property value and so people shy away from building close to airport environment. Airports attract business and people, but airports are noisy. Businesses and people do not like airport noise. At the very least, aircraft noise is distracting and it can be unhealthy. People recognize that noise has become environmental pollutant that can threaten their quality of life.

The extent of noise nuisance depends upon the climb out path of aircraft, type of engine propulsion and the gross weight of aircraft. Noise is generated from the propulsion system by the rotating machinery, the combustion process, the jet flow from the nozzle as well as by the aircraft from airflow over wing flaps and around the landing gear. Therefore, as operations increase, overall community noise impact increases.

The problem becomes more acute with jet engine aircraft. Therefore the site should be so selected that the landing and take-off paths of the aircraft pass over the land which is free from residential or industrial developments.

There is the need to protect as far as possible the sensitive areas such as residential, school and hospital zones from the discomfort caused by aircraft noise. Noise reduction goals should bring existing land uses into compatibility with levels of significant noise exposure around airports, and preventing the development of new non-compatible uses in these areas.

Airport operators should conduct environmental assessment and institute noise abatement program. The assessment will lead to the development of:

- Noise Exposure Maps (NEMs), which identify the levels of airport noise in areas around the airport; and

- Noise Compatibility Plan (NCP), designed to reduce the number of people and/or incompatible land uses within the airport’s noise contours.

*Note: See GCAD Part 22, Section III for details on the development of NCP*

Zoning agencies should make efforts to prevent building development in areas contained in designated noise impact areas. People who build very close to airport environment must put in place acoustic barriers and noise insulations to reduce noise impact.

Most noise exposure lies within the land area immediately beneath and adjacent to the aircraft approach and departure paths. Orientation of runways should be such that aircraft are not directed over populated areas.

The GCAA makes the Directives but airport operators are primarily responsible for planning and implementing action designed to reduce the effect of noise on residents of the surrounding area. Such actions include optimal site location, improvements in airport design, and noise abatement procedures.

Noise abatement procedures during takeoff and landing make for quieter airport operations. Procedures can include designated arrival and/or departure paths and procedures. Laying out runways so that air traffic patterns occur minimally over heavily populated areas is a practice now widely employed during runway expansion and when building new airports. Controlling the land use around an airport also helps reduce the interference of aircraft noise with the public. Some procedures consist of a faster takeoff speed quickly followed by slowing the engine once airborne over a populated area, then returning the engines to full speed and resuming normal flight operations. This lessens the amount of engine noise over the populated area without adversely affecting the flight. Improvements in engine design have also been a successful factor in reducing aircraft noise.

Land acquisition and restrictions on airport use should not unjustly discriminate against any user or impede the national interest in safety and management of the air navigation system.

Environmental impact requirements for airports ensure that due consideration is given to the effects on the quality of the environment and the surrounding communities in regard to airport expansion, use and development. Before building a new facility or expanding an existing facility, an impact study or feasibility study must be done. These studies include a critical assessment of all impact issues from soil to air quality. See Figure 6 for sample environmental impact report map.

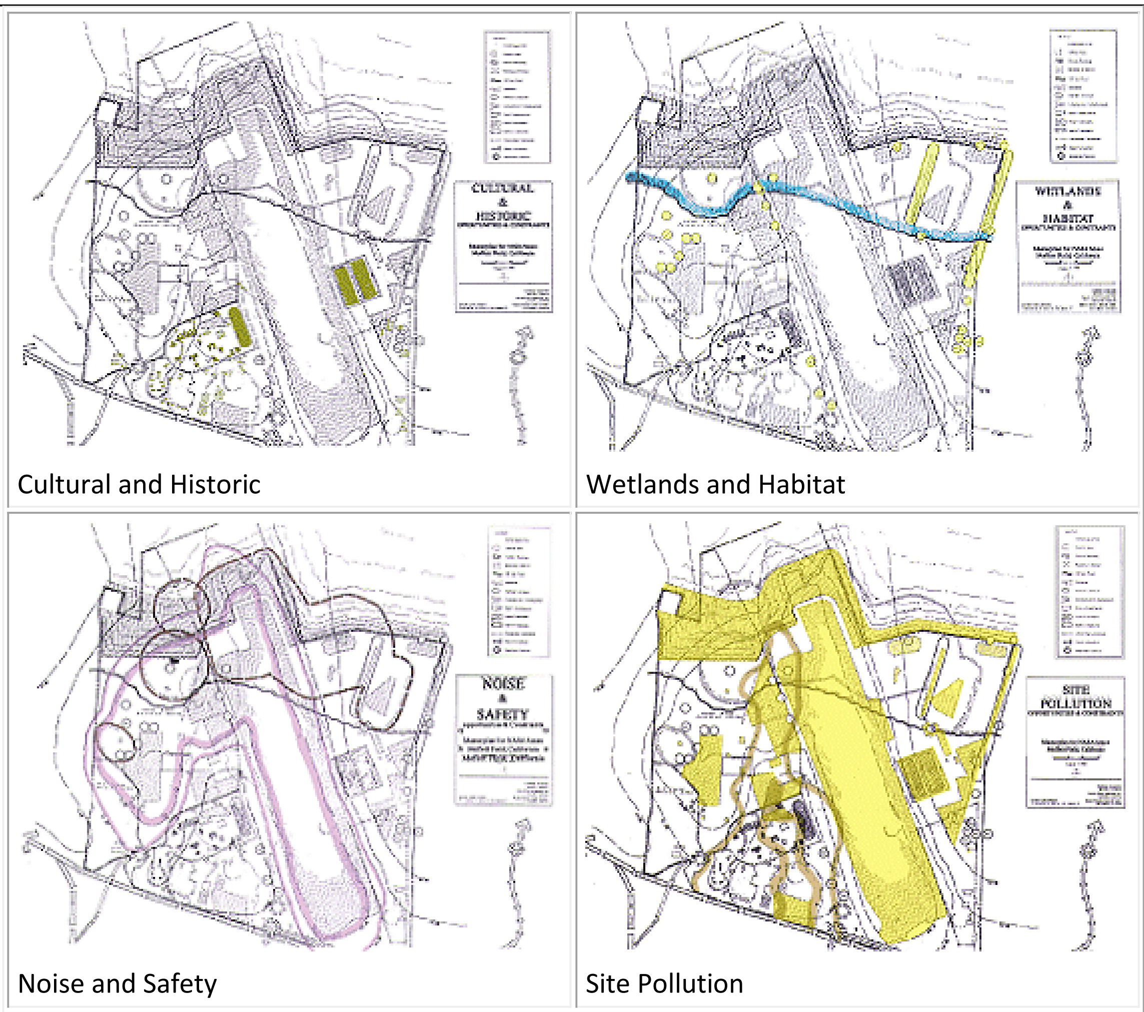


Figure 6 – Sample Impact Report Maps (Courtesy: Ames Research Center, 1999)

## 10. SOIL, ENGINEERING & CONSTRUCTION FACTORS

A comparative site evaluation for the principal engineering and construction factors.
Some engineering factors which may affect site development include

- Terrain/topography and amount of earthwork
- Soil considerations/conditions
- vegetative cover
- existing construction
- flood hazard
- suitability of the soils for construction and ease of excavation,
- availability of materials

***Note**: Consider site preparations & associated costs. Good topography may not require massive earthworks to meet slope requirements.*

## 11. AVAILABILITY OF UTILITIES

Location of utilities (primary utilities such as water, power, and telephone)

## 12. SOCIAL AND ECONOMIC CONSIDERATIONS

*Community needs; improve the status of social economic condition of the community; employment creation and commercial opportunity; or disruption of livelihood.*

### 12.1. ECONOMIC CONSIDERATIONS

- Support of aviation activities in the area
- Other project and businesses that may become feasible due to the construction of the airport access roadway (revenue generation potential and opportunity for related or induced development)
- Utility systems (development. of a water supply could encourage agric or the introduction of power).
- Proximity to Community population within 30 minutes,
- Employment center
- Adjacent industrial and commercial development
- Transport services

### 12.2. SOCIAL

- Spatial distribution of housing and population
- Amenities/attraction for social functions

## 13. EMERGENCY CONSIDERATIONS

Evaluate approach/departure paths to ensure accidents potential zones are not over difficult environments. Consider following factors:

- Response times
- Difficult areas and emergency access routes

## 14. GHANA CIVIL AVIATION DIRECTIVES

Design standards are set by the GCAA in order to ensure safety and efficiency of the aerodrome. Planners are to ensure that aerodrome designs satisfy standards prescribed in the GCADs.