



INTERNATIONAL CIVIL AVIATION ORGANIZATION

- **Second meeting of the AFI Region e-TOD Working Group**

(Dakar, Senegal , 19 July 2011)

Agenda Item 3 : Review and Analysis of e-TOD requirements

**EUROCAE / RTCA PROPOSITIONS FOR REVISION OF THE ELECTRONIC TERRAIN
AND OBSTACLE DATA PROVISIONS IN ICAO ANNEX 15**

(Prepared by EUROCAE WG44 / RTCA SC217
(Presented by the Secretariat)

SUMMARY

This Discussion Paper presents EUROCAE/RTCA proposed changes to electronic terrain and obstacle data provisions currently included in ICAO Annex 15, aiming at resolving some identified ambiguities. The proposed revisions are limited to simple changes that do not fundamentally change the current requirements, that have already been subject to extensive coordination.

1. INTRODUCTION

Through Amendment 33 to ICAO Annex 15, ICAO introduced the need for States to make available electronic terrain and obstacle data. The Standards and Recommended Practices (SARPs) introduced were, in the main, based upon the requirements identified within ED-98A / DO-276A. Since that time, ICAO has made a number of revisions to these SARPs through Amendments 34, 35 and 36 to ICAO Annex 15.

At the end of 2008, EUROCAE and RTCA decided to reactivate the industry group that developed the user requirements for terrain and obstacle data (ED-98A / DO-276A) and for aerodrome mapping data (ED-99B / DO-272B). The main rationale for the update of the terrain and obstacle data industry standard was to align the requirements specified and terminology used with those included in ICAO Annex 15. Yet, during the analysis of the ICAO latest provisions related to electronic terrain and obstacle data (after Amendment 36), a number of ambiguities and areas of concern have been pointed out in. The work was of EUROCAE/RTCA was therefore extended to address these topics.

This Discussion Paper outlines proposed changes that EUROCAE/RTCA intend to include within ED-98B / DO-276B so as to remove these ambiguities found. These proposals result from various dedicated subgroup meetings as well as a plenary session during the last WG44 / SC217 meeting in March 2011.

The change proposals are presented in paragraph 2 and Annex A of this DP. It should be noted that in developing these change proposals, the intent has been to restrict the revisions to simple changes that do not fundamentally change the current requirements.

2. DISCUSSION

This paragraph presents the change proposals and the rationale for each change. The proposed, revised text for ICAO Annex 15 is provided at Annex A and the change proposal numbers provided here are identified next to the relevant revised text. In addition, a few minor changes are made to ensure that the text is consistent and to renumber paragraphs etc. For example, specific reference to Figure A8-3 is proposed for paragraph 10.1.7.

Change Proposal 1 (Linked to Change Proposal 9)

The current text defining Area 2a is considered to be open to interpretation and therefore may lead to differences in implementation. This mainly stems from the use of the word 'comprises' which may result, in some cases, in Area 2a being defined as a significantly larger area than in other cases.

The proposal made is intended to more explicitly define the extent of Area 2a and to ensure that the resultant obstacles collected provide those necessary below the inner horizontal surface required by ICAO Annex 14. To this end, there is a necessity for Area 2a to extend 250m either side of the extended runway centreline and 250m beyond the runway ends and any stopways that exist. Furthermore, if a clearway exists, Area 2a should be commenced at the end of this clearway, if this itself is greater than 250m long.

Change Proposal 2 (Linked to Change Proposal 6)

Initial implementation has shown that whilst Area 2b is defined as being only 10 km in length, this does not allow for the collection of all the obstacles needed for approach and take-off climb surfaces and that, in practical terms, an Area 2b of 15km brings significantly more benefit.

Ideally, Area 2b would continue with a 1.2% slope until a height of 150m above its initial start point is reached (i.e. 12.5km), at which point it should continue as a horizontal plane at a height of 150m. Whilst such a modification was considered, it was felt that this forms a complex description and it may result in the introduction of another Area 2 subarea (Area 2b.1 and Area 2b.2?). Whilst there was thought to be good reasons to make such a change, it was concluded that this went beyond the simple changes that the group had established as a constraint.

It is, therefore, proposed that Area 2b is extended to 15km but that it continues at a slope of 1.2% for this entire distance.

Furthermore, there are situations where terrain dictates that the standard modes of operating to/from an airport mean procedures cannot follow the extended centreline of a runway, it is considered that there is little value collecting data for the defined Area 2b. This has been confirmed by some early implementation activities. It is, therefore, proposed that in such cases Area 2b may be realigned to follow the operating area.

Note: Figure A8-2 needs to be revised to reflect the changes to Area 2b but we do not have the source available to make the necessary changes.

Change Proposal 3 (Linked to Change Proposal 4)

The current text included in paragraph 10.1.5 mixes the requirements for terrain and obstacle data, referring to the figure relating to obstacle collection for both and requires that data for terrain that penetrates obstacle collection surfaces (even those that are defined as a height above terrain) to be

collected. As a result, Figure A8-1 which specifies the Area 1 and 2 terrain collection requirements is never referred to from the main body of the text and is contradictory to it.

It is, therefore, proposed that this text is revised to solely address the requirements for obstacle data collection and that a new paragraph (see Change Proposal 4) is introduced for terrain data collection.

Change Proposal 4 (Linked to Change Proposal 3)

With Change Proposal 3 having modified the existing requirements to only address obstacle data, this proposal addresses the need to clarify the terrain data that should be collected. The intention has been to maintain synergy between the requirements for terrain data and those for obstacle data so as to ensure a simple implementation. As such, the proposal calls for Area 2 terrain data to be collected for those regions for which Area 2 obstacle data shall be collected.

This requires a new paragraph 10.1.6 to be inserted and the following paragraphs to be renumbered.

Change Proposal 5 (Linked to Change Proposal 10)

The text of paragraph 10.1.8 (now numbered 10.1.9) contains two issues that it is considered should be corrected. Firstly, it refers to the “terrain and obstacles that penetrate the relevant obstacle data collection surface specified in Appendix 8 where no such surface is defined. Secondly, a description of the use of data is provided which is inconsistent with the specification of data collection for the other areas.

It is therefore proposed that the text is amended to refer to the data collection requirements specified in Figure A8-4 (which is not otherwise referenced) and that the description related to the use of the data is deleted.

A further issue exists with the note that suggests that an Area 2 dataset is normally sufficient to meet the requirements for obstacle data in Area 4. Research conducted has shown that this is rarely the case and, as a result of this text, there is concern that data will not be collected when needed. It is proposed, therefore, that the majority of the note is deleted, leaving only reference to where guidance on the selection of obstacles may be found.

Change Proposal 6 (Linked to Change Proposal 2)

This change revises the Figure A8-1 to bring consistency with the revisions proposed in Change Proposal 2.

Change Proposal 7

The provision of terrain data in accordance with the Area 2 numerical requirements, for the 45 km (or TMA) around the aerodrome, is considered beneficial and the current requirement that only that terrain data which “penetrates the horizontal plane 120m above the lowest runway elevation” is collected is not considered beneficial. The suitability of this change is reinforced by the corresponding need for all obstacles in this region to be collected in accordance with Area 2 numerical requirements.

As a result, the proposal is that Notes 1 and 2 to Figure A8-2 are merged and amended to remove mention of the 120m plane and that Note 3. is deleted.

Change Proposal 8 (Linked to Change Proposal 1)

Change Proposal 8 is required to ensure that Note 1. a) to Figure A8-1 is consistent with the description of Area 2a introduced through Change Proposal 1.

Change Proposal 9

The existing notes to Figure A8-2 mix the terms “collection surfaces” and “obstacle collection surfaces”. Furthermore, whilst the figures graphically depict the obstacle filters for Areas 2a, 2b and 2c, only the obstacle filters for Area 2a is described in the text. The changes proposed to Notes 1. b) and 1. c) to Figure A8-2 are introduced to address these issues by ensuring consistency in the descriptive notes provided.

Change Proposal 10 (Linked to Change Proposal 5)

To support Change Proposal 5, similar changes need to be introduced to the explanatory notes to Figure A8-4 which, again, incorrectly indicate that Area 2 obstacle data is normally sufficient to meet the needs of Area 4.

Change Proposal 11

Whilst the required attributes necessitated that the originator of the data be recorded for both terrain and obstacle data, it is considered that it is equally important to record who provides the data sets. As such a mandatory Data Source Identifier attribute is recommended for both terrain and obstacle data sets.

3. RECOMMENDATIONS

The proposals made are considered to provide a simple approach to removing the ambiguity that exists in the currently defined requirements of ICAO that have, in the main, been adopted for inclusion in the next release of ED-98() / DO-276().

This Discussion Paper recommends the inclusion of the propositions for amendment included in Annex A in the proposed amendment 37 to ICAO Annex 15.

4. ACTION BY THE MEETING

4.1 The meeting invited to:

- a) Note the contents of this paper, notably the proposals for amendment included in Annex A
- b) Support the inclusion of the propositions for amendment included in Annex A in the proposed amendment 37 to ICAO Annex 15.

Annex A Revised Text

CHAPTER 10. ELECTRONIC TERRAIN AND OBSTACLE DATA

Note.— *Electronic terrain and obstacle data is intended to be used in the following air navigation applications:*

- a) *ground proximity warning system with forward looking terrain avoidance function and minimum safe altitude warning (MSAW) system;*
- b) *determination of contingency procedures for use in the event of an emergency during a missed approach or take-off;*
- c) *aircraft operating limitations analysis;*
- d) *instrument procedure design (including circling procedure);*
- e) *determination of en-route “drift-down” procedure and en-route emergency landing location;*
- f) *advanced surface movement guidance and control system (A-SMGCS); and*
- g) *aeronautical chart production and on-board databases.*

The data may also be used in other applications such as flight simulator and synthetic vision systems, and may assist in determining the height restriction or removal of obstacles that pose a hazard to air navigation.

10.1 Coverage areas and requirements for data provision

10.1.1 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: within the vicinity of an aerodrome, sub-divided as follows;
 - Area 2a: a rectangular area around a runway ~~that comprises~~ extending to 250 m either side of the runway ~~strip~~ extended centre line and extending before the threshold and beyond the end of the runway or stopway for a distance of ~~at least~~ 250m. Area 2a shall be extended so as to fully include ~~plus~~ any clearway(s) that exists.

Note.— *See 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 150 km and a splay of 15% to each side;

Note.— *Where, for example as a result of terrain, flight operations are required to turn and do not operate along the extended centre line of the runway, Area 2b may be aligned such that it follows the planned flight paths.*

- 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: 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.
- Area 4: 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.

Note.— See Appendix 8 for descriptions and graphical illustrations of the coverage areas.

10.1.2 **Recommendation.** — *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.*

10.1.3 Electronic terrain data shall be provided for Area 1. The obstacle data shall be provided for obstacles in Area 1 higher than 100 m above ground.

10.1.4 From 12 November 2015, at aerodromes regularly used by international civil aviation, electronic obstacle data shall be provided for all obstacles within Area 2 that are assessed as being a hazard to air navigation.

10.1.5 From 12 November 2015, at aerodromes regularly used by international civil aviation electronic ~~terrain and~~ obstacle data shall be provided **in accordance with Appendix 8, Figure A8-2**, for:

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- a) Area 2a, for those obstacles that penetrate the relevant obstacle data collection surface specified in Appendix 8;
- b) penetrations of the take-off flight path area obstacle identification surfaces; and
- c) penetrations of the aerodrome obstacle limitation surfaces.

Note.— *Take-off flight path area obstacle identification surfaces are specified in Annex 4, 3.8.2 Aerodrome obstacle limitation surfaces are specified in Annex 14, Volume 1, Chapter 4.*

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10.1.6 From 12 November 2015, at aerodromes regularly used by international civil aviation, electronic terrain data shall be provided in accordance with Appendix 8, Figure A8-1 for:

- a) Area 2a;
- b) The take-off flight path area; and
- c) An area bounded by the lateral extents of the aerodrome obstacle limitation surfaces.

10.1.67 **Recommendation.**— At aerodromes regularly used by international civil aviation, electronic terrain and obstacle data should be provided for Areas 2b, 2c and 2d for obstacles and terrain that penetrate the relevant ~~obstacle~~ data collection surface specified in Appendix 8, except that data need not be collected for obstacles less than a height of 3m above ground in Area 2b and less than a height of 15m above ground in Area 2c.

10.1.78 **Recommendation.**— *At aerodromes regularly used by international civil aviation, electronic terrain and obstacle data should be provided for Area 3 for terrain and obstacles that penetrate the relevant obstacle data collection surface specified in Appendix 8, Figure A8-3.*

10.1.89 At aerodromes regularly used by international civil aviation, electronic terrain and obstacle data shall be provided for Area 4, in accordance with Figure A8-4, for terrain and obstacles that penetrate the relevant obstacle data collection surface specified in Appendix 8, for all runways where precision approach Category II or III operations have been established and where detailed terrain information is required by operators to enable them to assess the effect of terrain on decision height determination by use of radio altimeters.

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Note.— ~~Area 4 terrain data and Area 2 obstacle data are normally sufficient to support the production of the Precision Approach Terrain Chart — ICAO. When more detailed obstacle data is required for Area 4, this may be provided in accordance with the Area 4 obstacle data requirements specified in Appendix 8, Table A8-2.~~ Guidance on appropriate obstacles to be provided through aeronautical information for this chart is given in the Aeronautical Chart Manual (Doc 8697).

10.1.910 **Recommendation.**— *Where additional electronic obstacle or terrain data is collected to meet other aeronautical requirements, the obstacle and terrain data sets should be expanded to include these additional data.*

10.1.110 **Recommendation.**— *Arrangements should be made for the coordination of providing Area 2 electronic terrain and obstacle data for adjacent aerodromes where their respective coverage Areas overlap to assure that the data for the same obstacle or terrain is correct.*

10.1.124 **Recommendation.**— *At those aerodromes located near territorial boundaries, arrangements should be made among States concerned to share Area 2 electronic terrain and obstacle data.*

10.2 Terrain data set — content, numerical specification and structure

10.2.1 A terrain data set shall contain digital sets of data representing terrain surface in the form of continuous elevation values at all intersections (points) of a defined grid, referenced to common datum. A terrain grid shall be angular or linear and shall be of regular or irregular shape.

Note.— *In regions of higher latitudes, latitude grid spacing may be adjusted to maintain a constant linear density of measurement points.*

10.2.2 Sets of electronic 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, bodies of water, permanent ice and snow, and excluding obstacles. In practical terms, depending on the acquisition method used, this shall represent the continuous surface that exists at the bare Earth, the top of the canopy or something in-between, also known as “first reflective surface”.

10.2.3 In terrain data sets, only one feature type, i.e. terrain, shall be provided. Feature attributes describing terrain shall be those listed in Table A8-3. The terrain feature attributes listed in Table A8-3 represent the minimum set of terrain

attributes, and those annotated as mandatory shall be recorded in the terrain data set.

10.2.4 Electronic terrain data for each area shall conform to the applicable numerical requirements in Appendix 8, Table A8-1.

10.3 Obstacle data set — content, numerical specification and structure

10.3.1. Obstacle data shall comprise the digital representation of the vertical and horizontal extent of the obstacle. Obstacles shall not be included in terrain data sets. Obstacle data elements are features that shall be represented in the data sets by points, lines or polygons.

10.3.2 In an obstacle data set, all defined obstacle feature types shall be provided and each of them shall be described according to the list of mandatory attributes provided in Appendix 8, Table A8-4.

Note.— By definition, obstacles can be fixed (permanent or temporary) or mobile. Specific attributes associated with mobile (feature operations) and temporary types of obstacles are annotated in Appendix 8, Table A8-4, as optional attributes. If these types of obstacles are to be provided in the data set, appropriate attributes describing such obstacles are also required.

10.3.3 Electronic obstacle data for each area shall conform to the applicable numerical requirements in Appendix 8, Table A8-2.

10.4 Terrain and obstacle data product specifications

10.4.1 To allow and support the interchange and use of sets of electronic terrain and obstacle data among different data providers and data users, the ISO 19100 series of standards for geographic information shall be used as a general data modelling framework.

10.4.2 A comprehensive statement of available electronic terrain and obstacle data sets shall be provided in the form of terrain data product specifications as well as obstacle data product specifications on which basis air navigation users will be able to evaluate the products and determine whether they fulfil the requirements for their intended use (application).

Note.— ISO Standard 19131 specifies the requirements and outline of data product specifications for geographic information.

10.4.3 Each terrain data product specification shall include an overview, a specification scope, data product identification, data content and structure, reference system, data quality, data capture, data maintenance, data portrayal, data product delivery, additional information, and metadata.

10.4.4 The overview of terrain data product specification or obstacle data product specification shall provide an informal description of the product and shall contain general information about the data product. Specification of terrain data may not be homogenous across the whole data product but may vary for different parts of the data sets. For each such subset of data, a specification scope shall be identified. Identification information concerning both terrain and obstacle data products shall include the title of the product; a brief narrative summary of the content, purpose, and spatial resolution if appropriate (a general statement about the density of spatial data); the geographic area covered by the data product; and supplemental information.

10.4.5 Content information of feature-based terrain data sets or of feature-based obstacle data sets shall each be described in terms of an application schema and a feature catalogue. Application schema shall provide a formal

description of the data structure and content of data sets while the feature catalogue shall provide the semantics of all feature types together with their attributes and attribute value domains, association types between feature types and feature operations, inheritance relations and constraints. Coverage is considered a subtype of a feature and can be derived from a collection of features that have common attributes. Both terrain and obstacle data product specifications shall identify clearly the coverage and/or imagery they include and shall provide a narrative description of each of them.

Note 1. — ISO Standard 19109 contains rules for application schema while ISO Standard 19110 describes feature cataloguing methodology for geographic information.

Note 2.— ISO Standard 19123 contains schema for coverage geometry and functions.

10.4.6 Both terrain data product specifications and obstacle data product specifications shall include information that identifies the reference system used in the data product. This shall include the spatial reference system and temporal reference system. Additionally, both data product specifications shall identify the data quality requirements for each data product. This shall include a statement on acceptable conformance quality levels and corresponding data quality measures. This statement shall cover all the data quality elements and data quality sub-elements, even if only to state that a specific data quality element or sub-element is not applicable.

Note.— ISO Standard 19113 contains quality principles for geographic information while ISO Standard 19114 covers quality evaluation procedures.

10.4.7 Terrain data product specifications shall include a data capture statement which shall be a general description of the sources and of processes applied for the capture of terrain data. The principles and criteria applied in the maintenance of terrain data sets and obstacle data sets shall also be provided with the data specifications, including the frequency with which data products are updated. Of particular importance shall be the maintenance information of obstacle data sets and an indication of the principles, methods and criteria applied for obstacle data maintenance.

10.4.8 Terrain data product specifications shall contain information on how data held with data sets is presented, i.e. as a graphic output, as a plot or as an image. The product specifications for both terrain and obstacles shall also contain data product delivery information which shall include delivery formats and delivery medium information.

Note.— ISO Standard 19117 contains a definition of the schema describing the portrayal of geographic information including the methodology for describing symbols and mapping of the schema to an application schema.

10.4.9 The core terrain and obstacle metadata elements shall be included in the data product specifications. Any additional metadata items required to be supplied shall be stated in each product specification together with the format and encoding of the metadata.

Note.— ISO Standard 19115 specifies requirements for geographic information metadata.

10.4.10 The obstacle data product specification, supported by geographical coordinates for each aerodrome included within the dataset, shall describe the following areas:

- Areas 2a, 2b, 2c, 2d;

- the take-off flight path area; and
- the obstacle limitation surfaces.

APPENDIX 8. TERRAIN AND OBSTACLE DATA REQUIREMENTS

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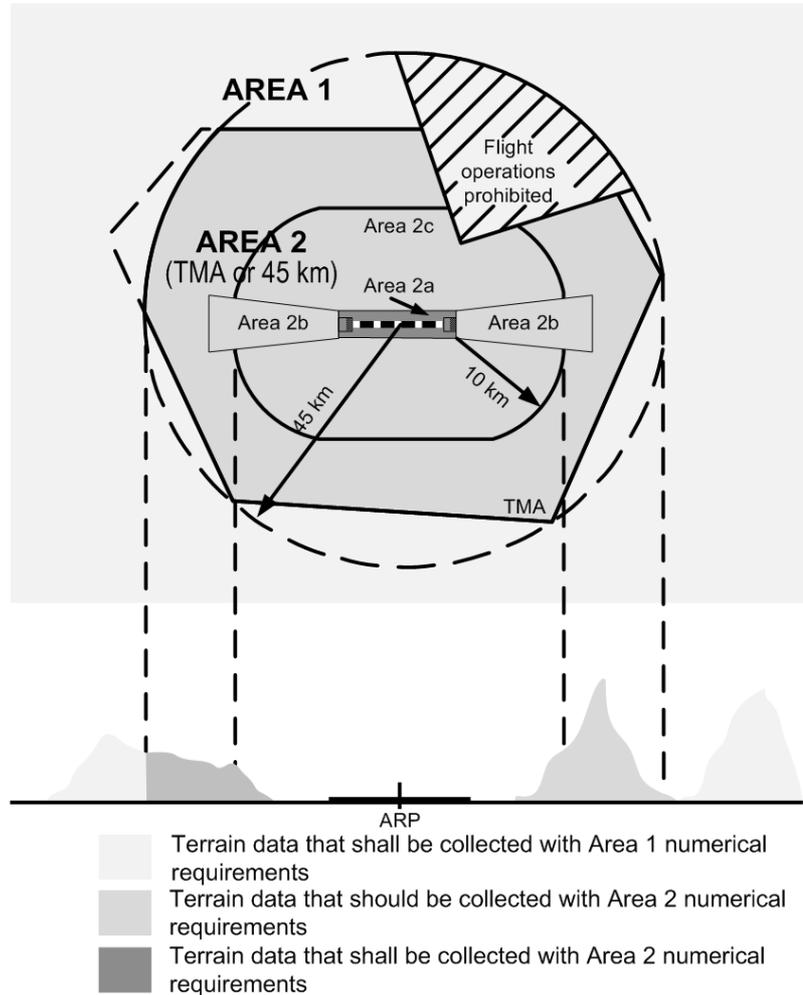


Figure A8-1. Terrain data collection surfaces — Area 1 and Area 2

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1. Within the area covered extending to the by a 10-km radius from the ARP, terrain data shall comply with the Area 2 numerical requirements.

2. In the area between 10 km and the enclosed by the TMA boundary or 45-km radius from the ARP (whichever is smaller), data on terrain data that penetrates the horizontal plane 120 m above the lowest runway elevation shall comply with the Area 2 numerical requirements

~~3. In the area between 10 km and the TMA boundary or 45-km radius (whichever is smaller), data on terrain that does not penetrate the horizontal plane 120 m above the lowest runway elevation shall comply with the Area 1 numerical requirements.~~

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, terrain data shall comply with the Area 1 numerical requirements.

Note.— Terrain data numerical requirements for Areas 1 and 2 are specified in Table A8-1

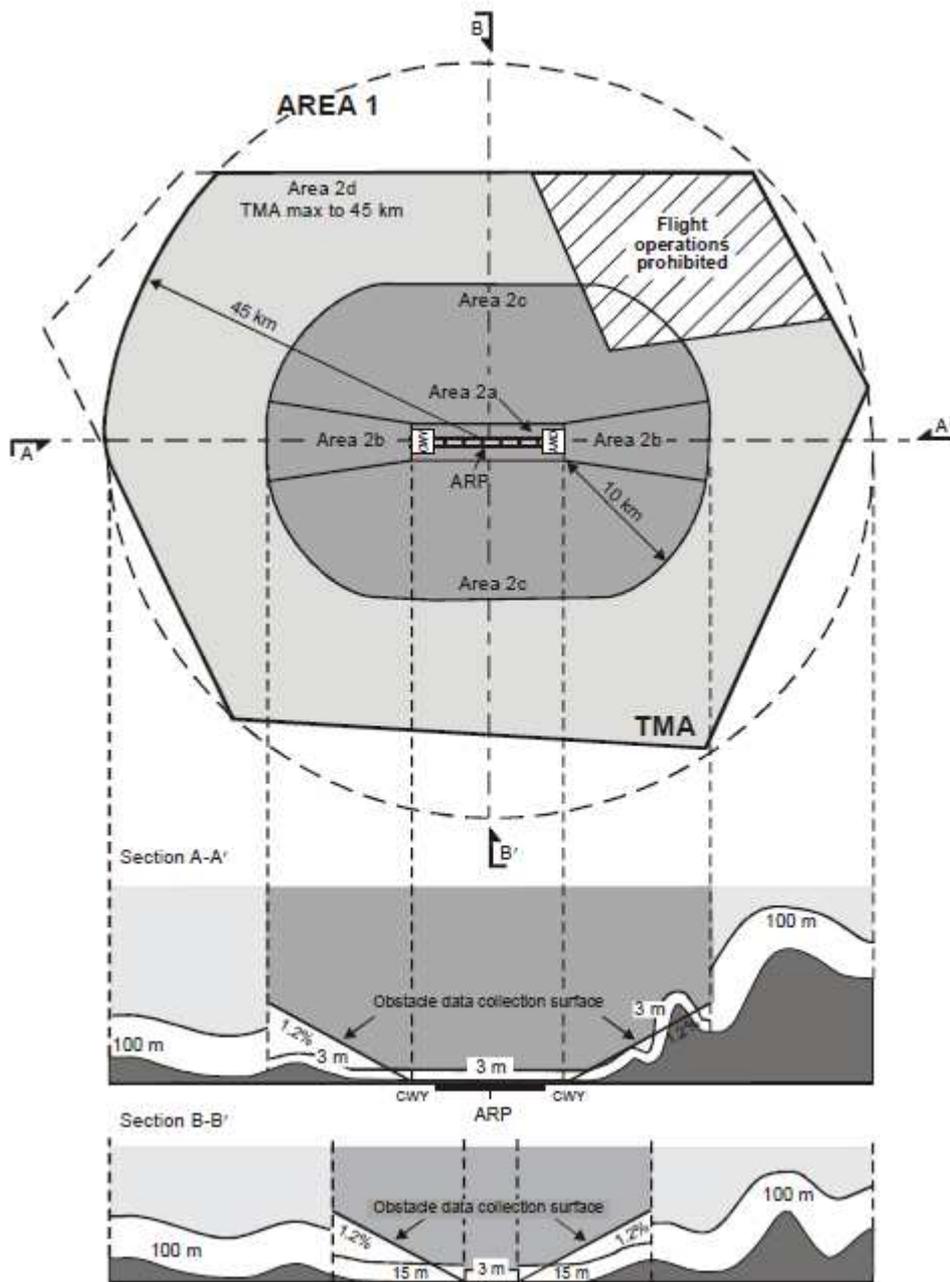


Figure A8-2. Obstacle data collection surfaces — Area 1 and Area 2

1. Obstacle data shall be collected and recorded in accordance with the Area 2 numerical requirements specified in Table A8-2:

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a) Area 2a: a rectangular area around a runway that comprises extending to 250 m either side of the runway strip centre line and extending before the threshold and beyond the end of the runway or stopway for a distance of 250m. Area 2a shall be extended so as to fully include plus any clearway(s) that exists. The Area 2a obstacle collection surface shall have height of 3 m above the nearest runway elevation measured along the runway centre line, and for those portions related to a clearway, if one exists, at the elevation of the nearest runway end;

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b) Area 2b: an area extending from the ends of Area 2a in the direction of departure, with a length of 105 km and a splay of 15% to each side. The Area 2b obstacle collection surface has a 1.2% slope extending from the ends of Area 2a at the elevation of the runway end in the direction of departure, with a length of 105 km and a splay of 15% to each side. Obstacles less than 3 m in height above ground need not be collected;

c) 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. The Area 2c obstacle collection surface has a 1.2% slope extending outside Area 2a and Area 2b at a distance of not more than 10 km from the boundary of Area 2a. The initial elevation of Area 2c shall be the elevation of the point of Area 2a at which it commences. Obstacles less than 15 m in height above ground need not be collected; and

d) 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. The Area 2d obstacle collection surface has a height of 100 m above ground.

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 in Table A8-2.

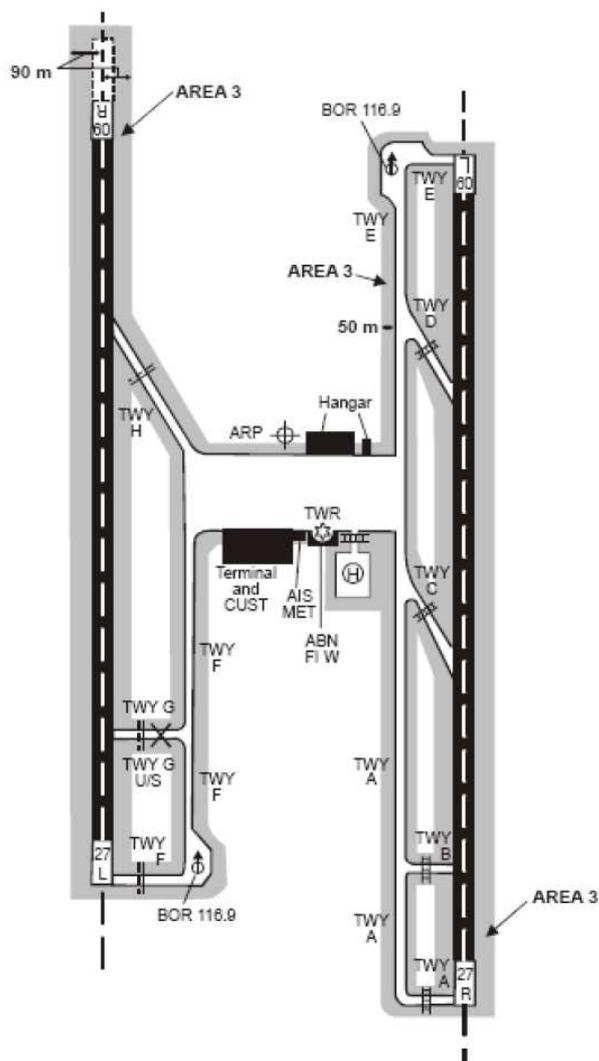


Figure A8-3. Terrain and obstacle data collection surface — Area 3

1. The data collection surface for terrain and obstacles extends a half-metre (0.5 m) above the horizontal plane passing through the nearest point on the aerodrome movement area.
2. Terrain and obstacle data in Area 3 shall comply with the numerical requirements specified in Table A8-1 and Table A8-2, respectively.

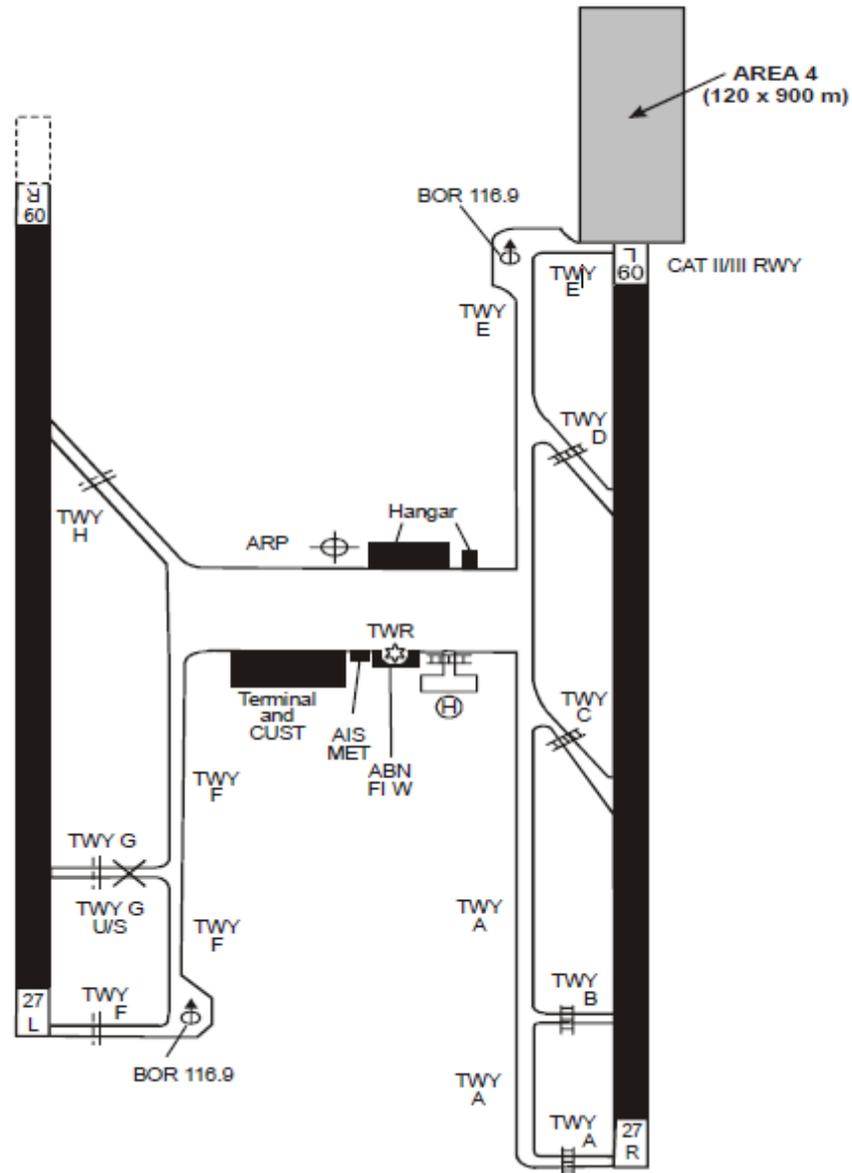


Figure A8-4. Terrain and obstacle data collection surface — Area 4

Terrain and obstacle data in Area 4 shall comply with the numerical requirements specified in Table A8-1 and Table A8-2, respectively.

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Note 1.— The horizontal extent of Area 2 covers Area 4. More detailed obstacle data may be collected in Area 4 in accordance with Area 4 numerical requirements for obstacle data specified in Table A8-2. (See 10.1.8.)

Note 2.— Area 4 may be extended in accordance with 10.1.2.

Table A8-1. Terrain data numerical requirements

	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%
Data classification Integrity level	Routine 1×10^{-3}	Essential 1×10^{-5}	Essential 1×10^{-5}	Essential 1×10^{-5}
Maintenance period	as required	as required	as required	as required

Table A8-2. Obstacle data numerical requirements

	Area 1	Area 2	Area 3	Area 4
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%
Data classification Integrity level	Routine 1×10^{-3}	Essential 1×10^{-5}	Essential 1×10^{-5}	Essential 1×10^{-5}
Maintenance period	as required	as required	as required	as required

Table A8-3. Terrain attributes

	Terrain attribute	Mandatory/Optional
	Area of coverage	Mandatory
	Data originator identifier	Mandatory
11	Data source identifier	Mandatory
	Acquisition method	Mandatory
	Post spacing	Mandatory
	Horizontal reference system	Mandatory
	Horizontal resolution	Mandatory
	Horizontal accuracy	Mandatory
	Horizontal confidence level	Mandatory
	Horizontal position	Mandatory
	Elevation	Mandatory
	Elevation reference	Mandatory
	Vertical reference system	Mandatory
	Vertical resolution	Mandatory
	Vertical accuracy	Mandatory
	Vertical confidence level	Mandatory
	Surface type	Optional
	Recorded surface	Mandatory
	Penetration level	Optional
	Known variations	Optional
	Integrity	Mandatory
	Date and time stamp	Mandatory
	Unit of measurement used	Mandatory

Table A8-4. Obstacle attributes

	Obstacle attribute	Mandatory/Optional
	Area of coverage	Mandatory
	Data originator identifier	Mandatory
11	Data source identifier	Mandatory
	Obstacle identifier	Mandatory
	Horizontal accuracy	Mandatory
	Horizontal confidence level	Mandatory
	Horizontal position	Mandatory
	Horizontal resolution	Mandatory
	Horizontal extent	Mandatory
	Horizontal reference system	Mandatory
	Elevation	Mandatory
	Height	Optional
	Vertical accuracy	Mandatory
	Vertical confidence level	Mandatory
	Elevation reference	Mandatory
	Vertical resolution	Mandatory
	Vertical reference system	Mandatory
	Obstacle type	Mandatory
	Geometry type	Mandatory
	Integrity	Mandatory
	Date and time stamp	Mandatory
	Unit of measurement used	Mandatory
	Operations	Optional
	Effectivity	Optional
	Lighting	Mandatory
	Marking	Mandatory