GHANA
CIVIL AVIATION AUTHORITY

ADVISORY CIRCULAR
AC-AD-013

ESTABLISHMENT OF AERODROMES
(Application Requirements and Approval Process)

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 Regulations.

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

PURPOSE
This Advisory Circular provides methods, acceptable to the Authority, for showing compliance with Part 24 of the Ghana Civil Aviation (Aerodrome), 2011, LI 2004, as well as explanatory and interpretative material to assist in showing compliance.

REFERENCE
The Advisory Circular relates specifically to the Aerodrome GCARs and Manual of Standards (MOS).

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

FORWARD
This document provides guidance to proponents/ prospective Aerodrome Operators on the approval processes for the establishment of aerodromes through through a phased approach. The AC outlines the entire process up to the initial registration or certification phase of an aerodrome.

APPROVAL

Issue No : 01	Approved by: Director-General	2015

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1.0 INTRODUCTION

Part 27 of the Ghana Civil Aviation Regulations (GCARs) requires that sponsors proposing to construct or make changes to airport layout provide notice to the Ghana Civil Aviation Authority (GCAR) for approval.

2.0 PHASE I - INITIAL ACTIONS

2.1 Selection of site for aerodromes

The proponent chooses site based on a number of factors. Expert consultant advice may be necessary in this phase. In selecting a suitable site for the project, the proponents, together with their consultants should discuss various alternatives based on user survey and considerations as outlined in the GCAA Advisory Circular (AC), *"Guidance on Aerodrome Site Selection and Layout*".

Comprehensive narrative report is prepared at the end of the site selection exercise. Elements of the report are included in a Project Exposition Manual which will be submitted to the GCAA during formal application.

The report should be thorough, and should include various considerations made in arriving at the choice location and especially orientation of runways. The report shall include maps/drawings to support the core narrative report. Paragraph 2.4 discusses the preparation of application package.

2.2 Expression of Interest

An application to construct a landing area (i.e., runway or heliport) is initiated by writing a letter of intent addressed to the Director-General of the Ghana Civil Aviation Authority (GCAA), expressing interest for the establishment of aerodrome at a location in the country, stating the purpose.

The GCAA then schedules appointment with proponent and discusses the entire process and technical requirements, including financial obligations.

2.3 Pre-Application Meeting

The objectives of the Pre-application Meeting are to provide the applicant with overview of the approval process. Some key management personnel/senior management and technical personnel that may be involved in the project should attend.

An application information package and overview about the package will be provided at this meeting. Also, the GCAA will answer questions you may have about the entire process.

At the end of this meeting the GCAA team should be satisfied that your organization has a clear understanding of the process and is willing to proceed with the preparation of a formal application and development of other relevant documentation as required.

2.4 Preparation of Application Package

The application package typically consists of Completed Application Form, Project Exposition Manual and Airspace Plan Drawing.

2.5 Completion of Application Form

The information required for the completion of application form **(GCAA /SRD/ASAS – 03)**

- Obstacle Data (natural & man-made)
- Populated areas and general human dwellings
- Other aerodromes
- Landfill sites
- Projected aircraft movement/activity (Data from traffic forecast)

2.6 Project Exposition Manual

Project Exposition Manual must be included in the application submitted. The manual provides background of the project including purpose and justification, location, rational for the selection of design aircraft and aerodrome design code.

It must also include analysis of weather elements that form parameters for runway length requirements and orientation. It must be noted that various forms of wind rose for different applications exist. Weather data sources and *acceptable aeronautical wind rose analysis* must be provided in the document. Analysis of runway requirement must also be included.

Note: Detail aerodrome design (including runway elements) will be looked later after necessary approvals have been obtained from the GCAA and the National Security Council.

The manual should include detail description of the Airspace Analysis and Plan discussed in subparagraph (iii). There should be an indication of approach category being considered. The Approach Category which is based on critical aircraft, weather visibility minimums and ground instrumentation establishes criteria for characteristics of Obstacle Limitation Surfaces.

2.7 The Airspace Plan (Drawing)

Aerodrome Obstacle Limitation Surfaces (plan and profile) and Runway Protection Zones must be depicted on a toposheet. Airspace plans will be based on the Airport Airspace Analysis.

Note: Toposheet should cover up to areas within 18.5km from center of proposed aerodrome.

Approach and Departure profiles should be depicted in the plan. Tabulation of penetrating and close-in[1] obstacles (natural and man-made) and alternate treatment plan should be shown.

3.0 PHASE II - APPLICATION & APPROVAL PROCESSES

3.1 Submission of Application Set to GCAA

This is where the proponent makes formal application to the GCAA. The minimum application package including completed Application Form, Exposition Manual and Airspace Plan should be submitted to the Director-General of the GCAA. See Appendix I for application package and the format acceptable to the GCAA.

3.2 Review of Application

On receipt of application, GCAA will acknowledge receipt and provide quotation of ***fee for inspection of site and evaluation.***

The GCAA, upon receipt of the application materials, the Aerodrome Safety and Standards Office will conduct cursory review of the package submitted to ensure that the entire package meet the criteria for acceptance and further analysis.

Once application package is accepted, further analysis of the package will be done by special committee set up to manage the project. Conduct of comprehensive study of the Exposition and accompanying drawings involves in-house consultations and at times consultations with external stakeholders such as the Air Force.

During this process, the proponents may be requested to make presentations to a team of evaluated constituted by the GCAA. The GCAA may also request the proponents to provide additional information deemed necessary.

When satisfied with the submittals and initial study concluded, the proponent will be advised to make arrangements for the initial site inspections and evaluation, given the background information gathered.

If your organization require further direction for clear understanding of the process to enable them proceed with the preparation of the formal application and development of other relevant documentation as required, you can make arrangements for another pre-application meeting between GCAA and your technical team.

3.3 Site Inspection and Evaluation

There would be a site inspection, evaluation and approval of the proposed site to ascertain its suitability for the project, as well as validity of information provided in the Project Exposition Manual.

[1] Obstacles within 5ft of OLS elevation/altitude

Applicant upon payment of applicable fees should contact the Head of Aerodrome Safety and Standards, GCAA and make arrangements for Aviation Safety Inspectors to conduct initial inspection of site. GCAA will assign an Aviation Safety Inspectors to visit the proposed site in connection with this exercise.

Transportation arrangements associated with the inspection will be borne by the applicant.

The site inspection will take into consideration the amount of land available for construction of the runway and the present use of the land contained in the approach and departure paths. Other considerations are the type of activities to be conducted at the airport and what obstructions must be removed.

When a proposed site is found unsuitable for the project, the Ghana Civil Aviation Authority (GCAA), at its option, will guide you in considering other alternatives. This will require detail desktop studies and field work.

Applicant will be responsible for the provision of necessary detailed maps, as may be required by the GCAA team of aviation safety inspectors. The team will require maximum co-operation from applicant's technical team in this process.

Usually the GCAA inspectors and applicant's technical team are joined by local representatives from the District Assembly, District Survey Office, District Environmental Protection Agency and Town and Country Planning office. It is recommended that local agencies are "taking on board" right from the initial stages as this will facilitate future actions and ensures co-operation.

Your organization may also consider separate inspections with the above named State Agencies/Departments after GCAA assessment proves that the location is acceptable in terms of risk to aircraft safety.

Note: The proponent will be required to ***pay appropriate fee for inspection and evaluation*** *of not later than 10 working days prior to the inspection.*

3.4 Airport Airspace Analysis of Site

After the site visit, GCAA initiates determination process. The GCAA will conduct internal coordination and complete Airspace Review process. The Airport Airspace Review process is quite complex and requires lots of internal and other external stakeholder inputs.

After consultation with aviation stakeholders as appropriate and considering all responses, the GCAA will issue internal determination, and advise all state agencies concerned of the determination.

3.5 Other State Agency Requirements, Referrals and Consultations

As stated above, GCAA consults with both in-house (inter-departmental) and may involve external stakeholders.

There may be other State legislation or regulations, which may require the approval of a competent authority from those areas of expertise. In that case, the CAA shall refer the expression of interest to the competent State entities for their clearance with the necessary documentation.

It should be noted that the processes of Town and Country Planning laws are outside the terms of reference of the GCAA. Planning and Environmental issues must therefore be channeled through the appropriate government agency or local office.

Note: Proponents are responsible for the identification of other legal requirements relating to aerodrome proposals.

3.5.1 National Security Council Approval

Approval of the National Security Council is required. This is sought through the GCAA in consultation with the National Security Coordinator.

If the result of the inspection and evaluation is positive, the GCAA will consults further with the National Security for security clearance. If the National Security issues a “no objection” to the proposal, the assigned inspector will file a report with the Director General, recommendations.

3.5.2 Environmental Impact Assessment

There should be an Environmental Impact Assessment (EIA) of the proposed airstrip site in consultation with the Environmental Protection Agency (EPA) and fulfilling applicable environmental requirements.

Some environmental issues may be covered in an airport master plan, but most are separate studies:

- Environmental assessment (EA); or
- Environmental impact statement (EIS)

Environmental Assessment Regulation 1999, L.I.1652 clearly states projects requiring registration, assessment and the issuance of environmental permit. Airport has been identified as potential project that requires environmental assessment under the regulation.

The Applicant will have to pursue environmental review with the EPA to secure the necessary environmental permit. Separate application will be made by the applicant to the Environmental Protection Agency (EPA).

An environmental overview, (noise, air quality, water quality, floodplains, wetlands, endangered and threatened species of flora and fauna, biotic communities, park and recreation lands, cultural resources and farmlands),

Appendices III provides checklist in accordance with global industry best practices. However, these are indicative only. Applicants are advised to contact relevant agencies for the specific requirements.

Appendix IV provide list of some environmental requirements in the country, as well as some international conventions on biodiversity. Please check for currency and amendments to these requirements. As minimum, planners and consultants of airport construction projects should consider the elements indicated in Appendices to this AC or sections of GCAA AC, "*Guidance on Aerodrome Site Selection and Layout (ASAS).*"

This is however advisory only, the exact scope of environmental considerations should be coordinated with the Environmental Protection Agency (EPA). It is recommended that detail and costly environmental studies should be initiated only when GCAA assessment of the site proves that the location is acceptable in terms of risk to aircraft safety.

3.5.3 Public Forum

There should be a Public Forum involving local community. This must be pursued in close coordination with the EPA.

The purpose of the public workshop was to inform the public about the airport planning process and to receive comments.

Tools and techniques an airport sponsor might use in the public involvement process includes: advisory committees, public information meetings, small group meetings and briefings and public awareness campaigns.

Large-scale public meeting will include presentations by government officials. Local stakeholders including local community leaders and administrators, district assembly officials, town and country planning officers, lawyers, local politicians and business leaders are to be involved. Comments will be submitted verbally and in writing by the public, as may be required by the EPA.

Periodic briefings on the project to State and local agencies, as well as the general public shall be conducted as necessary to keep stakeholders apprised of project updates and activities.

3.6 Issuance of Determination

The GCAA will issue and communicate external DETERMINATION to the proponent. The determination will communicate either GCAA's approval of the site or objection. An objectionable determination may be accompanied by an explanation of the circumstances that justify the decision. If there are items that can be corrected to meet the requirements

for issuance, these will be included in the explanatory statement of denial. If the Director General issues determination of approval of the site all adjacent property owners identified on the application may be mailed a Notice of Intent form.

The property owners, any person, affected by a decision of the Director General granting or denying the permit has thirty (30) days to file an appeal with the Authority for reconsideration. The appeal must be in writing and received at the offices of the GCAA within thirty (30) days of the Director General's decision. A request for a public hearing must be made within fifteen (15) days of the determination granting or denying the site approval. If a hearing matter becomes necessary, the Director General will initiate such a hearing in accordance with applicable state law.

In such cases where external hearing may be necessary, the applicant's presence and sponsorship will be requested.

3.7 Determinations

Aeronautical study results in determinations issued by the Director General. These determinations will be issued in one of the following categories:

(a) "No Objection" to the proposal when the Director General is satisfied that the proposed action will not adversely affect the safe and efficient use of airspace by aircraft nor the safety of persons or property on the ground.

(b) "Conditional No Objection" when the study identifies objectionable aspects of a proposed action but specifies conditions which, if complied with, satisfy the Director General that the proposed action will not adversely affect the safe and efficient use of airspace by aircraft, nor the safety of persons or property on the ground.

(c) "Objection" when the study identifies objectionable aspects of the proposed action. The determination will specify the reasons for finding the proposed action objectionable.

Should an action which was deemed to be objectionable proceed, the Director General will take such action considered necessary to remove or overcome any hazardous use of airspace.

When the airport study results in a conditional determination, conditions in the determinations will be set forth to avoid any misunderstanding.

The determination will be issued to the proponent and copied to appropriate local authorities, and other interested persons.

A determination issued by the Director General does not pre-empt or waive any applicable ordinances, laws or regulations of any other governmental body or agency.

3.8 Effective Period of the Determination

Unobjectionable and conditional determinations will contain a void date. The purpose of this is to allow for the orderly planning of aerodromes and to eliminate needless protection of airspace.

An extension to the void date may be granted if there are valid reasons for not completing the action by the void date.

Note: If construction work on the Aerodrome does not begin determination void or expiration date, a new airport site approval is required.

3.9 Revision of the Determination

A determination can be revised if any new facts that change the basis on which the determination was made are identified.

4.0 PHASE III – APPROVAL OF AIRPORT DESIGNS AND LAYOUT PLANS

Once a determination of "No Objection" has been issued by the GCAA, the proponent prepares and submits detailed aerodrome designs and Airport Layout Plans (ALP) or Airport Master Plans (AMP), as may be required by the GCAA for study and approval prior to the commencement of construction. For guidance on the preparation of ALP Sets, see GCAA AC, “Preparation of Airport Master Plans or Airport Layout Plan Set & Submittal Guidelines (ASAS)”.

Designs to the extent practicable should conform to the specifications sets out by GCAAA. Due to unique site, environmental, or other constraints, the GCAA make approvals not fully complying with design standards. Such approval requires GCAA study and finding that the proposed modification is safe for the specific site and conditions.

Unique local conditions may require modification to aerodrome design standards for a specific airport.
“Modification to standards” means any change to GCAA design standards other than dimensional standards for runway safety areas.

A sponsor must make specific request to the GCAA for modification to standards in their designs. The request for modification shall also show clearly that the modification will provide an equivalent level of safety, economy, durability, and workmanship acceptable to the GCAA.

When the GCAA upgrades a standard, aerodrome owners should, to the extent practicable, include the upgrade in the ALP before starting future development.

4.1 Preparation and Submission of Airport Layout Plan (ALP) Sets or Master Plans and Approval

An Aerodrome is a complex organisation with many interactive disciplines and functions. Therefore, it is possible that even the simplest of developments may need inter-departmental co-ordination. To initiate the development procedure, the sponsor should appoint a project co-ordinator to liaise with the Head of Aerodrome Safety & Standards (ASAS) of the GCAA.

Scope of the ALP set will largely depend on the complexity of the project and this must be discussed with the GCAA for specific and relevant drawings to be prepared.

For major airport improvement projects or the development of new airport, an Initial Development Meeting (IDM) will be held to brief the GCAA on the project. The aerodrome management will be responsible for providing a written brief and minutes (for this and subsequent meetings).

Although consultants may attend development meetings, ASAS will only deal directly with the aerodrome sponsor or their management representatives, at least one of whom should always be in attendance. GCAA will not deal with consultants directly unless the Head of Aerodrome Safety & Standards agree that this is absolutely necessary for the advancement of a project.

Required element to be included in the AMP or ALPs are listed in ALP Checklist in Appendix 10 of the GCAA AC, “Airport Master Plan & Airport Layout Plan Set - Preparation and Submittal Guidelines (ASAS) or as may required by the GCAA. Failure to include a completed and signed ALP checklist along with the ALP and/or Master Plan will result in rejection for review. The following are the components of ALP.

(i) ALP Narrative Report
(ii) Title Sheet;
(iii) Airport Layout Drawing
(iv) Airport Airspace Drawing;
(v) Inner Portion of the Approach Surface Drawing;
(vi) Airport Departure Surfaces Drawing & Declared Distances;
(vii) Terminal/Building Area Drawing;
(viii) Land Use Drawing;
(ix) Airport Property Map
(x) Airport Access Plan.

Note: Depending on the complexity of the project, GCAA may exclude some of the plans above.

4.1.1 Submission of Aerodrome Design Report

Detailed geometric and pavement designs will be submitted to the GCAA for approval along with the ALP/AMP sets.

Design standards should conform to the specifications sets out in the most current ICAO Annex 14. Pavement Analysis for various sectors of the movement area shall be discussed in the Design report. Completed Airport Pavement Design Form providing following information shall be completed as part of the Pavement Strength and Analysis:

- Gross Allowable Aircraft Weight
- Design Criteria
- Typical Sections
- Design Details
- Soil Analysis
- Subgrade Characteristics

Design of terminal and other aerodrome core infrastructure facilities shall be included in the Report.

4.2 Other Requirements

Evaluation and approval of the Aerodrome Designs, AMP/ALP sets *will attract a fee as per the GCAA scheme of charges*. Upon payment of applicable fee, the GCAA will conduct evaluation of the Designs and AMP/ALP. During this phase, the proponents and/or representatives will be engaged in discussions with the GCAA. The GCAA may direct sponsor to review aspects of the designs.

Once satisfied with the designs, the GCAA will approve and will issue authorization for the commencement of aerodrome construction works. The GCAA may specify material and construction requirements for the project.

Note: Design of airport physical characteristics should be in compliance with the Manual of Standards.

5.0 PHASE IV – CONSTRUCTION REQUIREMENTS & AUTHORISATION

5.1 Construction Requirements

During construction phase, it is advised that the proponent constantly engage the GCAA in discussions on the project.

The proponent may request the GCAA for advice during construction works. Such *request will attract appropriate fees for site inspections* that may arise out of such collaborations.

GCAA may also conduct adhoc inspections of the project and may request for material and construction data or records of quality arrangements in place.

Information on cored samples and laboratory analysis of material properties should be certified by laboratories of competent institutions such as the Ghana Highway Authority

(GHA), the Building and Road Research Institute (BRRI) of CSIR etc in order to be accepted by the GCAA. Materials and construction standards for the proposed construction must meet the specifications set out in the International Civil Aviation Organisation (ICAO) Aerodrome Design Manuals.

Upon completion of the project, proponent must request the GCAA for final inspection. GCAA will assign Inspector (s) to conduct the final inspection. The inspector will determine if the facility was constructed according to the plans and specifications submitted to the Authority. The inspection will determine what, if any, items must be addressed to be issued an operating permit. A final inspection report will be submitted to the Director General with a recommendation to grant or deny operating permit.

Note: Information in this paragraph is valid for any other construction that may take place at an aerodrome as part of an airport improvement programme.

5.2 Notification of Completion

Upon completion of the project, the proponent must notify the CAA and arrange for the conduct of final inspections of works by the GCAA.

5.3 Submission of Airport Master Record

The next decision will depend on the outcome of the final inspection, if the GCAA returns positive report, airport owner will be requested to complete and submit GCAA Form - *"Aerodrome Master Record".* This information is reviewed by the GCAA ASAS office for entry into the main database and inclusion in various aeronautical publications and charts. It is important to note that without the submittal of the Airport Master Record form; the aerodrome operations will not be authorized or considered an active facility.

5.4 Initial Authorization to Commence Flight Operations

The satisfaction of the GCAA upon final inspection does not permit the operator, automatic resumption of operations at the aerodrome.

Upon submission of the *Aerodrome Master Record* and review, the GCAA may issue initial authorization to commence operations.

It should be noted, however, that the initial authorization will largely depend on the availability of emergency equipment and minimum critical facilities required for the safety of air navigation.

Note: The final inspections and authorization to commence flight operations will together attract a fee

6.0 PHASE IV - DEMONSTRATION PHASE AND CERTIFICATION REQUIREMENTS

The operator must show proof of competence in operating the aerodrome safely within first 12 months of operations.

The Aerodrome Operator shall be subjected to adhoc inspections by the GCAA. During this period, the Aerodrome Operator will be required to store data and document all operational procedures.

Proof of competency can only be demonstrated through certification or registration process.

The Aerodrome Operator is required to make formal application for the certification or registration of the aerodrome, whichever appropriate, not later than 180 days of authorization to commence operations. Depending on the type of expected activities at the aerodrome, the proponent will apply for either aerodrome *certification* or *registration*. Please refer to GCAR Parts 24 and 25 for regulations concerning Certification and Registration of Aerodrome respectively.

Certain class of aerodromes operations may not require any of the above. However, they may be required to establish processes and procedures in place to ensure safe operations of the aerodrome.

Note: The operator of an aerodrome may be different from the owner.
Certification/registration process is expected to complete by end of 365days of authorization in order to enable renewal of authorization for flight operations to continue. Unsatisfactory conclusions resulting from the process may cause flight operations to be suspended.

Delay in this process may warrant GCAA to impose sanctions including suspension of operations at the aerodrome or closure.

The GCAA shall also prevent flight operations into the aerodrome for reasonable cause that safety is in compromise.

Note: Depending on the level of operations and traffic volumes, the CAA may require an aerodrome that falls into the category of Registration under Part 25 of the GCARs, to be certificated under Part 24 of the GCARs.

APPENDIX I

APPLICATION MATERIALS FOR DETERMINATION AND APPROVAL FOR THE CONSTRUCTION OF AERODROME

Part I – Landing Area Proposal for Operations of Airplanes

With a covering letter, submit the following to the Director General of Ghana Civil Aviation Authority (GCAA):

(1) Completed Application Form

A completed form, "Application for Landing Area" provides information on the proposed aerodrome location, proximity to other landing areas and obstructions, type of facility and landing area specifics.

(Note: Instructions for completing the application form can be found on pages 3&4 of the form)

Information on the form provides GCAA with brief description of the aerodrome and its environments. Initial information required to be gathered for completion of the form and to aid in the site evaluation airport/airstrips or seaplane base are as follows:

(a). Other Landing Areas in the Vicinity

- List VFR airports within 5nm
- List IFR airports within 20nm
- List heliports within 5nm

(b). Obstructions

List and plot on map any obstructions within:

- 3nm of a VFR airport or a seaplane base;
- 5nm of an IFR airport;

(c). Human Settlements

- List schools, churches and residential communities within a 2nm radius of airports

(d). Disposal Sites

- List all waste disposal sites within a 5nm radius.

(2) Project Exposition Manual

Note - The primary purpose of the narrative report is to provide useful and understandable information and guidance to the airport sponsor. It also provides the GCAA with important information needed to review and ultimately approve the ALP

Comprehensive narrative regarding purpose and justification for the project, including basic geographical information. Items to be included in a narrative report are not limited to, but should include the following:

(a). **Introduction -** Purpose and justification for the project, including name, type of landing site, basic geographical information (Associated town and geographic reference point).

(b). **Inventory** - Includes data on existing airport facilities, aviation activity (total operations, itinerant operations, and instrument operations), based aircraft information and critical aircraft characteristics. This element may also include the results of a need study or user survey where the planned improvements require documentation of need.

(c). **Forecasts** – Basic aeronautical forecast of aviation demand. Includes as a minimum, short (0-5 years), intermediate (6-10 years) and long range (11-20 years) forecasts for the following:

(i) Total annual operations
(ii) Annual itinerant operations
(iii) Based aircraft
(iv) Annual instrument approaches
(v) Existing and future annual operations by the critical design aircraft. For the critical design aircraft, identify the type of aircraft, (i.e.design group, approach speed, and gross loading characteristics)

(d). **Operational Considerations -** The operational information, such as the proposed hours of operation; the number, type and size of aircraft to be located at or expected to use the site; frequency of flight, on a daily, weekly, and annual basis; type of operations and any resulting public benefits.

Tonnage to be handled, estimated pavement life, and the number of aircraft to be accommodated is the operational considerations that influence aerodrome design criteria. Design life indicates the total number of loadings the surface will sustain. The number of aircraft to be accommodated and tonnage to be handled establish taxiway, parking, and other hardstand requirements.

(e). **Design Aircraft and Aerodrome Reference Code (ARC)**. Both physical and performance characteristics of most demanding aircraft expected to use the landing site.

Aircraft characteristics that influence pavement strength requirements are weight, landing-gear configuration, and tire pressure. Ground maneuvering and dimension characteristics affect aerodrome geometric layouts.

Analyze aircraft mix and determine ARC for geometric design. Gear loads and other performance characteristics of aircraft the mix will also influence pavement designs.

(f). Demand/Capacity Analysis - Includes a comparison of existing airport facilities and forecast needs to determine facility requirements, such as:

(i) Length, strength and number of runways
(ii) Apron and tiedown requirements
(iii) Area requirements for terminal buildings, hangars, and auto parking
(iv) NAVAIDS and other airport aids
(v) Taxiways

(g). Site Meteorology

Provide relevant site meteorological data available. Include all data in the appendix to the manual.

(i). **Wind Data Analysis**- Discuss the wind data and coverage. Identify the source, period covered, and the number of observations. If applicable, determine the best alignment for the primary and/or the crosswind runway for optimum wind coverage.

Construct and provide appropriate aeronautical wind rose in the Project Exposition Manual. Appendix II of this guide demonstrates analysis of wind data and construction of appropriate wind rose.

(ii). **Temperature Analysis**- Provide information on Aerodrome temperature. Discuss analysis of data and include raw data in the Appendix

(iii). **Occurrence of local fog and visibilities. -** Thorough analysis will help in the planning of ground instrument and type of operations.

(h). Site Selection & Alternative Analysis - If a new airport or new runway is being considered, include a discussion of the factors which influenced site location, such as: airspace, meteorological environmental considerations, community needs, airport access, land availability, total costs, and engineering factors which may affect site development.

Briefly discuss and analyze the obvious alternatives, explaining the selection of preferred alternative.

For more details on selection a suitable site location for aerodrome, see GCAA AC, “Guidance on Aerodrome Site Selection and Layout (ASAS).”

(i). Stage Development – Development summary for stages of construction and layout sketches depicting the main items of development in that stage. Indicate staging of improvements shown on the ALP, based on short, intermediate and long range (0-5, 6-10 and11- 20 years) forecasts of aviation activity.

(j). Aerodrome Physical Characteristics - Provide brief description of aerodrome layout and characteristics of main aerodrome facilities including dimensions and slopes, based on Forecast of Aeronautical activities, capacity and demand analysis.

(i). **Runway** - Details of runway regarding proposed dimensions, orientation in terms of magnetic heading and type of surface. Safety areas associated with the runway, Runway Protection Zones and Accident Potential Zones.

(ii). **Approaches and Departures -** Discuss the existing and future approaches. Planned number of approaches and departures. Provide details of approach/departure surfaces including proposed flight path locations, widths, lengths, slopes, nearby obstructions, and other necessary details.

(iii). **Obstacle Limitation Surfaces** - Determine if there are or will be any obstructions to Obstacle Limitation Surfaces. If there are obstructions, discuss their penetration and their proposed disposition. Identify any existing determinations of no hazard and the date granted. Determine if any additional determinations of no hazards are necessary. Describe the object and why a determination of no hazard is necessary.

(iv). **Waivers & Modifications to GCAR Design Standards** - Rationale for unusual design features and/or modification to GCAA Manual of Standards. Identify any existing waiver and the date granted. Determine if any additional waivers that are necessary. Identify the violations to all GCAR standards including: approach surfaces, runway and taxiway separation distances, runway and taxiway safety areas, building restriction lines, controlled activity area, and the instrument landing system critical areas. Describe what is being waived and why a waiver is necessary, or the proposed disposition of each violation.

(k). Compatible Land Use & Coordination - Describe any local and/or regional planning efforts and zoning ordinances in effect or anticipated which would have an effect on or be affected by the airport development. Obtain and append to the Report evidence that the ALP was coordinated with appropriate local and national governmental units (e.g., City, District Assemblies or Metropolitan Planning Authority, Ghana Highway Authority, Urban Roads, Utility Companies, etc.), and found to be consistent with their plans.

(l). Visual Aids - Description of proposed type of Markings, Lighting and other Visual aids where applicable

(m). Subgrade Characteristics - The strength of the subgrade soil may not be known at this stage of the process. However, visual description of the nature of in-situ soil should be provided. When the site had been approved, detail sieve analysis, specific gravity, hydrometer analysis, Atterberg limits and CBR analysis will be required to aid in the pavement design, evaluation and approval.

(n). Acoustical report and noise mitigation plan – Provide noise impact analysis. This is accomplished by supporting with appropriate Noise Exposure Maps (NEM) for each type of runway.

An independent acoustical report and a noise mitigation plan may be required by the Environmental Protection Agency (EPA) for approval. The plan must include a discussion of preferred approach/departure flight paths, preferred approach/departure path slopes, preferred approach/departure airspeeds, preferred times of use, and other relevant factors. In addition, the plan must include a discussion of the existing physical factors, such as topography and proposed physical barriers, such as walls, fences, structures or vegetation, and how these factors would be used to reduce noise impacts.

(3) Airport Airspace Analysis

The Airport Airspace Analysis which plays major role in the Airspace Review process includes *physical drawings* and a *supporting narration.* The narration on Airport Airspace Plan could be separate document or combined with the Project Exposition depending on the complexity of the project.

(a) Consideration should be given to all obstacles that may impact on the airspace of the proposed aerodrome. There is the need to conduct primary survey of obstacles in the vicinity of the aerodrome.

Provide drawing of the Obstacle Limitation Surfaces (OLS) as standards requirement for all types of operations, and additional PAN-OPS Obstacle Identification Surface (OIS) for planned instrument operations.

Significant terrain or man-made obstacles should be indicated on the map and where possible cover areas beyond the limits of OLS.

Narration should include visual maneuvering altitudes, OLS and OIS clearances, and departure and arrival procedures.

Note: Appendix 4 of GCA AC, "Preparation of Airport Master Plans or Airport Layout Plan Set & Submittal Guidelines (ASAS) provides useful information regarding the preparation of Airport Airspace Plans.

(b) Identify nearby aerodromes and air routes and plot Visual and IFR patterns, where appropriate, on aeronautical chart if available or equivalent, to demonstrate lateral and vertical separations from nearby traffic. Provide analysis of potential traffic conflict between neighboring aerodromes.

(c) Should the proposed development have any effect on existing Instrument Approach, Missed Approach, and Visual Maneuvering (Circling) Procedures, including SIDS and STARS, details should be included in the narrative report to the GCAA for the full impact to be considered by the appropriate units.

(4) Airport Property Boundary and Location Map

A drawing depicting the proposed development, property boundaries, and a location map. The drawing must show the runway location and orientation on the property. All adjacent property owners name and address must be included on the drawing.

(5) Land use Plans

A drawing showing land uses in the vicinity of aerodrome choice location.

(a). The drawing should show areas of human settlements, sensitive areas, schools, hospitals, churches and other places of human congregation or dense population.

(b). Runway Protection Zones, Accident Potential Zones (RPZ) and clear areas must be shown on this drawing.

(c). The drawing should indicate agricultural uses and limits of 3km and 8km bird circles for landfill sites

(d). The drawing should show existing and projected Noise Exposure Maps (NEM) based on 5 years projection. Indicate as minimum, the 65Ldn contour range and where appropriate, provide Noise Compatibility Programme (NCP) in the narrative. The compatibility of existing and planned land uses in the vicinity of an airport is usually associated with the extent of the airport's noise impacts. (Refer to GCAR Part 22, Section III)

Part II – Landing Area Proposal for Operations of Rotary Wing Aircraft (Heliport)

With a covering letter, submit the following to the Director General of Ghana Civil Aviation Authority (GCAA):

(1) Completed Application Form, "Application for Landing"

A completed form provides information on the proposed aerodrome location, proximity to other landing areas and obstructions, type of facility and landing area specifics.

(Note: Instructions for completing the application form can be found on pages 3&4 of the form)

Information on the form provides GCAA with brief description of the aerodrome and its environments. Initial information required to be gathered for completion of the form and to aid in the site evaluation heliports are as follows:

(a). Other Landing Areas in the Vicinity

- List VFR airports within 3nm
- List heliports within 3nm
- List IFR airports within 10nm

(b). Obstructions

List and plot on map any obstructions within:

- List and plot on map any obstructions within 5,000 feet of a heliport

(c). Human Settlements

- List schools, churches and residential communities within a 1nm radius of heliport

(d). Disposal Sites

- List all waste disposal sites within a 5nm radius.

(2) Project Exposition Manual

All applications for helicopter landing facilities must include Project Exposition Manual which provides comprehensive narratives regarding the project to be submitted in addition Application Form and Airspace Plan/Drawing as part of application package. Typical content of the Project Exposition Manual shall include but limited to the following information:

I. INTRODUCTION

(a) Purpose and justification for the project, including name, type of landing site, basic geographical information.

(b) Inventory - Includes data on existing airport facilities, aviation activity (total operations, itinerant operations, and instrument operations), based aircraft information and critical aircraft characteristics. This element may also include the results of a need study or user survey where the planned improvements require documentation of need.

(c) Operational Considerations. The operational information, such as the proposed hours of operation; the number, type and size of aircraft to be located at or expected to use the site; maximum number of helicopter trips on a daily, weekly, and annual basis; and the purpose of the helicopter trips and any resulting public benefits.

Frequency of flight, tonnage to be handled, estimated heliport life, and the number of helicopters to be accommodated is the operational considerations that influence heliport criteria. Design life indicates the total number of loadings the surface will

sustain. The number of helicopters to be accommodated and tonnage to be handled establish taxiway, parking, and other hardstand requirements.

(d) Design Aircraft. Both physical and performance characteristics of most demanding aircraft expected to use the landing site.

Helicopter characteristics that influence heliport strength requirements are weight, landing-gear configuration, and tire pressure. Ground run and dimension characteristics affect heliport geometric layouts,

(e) Wind Data Analysis- Discuss the wind data and coverage. Identify the source, period covered, and the number of observations. If applicable, determine the best alignment for the primary and/or the crosswind runway for optimum wind coverage.

(f) Site Selection - Include a discussion of the factors which influenced site location, such as: airspace, environmental considerations, community needs, airport access, land availability, total costs, and engineering factors which may affect site development. Availability of emergency sites, determined by obstacle environment and planned class of performance operations.

(g) Alternative Analysis - Briefly discuss and analyze the obvious alternatives. Explain why the selected alternative was chosen.

II. HELICOPTER LANDING SITE DETAILS

(a) Location:
(b) Geographic Reference Point(Geometric centre of helipad):
(c) Helipad elevation

III. HELICOPTER PHYSICAL CHARACTERISTICS

(a). Overview. Brief description of Helipad type, size and surface; lighting and markings; tie-downs; location; and fencing.

(b). Flight paths. Details of landing site regarding direction, angles, and number of approaches (ingress) and departures (egress). An approach/departure flight path site plan showing proposed flight path locations, widths, lengths, slopes, nearby obstructions, and other necessary details.

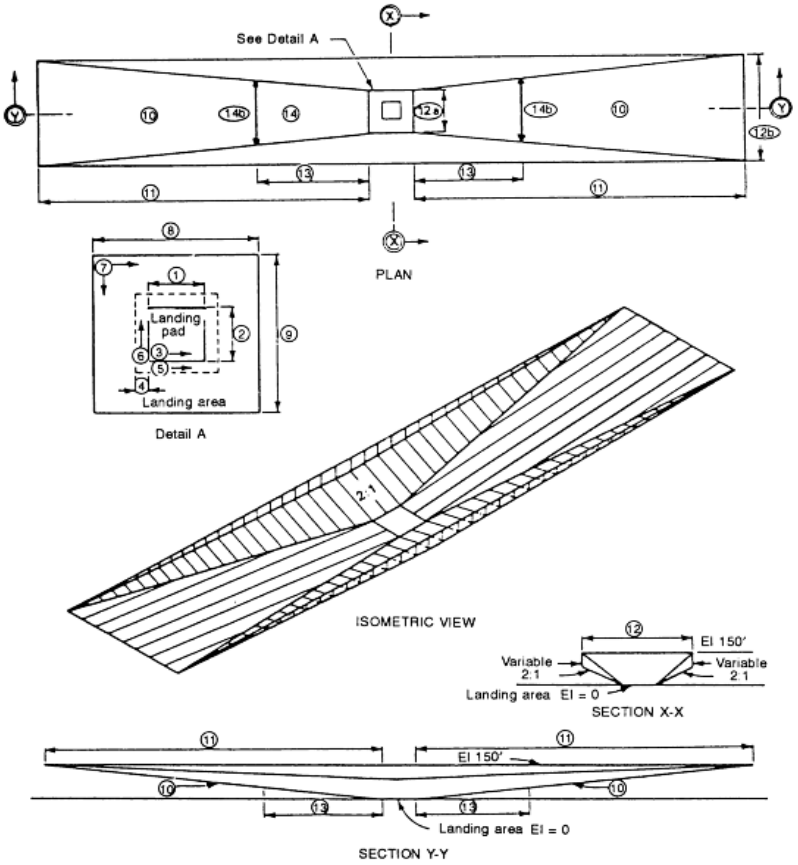
(c). Site Description and layout plan. A detailed site plan of the project showing helipad elements such as the layout of the aircraft landing and parking spaces, fire suppression equipment and access, auto parking areas, fences, landscaping, lights, walkways, adjacent streets and other details which relate to the development standards. Also included are Safety areas & Potential Zones, Object Distances and Propeller Downwash, Operational Weight Limits where applicable and Description of Helipad Access and Protection of People.

The first step in the design of such facilities is to identify the types and amount of traffic that will use the heliport or helipad. Next, establish requirements for geometric dimensions, surface types, and service facilities. Determine subgrade strength, design load, and design life to determine the proper surface type. There may be need for soil-stabilization requirements. Procedures for marking and lighting heliports and helipads are also discussed.

Factors that influence the development of heliport design criteria are helicopter characteristics, operational considerations, surface type requirements and dust-proofing. Location, traffic area, and safety also affect the design of heliports.

The geometric design requirements for helicopter landing areas can be simplified into four basic types: helipads (surface, elevated), heliports with taxi-hoverlanes and heliports with runways.

The geometric layout and section views of a helipad are shown in Figure below.



(d). **Visual Aids**. Description of Markings & Lighting where applicable (*Identification Marking, FATO, TLOF and Safety Area Marking)* & Wind Direction Indicators.

(e). **Subgrade Strength.** The strength of the subgrade soil must be known to determine the best type of heliport and helipad surface. The type and number of

soil test required depend on the characteristics. Generally, sieve analysis, specific gravity, hydrometer analysis, Atterberg limits and CBR analysis test are required.

(f). Surfacing and Dust proofing. Heliport surfaces are designed to withstand the load applied by the helicopter. This load is distributed to the heliport surface at several points in a pattern determined by the landing gear configuration. The loading for each wheel is determined by the total wheel load and the dimensions of the tire area in contact with the heliport surface. The contact area dimensions are influenced by tire pressure. The heliport surface must have sufficient strength to resist repeated applications of maximum unit loads.

Unpaved heliport traffic areas are brought to design strength by removing and replacing inadequate soils, compacting soil, and applying a bituminous pavement. Landing mats eliminate the need for these operations or reduce the time required to perform them. The mats are placed on low-strength soils to provide support for helicopter operations.

Membranes provide waterproofing and dustproofing on soils that have adequate strength for airfield traffic areas.

(g). Waivers & Modifications to GCAR Design Standards - Rationale for unusual design features and/or modification to GCAA Manual of Standards. Identify any existing waiver and the date granted. Determine if any additional waivers that are necessary. Identify the violations to all GCAR standards including: approach surfaces, runway and taxiway separation distances, runway and taxiway safety areas, building restriction lines, controlled activity area, and the instrument landing system critical areas. Describe what is being waived and why a waiver is necessary, or the proposed disposition of each violation.

(h). Compatible Land Use & Coordination- Describe any local and/or regional planning efforts and zoning ordinances in effect or anticipated which would have an effect on or be affected by the airport development. Obtain and append to the Report evidence that the ALP was coordinated with appropriate local and national governmental units (e.g., City, District Assemblies or Metropolitan Planning Authority, Ghana Highway Authority, Urban Roads, Utility Companies, etc.), and found to be consistent with their plans.

In general an ad hoc helicopter site will not attract the need for local authority planning consent unless it is intended for use more frequently in any calendar year. However, if any permanent structure is erected in connection with its use as a helicopter site, such as a hangar or hard standing, or if individual local council policies so demand, it may be necessary to obtain planning consent. It is always advisable to talk with the Local Planning Authority if there is any doubt as to the effect of such a site on the local community. For those sites intended for irregular, periodic use and for sites in congested areas it is also necessary that the local police are informed of any intended flying activity.

Note - Remember the primary purpose of the narrative report is to provide <u>useful</u> and <u>understandable</u> information and guidance to the airport sponsor. It also provides the GCAA with important information needed to review and ultimately approve the Helicopter Landing Site.

(i). Acoustical report and noise mitigation plan. An independent acoustical report and a noise mitigation plan may be required by Environmental Protection Agency (EPA) for approval. The plan must include a discussion of preferred approach/departure flight paths, preferred approach/departure path slopes, preferred approach/departure airspeeds, preferred times of use, and other relevant factors. In addition, the plan must include a discussion of the existing physical factors, such as topography and proposed physical barriers, such as walls, fences, structures or vegetation, and how these factors would be used to reduce noise impacts.

There may be need for Noise Impact Boundary Analysis. Please see Appendices III and IV for indication Environmental Requirements.

(3) Heliport Airspace Analysis

The Heliport Airspace Analysis which plays major role in the Airspace Review process includes *physical drawings* and a *supporting narration.* The narration on Heliport Airspace Plan could be separate document or combined with the Project Exposition depending on the complexity of the project.

(a) Consideration should be given to all obstacles that may impact on the airspace of the proposed aerodrome. There is the need to conduct primary survey of obstacles in the vicinity of the aerodrome.

Provide drawing of the Obstacle Limitation Surfaces (OLS) as standard requirements for all types of operations, and additional PAN-OPS Obstacle Identification Surface (OIS) for planned instrument operations. The following form parts of OLS:

i. Approach & Departure Surface
ii. Transitional Surface
iii. Inner Horizontal Surface
iv. Conical Surface

Determine if there are or will be any obstructions to Obstacle Limitation Surfaces. Discuss obstacle penetrations and their proposed disposition. Significant obstacles include actual OLS penetrations and close-in obstacles (i.e. within 10ft elevation of any surface).

Significant terrain or man-made obstacles should be indicated on the map and where possible cover areas beyond the limits of OLS.

Discuss the existing and future runway approaches. Narration should include visual maneuvering altitudes, OLS and OIS clearances, and departure and arrival procedures.

Identify any existing determinations of no hazard and the date granted. Determine if any additional determinations of no hazards are necessary. Describe the object and why a determination of no hazard is necessary.

Note: Appendix 4 of GCAA AC, "Preparation of Airport Master Plans or Airport Layout Plan Set & Submittal Guidelines (ASAS) provides useful information regarding the preparation of Airport Airspace Plans.

(b) Should the proposed development have any effect on existing Instrument Approach, Missed Approach, and Visual Maneuvering (Circling) Procedures, including SIDS and STARS, details should be included in the narrative report to the GCAA for the full impact to be considered by the appropriate units.

(c) Identify nearby aerodromes and air routes and plot Visual and IFR patterns, where appropriate, on aeronautical chart if available or equivalent, to demonstrate lateral and vertical separations from nearby traffic. Identify airspace overlaps, any restrictions and preferred operating directions

(d) Explore communications and airspace coordination tissues to arise. Where helicopter landing sites are established close to operating aerodromes, especially within an Aerodrome Traffic Zone (ATZ), or otherwise within a radius of 2nautical miles from any aerodrome, details of the site must be given to that aerodrome management or Air Traffic Service (ATS). The aerodrome management and/or ATS will need to mark the location of the site on their charts and maps in order to provide adequate local briefing and safe and speedy reaction to dealing with radio calls from helicopter pilots using the site. Pilots operating to these sites must comply with the aerodrome procedures when operating within the ATZ.

Heliport site owner has the duty of care to ensure that the helicopter landing site information is lodged with the aerodrome(s) concerned. The information can consist simply of the name of the site; the grid reference; and a contact telephone number.

In this context, "aerodrome" means any location where aviation activities are to be expected, for example; large and small civil and military airfields and airports, gliding club locations, flying club locations, microlight centres, parachuting centres, other helicopter landing sites etc.

(4) Location Map

A drawing depicting the proposed development, property boundaries, and a location map. The drawing must show the helipad location and orientation on the property.

(5) Airport Property Boundary and Land use Plans

A drawing showing land uses in the vicinity of aerodrome choice location.

(a). The drawing should show areas of human settlements, sensitive areas, schools, hospitals, churches and other places of human congregation or dense population.

(b). Runway Protection Zones, Accident Potential Zones (RPZ) and clear areas must be shown on this drawing.

(c). The drawing should indicate agricultural uses and limits of 3km and 8km bird circles for landfill sites

(d). The drawing should show existing and projected Noise Exposure Maps (NEM) based on 5 years projection. Indicate as minimum, the 65Ldn contour range and where appropriate, provide Noise Compatibility Programme (NCP) in the narrative. The compatibility of existing and planned land uses in the vicinity of an airport is usually associated with the extent of the airport's noise impacts. (Refer to GCAR Part 22, Section III)

(e). All adjacent property owners name and address must be included on the drawing. The plan must show land uses in the vicinity of heliport choice location.

APPENDIX II

Runway Location & Orientation

(1) Number of runways and Usability Factor

(a) The number of runways must be sufficient to meet air traffic demands, which consist of the number of aircraft arrivals and departures, and the mixture of aircraft types, to be accommodated in one hour during the busiest periods.

(b) The number and orientation of runways at an aerodrome should meet the usability factor of 95% or more for the aeroplane that the aerodrome is intended to serve. In the application of the 95% usability factor it should be assumed that landing or take-off of aeroplanes is, in normal circumstances, precluded when the cross-wind component exceeds:

— 37 km/h (20 kt) in the case of aeroplanes whose reference field length is 1 500 m or over, except that when poor runway braking action owing to an insufficient longitudinal coefficient of friction is experienced with some frequency, a cross-wind component not exceeding 24 km/h (13 kt) should be assumed;
— 24 km/h (13 kt) in the case of aeroplanes whose reference field length is 1 200 m or up to but not including 1 500 m; and
— 19 km/h (10 kt) in the case of aeroplanes whose reference field length is less than 1 200 m.

(2) Location of Threshold

(a) The threshold is normally located at the extremity of a runway (*if there are no obstacles penetrating above the approach surface)*. In some cases, however, due to local conditions it may be desirable to displace the threshold permanently (see paragraph c). When studying the location of a threshold, consideration should also be given to the height of the ILS reference datum and the determination of the obstacle clearance limits. *(Specifications concerning the height of the ILS reference datum are given in Annex 10, Volume I*.)

(b) In determining that no obstacle penetrates above the ***approach surface***, account should be taken of ***mobile objects*** (vehicles on roads, trains, etc.) at least within that portion of the approach area within 1 200 m longitudinally from the threshold and of an overall width of not less than 150 m.

(c) If an object extends above the approach surface and the object cannot be removed, consideration should be given to displacing the threshold permanently.

(d) To meet the obstacle limitation objectives, the threshold should ideally be displaced down the runway for the distance necessary to ensure that the approach surface is clear of obstacles.

(e) However, displacement of the threshold from the runway extremity will inevitably cause reduction of the landing distance available, and this may be of greater operational significance than penetration of the approach surface by marked and lighted obstacles. A decision to displace the threshold, and the extent of such displacement, should therefore have regard to an optimum balance between the considerations of clear approach surfaces and adequate landing distance. In deciding this question, account will need to be taken of the types of aeroplanes which the runway is intended to serve, the limiting visibility and cloud base conditions under which the runway will be used, the position of the obstacles in relation to the threshold and extended centre line and, in the case of a precision approach runway, the significance of the obstacles to the determination of the obstacle clearance limit.

(f) Notwithstanding the consideration of landing distance available, the selected position for the threshold should not be such that the obstacle-free surface to the threshold is steeper than 3.3% where the code number is 4 or steeper than 5% where the code number is 3.

(3) Wind Data Analysis

Wind directions are relative to true north. Analysis of wind data is done to determine runway orientation.

(a) A factor influencing runway orientation and number of runways is wind. Ideally a runway should be aligned with the prevailing wind. Wind conditions affect all airplanes in varying degrees. Generally, the smaller the airplane, the more it is affected by wind, particularly crosswind components. Crosswinds are often a contributing factor in small airplane accidents.

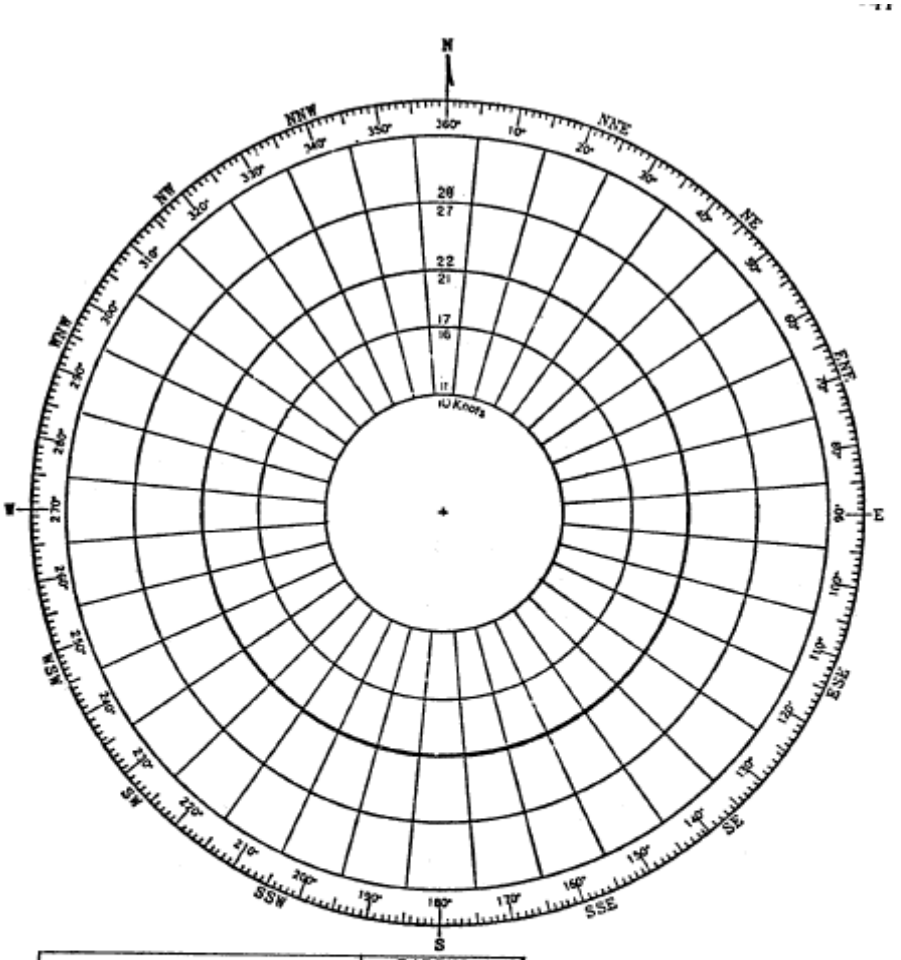
(b) Airport planners and designers should make an accurate analysis of wind to determine the orientation and number of runways. In some cases, construction of two runways may be necessary to give the desired wind coverage (95 percent coverage). The proper application of the results of this analysis will add substantially to the safety and usefulness of the airport.

(c) The crosswind component of wind direction and velocity is the resultant vector which acts at a right angle to the runway. Refer to paragraph 1(b) of this appendix or Appendix I (8) for allowable crosswind components.

(d) Two Procedures are involved in Analysis of Wind data. One wind analysis procedure uses a scaled graphical presentation of wind information known as a windrose. The other wind analysis procedure uses a computer program.

(i) ***Drawing the Windrose***. The standard windrose (figure A2-1) is a series of concentric circles cut by radial lines. The perimeter of each concentric circle represents the division between successive wind speed groupings. Radial lines are drawn so that the area between each successive pair is centered on the direction of the reported wind.

Each segment of the windrose represents a wind direction and speed grouping corresponding to the wind direction and speed grouping on the Meteorological data summary. The recorded directions and speeds of the wind summary are converted to a percentage of the total recorded observations. Computations are rounded to the nearest one-tenth of 1 percent and entered in the appropriate segment of the windrose. Figure A2-3 illustrates a completed windrose based on data from figure A2-2. Plus (+) symbols are used to indicate direction and speed combinations which occur less than one-tenth of 1 percent of the time.



WIND SPEED DIVISIONS		RADIUS OF CIRCLE (KNOTS)
KNOTS	M.P.H.	
0 - 3.5	0 - 3.5	* 3.5 Units
3.5 - 6.5	3.5 - 7.5	* 6.5 "
6.5 - 10.5	7.5 - 12.5	10.5 - "
10.5 - 16.5	12.5 - 18.5	16.5 - "
16.5 - 21.5	18.5 - 24.5	21.5 - "
21.5 - 27.5	24.5 - 31.5	27.5 - "
27.5 - 33.5	31.5 - 38.5	*33.5 - "
33.5 - 40.5	38.5 - 46.5	*40.5 - "
40.5 - over	46.5 - over	

*May not be needed for most windrose analyses.

Figure A2-1. Windrose blank showing direction and divisions

WIND DIRECTION VERSUS WIND SPEED

STATION: Anywhere, USA HOURS: 24 Observations/Day PERIOD OF RECORD: 1964-1973

DIRECTION	HOURLY OBSERVATIONS OF WIND SPEED										AVERAGE SPEED	
	KNOTS											
	0-3	4-6	7-10	11-16	17-21	22-27	28-33	34-40	41 OVER	TOTAL	KNOTS	MPH
	MPH											
	0-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	47 OVER			
01	469	842	568	212						2091	6.2	7.1
02	568	1263	820	169						2820	6.0	6.9
03	294	775	519	73	9					1670	5.7	6.6
04	317	872	509	62	11					1771	5.7	6.6
05	268	861	437	106						1672	5.6	6.4
06	357	534	151	42	8					1092	4.9	5.6
07	369	403	273	84	36	10				1175	6.6	7.6
08	158	261	138	69	73	52	41	22		814	7.6	8.8
09	167	352	176	128	68	59	21			971	7.5	8.6
10	119	303	127	180	98	41	9			877	9.3	10.7
11	323	586	268	312	111	23	28			1651	7.9	9.1
12	618	1397	624	779	271	69	21			3779	8.3	9.6
13	472	1375	674	531	452	67				3571	8.4	9.7
14	647	1377	574	281	129					3008	6.2	7.1
15	338	1093	348	135	27					1941	5.6	6.4
16	560	1399	523	121	19					2622	5.5	6.3
17	587	883	469	128	12					2079	5.4	6.2
18	1046	1984	1068	297	83	18				4496	5.8	6.7
19	499	793	586	241	92					2211	6.2	7.1
20	371	946	615	243	64					2239	6.6	7.6
21	340	732	528	323	147	8				2078	7.6	8.8
22	479	768	603	231	115	38	19			2253	7.7	8.9
23	187	1008	915	413	192					2715	7.9	9.1
24	458	943	800	453	96	11	18			2779	7.2	8.2
25	351	899	752	297	102	21	9			2431	7.2	8.2
26	368	731	379	208	53					1739	6.3	7.2
27	411	748	469	232	118	19				1997	6.7	7.7
28	191	554	276	287	118					1426	7.3	8.4
29	271	642	548	479	143	17				2100	8.0	9.3
30	379	873	526	543	208	34				2563	8.0	9.3
31	299	643	597	618	222	19				2398	8.5	9.8
32	397	852	521	559	158	23				2510	7.9	9.1
33	236	721	324	238	48					1567	6.7	7.7
34	280	916	845	307	24					2372	6.9	7.9
35	252	931	918	487	23					2611	6.9	7.9
36	501	1568	1381	569	27					4046	7.0	8.0
00	7729									7729	0.0	0.0
TOTAL	21676	31828	19849	10437	3357	529	166	22		87864	6.9	7.9

Figure A2-2. Typical Meteorological wind summary

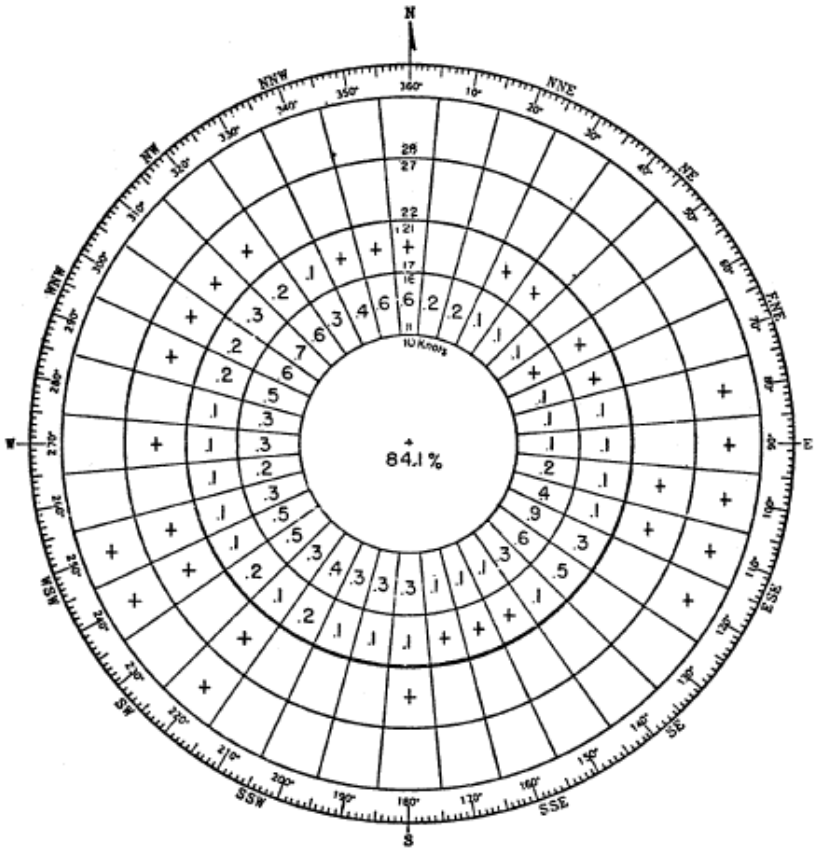
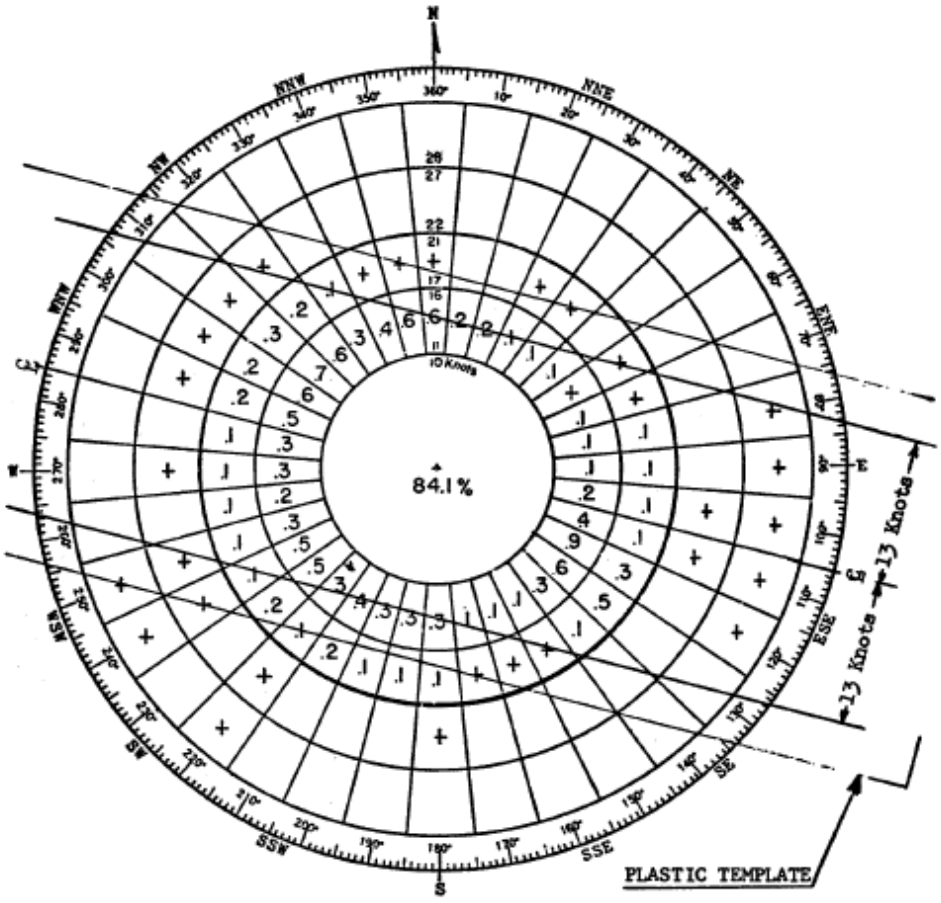


Figure A2-3. Completed windrose using A2-2 data

Crosswind Template. A transparent crosswind template is a useful aid in carrying out the windrose analysis. The template is essentially a series of three parallel lines drawn to the same scale as the windrose circles. The allowable crosswind for the runway width establishes the physical distance between the outer parallel lines and the centerline. When analyzing the wind coverage for a runway orientation, the design crosswind limit lines can be drawn directly on the windrose.

Note: Meteorological wind directions are recorded on the basis of true north.

Analysis Procedure. The purpose of the analysis is to determine the runway orientation which provides the greatest wind coverage within the allowable crosswind limits. This can be readily estimated by rotating the crosswind template about the windrose center point until the sum of the individual segment percentages appearing between the outer "crosswind limit" lines is maximized. It is accepted practice to total the percentages of the segments appearing outside the limit lines and to subtract this number from 100. For analyses purposes, winds are assumed to be uniformly distributed throughout each of the individual segments. Figures A2-4 illustrate the analysis procedure as it would be used in determining the wind coverage for a runway, oriented 105-285, intended to serve all types of airplanes. The wind information is from figure A2-2. Several trial orientations may be needed before the orientation which maximizes wind coverage is found.



A runway oriented 105 – 285 (true north) would have 2.72% of the winds exceeding the design crosswind/crosswind component of 13 knots

Figure A2-4. Completed windrose using A2-2 data

Conclusions. The example wind analysis shows that the optimum wind coverage possible with a single runway and a 13-knot crosswind is 97.28 percent. If the analysis had shown that it was not possible to obtain at least 95-percent wind coverage with a single runway, then consideration should be given to provide an additional (crosswind) runway oriented to bring the combined wind coverage of the two runways to at least 95 percent.

Presumptions. The analysis procedures presume that winds are uniformly distributed over the area represented by each segment of the windrose. The larger the area, the less accurate is this presumption. Therefore, calculations made using nonstandard windrose directions or speeds result in a derivation of wind coverage (and its associated justification for a crosswind runway) which is questionable.

(ii) ***Computer wind analysis***. There are number of commercially available softwares for generating wind coverage out of processed data such as Figure A2-2.

APPENDIX III

Suggested Checklist to Support Environmental Review

The preparer of this checklist should have knowledge of the environmental features of the aerodrome and general potential impacts associated with the proposed development. Although some of the responses may be obtained from the preparer's own knowledge and observations, previous environmental documents and current agency correspondence should be cited.

Aerodrome Name and Location	
Complete Project Description	
Estimated Start Date	

	Environmental Resource Area Review for Potential Effects and Impacts	**Impact Anticipated ?**		**Documentation Attached / Remarks**
		Yes	No	
1.	**Air quality:** Will the project have the potential to increase landside or airside capacity, including an increase of surface vehicles? *Check for acceptable levels of air pollutant*			
2.	**Archaeological:** Will action have an effect on property included in or eligible for State, Tribal or local historical, archeological, or cultural significance? <u>Check all appropriate boxes</u> ☐ Project does not involve any disturbance of previously undisturbed ground. ☐ Project involves disturbance of previously undisturbed ground Coordination and concurrence with State Organization responsible for historical preservation is advised. The Aerodrome Sponsor shall ensure that construction specifications include conditions required by the state organization regarding			

	Environmental Resource Area Review for Potential Effects and Impacts	**Impact Anticipated ?**		**Documentation Attached / Remarks**
		Yes	No	
	unknown items found during construction.			
3.	**Biotic communities:** Will the project impact plant communities and/or cause displacement of wildlife?			
4.	**Coastal resources:** Will the project occur in, or impact a coastal zone as defined by the State Coastal Zone Management Plan?			

	Environmental Resource Area Review for Potential Effects and Impacts	**Impact Anticipated ?**		**Documentation Attached / Remarks**
		Yes	No	
5.	**Compatible land use:** Will the project be inconsistent with plans, goals, policy, zoning or local controls that have been adopted for the area in which the airport is located?			
6.	**Construction impacts:** Will the project produce construction impacts, such as reducing local air quality, produce erosion or pollutant runoff, or disrupt local traffic patterns?			
7.	**Endangered species:** Is there any impact on any listed endangered, threatened, and candidate species (flora or fauna) or designated critical habitat? <u>Check all appropriate boxes</u> ☐ Project will not adversely affect the physical environment (land disturbance, vegetation removal, sedimentation, dust, noise/ waste/hazardous materials emission into the environment, etc.). ☐ Project will have an effect on the physical environment. Forest Commission or Dept of Wildlife documentation is required: ☐ Threatened or endangered species not present – Forest Commission or Dept of Wildlife concurrence attached			

	☐ Species present – Forest Commission or Dept of Wildlife agrees endangered or threatened species will not be impacted by the project. Review and consultation completed and attached. Project conditions required are listed in comments and shall be included in construction specification.			
8.	**Energy supply and natural resources:** Will the project impact energy supply of natural resources?			
9.	**Environmental justice:** Will the project cause any adverse and disproportionate impacts on minority and low-income populations?			
10.	**Essential fish habitat:** Is project located in or cause adverse effects to a waterway, stream, or water body? Check all appropriate boxes ☐ Project is not within or near a waterway, stream, or other body of water. ☐ Project is within or near a waterway, stream, or other body of water:			

	Environmental Resource Area Review for Potential Effects and Impacts	**Impact Anticipated ?**		**Documentation Attached / Remarks**
		Yes	No	
11.	**Farmland:** Will action involve acquisition and conversion of farmland? Check all appropriate boxes ☐ Project does not involve new disturbance of farmland.			
12.	**Migratory Bird Treaty Act:** Will the project have the potential to adversely impact birds protected by the migratory bird treaty act?			
13.	**Floodplains:** Will project be located in, encroach upon or otherwise impact a floodplain? Check all appropriate boxes ☐ Project is not located in and does not impact floodplains ☐ Project is located in floodplain and will not			

	negatively impact floodplains.			
14.	**Hazardous materials:** Does project involve or affect hazardous materials or involve construction in an area that contains hazardous materials and/or hazardous waste?			
15.	**Historic:** Will action have an effect on property included in or eligible for the National Register of Historic Places or other property of Tribal, State or local significance? Check all appropriate boxes ☐ Project does not involve any "Historic" Structures. ☐ Project does not involve any property of Tribal, State or local significance			
16.	**Light emissions:** Will the project produce significant light emission impacts to residential areas, schools, or hospitals?			
17.	**Natural resources:** Will action have significant impact on natural, ecological, cultural or scenic resources of national, or local significance?			
18.	**Parks, public lands, refuges and recreational resources:** Will project impact publicly owned land from a public park, recreation area, or wildlife of national or local significance, or land of a historic site with national or local significance?			
19.	**Surface transportation:** Will project cause a significant increase in surface traffic congestion or cause a degradation of level of service?			

	Environmental Resource Area Review for Potential Effects and Impacts	**Impact Anticipated ?**		**Documentation Attached / Remarks**
		Yes	No	
20.	**Noise levels:** Will project have a significant impact (DNL 1.5 dB or greater) on noise levels over noise sensitive areas (residences, schools, churches, hospitals) within the 65 DNL noise contour?			

	Check all appropriate boxes ☐ Project will enable a significant increase in aircraft operations. ☐ Project will enable a significant change in aircraft fleet mix. ☐ Project will cause a change in airfield configuration and/or use: ☐ Intermittent ☐ Temporary (i.e., less than 180 days) ☐ Long-term or permanent			
21.	**Water quality:** Will project have a significant impact to water quality to groundwater, surface water bodies, public water supply systems or violate water quality standards? Check all appropriate boxes ☐ Project will not produce water quality impacts or other modifications to groundwater, surface bodies, or public water supply systems. ☐ Project will produce water quality impacts or other modifications to groundwater, surface bodies, or public water supply systems. *The Aerodrome Sponsor shall ensure that EPA permits are obtained as required for construction projects and airport operation.*			
22.	**Wetlands:** Will project impact any wetlands? Check all appropriate boxes ☐ Project will not involve dredging or disposal of dredged material, or excavation, bank stabilization, filling or other changes to wetlands ☐ Project will involve dredging or disposal of dredged material, or excavation, bank stabilization, filling or other changes to wetlands			

	Environmental Resource Area Review for Potential Effects and Impacts	**Impact Anticipated ?**		**Documentation Attached**
		Yes	No	

23.	**Wild and Scenic Rivers:** Does action impact Wildlife Park or Scenic River?			
Other required environmental considerations				
24.	**Connected actions:** Are there other closely related actions that should be considered?			
25.	**Cumulative actions:** When viewed with other planned actions, are the project impacts significant?			
26.	**Cumulative impacts:** When considered together with other past, present, and reasonably foreseeable future development projects, on or off the airport, regardless of funding source, would the proposed project produce a significant cumulative effect?			
27.	**Environmental laws:** Is project inconsistent with any other state or local laws relating to environment?			
28.	**Highly controversial:** Is the proposed project likely to be highly controversial on environmental grounds? A proposed action is considered highly controversial when an action is opposed on environmental grounds by a state, or local government, or by a substantial number of persons affected by such action.			
29.	**Community disruption:** Will project cause disruption of a community, disrupt planned development or be inconsistent with plans or goals of the community?			
30.	**Relocation of housing:** Is the availability of adequate housing a highly controversial issue?			
31.	**Social impact:** Are residents or businesses being relocated?			
33.	**Similar actions:** Are there other similar state actions that would cause this project to be significant?			

APPENDIX IV

(1) Some Environmental Regulations in force in Ghana

Ghanaian legislation for environmental management is fragmented and it is recommended that relevant authorities are consulted for up to date information pertaining to legal requirements. It should be noted that there are changes being made to Ghanaian legislation and that this list will need to be updated. Lack of knowledge about the law is no defence.

The table below provides information about the authorities involved in environmental management and existing legislative requirements. Information is also provided about permits or written authority that may require for the undertaking of work related to road developments.

Relevant Authorities	Comments
Environmental Protection Agency (EPA) Act 1994 (Act 490)	Provides for the establishment of the Environmental Protection Agency (EPA) which carries legal authority to carry out a number of functions to protect the environment. The EPA is responsible for ensuring that the environmental assessment process is effectively implemented. They review Environmental Impact Assessment reports. The EPA is also responsible for pollution monitoring. They should be contacted for information on their standards for air and water quality. There are 10 regional offices responsible for air and water quality monitoring. The District Assemblies under the decentralization program are required to establish environmental management committees to assist EPA in its duties.
Environmental Assessment Regulation, L.I 1652 of 1999	These regulations have been established to ensure that all new investments and developments are undertaken in a manner that reduces any impact on the environment. The regulations lay down the procedures for obtaining an environmental permit for a new development.
Guidelines for Effluent Discharges into natural water bodies	Effluent quality guidelines for discharges into natural water bodies have been published by the EPA. These can be obtained from the EPA
Environmental Quality Guidelines for Ambient Air	Published by EPA and can be obtained from EPA

Environmental Quality Guidelines for Ambient Noise Level	Published by EPA and can be obtained from EPA

Relevant Authorities	**Comments**
Community Water and Sanitation Agency Act 1998 (Act 564)	The Act provides for regulations to be made for the setting of standards and guidelines for safe water supply and sanitation services. Community Water and Sanitation Agency is responsible for facilitating the safe provision of water and related sanitation services in rural communities. One of its defined functions is the facilitation of formal and non-formal educational programs for water related health hazards and sanitation hygiene in conjunction with Ministries of Local Government, Environmental, Health and Education.
Water Resource Commission	This is the responsible body for the granting of water rights for the use for water activities other than domestic use and for firefighting purposes. It also carries a responsibility for controlling activities that will pollute water resources or put the public health at risk. Water Resources Commission Act, 1996 (Act 522), Part III provides for regulation of the use of water resources. Under section 13 (1) no person shall; (a) divert, dam, store, abstract or use water resources; or (b) construct or maintain any works for the use of water resources except in accordance with the provision of this Act. Section 21 allows the Commission to convict a person who interferes with or alters the flow or pollutes a water resource beyond standards set by the Environmental Protection Agency. An application to the Commission for grant of water right is required for the use of water under the provisions of this Act.

[2]Forestry Commission Act, 1999 (Act 571)	The Forestry Commission was established under the enactment of the Forestry Commission Act, 1999 (Act 571) for the purposes of bringing the main public bodies and agencies implementing the functions of protection, development, management and regulation of forests and wildlife resources. The Forestry Commission is responsible for directing the management of all savannah woodland reserves. The Forestry Commission consists of 4 divisions: • Forest Service Division • Forest Products Inspection Division • Timber Export Development Division and Wildlife
Forest Protection Decree (N.R.C.D 273, 1974)	Provides for the protection of Forest Reserves from all forms of encroachment. This decree restricts entry to a reserve to carry out any activity that may cause injury or removal of any plant or forest produce or obstruct the flow of any river or stream. It also specifies types of forest offences, penalties and the duties of forest officers relating to the prevention of the commission of offences and the arrest of the offenders. Permission would be required from an appropriate official for the undertaking of works in a forest reserve.

Relevant Authorities	**Comments**
Trees and Timber Decree (N.R.C.D. 273, 1974) Amended in 1994	This provides for the prevention of destruction of trees and timber and the control of farming in Protected Timber Lands.
Timber Resources Management Act, 1997 (Act 547)	This act provides for the granting of Timber rights in a manner that secures the sustainable management and utilization of Timber Resources of Ghana and to provide for related purposes. Its main purpose is to manage harvesting of Timber of commercial activity rather than for the felling of trees to clear areas for development.
[3]Wild Animals Preservation Act, 1961 (Act 43)	This is the framework Act and since its enactment a number of subsidiary legislative instruments have been enacted. The key legislative instruments that may impact on road projects are discussed below.

[2] The main national resource management policy is embodied in the Forestry and Wildlife Policy and the Forest Development Master Plan (1996 – 2000). In support of this policy a number of reforms are being undertaking with respect to forest revenue policy, concessions, allocation procedures, restructuring of sector institutions responsible for natural resource management and environmental management coordination. Some work on the reforms has started with enactment of the Timber Resources Management Act, No. 547 of 1997 and Forestry Commission Act No. 571 of 1999 and the development of new wildlife legislation.

[3] The Wildlife Division has produced a publication that compiles all the legislative instruments relating to management of wildlife and wildlife reserves in Ghana.

Wildlife Conservation Regulations, LI 684 of 1971	Prohibits hunting without a game license
Wildlife Reserve Conservation Regulations, LI 710 of 1971	Defines the wildlife reserves in Ghana and prohibits entry into them and damage to animals and plants in the reserves without the consent of the Chief Wildlife Officer. Permissions would be required from an appropriate official for the undertaking of any works in a wildlife reserve.
National Development Planning (system) Act, 1994(Act 480)	Under this Act District Planning Authorities and their coordinating units are required to ensure that any planning and development activities are undertaken" in conformity with sound environmental principles"(Section 2(1)(e)). District Assemblies also carry a responsibility to ensure that any new developments within their area of jurisdiction conform to good environmental practice.
National Museum Decree (N.L.C.D. 387, 1969)	Under this Decree the Ghana Museum and Monuments Boards is to be informed of any discovery of an antiquity and permission to be sought to remove an antiquity, as defined by the decree from a site.
Ghana Highways Authority Act, 1997; State Property and Contracts Act, 1960; State Lands Act, 1962 (Act 125); Lands (Statutory Wayleaves) Act, 1963(Act 186)	These pieces of legislation set out the requirements for land acquisition and compensation for road developments. The recently published National Land Policy by the Ministry of Lands and Forestry, (1999) should also be referred to as it sets out provisions for more equitable land management practices and covers aspects relating to land acquisition and compensation.
Ministry of Health	Responsible for HIV/AIDS awareness campaigns
District Assemblies	They may have local by-laws that relate to environmental management, e.g. permits for the extraction of pit sand, borrow material, etc.

(2) Some Environmental Regulations in force in Ghana

Six international conventions focus on biodiversity issues:

	International Convention	Comments
1.	**Convention on Biological Diversity**	The Convention on Biological Diversity or 'CBD' (year of entry into force: 1993) The objectives of the CBD are the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising from commercial and other utilization

		of genetic resources. The agreement covers all ecosystems, species, and genetic resources. Contracting parties to the CBD must develop national strategies, plans or programmes for the conservation and sustainable use of biological diversity or adapt for this purpose existing strategies, plans or programmes which shall reflect, *inter alia*, the measures set out in the Convention relevant to the Contracting Party concerned. Parties must integrate, as far as possible and as appropriate, the conservation and sustainable use of biological diversity into relevant sectoral or cross-sectoral plans, programmes and policies.
2.	**Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)**	The Convention on International Trade in Endangered Species of Wild Fauna and Flora, or 'CITES' (1975) The CITES aims to ensure that international trade in specimens of wild animals and plants does not threaten their survival. Through its three appendices, the Convention accords varying degrees of protection to more than 30,000 plant and animal species.
3.	**Convention on the Conservation of Migratory Species of Wild Animals**	The CMS, or the Bonn Convention aims to conserve terrestrial, marine and avian migratory species throughout their range. Parties to the CMS work together to conserve migratory species and their habitats by providing strict protection for the most endangered migratory species, by concluding regional multilateral agreements for the conservation and management of specific species or categories of species, and by undertaking co-operative research and conservation activities.

(Source: http://www.cbd.int)

	International Convention	Comments
4.	**The International Treaty on Plant Genetic Resources for Food and Agriculture**	The International Treaty on Plant Genetic Resources for Food and Agriculture (2004) 6. The World Heritage Convention (1972) The objectives of the Treaty are the conservation and sustainable use of plant genetic resources for food and agriculture and the fair and equitable sharing of the benefits arising out of their use, in harmony with the Convention on Biological Diversity, for sustainable agriculture and food security. The Treaty covers all plant genetic resources for food and agriculture, while its Multilateral System of Access and Benefit-sharing covers a specific list of 64 crops and forages. The Treaty also includes provisions on Farmers' Rights.
5.	**Convention on Wetlands (popularly known as the Ramsar Convention)**	The Ramsar Convention on Wetlands of International Importance especially as Waterfowl Habitat (1971) The Ramsar Convention provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. The convention covers all aspects of wetland conservation and wise use, recognizing wetlands as ecosystems that are extremely important for biodiversity conservation in general and for the well-being of human communities.
6.	**World Heritage Convention (WHC)**	The primary mission of the WHC is to identify and conserve the world's cultural and natural heritage, by drawing up a list of sites whose outstanding values should be preserved for all humanity and to ensure their protection through a closer co-operation among nations.

(Source: http://www.cbd.int)