ICAO RBIS TOD PROJECT

TERRAIN AND OBSTACLES DATA

OVERSIGHT OF TOD IMPLEMENTATION PROCEDURE TEMPLATE

Doc No. AFI_AIM_RBIS_TOD_PROC_TMP

0. DOCUMENT ADMINISTRATION

0.1. APPROVAL PAGE

	Position	Name and Signature	Date
Prepared by			
Reviewed by			
Approved by			

0.2. LIST OF EFFECTIVE PAGES

List of Effective Pages	
Page Number	Revision Date

0.3. RECORD OF AMENDMENTS AND CORRIGENDA

Record of amendments			
Ed.	**Rev.**	**Date of the amendments**	**Reason for the amendments**

Record of corrigenda			
Ed	**Rev**	**Date of the corrigenda**	**Reason for the corrigenda**

0.4. DOCUMENTS REFERENCES

- ICAO Annex 15 – Aeronautical Information Services;
- ICAO Annex 4 – Aeronautical Charts;
- ICAO Annex 14– Aerodromes;
- ICAO Doc 9674 – World Geodetic System – 1984 Manual;
- ICAO Doc 9881 – Guidelines for Electronic Terrain, Obstacle and Aerodrome Mapping Information;
- ICAO Doc 10066 – Procedures for Air Navigation Services — Aeronautical Information Management;
- ICAO Doc 8126: Aeronautical Information Services Manual;
- EUROCONTROL Terrain and Obstacle Data Manual;
- EUROCONTROL Guidelines for harmonised AIP publication and data set provision;
- EUROCONTROL Specification for the Origination of Aeronautical Data.

0.5. DEFINITIONS AND ABBREVIATION

0.5.1. DEFINITION

Aerodrome. A defined area on land or water (including any buildings, installations and equipment) intended to be used either wholly or in part for the arrival, departure and surface movement of aircraft.

Calendar. Discrete temporal reference system that provides the basis for defining temporal position to a resolution of one day (ISO 19108*).

Confidence level. The probability that the true value of a parameter is within a certain interval around the estimate of its value.

Data product specification. Detailed description of a data set or data set series together with additional information that will enable it to be created, supplied to and used by another party (ISO 19131*).

Data quality. A degree or level of confidence that the data provided meet the requirements of the data user in terms of accuracy, resolution, integrity (or equivalent assurance level), traceability, timeliness, completeness and format.

Data Set. A collection of data compliant with ISO 19101

Datum. Any quantity or set of quantities that may serve as a reference or basis for the calculation of other quantities (ISO 19104*).

Feature attribute. Characteristic of a feature (ISO 19101*).

Feature. Abstraction of real world phenomena (ISO 19101*).

Geoid. The equipotential surface in the gravity field of the Earth which coincides with the undisturbed mean sea level (MSL) extended continuously through the continents.

Gregorian calendar. Calendar in general use; first introduced in 1582 to define a year that more closely approximates the tropical year than the Julian calendar (ISO 19108*).

Height. The vertical distance of a level, point or an object considered as a point, measured from a specific datum.

Integrity classification (aeronautical data). Classification based upon the potential risk resulting from the use of corrupted data. Aeronautical data is classified as:

a) routine data: there is a very low probability when using corrupted routine data that the continued safe flight and landing of an aircraft would be severely at risk with the potential for catastrophe;

b) essential data: there is a low probability when using corrupted essential data that the continued safe flight and landing of an aircraft would be severely at risk with the potential for catastrophe; and

c) critical data: there is a high probability when using corrupted critical data that the continued safe flight and landing of an aircraft would be severely at risk with the potential for catastrophe

Metadata. Data about data (ISO 19115*).

Movement area. That part of an aerodrome to be used for the take-off, landing and taxiing of aircraft, consisting of the manoeuvring area and the apron

Obstacle/terrain data collection surface. A defined surface intended for the purpose of collecting obstacle/terrain data.

Origination (aeronautical data or aeronautical information). The creation of the value associated with new data or information or the modification of the value of existing data or information.

Originator (aeronautical data or aeronautical information). An entity that is accountable for data or information origination and/or from which the AIS organization receives aeronautical data and aeronautical information.

Post spacing. Angular or linear distance between two adjacent elevation points.

Prohibited area. An airspace of defined dimensions, above the land areas or territorial waters of a State, within which the flight of aircraft is prohibited.

Requirement. Need or expectation that is stated, generally implied or obligatory (ISO 9000*).

Validation. Confirmation, through the provision of objective evidence, that the requirements for a specific intended use or application have been fulfilled (ISO 9000*).

Verification. Confirmation, through the provision of objective evidence, that specified requirements have been fulfilled (ISO 9000*).

0.5.2. ABBREVIATIONS

AIP: Aeronautical Information Publication

ARP: Aerodrome Reference Point

ATS: Air traffic services

EGM: Earth Gravitational Model

ICAO: International Civil Aviation Organisation

ISO: International Organisation for Standardisation

MSL: Mean sea level

OLS: Obstacle Limitation Surface(s)

PANS-AIM: Procedures for Air Navigation Services — Aeronautical Information Management

PATC: Precision Approach Terrain Chart

SLA: Service Level Agreement

TMA: Terminal Area

TOD: Terrain and obstacle data

UTC: Co-ordinated Universal Time

WGS-84: World Geodetic System-1984

0.6. CONTENTS

0.7. INTRODUCTION

Knowledge of terrain and obstacles is a requirement to ensure safety when evaluating structures to be built or altered in a State's airspace. Increased economic development and prosperity often include infrastructure (buildings, towers etc.) which may encroach upon airspace.

Due to the implications for air traffic and safety operations, it is essential that the impact of these obstacles is continuously assessed, reviewed, and updated. ICAO requires States to make terrain and obstacle data available to airspace users in electronic format.

0.8. PURPOSE OF THE DOCUMENT

This document assists to AIS inspectors to oversight implementation for terrain and obstacle data from origination to provision based on the national TOD policy and regulatory framework. To this end, they must use checklist (see annex1) to ensure that TOD requirements are attend.

CHAPITER 01: REGULATORY REMINDER

1.1. DEFINITION OBSTACLES

Obstacle: All fixed (whether temporary or permanent) or mobile objects, or parts thereof, that:

a) are located on an area intended for the surface movement of aircraft; or

b) extend above a defined surface intended to protect aircraft in flight; or

c) stand outside those defined surfaces and that have been assessed as being a hazard to air navigation.

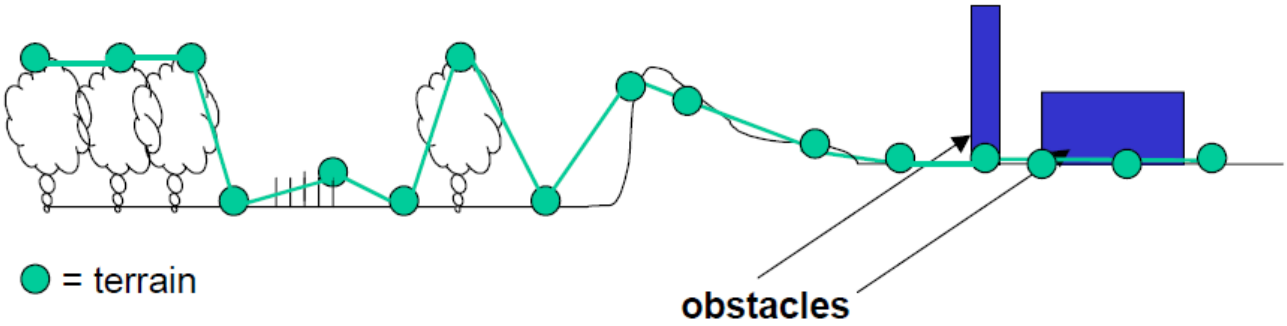

Figure 1: Obstacle definition

1.2. DEFINITION OF TERRAIN

Terrain is the surface of the Earth containing naturally occurring features such as mountains, hills, ridges, valleys, bodies of water, permanent ice and snow, and excluding obstacles, as shown in the following figure:

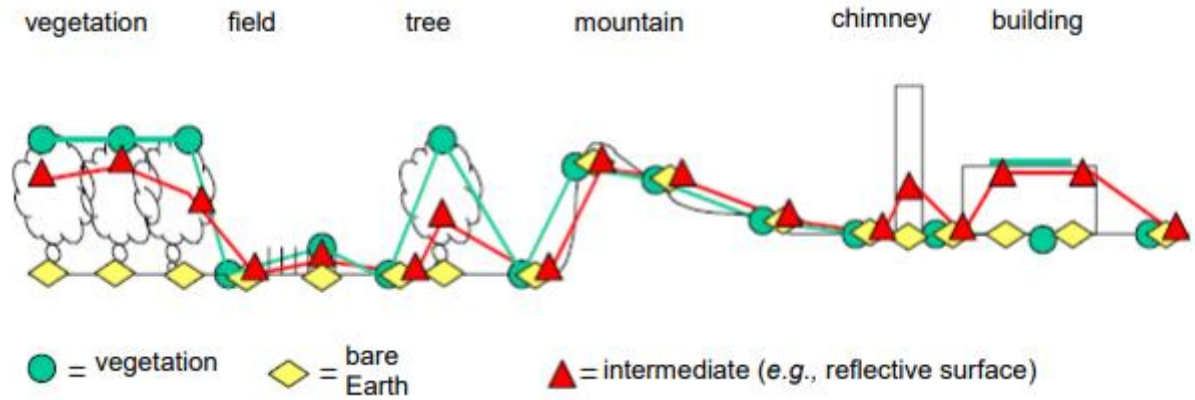

Figure 2: Terrain definition

1.3. TOD-RELEVANT AREAS AND SURFACES

Different geographic areas and 3D-surfaces constitute the spatial scope of the ICAO TOD provisions.

The majority of these areas and surfaces are related to airport geometry. They are defined in the following ICAO Annexes and PANS and are presented in this section:

- Annex 15 and PANS-AIM (coverage areas),
- Annex 14 (obstacle limitation surfaces),
- Annex 4 (take-off flight path area).

1.4. COVERAGE AREAS DEFINED TOD

1.4.1. OVERVIEW OF FOUR AREAS

ICAO has defined four coverage areas where different numerical requirements apply for terrain and obstacle data. The coverage areas for sets of electronic terrain and obstacle data shall be specified as:

- Area 1: The entire territory of a State
- Area 2: The vicinity of an aerodrome which was broken down into four sub-areas
  - Area 2a: A rectangular area around a runway that comprises the runway strip plus any clearway that exists;

    Note.— See ICAO Annex 14, Volume I, Chapter 3 for dimensions for runway strip.
  - Area 2b: An area extending from the ends of Area 2a in the direction of departure, with a length of 10 km and a splay of 15% to each side;
  - Area 2c: An area extending outside Area 2a and Area 2b at a distance of not more than 10 km from the boundary of Area 2a; and
  - Area 2d: An area outside the Areas 2a, 2b and 2c up to a distance of 45 km from the aerodrome reference point, or to an existing TMA boundary, whichever is nearest;
- Area 3: An area bordering the movement area on an aerodrome
- Area 4: The radio altimeter area operating in front of a precision approach runway, Category II or III.

Where the terrain at a distance greater than 900 m (3 000 ft) from the runway threshold is mountainous or otherwise significant, the length of Area 4 should be extended to a distance not exceeding 2 000 m (6 500 ft) from the runway threshold.

1.4.1.1. AREA 1

Area 1 encompasses the entire territory of the State, including terminal control area and aerodromes/heliports and those areas over the high seas for which the State is responsible for the provision of air traffic services (ATS).

Table 1 presents the quality requirements for terrain data in Area 1.

Every obstacle within Area 1 whose height above the ground is equal to or greater than 100 m must be collected and recorded in the obstacle database in accordance with the Area 1 obstacle data quality requirements specified on Figure 9.

1.4.1.2. AREA 2

Area 2 is the terminal control area as defined in the Aeronautical Information Publication (AIP) of the State, limited to a maximum of 45 km from the ARP. For airfields which do not have a legally defined Terminal Area (TMA), Area 2 is the area covered by a radius of 45 km from the ARP excluding sub areas where flight operations are restricted due to high terrain or "no fly" conditions. Area 2 numerical requirements of obstacle defined on Figure 15 and Table 1 presents the quality requirements for terrain data in Area 1.

- Area 2a

Area 2a is a rectangular area which encompasses the runway strip and any clearways that exist. To elaborate, the rectangular area will comprise the area between the runway thresholds (or runway end(s) where displaced threshold(s) exist) and beyond this to the end of any defined clearway(s). Area 2a is intended to reduce the risk of damage to aircraft running off a runway and to protect aircraft flying over the strip and clearway during take-off or landing.

- Area 2b

Area 2b covers an area for take-off and landing and, as described, extends from the outer ends of Area 2a, with a 15% splay to either side and a length of 10 km.

- Area 2c

Area 2c is described as the area within 10km of the edges of Area 2a, excluding those parts identified as being Area 2b.

- Area 2d

Area 2d is identified as the area extending from the outer edges of Area 2a, Area 2b and Area 2c, out to a distance of 45 km from the aerodrome reference point or the TMA boundary, whichever is the closest. Given that the TMA boundary is only mentioned with respect to Area 2d, it is assumed that should the TMA end closer to Area 2a than 10 km, Area 2b and 2c would still extend to 10 km, despite extending further than the TMA boundary.

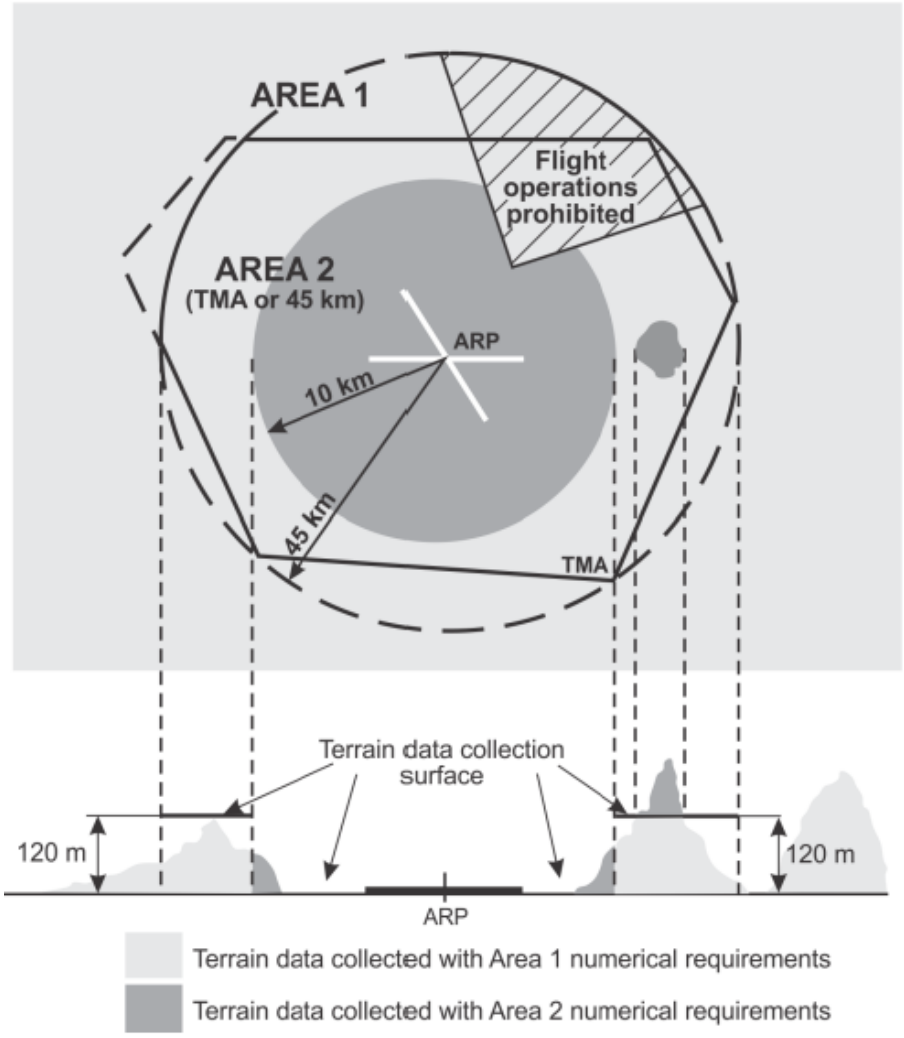

Figure 3: Terrain data collection surfaces — Area 1 and Area 2

Table 1 presents the quality requirements for terrain data in Area 2.

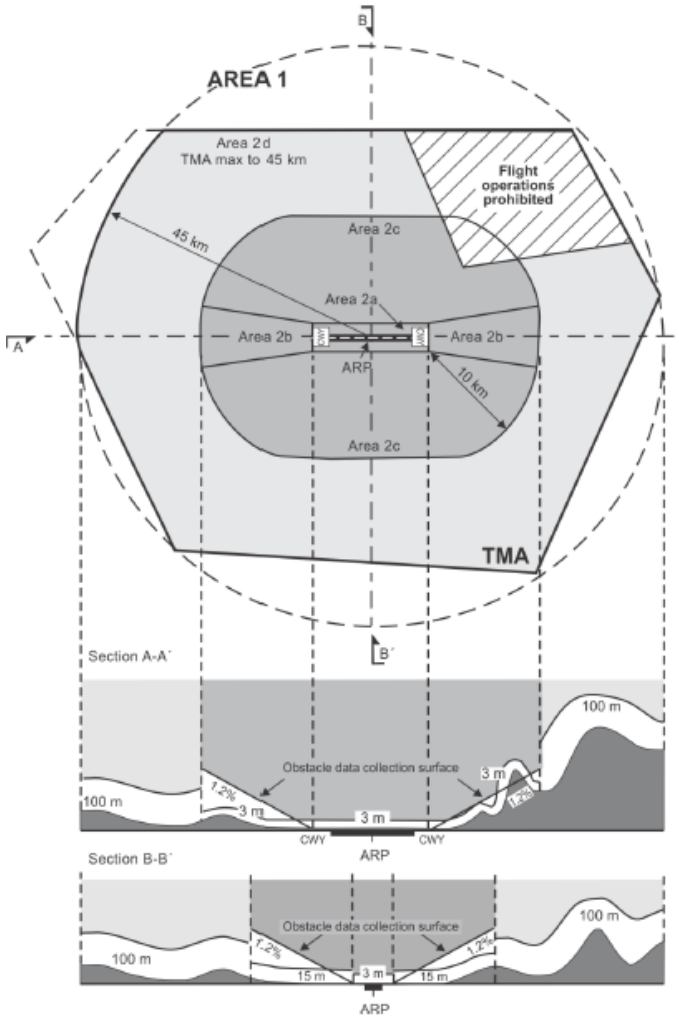

Figure 4: Obstacles data collection surfaces — Area 1 and Area 2

1 Obstacle data shall be collected and recorded in accordance with the Area 2 numerical requirements specified on figure 4.

2 In those portions of Area 2 where flight operations are prohibited due to very high terrain or other local restrictions and/or regulations, obstacle data shall be collected and recorded in accordance with the Area 1 requirements.

3 Data on every obstacle within Area 1 whose height above the ground is 100 m or higher shall be collected and recorded in the database in accordance with the Area 1 numerical requirements specified on figure 4.

1.4.1.3 AREA 3

It is the area bordering an aerodrome movement area that extends horizontally from the edge of a runway to 90 m from the runway centre line and 50 m from the edge of all other parts of the aerodrome movement area.

It should be noted that the movement area is defined as that part of an aerodrome to be used for the take-off, landing and taxiing of aircraft, consisting of the manoeuvring area and the apron(s). The taxiway shoulders are therefore not part of the movement area but part of Area 3, i.e. the 50 m bordering area starting at the edge of the taxiway and not at the edge of the taxiway shoulder.

Table 1 presents the quality requirements for terrain data in Area 3.

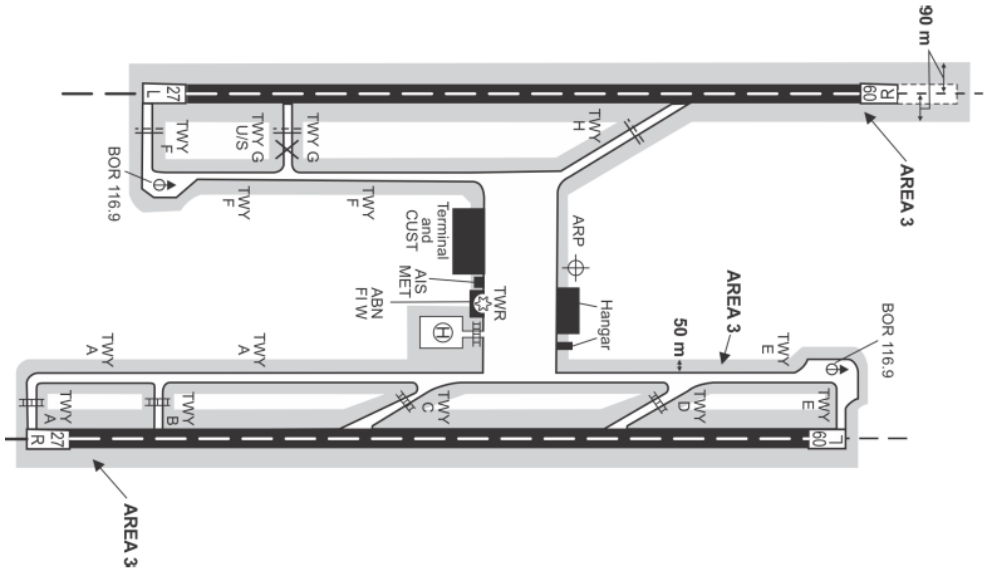

Figure 5: Terrain and obstacle data collection surface — Area 3

1.4.1.4. AREA 4

It is the area extending 900 m prior to the runway threshold and 60 m each side of the extended runway centre line in the direction of the approach on a precision approach runway, Category II or III (see figure 6). This area corresponds to the area of the Precision Approach Terrain Chart (PATC) as defined in ICAO Annex 4.

When obstacle data is collected, it should be done so in accordance with the Area 4 numerical requirements specified on figure 9.

Table 1 presents the quality requirements for terrain data in Area 4.

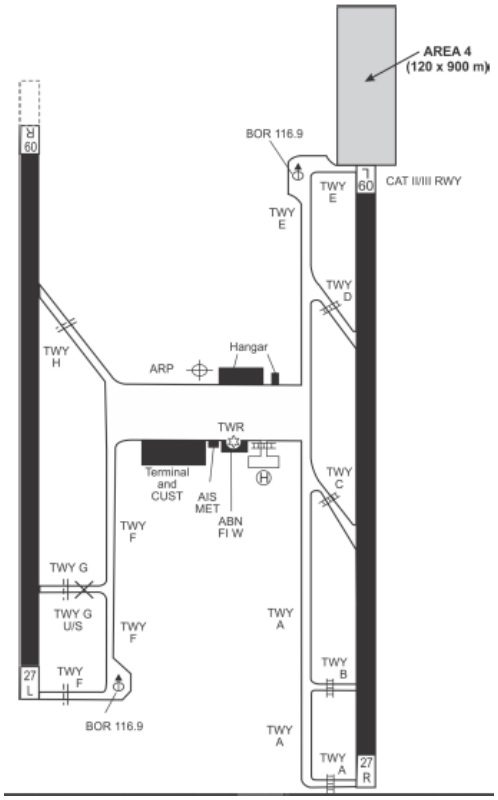

Figure 6: Terrain and obstacle data collection surface — Area 4

1.4.2. OBSTACLE LIMITATION SURFACES DEFINED IN ICAO ANNEX 14

ICAO Annex 14, Chapter 4 defines a series of obstacle limitation surfaces whose are to define the airspace around aerodromes to be maintained free from obstacles so as to permit the intended aeroplane operations at the aerodromes to be conducted safely and to prevent the aerodromes from becoming unusable by the growth of obstacles around the aerodromes.

The components which make up the obstacle limitation surfaces and it is the objects which penetrate these surfaces which must be included within the obstacle data set.

The obstacle limitation surfaces comprise of:

- Outer horizontal surface;
- Conical surface;
- Inner horizontal surface;
- Approach surface;
- Inner approach surface;
- Transitional surface;
- Inner transitional surface;
- Balked landing surface; and
- Take-off climb surface.

The precise dimensions of each of these surfaces varies depending upon the classification of the runway in question, with the dimensions being provided by ICAO Annex 14 in Table 4-1 for approach runways and Table 4-2 for runways meant for take-off.

Figure 7 provides a graphical representation of the listed obstacle limitation surfaces.

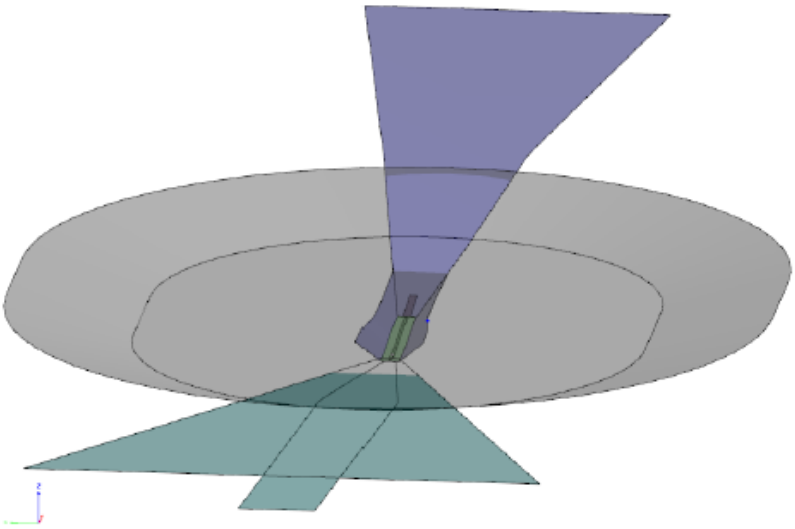

Figure 7: Graphical representation of the listed obstacle limitation surfaces

It should be noted that the obstacle limitation surfaces extend up to 15 km, which is different to Area 2b, whose extension is only 10 km.

1.4.3. TAKE-OFF FLIGHT PATH AREA DEFINED IN ICAO ANNEX 04

The take-off flight path area is defined in ICAO Annex 4 Paragraph 3.8.2.1:

The take-off flight path area consists of a quadrilateral area on the surface of the earth lying directly below, and symmetrically disposed about, the take-off flight path. This area has the following characteristics:

a) it commences at the end of the area declared suitable for take-off (i.e. at the end of the runway or clearway as appropriate);

b) its width at the point of origin is 180 m (600 ft) and this width increases at the rate of 0.25D to a maximum of 1 800 m (6 000 ft), where D is the distance from the point of origin;

c) it extends to the point beyond which no obstacles exist or to a distance of 10.0 km (5.4 NM), whichever is the lesser.

Figure 8 provides a graphical representation of take-off flight path area as defined in ICAO Annex 4.

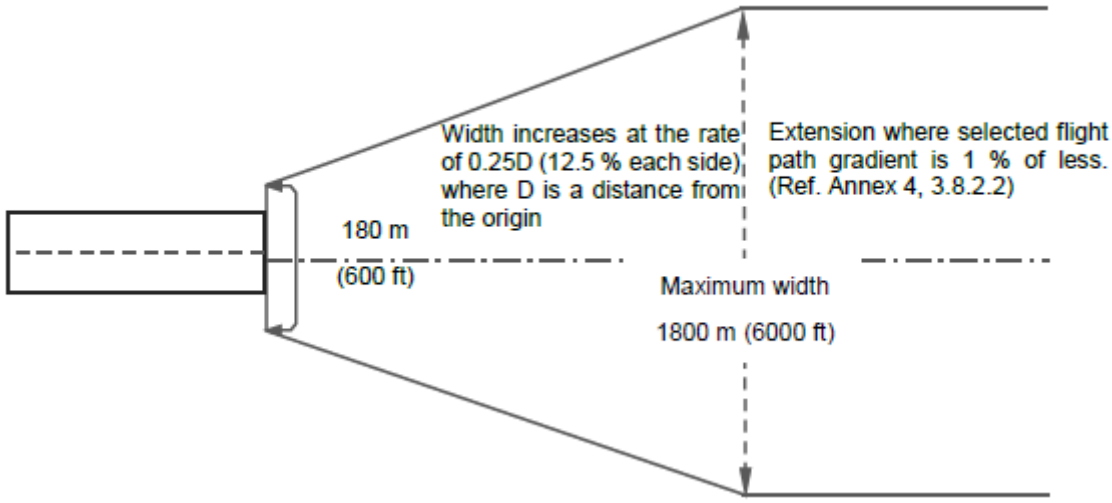

Figure 8: Graphical representation of take-off flight path area as defined in ICAO Annex 4

Table 1 presents the quality requirements for terrain data in Area 3

	Area 1	**Area 2**	**Area 3**	**Area 4**
Post spacing	3 arc seconds (approx. 90 m)	1 arc second (approx. 30 m)	0.6 arc seconds (approx. 20 m)	0.3 arc seconds (approx. 9 m)
Vertical accuracy	30 m	3 m	0.5 m	1 m
Vertical resolution	1 m	0.1 m	0.01 m	0.1 m
Horizontal accuracy	50 m	5 m	0.5 m	2.5 m
Confidence level	90%	90%	90%	90%
Integrity classification	routine	essential	essential	essential
Maintenance period	as required	as required	as required	as required

Table A1-6 Obstacle data

Subject	Property	Sub-Property	Type	Description	Note	Accuracy	Integrity	Orig Type	Pub. Res.	Chart Res.
Obstacle				All fixed (whether temporary or permanent) and mobile						
	Obstacle identifier		Text	Unique identifier of obstacle						
	Operator / Owner		Text	Name and Contact information of obstacle operator or owner						
	Geometry type		Code list	An indication whether the obstacle is a point, line or polygon.						
	Horizontal position		Point Line Polygon	Horizontal position of obstacle		See Note 1)				
	Horizontal extent		Distance	Hoizontal extent of the obstacle						
	Elevation		Elevation	Elevation of the highest point of the obstacle.		See Note 2)				
	Height		Height	Height of the obstacle above ground						
	Type		Text	Type of obstacle						
	Date and time stamp		Date	Date and time the obstacle was created						
	Operations		Text	Feature operations of mobile obstacles						
	Effectivity		Text	Effectivity of temporary types of obstacles						
	Lighting									
		Type	Text	Type of lighting						
		Colour	Text	Colour of the obstacle lighting						
	Marking		Text	Type of marking of obstacle						
	Material		Text	Predominant surface material of the obstacle						
			Note 1)	Obstacles in Area 1		50 m	routine	surveyed	1 sec	as plotted
				Obstacles in Area 2 (including 2a, 2b, 2c, 2d, take-off flight path area and		5 m	essential	surveyed	1/10 sec	1/10 sec
				Obstacles in Area 3		0.5 m	essential	surveyed	1/10 sec	1/10 sec
				Obstacles in Area 4		2.5 m	essential	surveyed		
			Note 2)	Obstacles in Area 1		30 m	routine	surveyed	1 m or 1 ft	3 m (10 ft)
				Obstacles in Area 2 (including 2a, 2b, 2c, 2d, take-off flight path area and		3 m	essential	surveyed	1 m or 1 ft	1 m or 1 ft
				Obstacles in Area 3		0.5 m	essential	surveyed	0.1 m or 0.1	1m or 1 ft
				Obstacles in Area 4		1 m	essential	surveyed	0.1 m	

Figure 9: Obstacle numerical requirements

CHAPITER 02: OVERSIGHT PROCEDURES

AIS inspector shall ensure that related TOD stakeholders, analysed the current environment and developed a plan/roadmap demonstrating the feasibility of achieving the necessary steps to enable the collection (where applicable), management and provision of electronic terrain and obstacle data in accordance with the national TOD policy.

The implementation planning should cover the following topics, as applicable:

2.1. DATA ORIGINATION

Data Origination addresses the functions performed by Requesting Authorities, Originating Authorities, Surveyors and any other third party organizations supplying TOD to such authorities. Those functions are:

a) Geodetic datum specification and use;

b) Recommended procedures for achieving minimum data requirements;

c) Documentation of survey control stations;

d) Production of survey reports;

e) Ongoing maintenance of data;

f) Data management and quality assurance;

g) Document configuration management.

AIS inspector shall ensure that the organization responsible for data origination for each specific coverage areas be identified and mandated.

The contact details of this organization shall contain at least:

- name of the service or organization;
- street address and e-mail address of the service or organization;
- telefax number of the service or organization;
- contact telephone number of the service or organization and;
- supplemental information, if necessary, on how and when to contact the service or organization.

This organization may be ANSP or aerodrome operator.

AIS inspector shall ensure that the organization identified the data sources of electronic terrain data for each specific coverage areas.

According to TOD regulatory, AIS inspector shall ensure that formal arrangements are established between originators of aeronautical data and aeronautical information and the aeronautical information service in relation to the timely and complete provision of aeronautical data and aeronautical information. If the provision of data is likely to take place regularly, over a period of time, a Service Level Agreement (SLA) may be an appropriate means of formalizing the data provision.

Also the arrangements (to be put) in place with adjacent States for the exchange, provision and receipt of electronic terrain and obstacle data should be documented. Arrangements could include sharing the survey costs or use of the same survey company, all with the intention of reducing the cost of data acquisition.

2.2. DATA PUBLICATION

TOD publication addresses the functions undertaken by the organization responsible receiving TOD from their receipt to publication. These apply to both electronic and paper publication.

AIS inspector shall ensure that the organization responsible for TOD publication for each specific coverage areas be identified and mandated. If it is the ANSP, he has adjust the AIM system (i.e. people, equipment and procedures) to ensure the collection (where applicable), management and provision of TOD in accordance with the national TOD policy and regulatory framework. For this purpose, the inspector must ensure the adjustment of the AIM system.

The contact details of this organization shall contain at least:

- name of the service or organization;
- street address and e-mail address of the service or organization;
- telefax number of the service or organization;
- contact telephone number of the service or organization;
- hours of service (time period including time zone when contact can be made);
- online information that can be used to contact the service or organization; and
- supplemental information, if necessary, on how and when to contact the service or organization.

2.3. DATA MANAGEMENT PROCEDURE

AIS inspectors shall ensure that TOD quality characteristics are correctly established for the data's intended usage. They shall ensure that the data quality requirements are clearly documented. The data shall have the agreed and documented data quality, characterized by:

a) The accuracy of the data (expressed in the same units as the data itself);

b) The resolution of the data;

c) The confidence (termed 'assurance level') that the data is not corrupted while stored or in transit;

d) The ability to determine the origin of the data (termed 'traceability');

e) The level of confidence that the data is applicable to the period of intended use (termed 'timeliness');

f) The confidence that all of the data needed to support the function is provided (termed 'completeness');

The format of the data meets the requirements stated in this document plus any other standards imposed by civil aviation regulations, as appropriate.

2.4. DATA REPOSITORY

AIS inspectors shall ensure that the organization responsible for data storage be identified and mandated. The contact details of this organization shall contain at least:

- name of the service or organization;
- street address and e-mail address of the service or organization;
- telefax number of the service or organization;
- contact telephone number of the service or organization and;
- supplemental information, if necessary, on how and when to contact the service or organization.

This organization may be ANSP, aerodrome operator or National Geodetic Agency.

It must be establish the procedure or mechanism of repository.

2.5. DATA MAINTENANCE

AIS inspectors shall ensure that the organization responsible for data consistency (maintenance and update) with the evolution of the terrain and obstacle should be identified and mandated. The contact details of this organization shall contain at least:

- name of the service or organization;
- street address and e-mail address of the service or organization;
- telefax number of the service or organization;
- contact telephone number of the service or organization and;
- supplemental information, if necessary, on how and when to contact the service or organization.

This organization may be ANSP, aerodrome operator or National Geodetic Agency.

It must be defined a period of maintenance of obstacle and terrain data. ICAO defines the maintenance period for digital data sets as “at such regular intervals as may be necessary to keep them up to date”. Yearly checks can be considered to meet the requirement for “regular intervals”.

However, the frequency of obstacle data maintenance has proven impossible to determine as the need for maintenance changes on a case-by-case basis.

2.6. DATA VALIDATION AND VERIFICATION

AIS inspectors shall ensure that the organization responsible for TOD validation and verification for each specific coverage areas should be identified and mandated.

The contact details of this organization shall contain at least:

- name of the service or organization;
- street address and e-mail address of the service or organization;
- telefax number of the service or organization;
- contact telephone number of the service or organization;
- supplemental information, if necessary, on how and when to contact the service or organization.

All data received from sources shall, be validated and/or verified before entering the processing chain. For this purpose, it must be establish the mechanism or procedure for validation and verification.

The techniques available are wide ranging and the most appropriate should be selected based upon the data item in question.

Sufficient resources should be provided to permit each point within the data chain to undertake adequate validation and verification.

All data processed shall be verified to ensure its correctness before transmission to the next actor in the data chain. Suitable verification may take one, or more, of three approaches:

i). Feedback: Feedback testing is the comparison of a data set between its output and input state.

ii). Independent Redundancy: Independent redundancy testing involves processing the same data through two (or more) independent processors and comparing the data output of each process.

iii). Update Comparison: Updated data can be compared to its previous version. This comparison can identify all data elements that have changed. The list of changed elements can then be compared to a similar list generated by the supplier. A problem can be detected if an element is identified as changed on one list and not on the other. This method can also be used to reduce the amount of data that is subjected to other forms of verification, concentrating on only those elements that have changed.

The main source of information for this validation is the metadata and survey report accompanying the collected data. The following checks should be done:

- Accuracy: Is the accuracy of the data indicated and does it meet the requirements?
- Resolution: Is the resolution commensurate with the accuracy? That means: is the data provided with enough digits not to jeopardise its accuracy?
- Integrity: Is there comprehensible evidence that the data has been processed according to the integrity classification (see traceability)?
- Traceability: Have all the relevant origination, translation and validation processes been documented by the data originator (Lineage information in the metadata).
- Timeliness: Is the effective period of the data elements defined?
- Completeness: Do the features (obstacles, terrain models) have all the required attributes? Does the metadata have all required information? Is there comprehensive evidence that the data

originator has validated the data for completeness (e.g. that all the obstacles in the area of interest have been surveyed)?

- Format: Has the data been provided in the format specified in the formal arrangements?

2.7. DATA FORMATS

2.7.1. DATA CONVERSION

Whenever a conversion is necessary from one unit of measurement to another, the approved conversion value shall be used.

Note: Conversions shall include:

i). map projection, which is a method using mathematical functions to convert ellipsoidal co-ordinates (excluding height) to two-dimensional Cartesian coordinates, or vice-versa;

ii). coordinate conversion of ellipsoidal co-ordinates (including ellipsoidal height) to three-dimensional Cartesian co-ordinates, or vice-versa;

iii). unit change by application of a multiplication factor (for example, metres to feet) or an algorithm (for example, radians to degrees, minutes and seconds).

2.7.2. CO-ORDINATES

AIS inspectors shall ensure that all coordinate of TOD be collected or computed using the WGS-84 co-ordinate reference system.

Note: Co-ordinates collected using other reference systems should be transformed into the WGS-84 coordinate system.

If a transformation is performed, the original data shall have met the quality requirements laid down within this guidance material. If the co-ordinate has been transformed from another co-ordinate system to WGS-84, it shall be clearly indicated as such. The data structure used for storage of the coordinate shall allow for the clear indication of any co-ordinate transformation.

2.7.3. GEOID

The Earth Gravitational Model — 1996 (EGM-96), containing long wavelength gravity field data to degree and order 360, shall be used by international air navigation as the global gravity model. At those geographical positions where the accuracy of EGM-96 does not meet the accuracy requirements for elevation and geoid undulation specified in Annex 14, Volumes I and II, on the basis of EGM-96 data, regional, national or local geoid models containing high resolution (short wavelength) gravity field data, shall be developed and used. When a geoid model other than the EGM-96 model is used, a description of the model used, including the parameters required for height transformation between the model and EGM-96, shall be provided in the Aeronautical Information Publication (AIP).

2.7.4. DATES

AIS inspectors shall ensure that any date use the Gregorian calendar.

2.7.5.TIME

AIS inspectors shall ensure that any time use Coordinated Universal Time (UTC). A time using a local time system may be published. If times use a local time frame, this shall be clearly indicated.

2.8. METADATA

AIS inspectors shall ensure that:

(a) Metadata shall be collected at each stage of the process and for each action undertaken. Metadata may also include any additional information needed by a particular organisation.

(b) If additional metadata attributes are required by an organisation, they should be specified for such entities. If they are not applicable, this should be specified within the attribute.

(c) As a minimum, the following metadata shall be collected:

- the names of the organizations or entities performing any action of originating, transmitting or manipulating the data;
- the action performed or amendments made to the data;
- details of any validation and verification of the data that has been performed
- the date and time the action was performed and when the data set was provided;
- period of validity of the data set;
- for geospatial data:
    - the earth reference model used,
    - the coordinate system used;
- for numerical data:
    - the statistical accuracy of the measurement or calculation technique used,
    - the resolution,
    - the confidence level as required by the ICAO standards;
- details of any functions applied if data has been subject to conversion/transformation,
- details of any limitations with regard to the use of the data set

2.9. SURVEY SPECIFIC QUALITY RECORDS

AIS inspectors shall ensure that:

(a) All co-ordinates shall be traceable to their source of production by an unbroken audit trail.

(b) Information on the source of production shall include:

- Name of Surveyor;
- Surveying organisation;
- Date of survey;
- Method of survey;
- Equipment used.

(c) Records shall be maintained for at least ten years for all designated co-ordinates that are published in the Aeronautical Information Publication (AIP)

2.10. MANAGEMENT OF THIRD PARTIES

AIS inspectors shall ensure that:

(a) TOD origination shall take all necessary steps to ensure the quality of products delivered by third parties and that the products are in accordance with the TOD requirements.

In particular, TOD origination shall establish Quality Management Procedures, which specify:

- Deliverables or products to be provided by each third party;
- Acceptance criteria to be applied to each product;
- Procedures for defect detection and subsequent resolution;
- Methods for ensuring compliance against Quality Assurance requirements.

(b) These documented procedures should take into account the requirements for interface management.

(c) This requirement is particularly important to Requesting Authorities who elect to subcontract data survey services to a third party and must adhere to the requirements.

ANNEX 1: OVERSIGHT TOD CHECKLIST

N°	CHECKLIST QUESTIONS	EVIDENCES	COMPLIANCE			OBSERVATIONS
			S	NS	NA	
	HORIZONTAL REFERENCE SYSTEM					
1.	Are terrain and obstacle data provided in the World Geodetic System-1984 (WGS-84) as the horizontal (geodetic) reference system for air navigation?		☐	☐	☐	
2.	If the horizontal reference system is not WGS-84, the transformation parameters to WGS-84 is specified?		☐	☐	☐	
3.	Are TOD published in aeronautical geographical coordinates indicating latitude and longitude in terms of the WGS-84 datum?		☐	☐	☐	
4.	**VERTICAL REFERENCE SYSTEM**					
5.	Are terrain and obstacle data provided in the mean sea level (MSL) datum as the vertical reference system for air navigation?		☐	☐	☐	
6.	Are terrain and obstacle data provided in the earth gravitational model — 1996 (EGM-96) as the global gravity model for air navigation?		☐	☐	☐	
7.	If not, does provided in the Aeronautical Information Publication (AIP) a description of the model used, including the parameters required for height transformation between the model and EGM-96, when a geoid model other than the EGM-96 is used?		☐	☐	☐	

8.	**TEMPORAL REFERENCE SYSTEM**					
9.	Are the Gregorian calendar and coordinated universal time used as the temporal reference system for air navigation for TOD?		☐	☐	☐	
10.	**RESPONSIBILITIES AND FUNCTIONS**					
11.	Does terrain and obstacle data Provider ensure that the provision of terrain and obstacle data covers the entire territory of a State and those areas of the its responsible for the provision of air traffic services?		☐	☐	☐	
12.	Does terrain and obstacle data Provider remain responsible for the terrain and obstacle data provided in accordance to regulation?		☐	☐	☐	
13.	Does terrain and obstacle data Provider provide terrain and obstacle data for and on behalf of the State and clearly indicate that it is provided under the Authority of the State regardless of the format in which they are provided?		☐	☐	☐	
14.	Does terrain and obstacle data Provider established a mechanism to ensure that terrain and obstacle data provide that are in accordance with the quality requirements?	Review mechanism established to ensure effective implementation.	☐	☐	☐	
15.	Does terrain and obstacle data Provider established formal arrangements with originators of obstacle and terrain data in relation to the timely and complete provision of obstacles data?	1) Review mechanism established to ensure effective implementation. 2) Confirm that formal arrangements are in place and up-to-date with the data originators and consistent with	☐	☐	☐	

		the aeronautical data catalogue (including how the aeronautical data catalogue is made available and enforced).				
16.	Does terrain and obstacle data Provider have a mechanism to thoroughly check the data prior storage, distribution or sharing with the intended user?	Review mechanism established to ensure effective implementation.	☐	☐	☐	
17.	**Automate Terrain and obstacle data systems**					
18.	Is the terrain and obstacle data provider an automated system for the processing, storing of terrain and obstacle as part of providing its functions?		☐	☐	☐	
19.	This system enabled the digital exchange and supply of terrain and Obstacle data?		☐	☐	☐	
20.	This system use digital data error detection techniques during the transmission and/or storage of terrain and obstacle data sets?		☐	☐	☐	
21.	**Quality Management System**					
22.	Does terrain and Obstacle provider implemented and maintain a quality management system as applied to terrain and obstacle data management processes?	1) Review mechanism established to ensure effective implementation. 2) Review documented evidence of established quality system including procedures, processes and resources.	☐	☐	☐	
23.	**Metadata**					

24.	Does terrain and obstacle data provider collect metadata for terrain and obstacle data processes and exchange points?		☐	☐	☐	
25.	Does terrain and obstacle data provider apply metadata collection throughout the terrain and obstacle data chain, from origination to distribution to the next intended user?	Verify that metadata includes: a) the names of the organizations or entities performing any action of originating, transmitting or manipulating the data; b) the action performed or amendments made to the data; c) details of any validation and verification of the data that has been performed d) the date and time the action was performed and when the data set was provided; e) period of validity of the data set; f) for geospatial data: — the earth reference model used, — the coordinate system used; g) for numerical data: — the statistical accuracy of the measurement or calculation technique used,	☐	☐	☐	

		— the resolution, — the confidence level as required by the ICAO standards; h) details of any functions applied if data has been subject to conversion/transformation, i) details of any limitations with regard to the use of the data set.				
26.			☐	☐	☐	
27.	**Data originator requirements**					
28.	Has the terrain and obstacle data originator collected, verified and transmitted data in accordance with the accuracy requirements and integrity classification specified in Tables A1.1, A1.6, A1.7 and A1.8, contained in Appendix 1 of PANS-AIM (Doc 10066)?		☐	☐	☐	
29.	Has the terrain and obstacle data originator determined and report geographical coordinates indicating latitude and longitude in terms of the World Geodetic System — 1984 (WGS-84) geodetic reference datum?		☐	☐	☐	
30.	Has the terrain and obstacle data originator identified geographical coordinates that have been transformed into WGS-84 coordinates by mathematical means and whose accuracy of original field work does not meet the applicable requirements contained in Tables		☐	☐	☐	

	A1.1, A1.6, A1.7 and A1.8, contained in Appendix 1 of PANS-AIM (Doc 10066)?					
31.	Does the terrain and obstacle data originator have verification and validation processes and procedures in place to ensure the required data quality is met when terrain and obstacle data is provided?		☐	☐	☐	
32.	Does the terrain and obstacle data originator determined and report elevation referenced to the MSL (geoid), for the specific surveyed ground positions as well as geoid undulation (referenced to the WGS-84 ellipsoid) for those positions specified in Tables A1.1, A1.6, A1.7 and A1.8, contained in Appendix 1 of PANS-AIM (Doc 10066) ?		☐	☐	☐	
33.	**Digital data sets**					
34.	Does the organization responsible for the provision of data to next intended users identified and mandated?	Contact details of this organization shall contain at least: • name of the service or organization; • street address and e-mail address of the service or organization; • telefax number of the service or organization; • contact telephone number of the service or organization;				

		• hours of service (time period including time zone when contact can be made); • online information that can be used to contact the service or organization; and • supplemental information, if necessary, on how and when to contact the individual, service or organization.				
35.	Does a terrain and Obstacle data Provider provided digital data be in the form of terrain and obstacle data sets?		☐	☐	☐	
36.	Does each data set be provided to the next intended user together with a minimum set of metadata that ensures data traceability from the end-user to the originator?		☐	☐	☐	
37.	Does a terrain and Obstacle data Provider a checklist of valid data sets regularly provided?		☐	☐	☐	
38.	Has the terrain and obstacle data Provider specified the coverage areas for sets of terrain and obstacle data?		☐	☐	☐	
39.	Has the terrain and obstacle data Provider provided terrain data set that contain the digital representation of the terrain surface in the form of continuous		☐	☐	☐	

	elevation values at all intersections (points) of a defined grid, referenced to common datum?					
40.	Did the terrain and obstacle data Provider provide terrain data for Area 1?		☐	☐	☐	
41.	Does the terrain and obstacle data Provider provide for aerodromes regularly used by international civil aviation, terrain data as follow : a) Area 2a? b) the take-off flight path area? and c) an area bounded by the lateral extent of the aerodrome obstacle limitation surfaces?		☐	☐	☐	
42.	Does the terrain and obstacle data Provider made arrangements for the coordination of providing terrain data for adjacent aerodromes where their respective coverage areas overlap to assure that the data for the same terrain are correct?		☐	☐	☐	
43.	Does the terrain and obstacle data Provider made arrangements among States concerned to share terrain data for those aerodromes located near territorial boundaries?		☐	☐	☐	
44.	Does the terrain and obstacle data Provider provide terrain data for Area 4 for all runways where precision approach Category II or III operations have been established?		☐	☐	☐	

45.	Does the terrain and obstacle data Provider define an angular or linear and of regular or irregular shape as terrain grid?		☐	☐	☐	
46.	Does the terrain and obstacle data Provider define of terrain data shall include spatial (position and elevation), thematic and temporal aspects for the surface of the Earth containing naturally occurring features such as mountains, hills, ridges, valleys and bodies of water excluding obstacles?		☐	☐	☐	
47.	Does the terrain and obstacle data Provider provide the feature attributes annotated as mandatory describing terrain?		☐	☐	☐	
48.	Does the terrain and obstacle data Provider publish or provide no obstacle data in terrain data sets?		☐	☐	☐	
49.	Does the terrain and obstacle data Provider publish or provide obstacle data for obstacles in Area 1 whose height is 100 m or higher above ground?		☐	☐	☐	
50.	Does the terrain and obstacle data Provider publish or provide obstacle data for all obstacles within Area 2 that are assessed as being a hazard to air navigation, for aerodromes regularly used by international civil aviation?		☐	☐	☐	
51.	Does the terrain and obstacle data Provider publish or provide obstacles that penetrate an obstacle data collection surface of an area 2a?		☐	☐	☐	

•	Does the terrain and obstacle data Provider publish or provide objects in the take-off flight path area which project above a plane surface having a 1.2 per cent slope and having a common origin with the take-off flight path area?		☐	☐	☐	
52.	Does the terrain and obstacle data provider publish or provide obstacles that penetrate the aerodrome obstacle limitation surfaces?		☐	☐	☐	
53.	Does the terrain and obstacle data provider publish or provide obstacle data for Area 4 for all runways where precision approach Category II or III operations have been established for aerodromes regularly used by international civil aviation?		☐	☐	☐	
54.	Has obstacle data elements represented in the data sets by points, lines or polygons?		☐	☐	☐	
55.	Has obstacle data for each area conform to the applicable numerical requirements?		☐	☐	☐	
56.	Is the obstacle data product specification supported by geographic coordinates for each aerodrome included in the data set?		☐	☐	☐	
57.	Are the arrangements for coordinating the provision of obstacle data for adjacent aerodromes where their respective coverage areas overlap to assure that the data for the same obstacle is correct established?		☐	☐	☐	
58.	Does the terrain and obstacle data provider publish or provide obstacle data for Area 3?		☐	☐	☐	

59.	Does the terrain and obstacle data provider publish or provide obstacle data for area 4 for all runways where precision approach Category II or III operations have been established?		☐	☐	☐	
60.	**TERRAIN AND OBSTACLE UPDATES**					
61.	Does the terrain and obstacle data provider amend or reissue data sets at such regular intervals as may be necessary to keep them up to date?		☐	☐	☐	
62.	Does the terrain and obstacle data provider make available as digital data permanent changes and temporary changes of long duration (three months or longer) and issue in the form of a complete data set or a sub-set that includes only the differences from the previously issued complete data set?		☐	☐	☐	
63.	**ADMINISTRATIVE AND PERSONNEL REQUIREMENTS**					
64.	Does the terrain and obstacle data provider/originator have the facilities and equipment that are necessary for providing its terrain and obstacle data, including appropriate premises and equipment to allow operational personnel to perform their duties?		☐	☐	☐	
65.	Does the terrain and obstacle data provider/originator provide its operational personnel with access to the terrain and obstacle data required for the publication of the aeronautical information products or sharing with intended users?		☐	☐	☐	