International Civil Aviation Organization SAM/AIM/4-WP/02
South American Regional Office 15/09/12
Fourth SAM AIM Multilateral Meeting for AIS-AIM Transition (SAM/AIM/4)
Lima, Peru, 15-19 October 2012

Agenda Item 1: Implementation of electronic terrain and obstacle data (e-TOD) provision

(Presented by the Secretariat)

Summary

This working paper presents the status of the e-TOD project for the provision of terrain and obstacle data so that the States participating at the Meeting may review the progress and adjust the project description and the associated GANT that will be submitted at the next meeting of the GREPECAS Programme and Project Review Committee.

References:
- Annex 15 to the ICAO Convention.
- GREPECAS CRPP/1 meeting.
- SAM/AIM/2 multilateral meeting
- SAM/AIM/3 multilateral meeting

ICAO strategic objectives:	*A – Safety* *C – Environmental protection*

1 Background

1.1 The SAM/AIM/2 meeting took note of the new organisation and the programme- and project-based work methodology adopted by the GREPECAS/16 meeting, and that in the new work methodology, the regional officers act as programme coordinators and officials designated by the States act as project coordinators, applying a project management methodological approach.

1.2 At the SAM/AIM/3 meeting, the States of the Region completed the survey prepared by the e-TOD project coordinator with a view to establishing the project baseline and adjusting in more detail the tasks to be fulfilled for the planning of the project and the drafting of action plans.

2 Discussion

2.1 With the support of Regional Project RLA/06/901, Mr. Juan González was hired as project coordinator to develop an action plan for the implementation of functional improvements to the provision of aeronautical information services, pursuant to output 1.7 of Regional Project RLA/06/901 related to GPI 18 of the Global Air Navigation Plan.

2.2 In order to achieve the objective of the mission, account was taken of the status of implementation of the WGS-84 and GIS in the States of the Region, with a view to developing the guidance document based on their needs.

2.3 It was initially established that, in order to meet the aforementioned needs, 3 documents had to be drafted, namely:

- The guidance document containing the objectives of the e-TOD project;
- The technical and e-TOD project specifications; and
- The e-TOD technical specifications document.

2.4 However, it was finally understood that it would be more appropriate and easier for States if there were only 2 documents containing, in a more efficient manner, the requirements defined for meeting regional e-TOD implementation requirements. Thus, the following documents were generated:

- Guidance document containing the objectives of the e-TOD project
- Technical and e-TOD project specifications

2.5 The work done resulted in a report, a main document that would serve as a guide for defining the objectives related to the development of the e-TOD project, and an attachment containing all the technical aspects involved in e-TOD implementation in the States.

2.6 The resulting documentation is related to ICAO strategic objectives concerning safety, and environmental protection, and to the performance objectives of the regional air navigation implementation plan associated to PBN implementation.

2.7 The “Guidance document on the objectives of the e-TOD project” makes reference to the background of e-TOD implementation in the States of the Region, describes in detail the tasks to be accomplished for that implementation, and addresses the economic aspects (elements to be considered for cost calculation) and target dates for project completion. It finally provides guidance for conducting the risk analysis of the project. This document appears in **Appendix A** to this working paper.

2.8 The document attached to the Guidance Document, entitled “Technical and e-TOD project specifications” contains plenty information especially addressing the technical aspects related to the implementation of the e-TOD project. It contains abundant conceptual information on digital elevation models, obstacles, metadata, quality, etc. Subsequently, it relates the need to manage terrain and obstacle information to the specifications provided in ISO 19131, which is taken as a reference for that area. These technical specifications are shown in **Appendix B** to this working paper.

2.9 The result is a purely technical document that may be used by project designers and managers, as well as by those related in one way or another to data collection, storage, and exchange.

2.10 This work conducted by the expert and also coordinator of Project G1 was done in coordination with the Secretariat, and resulted in the project description update shown in **Appendix C** to this working paper and the GANTT template shown in **Appendix D** to this working paper.

3 Suggested action

3.1 The Meeting is invited to analyse Appendices A, B, C, and D to this working paper and make the adjustments and changes it may deem advisable to GREPECAS Project G1.

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APPENDIX A

GUIDANCE DOCUMENT
Etod Project Objectives

Guidance Document
eTOD Project Objectives

	Prepared by:	*Reviewed by:*	*Approved by:*
Position			
Signature			
Fecha			

Scope

This Document must serve as a guide for defining the objectives related to the execution of the eTOD project.

This Document applies to the Aeronautical Information Service (AIS) and State offices providing terrain and obstacle data.

The Document describes in detail the steps required to ensure a satisfactory implementation and to have electronic terrain and obstacle data available, which in turn may be used for the production of charts and by users that so require it.

Control of changes

Document

Coding:	DG
Title:	Guidance Document – Objectives of the eTOD project
Owner:	AIS of (country)
Master copy location:	AIS of (country)
Date of last update:	00/00/0000

Control of Modifications

Date	*Version*	*Reason for the modification*	*Responsible party*
24/08/2012	01	Document definition	

This copy of the Document will be updated each time a new version of the document is released.

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Record Sheet and List of Amendments

Amendments

Amendments to this Document must be made by page: replaced, added, deleted, or completely revised.

The personnel responsible for amending this Document must complete the following Record of Amendments.

Record of Amendments

Amendment No.	*Date of the amendment*	*Amended by*	*Date*

Table of Contents

Reference Documentation

- ICAO Annex 4 – Aeronautical Charts
- ICAO Annex 15 - Aeronautical Information Services
- ICAO Doc 8126 OACI – Aeronautical Information Services Manual
- ICAO Doc 8697 OACI – Aeronautical Chart Manual
- ICAO Doc 8400 OACI – ICAO Abbreviations and Codes
- ICAO Doc 9881 - Guidelines for Electronic Terrain, Obstacle and Aerodrome Mapping Information

Terms and Definitions

The definitions and abbreviations contained in ICAO Doc 8400 – ICAO Abbreviations and Codes are adopted.

Other Definitions

AIS-AIM Transition Roadmap:	Plan established for the set of tasks that will permit the transition from the current AIS to the new AIM concept
Amendment:	Correction of existing information

Abbreviations

AIM:	Aeronautical information management
AIP:	Aeronautical information publication
AIS:	Aeronautical information service
CAR:	Caribbean Region
eTOD:	Electronic terrain and obstacle data
GIS:	Geographic information system
GPWS:	Ground proximity warning systems
MSAW:	Minimum safe altitude warning
ICAO:	International Civil Aviation Organization
PBN:	Performance-Based Navigation
SAM:	South American Region
SLA:	Service Level Agreement

1. Background

This AIS-AIM Transition Roadmap describes in detail the provision of terrain and obstacle data by States, as a priority task for the first phase.

Amendment 33 to ICAO Annex 15 introduces the concept of electronic terrain and obstacle data (eTOD) sets to be made available to users.

Given the importance of this proposal, the SAM/AIM/2 meeting issued draft Conclusion 13/3, Provision of Electronic Terrain and Obstacle Data (eTOD), as follows:

That CAR/SAM States and Territories take urgent action to:

a) Represent the geodetic data of WGS-84 aeronautical charts in electronic format in support of performance-based navigation (PBN), and

b) Have electronic terrain and obstacle data of high quality and integrity available, as required in ICAO Annex 15.

Accordingly, the aformentioned meeting worked on the definition of a work project, which was finally called G1 “Developments for the provision of electronic terrain and obstacle data (eTOD) (SAM)”.

Task 10 of said project is *“Establish and prioritise objectives of eTOD implementation project (tasks, costs, implementation, target dates, project risks)*”, based on which the deliverable “Draft the Guidance Document containing the objectives of the ETOD project” Is defined.

It should be noted that it is very important to define the area of influence for the collection of both terrain and obstacle data, as defined in Amendment 36 to Annex 15. Accordingly, Appendix 1 contains the latest definitions of the “terrain and obstacle data collection area”.

The quality of the aforementioned terrain and obstacle information will have a direct impact on:

- ground proximity warning systems (GPWS),
- the minimum safe altitude warning (MSAW),
- the definition of contingency procedures to be used in case of an emergency during a missed approach or rejected take-off,
- the analysis of aircraft operational limitations,
- the design of instrument approach procedures,
- the determination of en-route cruise descent procedures and location of en-route emergency landing,
- advanced surface movement guidance and control systems (A-SMGCS);
- the production of aeronautical charts and on board databases,
- the performance-based navigation (PBN) concept,
- search and rescue activities (especially in mountainous areas)

Since eTOD requirements have raised the level of concern by States from both the technical and institutional perspective, it has been deemed necessary to present this guidance document in support of the tasks that need to be implemented.

To that end, this Guidance Document contains a series of tasks, costs, target dates, and risks for the implementation of the eTOD project as a whole.

2. Tasks

The tasks to be carried out are detailed below.

2.1. Understand ICAO requirements and State policies in force

ICAO has designated eight (8) geographic areas for the collection of electronic terrain and obstacle data (eTOD) that States must make available to users of airspaces defined in their territory. A proper understanding of such requirements will be essential for subsequent tasks.

To that end, Appendix 1 to this document contains a description of such areas. Likewise, ICAO Annex 15 “Aeronautical Information Services”, in Chapter 10 and Appendix 8, describes such areas and suggests dates when terrain and obstacle information shall start being provided.

In addition to ensuring a proper understanding of such requirements, existing State policies must also be identified. These may include domestic regulatory restrictions, State policies that are in conflict with Annex 15, data collection problems, data processing, and participation of third parties in such task. It is recommended that all States review their current policies concerning ICAO requirements and identify the adjustments or new procedures that may be required.

States that do not meet the relevant dates must file a ”difference” before ICAO and set a date for compliance and an action plan.

States must recognise that compliance requirements may imply collaboration by organisations other than the aeronautical authority. That would be the case if the responsibility for data collection is shared or delegated to more than one organisation, which will result in agreements and eventually some type of training to make sure that information received is the right one.

2.2. Identification of data types

The types of data to be collected are related to “terrain” and “obstacles”.

“Terrain” is defined as 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 (Annex 15, Chapter 2 “Definitions”).

“Obstacles”, in turn, are defined as all fixed (whether temporary or permanent) and mobile objects, or part thereof, that are located on an area intended for the surface movement of aircraft or that extend above a defined surfface intended to protect aircraft in flight. (Annex 15, Chapter 2 “Definitions”).

The State must identify the sources of such data. In general, terrain data is available at

State geographical institutes. There may also be other providers of such data, reason why there may be a need to enter into some type of agreement to that end. In this sense, the signing of a service level agreement (SLA) with such providers is recommended in order to formalise the initial and subsequent acquisition of data.

As to obstacles, data may be available from:

- Mobile telephone companies (antennae, transmission frequencies)
- Aviation service provider (NAVAIDS / aerodrome data)
- Airports (aerodrome data)
- Public service authorities (electric lines, dams, cable railways, chimneys, wind mills, etc.)
- Military
- Local authorities (buildings)
- Existing studies on obstacles

Some States have offices that collect all this information; consequently, such offices shall be identified and queried accordingly.

These sources will provide all the basic data for building an eTOD database, which will be modified as new data emerges, or when the existing data is modified or deleted.

2.3. Data collection

Once originating data sources, both internal and external, have been identified, and taking into account that such sources are capable of sharing such data, the State may import the available electronic data.

Similarly, the imported data may be incomplete, given the fact that there are much more data still uncollected. In that case, and if no terrain and obstacle data were available, an analysis shall be made of how to obtain them.

The State must create mechanisms for collecting new or additional data for the database in such a way as to ensure that the information is accurage and up-to-date. It must take into account the amount of data that needs to be collected, and do it efficiently.

These data collection methodologies will depend on the data already available, the extent of the territory, and economic resources available. Therefore, it is recommended that a study be made on the possibility of working together with other areas of the States so that they can all benefit from the collection of this type of information.

Another point to consider is the need to collect data on territory of another State. In that case, it is recommended that an agreement be signed whereby the parties define the corresponding data collection permits and data sharing criteria. In this regard, Annex 15 “Aeronautical Information Services”, Ch. 3, 3.1.5, 3.1.6, and 3.3.4 should be considered.

2.4. Ensure data validity, quality and accuracy

Before gathering data in a database, it is essential to make sure that such data meets quality, validity, and accuracy requirements. Appendix 2 to this document describes the level of detail required from the data collected.

In order to meet quality requirements, data must be accompanied by the corresponding metadata, that is, a registry of data sources or origin and all relevant aspects concerning how it was obtained, training of those who obtained them, conditions, etc., with the corresponding records.

2.5. Creation of an eTOD database

Before entering data on an eTOD database, the State must consider the following:

- The ideal database shall provide real-time support to operations, imposing no restrictions on size, and run on an open systems environment in order to enable future analysis.
- The database must be structured in an industry standard format with sufficient safety mechanisms against unauthorised access.
- The database must permit immediate inclusion of new data sources and obstacles.
- The database shall permit the export and publication of data, especifically in AIXM standards.

Furthermore, the authority may analyse how to structure the database in such a way as to provide operational benefits not only to airspace users, but to the authority itself, since this could generate cost savings. The eTOD database designed to meet ICAO terrain and obstacle data requirements could also offer:

- Inclusion and management of data on aerodromes, navaids, obstacles, Annex 14, and data on other surfaces;
- Easier assessment of obstacles through advanced 2D and 3D displays;
- Inclusion of GIS tools to facilitate the analysis;
- Automation mechanisms to increase efficiency and improve the assessment; and
- Historical reference data for assessment purposes.

2.6. Publication of information

ICAO Annex 15, Chapter 10.6 points to the need to public electronic terrain and obstacle data. Once the State has created an eTOD database, it will have to consider what data will be published and what mechanisms will be used for that purpose.

Likewise, the State shall also consider if it will charge the users for the provision of data or it will make them available free of charge.

A possible platform for publication could be the web, since it offers a simple means of publication. Likewise, there is the possibility of doing the publication directly to the user, that is, through some magnetic or digital medium.

An additional benefit would be the ability to export the aforementioned data in industry standard formats, such as AIXM, XML, for their use in other applications.

2.7. Continuous review

Within the context of the quality concept, the State shall also consider conducting a continuous review of its information so as to keep the database up-to-date at all times. Equally important is to take into account the responsibility and impact of the data provided. Accordingly, their review will be crucial.

3. Costs

The generation of an eTOD database will generate expenses that must be taken into account by the State.

3.1. Elements to be taken into account

For cost calculations, a set of elements must be taken into account and specifically analysed by each State based on a series of parameters:

- the extent of its territory,
- the existence or absence of previous terrain and obstacle data,
- the methodology to be used for capturing information,
- others that may have an impact on the equation.

In addition to these parameters, consideration shall also be given to the way in which new information will be collected in the future. This aspect is extremely important de define whether the information will be collected directly by the State or through third parties.

In case of outsourcing, the cost of training and the possible signing of an SLA clearly specifying the required data shall also be taken into account.

As an example, the cost could include:

- work planning,
- data collection,
- entry of data in the database,
- final verification of data

Likewise, consideration shall be given to paragraph 2.6 of this document referred to the way in which both the initial investment as well as any future investment on future data collections will be recovered.

Accordingly, States must analyse how they will recover their investment. Some mechanisms are listed below by way of example:

- payment for using the information whenever the database is queried,
- an initial payment for the right to use the information and a fixed annual charge for such use,
- other options that the State may consider appropriate

4. Implementation timetables

Taking into account the eTOD Project Plan defined at the SAM/AIM/2 meeting, the deadline for the completion of this document has been set for 31 August 2012.

In turn, the technical specifications for the execution of the eTOD project will be based on this document.

But States should make reference to the aforementioned eTOD project plan in order to properly plan the implementation timetable for each of the tasks contained therein. The analysis of the possibility of complying with the timetable will be extremely important in order to put the database at the disposal of users by 12 November 2015.

Likewise, the analysis of the eTOD project plan will be very useful if, for any reason, the State is unable to meet the date or any of the tasks contained therein.

5. Project risks

The risk analysis must be conducted by each State in the event it is unable to develop the eTOD database or any of the tasks contained in the aforementioned eTOD project plan, in accordance with the forms shown below.

DEFICIENCY (HAZARD) REPORT AND RISK ASSESSMENT	
1. Description of the identified deficiency	
2. State/Territory/ Organisation:	
3. Report N°:	
4. Date of identification:	
5. Deficiency reported by:	
6. Air navigation area – Facility/service involved:	
7. Specific requirement:	
8. Potential consequences of the deficiency:	
9. Currently implemented mitigation (if known):	
10. Remarks:	
11. Report prepared by:	

DEFICIENCY (HAZARD) REPORT AND RISK ASSESSMENT (CONT.)						
		RISK SEVERITY				
		Catastrophic **A**	Hazardous **B**	Major **C**	Minor **D**	Insignificant **E**
RISK PROBABILITY	Frequent **5**	***5A***	***5B***	***5C***	***5D***	***5E***
	Occasional **4**	***4A***	***4B***	***4C***	***4D***	***4E***
	Remote **3**	***3A***	***3B***	***3C***	***3D***	***3E***
	Improbable **2**	***2A***	***2B***	***2C***	***2D***	***2E***
	Extremely Improbable **1**	***1A***	***1B***	***1C***	***1D***	***1E***

Risk index	*Tolerance*	*Required action*
5A, 5B, 4A	Extreme risk	IMMEDIATE STOP THE OPERATION OR PROCESS. Unacceptable under the current circumstances. No operation is to be permitted until sufficient control measures are implemented to reduce the risk to an acceptable level. Top management approval is required.
3A, 4B, 5C	High risk	CAUTION. Make sure the risk assessment has been satisfactorily completed and the corresponding preventive controls have been established. Management authorisation of the risk assessment is required before starting the operation or process.
1A, 2A, 2B, 3B, 3C, 4C, 4D, 5D, 5F	Moderate risk	Implement or review risk mitigation as necessary. The approval by the risk assessment department is required.
1B, 1C, 2C, 2D, 3D, 3E, 4E	Low risk	Risk mitigation or revision is optional.
1D, 1E, 2E	Insignificant risk	Acceptable as it is. No risk mitigation is required.

PROBABILITY	Is defined as the probability that an event or unsafe condition may occur
Frequent:	Likely to occur many times (has occurred frequently)
Occasional:	Likely to occur some times (has occurred infrequently)
Remote:	Unlikely, but may occur (rarely occurs)
Improbable:	Very unlikely (no occurrence is known)
Extremely improbable:	Almost unconceivable that the event may occur.

SEVERITY:	Is defined as the possible consequence of an event or unsafe condition, taking as a reference the worst case scenario
Catastrophic:	• Equipment destruction • Multiple casualties
Hazardous:	• Major reduction of safety margins, physical damage or workload such that operators cannot perform their tasks in a precise and complete manner • Severe injury • Major damage to equipment
Major:	• Significant reduction of safety margins, reduced ability of the operator to respond to adverse operational conditions resulting from increased workload or conditions hindering its efficiency • Serious incident • Personal injury
Minor:	• Interference • Operational limitations • Use of emergency procedures • Minor incidents
Insignificant:	• Minor consequences

EXPLANATION OF THE FORM "DEFICIENCY (HAZARD) REPORT AND RISK ASSESSMENT"

1. **Description of the identified deficiency:** Specifies the deficiency identified and validated by the corresponding Regional Office.

2. **State/Territory/Organisation:** Identifies the name of the State/Territory/Organisation involved.

3. **Report N°:** Unique code that identifies the deficiency by State.

4. **Date of identification:** Indicates the date of notification of the identified deficiency, if applicable.

5. **Deficiency reported by:** Indicates the source that identified and reported the deficiency.

6. **Air navigation area facility/service involved:** Specifies the air navigation area directly involved in the identified deficiency. More than one area may be listed.

7. **Specific requirement:** ICAO Annex standard/recommended practice or reference to the requirement of the air Navigation Plan associated to the deficiency. If known, the error or specific failure that affecte the operation is included.

8. **Potential consequences of the deficiency**: Initial assessment of the consequences of the identified deficiency, either by the source that reports the deficiency or by the Regional Office that sends the notification.

9. **Currently implemented mitigation (if known):** If known, currently implemented defences are included.

10. **Remarks:** Remarks or comments on the identified deficiency may be included.

11. **Report prepared by (ICAO Officer):** Indicates the Regional Office and the ICAO Officer that send the notification.

REPORT OF RECOMMENDATIONS TO MITIGATE THE RISK				
1. Description of the identified deficiency:				
2. State/Territory/Organisation:				
3. Report N°:				
4. Date of identification:				
5. Level of risk before the adoption of mitigation measures				
6. Solution # 1				
7. Description of the solution:				
8. Estimated cost and time for implementation of this solution: $ _____	9. Revised risk assessment if only this solution is to be implemented	10. Probability:		
		11. Severity:		
		12. Level of risk:		
13. Potential implementation problems:				
14. Solution # 2				
15. Descripción de la Solución:				
16. Estimated cost and time for implementation of this solution $ _____	17. Revised risk assessment if <u>only</u> this solution must be	18. Probability:		
		19. Severity:		

REPORT OF RECOMMENDATIONS TO MITIGATE THE RISK				
	implemented:	20. Level of risk		
21. Potential implementation problems:				
22. Solution # 3				
23. Description of the solution:				
24. Estimated cost and time for implementation of this solution $ _____	25. Revised risk assessment if only this solution must be implemented:	26. Probability:		
		27. Severity:		
		28. Level of risk:		
29. Potential implementation problems:				
30. Recommended solution(s):				
31. Estimated cost and time for implementation of the recommended solution(s):	$			
32. Revised risk assessment if implemented as recommended:				

		RISK SEVERITY				
		Catastrophic **A**	Hazardous **B**	Major **C**	Minor **D**	Insignificant **E**
RISK PROBABILITY	Frequent **5**	***5A***	***5B***	***5C***	***5D***	***5E***
	Occasional **4**	***4A***	***4B***	***4C***	***4D***	***4E***
	Remote **3**	***3A***	***3B***	***3C***	***3D***	***3E***
	Improbable **2**	***2A***	***2B***	***2C***	***2D***	***2E***

REPORT OF RECOMMENDATIONS TO MITIGATE THE RISK						
	Extremely Improbable **1**	***1A***	***1B***	***1C***	***1D***	***1E***
33. Report prepared by (State/Territory/ Organisation):						

EXPLANATION OF THE FORM "REPORT OF RECOMMENDATIONS TO MITIGATE RISK DE"

The State involved shall complete the form in accordance with the following explanations:

1. **Description of the identified deficiency:** Complete with the same text as the deficiency report validated by the corresponding Regional Office.

2. **State/Territory/Organisation:** Complete with the name of the State/Territory/Organisation.

3. **Report N°:** Complete with the same code as the deficiency identified for each State.

4. **Date of identification:** Insert the date of completion of this form.

5. **Level of risk before the adoption of mitigation measures:** Complete with the level of risk calculated with the existing mitigation measures.

6. **Solution # 1:** Identifies the number of the solution.

7. **Description of the solution:** Complete with a brief description of the first solution to be implemented.

8. **Estimated cost and time for implementation of this solution:** Insert the estimated cost for the implementation of the first solution.

9. **Revised risk assessment if <u>only</u> this solution is to be implemented:** Associated to boxes 10, 11, and 12.

10. **Probability:** Insert the probability index, in code and in simple text, that would be achieved with the implementation of this mitigation measure.

11. **Severity:** Complete with the severity index, in code and in simple text, that would be achieved with the implementation of this mitigation measure.

12. **Level of risk:** Complete with the tolerability index resulting from the implementation of this mitigation measure, in code and in simple text.

13. **Potential implementation problems:** Insert a brief description of potential implementation problems that might prevent the application of the identified solution.

14. **Solution # 2:** Identifies the number of the solution or scenario.

15. **Description of the solution:** Insert a brief description of the second solution to be implemented.

16. **Estimated cost and time for the implementation of this solution:** Insert the estimated cost for the implementation of the second solution.

17. **Revised risk assessment if <u>only</u> this solution is to be implemented:** Associated to boxes 18, 19, and 20.

18. **Probability:** Insert the probability index, in code and in simple text, to be attained with the implementation of this mitigation measure.

19. **Severity:** Complete with the severity index, in code and in simple text, that would be attained with the implementation of this mitigation measure.

20. **Level of risk:** Insert the tolerability index resulting from the implementation of this mitigation measure, in code and in simple text.

21. **Potential implementation problems:** Insert a brief description of the potential implementation problems that might prevent the execution of the identified solution

22. **Solution # 3:** Identifies the number of solution or scenario.

23. **Description of the solution:** Insert a brief description of the third solution to be implemented.

24. **Estimated cost and time for implementation of this solution:** Insert the estimated cost of the implementation of the third solution.

25. **Revised risk assessment if <u>only</u> this solution is to be implemented:** Associated to boxes 26, 27, and 28.

26. **Probability:** Insert the probability index, in code and in simple text, to be achieved with the implementation of this mitigation measure.

27. **Severity:** Inser tht severity index, in code and in simple text, to b achieved with the implementation of this mitigation measure.

28. **Level of risk:** Insert the tolerability index resulting from the implementation of this migitation measure, in code and in simple text.

29. **Potential implementation problems:** Insert a brief description of potential implementation problems that might prevent the application of the identified solution.

30. **Recommended solution(s):** Insert the solution(s) to be implemented to reduce the tolerability index to an acceptable level.

31. **Estimated cost and time for implementation of the recommended solution(s):** Insert with the estimated cost related to the solutions to be implemented.

32. **Revised risk assessment if implemented as recommended:** Complete with the risk assessment once the aforementioned solution(s) has(have) been implemented.

33. **Report prepared by (State/Territory/Organisation):** Insert the name of the aeronautical authority or person/area generating the report.

Appendix 1 – Data collection areas

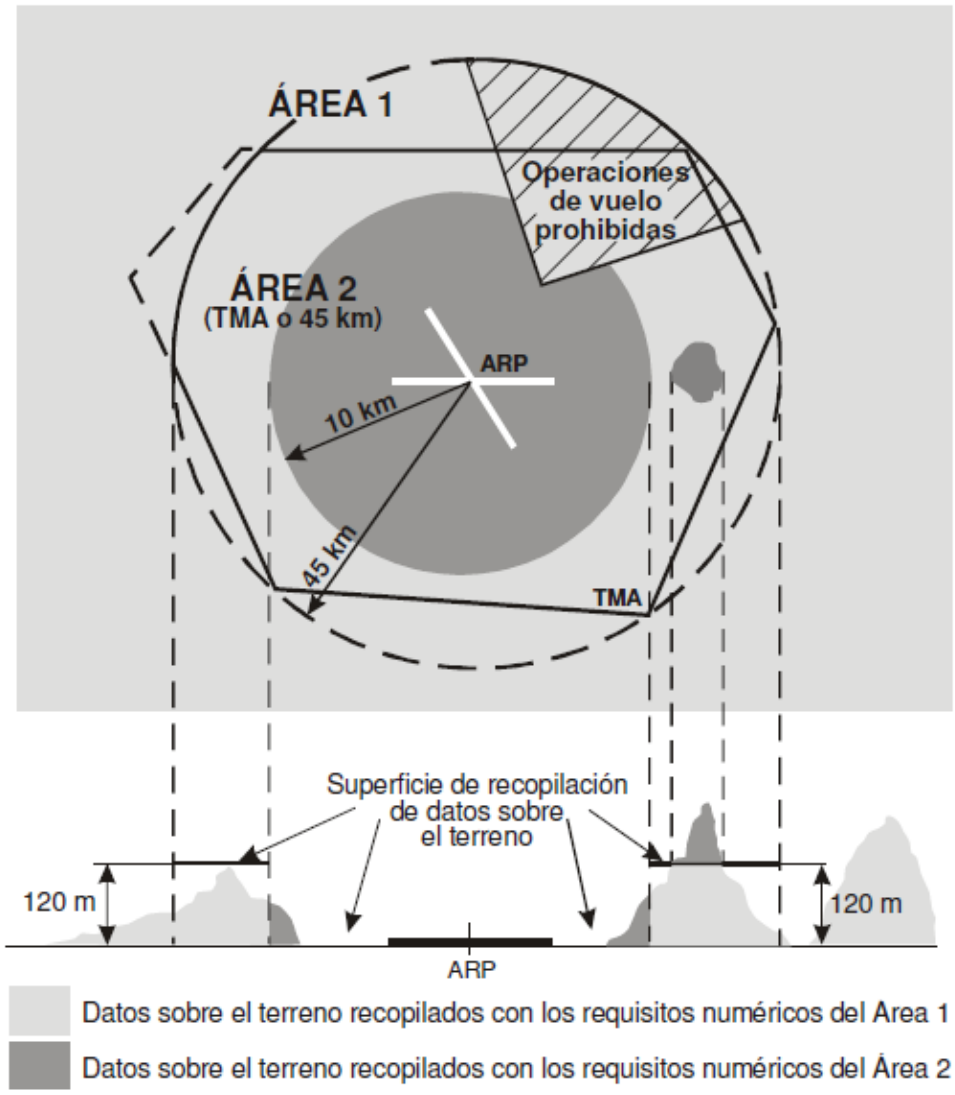

Figure A1-1. Terrain data collection surfaces — Area 1 and Area 2

1. In the area contained within a radius of 10 km from the ARP, terrain data will be adjusted to the numerical requirements of Area 2.

2. In the area between 10 km and TMA boundaries or 45 km from the radius (whichever is smaller), terrain data that penetrates 120 m of the horizontal plane above the lowest runway elevation will be adjusted to the numerical requirements of Area 2.

3. In the area between 10 km and TMA boundaries or 45 km from the radius (whichever is smaller), terrain data that do not penetrate 120 m of the horizontal plane above the lowest runway elevation will be adjusted to the numerical requirements of Area 1.

4. In those sectors of Area 2 where flight operations are prohibited because of too high terrain or other local restrictions or regulations, terrain data will be adjusted to the numerical requirements of Area 1.

Note.- The numerical requirements of terrain data for Areas 1 and 2 are shown in Table A2-6.

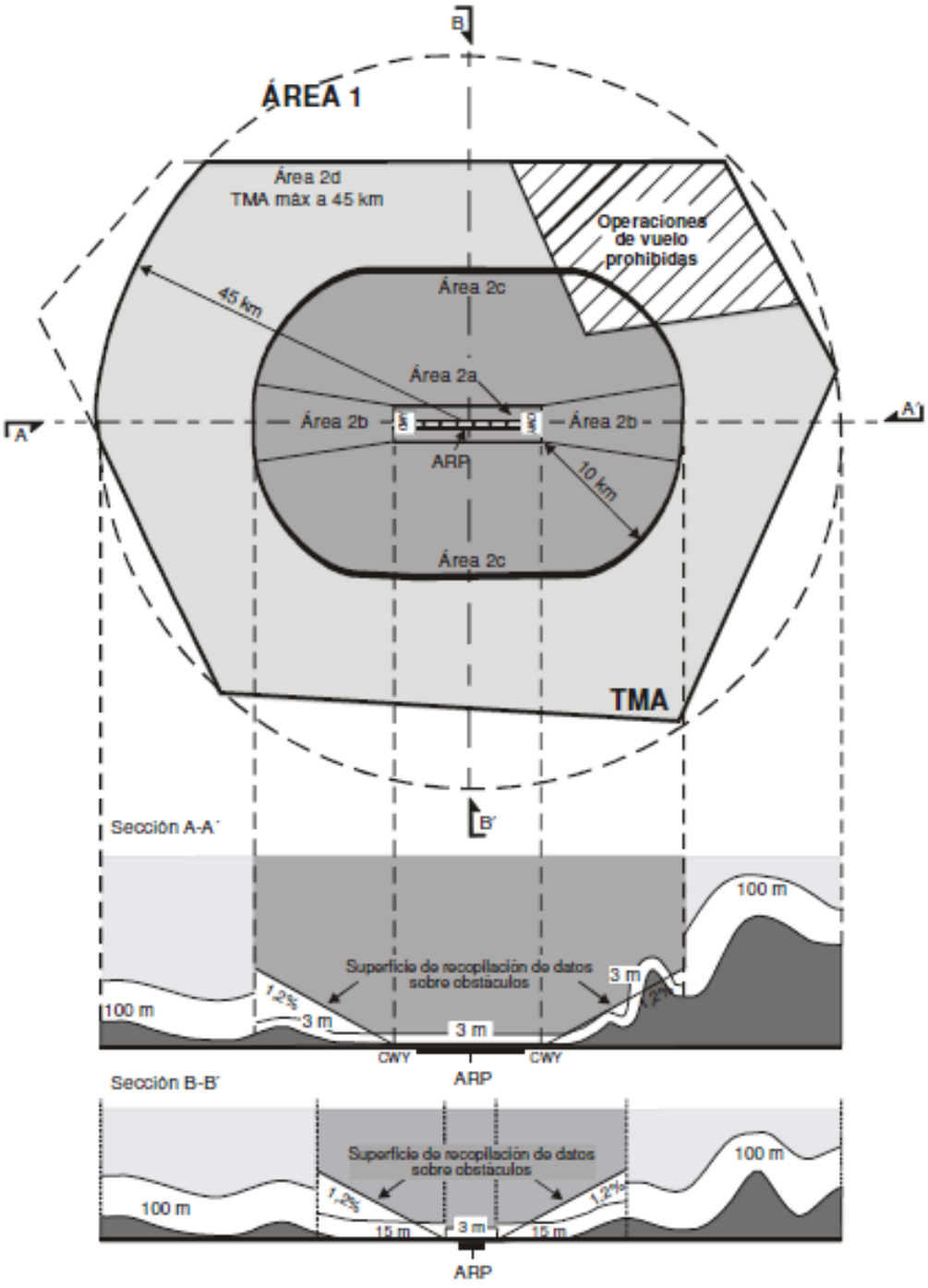

Figure A1-2. Obstacle data collection surfaces — Area 1 and Area 2

1. Obstacle data will be collected and recorded in accordance with the numerical requirements of Area 2 shown in Table A2-7:

   a) Area 2a: rectangular area around a runway that includes the runway strip and whatever clearway exists. The obstacle data collection surface of Area 2a will be at a height of three metres above the closest runway elevation measured along the runway centre line, and for those parts related to a clearway, if any, the elevation of the closest runway end;

   b) Area 2b: area that extends from the ends of Area 2a in the outbound direction, with a length of 10 km and a widening of 15% to each side. The data collection surface of Area 2b follows a slope of 1,2% that extends from the ends of Area 2a to the elevation of the runway end in the outbound direction, with a length of 10 km and a widening of 15% to each side;

   c) Area 2c: area extending outside of Area 2a and Area 2b to a distance not exceeding 10 km with respect to the boundaries of Area 2a. The data collection surface of Area 2c follows a slope of 1,2% that extends outside of Areas 2a and 2b at a distance not exceeding 10 km with respect to the boundary of Area 2a. The initial elevation of Area 2c will be the elevation of the point of Area 2a where it starts; and

   d) Area 2d: Area extending outside of Areas 2a, 2b and 2c up to a distance of 45 km with respect to the aerodrome fix, or up to the existing TMA boundary, if this boundary is closer. The obstacle data collection surface of Area 2d is located at a height of 100 m above the terrain.

2. In those sectors of Area 2 where flight operations are prohibited because of too high terrain or other local restrictions or regulations, obstacle data will be identified and recorded in accordance with the requirements of Area 1.

3. The data on each obstacle within Area 1 that has a height above the ground of 100 m or more will be collected and recorded in the data set, in accordance with the numerical requirements of Area 1 specified in Table A2-7.

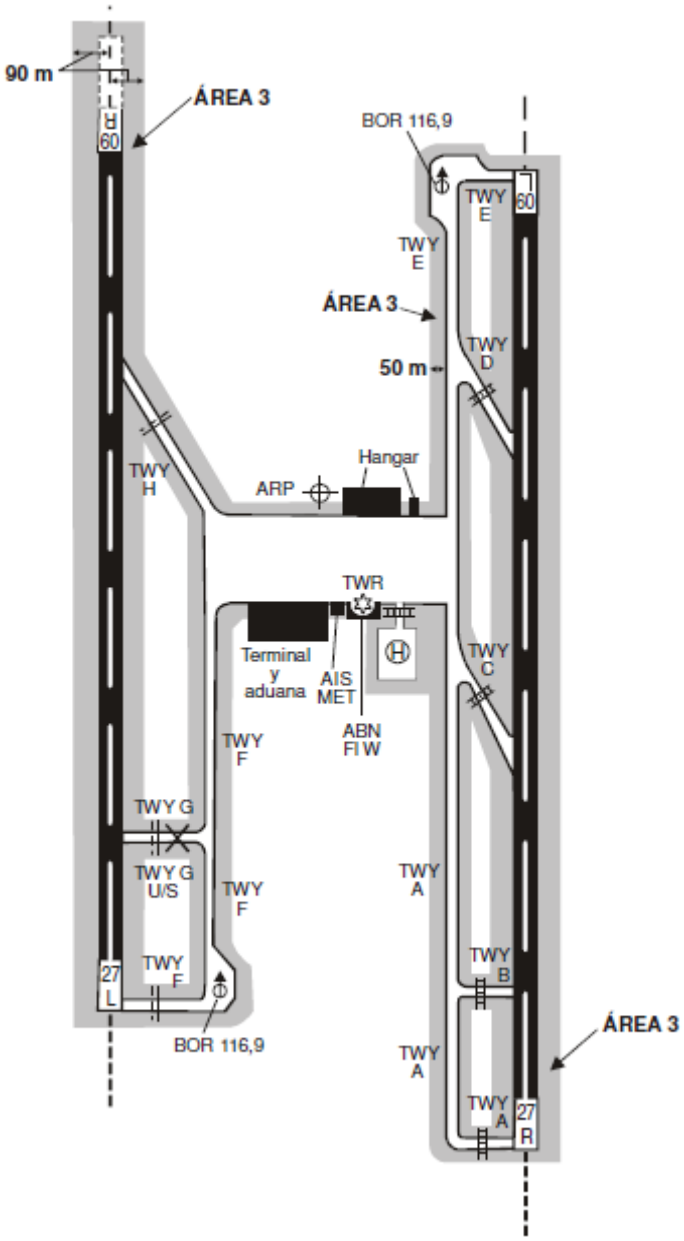

Figure A1-3. Terrain and obstacle data collection surface — Area 3

1. The terrain and obstacle data collection surface is prolongued half a metre (0,5 m) over the horizontal plane crossing the closes point in the aerodrome movement area.

2. Terrain and obstacle data in Area 3 will be adjusted to the numerical requirements specified in Table A2-6 and Table A2-7, respectively.

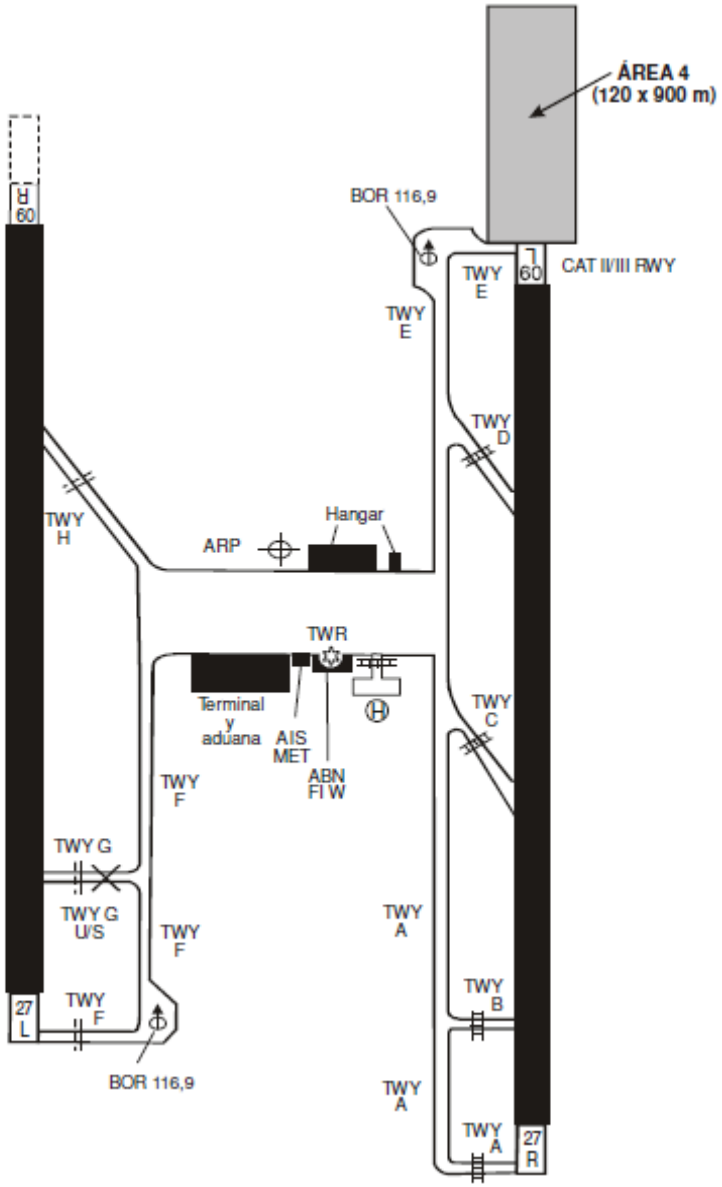

Figure A1-4. Terrain and obstacle data collection surface — Area 4

Terrain data in Area 4 will be adjusted to the numerical requirements specified in Table A2-6.

Note 1.- Area 2 spreads over Area 4, in the horizontal plane. More detailed obstacle data may be collected in Area 4 in accordance with the numerical requirements of Area 4 for the obstacle data specified in Table A2-7. (see Annex 15, 10.1.8.).

Note 2.- Area 4 may be extended in accordance with Annex 15, 10.1.2.

Appendix 2 – Data precision

Table A2-1 Latitude and Longitude

APPENDIX 7. AERONAUTICAL DATA QUALITY REQUIREMENTS

Table A7-1. Latitude and longitude

Latitude and longitude	Publication resolution	Integrity Classification
Flight information region boundary points	1 min	1×10^{-3} routine
P, R, D area boundary points (outside CTA/CTR boundaries)	1 min	1×10^{-3} routine
P, R, D area boundary points (inside CTA/CTR boundaries)	1 sec	1×10^{-5} essential
CTA/CTR boundary points	1 sec	1×10^{-5} essential
En-route NAVAIDS, intersections and waypoints, and holding, and STAR/SID points	1 sec	1×10^{-5} essential
Obstacles in Area 1 (the entire State territory)	1 sec	1×10^{-3} routine
Aerodrome/heliport reference point	1 sec	1×10^{-3} routine
NAVAIDS located at the aerodrome/heliport	1/10 sec	1×10^{-5} essential
Obstacles in Area 3	1/10 sec	1×10^{-5} essential
Obstacles in Area 2	1/10 sec	1×10^{-5} essential
Final approach fixes/points and other essential fixes/points comprising the instrument approach procedure	1/10 sec	1×10^{-5} essential
Runway threshold	1/100 sec	1×10^{-8} critical
Runway end	1/100 sec	1×10^{-8} critical
Runway holding position	1/100 sec	1×10^{-8} critical
Taxiway centre line/parking guidance line points	1/100 sec	1×10^{-5} essential
Taxiway intersection marking line	1/100 sec	1×10^{-5} essential

Latitude and longitude	Publication resolution	Integrity Classification
Exit guidance line	1/100 sec	1×10^{-5} essential
Aircraft stand points/INS checkpoints	1/100 sec	1×10^{-3} routine
Geometric centre of TLOF or FATO thresholds, heliports	1/100 sec	1×10^{-8} critical
Apron boundaries (polygon)	1/10 sec	1×10^{-3} routine
De-icing/anti-icing facility (polygon)	1/10 sec	1×10^{-3} routine

Note.— See Appendix 8 for graphical illustrations of obstacle data collection surfaces and criteria used to identify obstacles in the defined areas.

Table A7-2. Elevation/altitude/height

Elevation/altitude/height	Publication resolution	Integrity Classification
Aerodrome/heliport elevation	1 m or 1 ft	1×10^{-5} essential
WGS-84 geoid undulation at aerodrome/heliport elevation position	1 m or 1 ft	1×10^{-5} essential
Runway or FATO threshold, non-precision approaches	1 m or 1 ft	1×10^{-5} essential
WGS-84 geoid undulation at runway or FATO threshold, TLOF geometric centre, non-precision approaches	1 m or 1 ft	1×10^{-5} essential
Runway or FATO threshold, precision approaches	0.1 m or 0.1 ft	1×10^{-8} critical
WGS-84 geoid undulation at runway or FATO threshold, TLOF geometric centre, precision approaches	0.1 m or 0.1 ft	1×10^{-8} critical
Threshold crossing height, precision approaches	0.1 m or 0.1 ft	1×10^{-8} critical
Obstacles in Area 2	1 m or 1 ft	1×10^{-5} essential
Obstacles in Area 3	0.1 m or 0.1 ft	1×10^{-5} essential
Obstacles in Area 1 (the entire State territory)	1 m or 1 ft	1×10^{-3} routine

Latitude and longitude	Publication resolution	Integrity Classification
Exit guidance line	1/100 sec	1×10^{-5} essential
Aircraft stand points/INS checkpoints	1/100 sec	1×10^{-3} routine
Geometric centre of TLOF or FATO thresholds, heliports	1/100 sec	1×10^{-8} critical
Apron boundaries (polygon)	1/10 sec	1×10^{-3} routine
De-icing/anti-icing facility (polygon)	1/10 sec	1×10^{-3} routine

Note.— See Appendix 8 for graphical illustrations of obstacle data collection surfaces and criteria used to identify obstacles in the defined areas.

Elevation/altitude/height	Publication resolution	Integrity Classification
Aerodrome/heliport elevation	1 m or 1 ft	1×10^{-5} essential
WGS-84 geoid undulation at aerodrome/heliport elevation position	1 m or 1 ft	1×10^{-5} essential
Runway or FATO threshold, non-precision approaches	1 m or 1 ft	1×10^{-5} essential
WGS-84 geoid undulation at runway or FATO threshold, TLOF geometric centre, non-precision approaches	1 m or 1 ft	1×10^{-5} essential
Runway or FATO threshold, precision approaches	0.1 m or 0.1 ft	1×10^{-8} critical
WGS-84 geoid undulation at runway or FATO threshold, TLOF geometric centre, precision approaches	0.1 m or 0.1 ft	1×10^{-8} critical
Threshold crossing height, precision approaches	0.1 m or 0.1 ft	1×10^{-8} critical
Obstacles in Area 2	1 m or 1 ft	1×10^{-5} essential
Obstacles in Area 3	0.1 m or 0.1 ft	1×10^{-5} essential
Obstacles in Area 1 (the entire State territory)	1 m or 1 ft	1×10^{-3} routine

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Note.- See in Appendix 1 the graphical illustrations of obstacle data collection surfaces and criteria used to identify obstacles in the defined areas.

Table A7-3. Declination and magnetic variation

Declination/variation	Publication resolution	Integrity Classification
VHF NAVAID station declination used for technical line-up	1 degree	1×10^{-5} essential
NDB NAVAID magnetic variation	1 degree	1×10^{-3} routine
Aerodrome/heliport magnetic variation	1 degree	1×10^{-5} essential
ILS localizer antenna magnetic variation	1 degree	1×10^{-5} essential
MLS azimuth antenna magnetic variation	1 degree	1×10^{-5} essential

Table A7-4. Bearing

Bearing	Publication resolution	Integrity Classification
Airway segments	1 degree	1×10^{-3} routine
En-route and terminal fix formations	1/10 degree	1×10^{-3} routine
Terminal arrival/departure route segments	1 degree	1×10^{-3} routine
Instrument approach procedure fix formations	1/100 degree	1×10^{-5} essential
ILS localizer alignment (True)	1/100 degree	1×10^{-5} essential

Table A2-5 Length/distance/dimension

Table A7-5. Length/distance/dimension

Length/distance/dimension	Publication resolution	Integrity Classification
Airway segment length	1/10 km or 1/10 NM	1×10^{-3} routine
En-route fix formation distance	1/10 km or 1/10 NM	1×10^{-3} routine
Terminal arrival/departure route segment length	1/100 km or 1/100 NM	1×10^{-5} essential
Terminal and instrument approach procedure fix formation distance	1/100 km or 1/100 NM	1×10^{-5} essential
Runway and FATO length, TLOF dimensions	1 m or 1 ft	1×10^{-8} critical
Runway width	1 m or 1 ft	1×10^{-5} essential
Displaced threshold distance	1 m or 1 ft	1×10^{-3} routine
Clearway length and width	1 m or 1 ft	1×10^{-5} essential
Stopway length and width	1 m or 1 ft	1×10^{-8} critical
Landing distance available	1 m or 1 ft	1×10^{-8} critical
Take-off run available	1 m or 1 ft	1×10^{-8} critical
Take-off distance available	1 m or 1 ft	1×10^{-8} critical
Accelerate-stop distance available	1 m or 1 ft	1×10^{-8} critical
Runway shoulder width	1 m or 1 ft	1×10^{-5} essential
Taxiway width	1 m or 1 ft	1×10^{-5} essential

Length/distance/dimension	Publication resolution	Integrity Classification
Taxiway shoulder width	1 m or 1 ft	1×10^{-5} essential
ILS localizer antenna-runway end, distance	1 m or 1 ft	1×10^{-3} routine
ILS glide slope antenna-threshold, distance along centre line	1 m or 1 ft	1×10^{-3} routine
ILS marker-threshold distance	1 m or 1 ft	1×10^{-5} essential
ILS DME antenna-threshold, distance along centre line	1 m or 1 ft	1×10^{-5} essential
MLS azimuth antenna-runway end, distance	1 m or 1 ft	1×10^{-3} routine
MLS elevation antenna-threshold, distance along centre line	1 m or 1 ft	1×10^{-3} routine
MLS DME/P antenna-threshold, distance along centre line	1 m or 1 ft	1×10^{-5} essential

Table A2-6 Terrain data numerical requirements

Table A2-7 Length/distance/dimension - Obstacle data numerical requirements

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

APPENDIX B

Etod Technical and Project Specifications

→→→ DRAFT←←←

eTOD Technical and Project Specifications

	Prepared by:	*Reviewed by:*	*Approved by:*
Position			
Signature			
Date			

Scope

This Document describes eTOD technical and project specifications to be developed for the implementation of eTOD by the State.

This Document applies to the Aeronautical Information Service (AIS), those responsible for defining the project, and those offices providing data, including companies hired to capture such data.

The document contains both the technical aspects as well as the necessary elements to execute the project if the State had a terrain and obstacle database (eTOD) that meets both its own needs as well as the requirements of ICAO Annex 15.

It would be almost impossible to address each and all the questions arising during the execution of said project, which would make it necessary to have a very extensive document that would be almost impossible to use. Therefore, it has been decided to generar a document that contains sufficient and useful information for both the organisation and those involved in the project.

Furthermore, it is expected that this will be a dynamic document, to be updated based on the experience acquired during execution.

Control of changes

Document

Coding:	ET
Title:	eTOD Technical and Project Specifications
Owner:	(country) AIS
Master copy location:	AIS (país)
Date of last update:	00/00/0000

Control of Modifications

Date	*Version*	*Reason for the modification*	*Responsible party*
24/08/2012	01	Document definition	

This copy of the Document will be updated each time a new version of the document is released.

Record Sheet and List of Amendments

Amendments

Amendments to this Document must be made by page: replaced, added, deleted, or completely redrafted.

The personnel responsible for amending this Document must complete the following Record of Amendments.

Record of Amendments

Amendment No.	*Date of Amendment*	*Amended by*	*Date*

Table of Contents

Reference Documents

- ICAO Annex 4 – Aeronautical Charts
- ICAO Annex 15 – Aeronautical Information Services
- ICAO Doc 8126 – Aeronautical Information Services Manual
- ICAO Doc 8697 – Aeronautial Chart Manual
- ICAO Doc 8400 – ICAO Abbreviations and Codes
- ICAO Doc 9881 - Guidelines for Electronic Terrain, Obstacle and Aerodrome Mapping Information

Terms and Definitions

The definitions and abbreviations contained in ICAO Doc 8400 – ICAO Abbreviations and Codes are adopted.

Other definitions

AIS-AIM Transition Roadmap:	Plan containing the sequence of tasks for the transition from the current AIS to the new AIM concept
Amendment:	Correction of existing information

Abbreviations

AIM:	Aeronautical information management
AIP:	Aeronautical information publication
AIS:	Aeronautical information service
CAR:	Caribbean Region
eTOD:	Electronic terrain and obstacle data
GIS:	Geographical information system
GPWS:	Ground proximity warning system
ILS:	Instrument landing system
MSAW:	Minimum safe altitude warning
OACI:	International Civil Aviation Organization
PBN:	Performance-based navigation
SAM:	South American Region

Spanish terms and their equivalent in English

Introducción al Producto:	Overview
Campo de aplicación de las Especificaciones:	Specification scope
Identificación del producto:	Data product identification
Contenido y estructura de los Datos:	Data content and structure
Sistemas de referencia:	Reference system
Calidad de datos:	Data quality
Captura de datos:	Data capture
Mantenimiento de los datos:	Data maintenance
Representación:	Portrayal
Suministro del producto:	Data product delivery
Información adicional:	Additional information
Metadatos:	Metadata

1. Background

1.1. SARPs and the new amendments to Annex 15

Traditionally, States have published information on obstacles, always taking into account that they could affect air navigation routes, the areas around the aerodromes, or the take-off and landing flight phases at an aerodrome.

In the case of a detailed portrayal of the terrain, the topographic chart for precision approaches provides precise terrain information. However, the production of that chart was only required if ILS Category II or greater was available.

The remaining charts, in some cases, provide terrain information but details are not as meticulous as in the aforementioned chart.

In short, with the products developed to date, it was not possible to provide full FIR coverage with an adequate level of detail of both obstacles and terrain.

The provision of the digital data required by the industry on both terrain and obstacles led to some modifications to the traditional way in which information was collected and displayed.

Annex 15 through Amendment 33, proposed some major modifications to the collection of both obstacle and terrain data, through the inclusion of Areas 1 to 4 with a view to meeting the aforementioned need.

Subsequently, through Amendment 36, those areas were adjusted, resulting in the creation of Areas, 2a, 2b, 2c, and 2d, resulting in cost savings in the collection of the information required, and in a modification of the dates in which said information would be made available to users. Appendix 8 to ICAO Annex 15 contains a complete description of those areas.

1.2. Application of the new concepts

No doubt these new concepts may be applicated to:

1.2.1. Ground proximity warning systems (GPWS):

The idea is to have a terrain profile that may be used at any point of the terrain, rather than a single value of the minimum sector altitude for a whole area.

1.2.2. Instrument and circling approach procedures

The use of terrain and obstacle profiles is more focused on the centre line of limiting surfaces. In this new way, quality information will be available for both the centre line and any other part of the limiting surface, including missed approaches.

1.2.3. Contingency procedures (other than the existing ones)

In case of occurrence, no mejor effort will be required to obtain the data, since both obstacle and terrain areas will be fuly covered.

1.2.4. Aerodrome obstacle planes (analysis)

Basic understanding of underlying terrain and obstacles by airline operators, and availability of sufficient information for pilots to plan and take emergency action (especially during take-off)

1.2.5. Minimum safe altitude warning (MSAW)

(9881 pag A-5) As a last line of defence, the availability of precise data will be more than beneficial.

1.2.6. Performance-based navigation (PBN)

The inclusion of data on Area 2 (both terrain and obstacles) will be of great help support for the implementation of the PBN concept.

1.2.7. Advanced surface movement guidance and control systems (A-SMGCS)

In accordance with Doc 9830, the SMGCS requires a digital portrayal of the terrain and obstacles at the aerodrome that could affect aircraft and ground vehicle operations. The precision of the collected data will be of greater importance to support this concept.

1.2.8. Search and rescue (especially in mountainous terrain)

Models may provide greater support in this respect, since a DTM for all the territory will be available.

1.2.9. On-board production of aeronautical charts and databases

To the extent on-board charting products and databases start to evolve, it will be an increasing need for digital information. Furthermore, for the remaining aeronautical charts, it will be extremely important for this information to be detailed and precise.

1.2.10. Flight simulators

The use of simulators for personnel training requires precise terrain information, especially when providing training on emergency situations.

1.2.11. Synthetic displays

Although the data collected is not enough to define a synthetic vision of reality (what the pilot can see under VFR conditions), it will be critical to collect the rest of the required data (building facades, etc.)

1.2.12. Restriction and removal of obstacles at aerodromes/heliports

It will be extremely important to have terrain and obstacle (those that penetrate and do not penetrate surfaces) information for the purpose of managing them.

1.3. Benefits

Benefits will be seen mainly with the passage of time, given the impact that this new information will have on the provision of both the traditional products and the new ones that may emerge.

The benefits include a better visualization of the construction of GIS-related procedures, a better visualization of charts together with the metadata, the possibility of applying quality criteria in support of AIM for the provision not only of static AIS products but data as well.

Finally, it will be of great advantage for data exchange (AIXM).

2. Concepts

The precise meaning of the terms is essential for a clear understanding of the information contained in this document. Accordingly, some basic concepts that will be used in the document are described below.

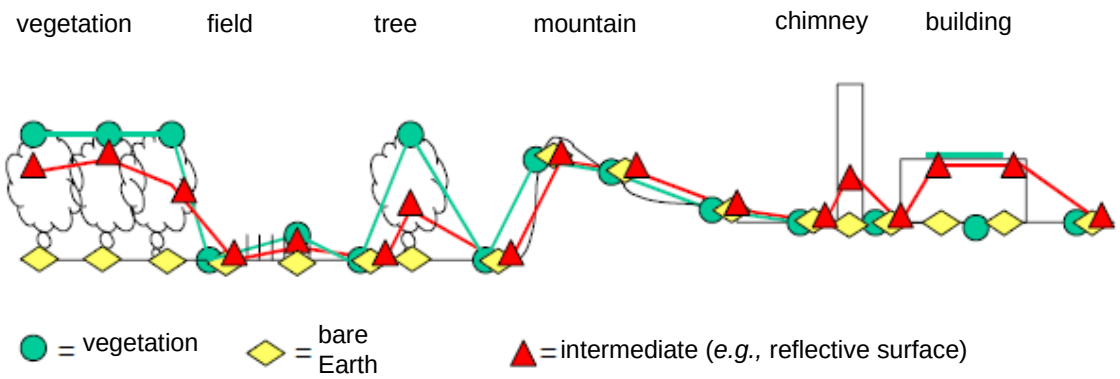
2.1. Terrain

For the purpose of this document, the following definition will be used:

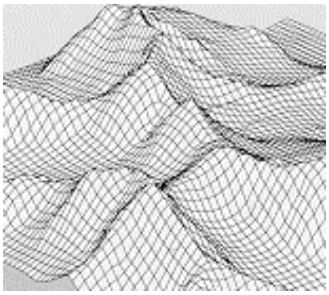
Terrain: The surface of the Earth containing naturally occurring features such as mountains, hills, ridges, valleys, bodies of water, permanent ice and snow, and excluding obstacles.

A terrain database is a digital portrayal of the vertical extension (elevation) of the terrain in a number of discrete points.

Depending on the study source, a terrain database may be envisaged for “bare earth” or “bare earth with cultural features and/or obstacles” (vegetation, buildings, etc.), or for an intermediate surface, resulting from the “reflection” of part of the terrain and obstacles, as shown in the following figure:



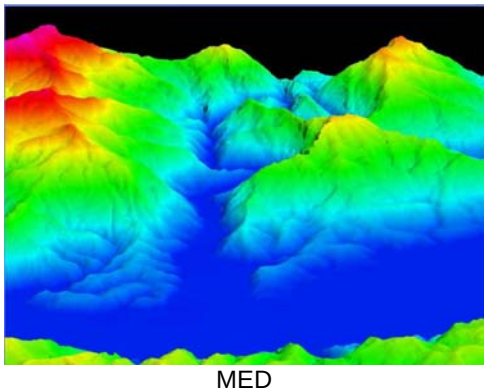
The terrain must be represented by elevation at regular intervals. The result is a digital elevation model.



Elevation grid

Therefore, digital elevation models (DEM) are defined as the 3-D representation of terrain surface by continuous elevation values at all intersections of a defined grid, referenced to a common datum.

As an example, a terrain database represented by a coloured MED is shown below.



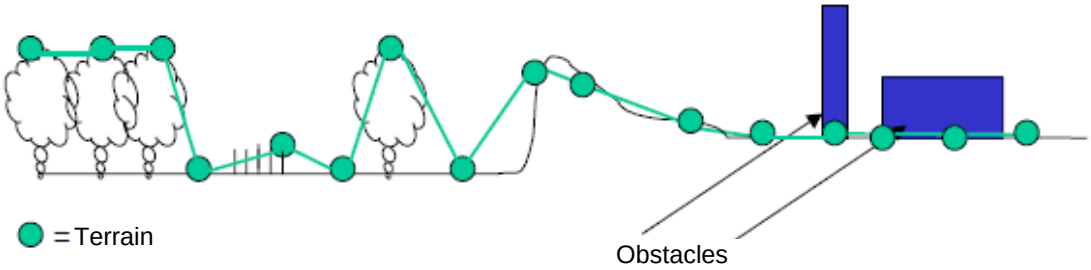
MED

2.2. Obstacles

The definition to be used for the document is as follows:

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.

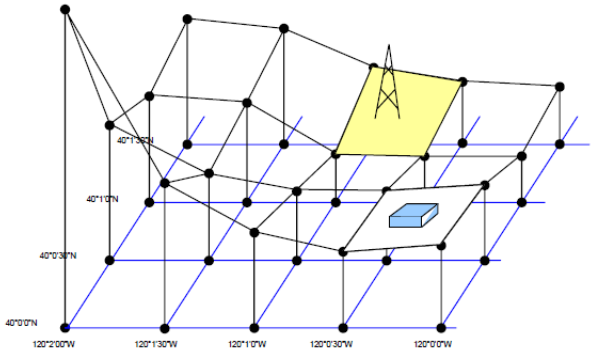


It should be noted that the obstacle concept, depending on its use and the user, could be different from the one set forth herein. For this document, whenever the term “obstacle” is used, it will refer to the aforementioned definition, unless stated otherwise.

An obstacle is an individually identifiable object of a limited spatial extension. Some of the features of the object are captured in the database. Obstacles are not included in a terrain database.

Obstacle data will comprise the digital representation of the vertical and horizontal extension of significant man-made and natural features, such as isolated rocky pillars and natural vegetation (trees).

Obstacle representation on an elevation grid is as follows:



MED with obstacles

2.3. Metadata

In general, metadata is defined as “data on data” or “data defining data”.

Metadata provide information that describes a number of attributes related to a set of actual data.

By way of clarification, it is important to note that product specifications describe what a data set must be, they are defined before production and do not vary through time, while metadata describe what a data set is, they are determined after their production and vary with each new version or update fot he product.

One of the objectives of publishing metadata is to permit the user determine the ability to use a data set with respect to the requirements of a specific application, without having to assess the data itself.

2.4. Reference system

Is defined as a reference to “any amount or set of amounts that may serve as reference or basis for calculating other amounts”.

A ground reference system defines a spatial reference system where the position of a point located on the solid surface of the Earth has coordinates.

The reference system has 3 elements:

- Horizontal reference
- Vertical reference
- Temporal reference

2.4.1. Horizontal reference

The WGS-84 defines a global earth reference system (geodetic datum) and geocentric-referenced ellipsoid. It was developed by the United States Department of Defense, together with scientists of other countries and institutions. Currently, the WGS-84 is the reference system that ICAO requires for georeferencing aeronautical information and will be the one used in this document.

2.4.2. Vertical reference

Mean sea level (MSL), which gives the relationship of gravity-related height (elevation) to a surface known as the geoid, is used as the vertical reference system for international air navigation.

The geoid defined as the equipotential surface in the gravity field of the Earth that coincides with the undisturbed MSL extended continuously through the continents. Gravity-related heights (elevations) are also referred to as orthometric heights while distances of points above the ellipsoid are referred to as ellipsoidal heights.

The Earth Gravitational Model - 1996 (EGM-96), for the purpose of this document, will be used as the global gravity model. In those cases in which the accuracy of EGM-96 does not meet the accuracy requirements for elevation and geoid undulation, regional, national or local geoid models containing high resolution gravity field data will be developed and used.

2.4.3. Temporal reference

Temporal reference systems are used for time-related aeronautical information elements. In this context, time is used to specifically identify the unique moment when an event occurs. A temporal reference system comprises a calendar and time system.

In accordance with Annex 15, Section 3.7.3.1, "For international civil aviation, the Gregorian calendar and coordinate duniversal time (UTC) shall be used as the temporal reference system".

Therefore, the same principle will be applied in this Document.

2.5. Quality criteria

The quality philosophy to be applied for both terrain and obstacle data must reflect a holistic approach based on a set of ISO 19100 standards.

Accordingly, it should be noted that in order to have quality spatial data, such methodology must consider the different stages, from data set design and the required data quality level (both based on the requirements of a specific application), through data quality measurement (quality assessment), to data reporting.

The data quality philosophy comprises the following four topics:

a) Data product specifications (DPS):
A data product specification defines the data product requirements. The content of the DPS is designed to assist potential users to assess the suitability of the data product for its use. The information contained in a DPS is different from that contained in the metadata for the same data set.

b) Quality elements of spatial data:
The quality of data will not only depend on the precision of the data. The following elements must also be considered:
a) Precision: thematic precision, temporal accuracy;
b) Data resolution
c) Integrity

d) Traceability:
e) Integrity: excess, omission:
f) Logical consistency: format consistency, conceptual consistency, domain consistency, topological consistency.

c) Data quality assessment procedures:
A data quality assessment procedure describes the methodology used for applying a data quality measurement to the specified data.

d) Data/metadata quality report
The reporting of data quality assessment results is closely related to metadata.
The objective of each data quality report is to provide sufficient information to enable the end user to determine what has been tested, the way it has been tested, conformity, and the quantitative results of the quality assessment.

2.6. Use of the GIS

Use of the GIS (data access and data exchange)
The provision of terrain and obstacle data in accordance with ISO 19100 enables the delivered data sets to be easily used by the GIS (geographical information system).

A GIS is a set of technological components used for describing real life phenomena in a structured manner. Contrary to other information systems, the GIS highlights the spatial property of a phenomenon.

Therefore, a GIS is used for capturing, maintaining, storing, analysing, managing, and presenting data related to a location. In a more general sense, GIS applications are tools that permit users to create interactive queries (user-created searches), analyse spatial information, edit data, and present the results of all these operations (on the screen or as maps).

2.7. Applicable specifications in accordance with ISO 19131

The specifications of a product are defined as a detailed description of a data set and any additional information required for its production, provision, and use. In other words, it is like a complete and comprehensive description that clearly defines a data set.

The specifications of a product establish user requirements, that is, what is expected of the data set.

For the terrain specification and the obstacle-related data set, the DPS must be based on the structure provided by ISO 19131, and must cover the following topics (mandatory elements in accordance with ISO 19131):

- Introduction to the product:

Informal description of the product and general information on the creation of the DPS. *Definition, content, extent, purpose, sources, production process, metadata description, definitions, maintenance, main characteristics. Reference: Informal*

- Field of application of the specifications:

For each subset of a homogeneous data set, the scope (or foreseen use, coverage) must be proportional. Multiple scopes may be used to distinguish the four areas. *Physical/logical extension (does not neet to be the whole file, could be a layer, an area, or a group of types of phenomena). Reference: ISO19115*

- Product identification:

Product title, a brief summary of the content, purpose, and expected spatial resolution, geographical area covered by the data product; supplementary information, such as legal limitations. *Title, extent, topic, scale, summary, purpose, supplementary information. Referencia: ISO19115*

- Data content and structure:

Application scheme (formal description of the data structure and content of data sets) and feature catalogue (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);

1) Vector file
- *Application model Reference: ISO19109, ISO19137*
- *Catalogue of phenomena Reference: ISO19110*

2) Raster file
- *Identifier*
- *Description*
- *Range of attribute values*
- *Spatial and temporal extension*
- *Type of coverage*

Reference: ISO19123

- Reference systems:

Spatial and temporal reference system
1) Coordinate reference system. Reference: ISO19111
2) Geographical identification reference system. Reference: ISO19112
3) Temporal reference system. Reference: ISO19108

- Data quality:

Acceptable conformity quality and quality of the corresponding data. Quality data elements and sub-elements. *Position, thematic, and logical accuracy, logical consistency, completion (omission and comission), legacy, purpose and use. Reference: ISO19113, ISO19114*

- Data capture:

General description of data sources and data capture processes. *Literal description of the data capture phase and subsequent data handling and editing processes in order to obtain a data set with the required properties. This description must be sufficiently clear and detailed to serve for data set production.*

The best way of documenting such description with precision and in detail is by implementing a quality management system (QMS) that describes all processes and quality controls.

- Data maintenance:

Principles and criteria applied, including update frequency. *Maintenance frequency, next date, scope, contact. Reference: ISO19115*

- Representation:

Information about data representation (graphic output: plot/image). *Representation catalogue, with colours, thicknesses, spot, lineal, and surface symbols, fonts… Reference: ISO19117*

- Product delivery:

Delivery formats and information delivery media. *Native format, supports, and available formats. Reference: ISO19115*

- Additional information

  Information not contemplated in other items:
  + Organisation in sheets
  - *Division, corners*
  - *Sheet nomenclature*

  + Coordinate conversion
  + Units
  + Nº of coordinates
  + Cases
  + Consistency with other products
  + Consistency with other products (MED, raster, orthophoto, files on other countries)
  Reference: ISO19115

- Metadata

  To be included as part of the product. Reference: ISO19115

The catalogue of metadata is based on ISO 19115, and must be adjusted to the requirements of the application.

3. Terrain specifications

The items to be included in the terrain specifications are described below.

3.1. Introduction to the product

3.1.1. DPS metadata

Title of the data set
Title of the data set. May require alignment with the national spatial data infrastructure
Example: Terrain in accordance with data contained in ICAO Annex 15, for <country>.

Date of the reference data set
Date of publication of the DPS
Example: 23/08/2012.

Responsible for the data set
The party responsible for DPS creation.
Example: <Name of the organisation>
<Address>
<Telephone>
<Fax>
<email >
<URL>

Language of the data set
The language in which the DPS and the data set are published.
Example: Spanish.

Data set category
A classification of the data set according to the numbering list provided in MD_TopicCategoryCode of ISO 19115, optionally strengthened with the domain.
Example: 018 - Transportation (Aviation).

3.1.2. Terms and definitions

Important terms used in the DPS may be described in this section. The target audience of the DPS must be taken into account importantes que se utilizan en el DPS puede describirse en esta sección. The target audience of the DPS must be considered when compiling the list of terms (for example, there is no need to explain what a geoid is to inspectors).
Example: Integrity, obstacle, terrain data set, traceability.

3.1.3. Abbreviations

All abbreviations used in this DPS are described in this section.
Example: AIP, AIXM, CRC, ICAO.

3.1.4. Informal description of the product

Given the importance of clearly defining the area for terrain data collection, it will be beneficial to include a detailed description thereof; it would even be advisable to include a graph like those shown in Annex 15, Appendix 8, or those deemed more appropriate.

3.2. Field of application of the specifications

The terrain data set is not homogeneous throughout its length; therefore, consideration must be given to the option of using a subset. The scope of each of these subsets shall be defined.

The following elements must be considered:

3.2.1. Identification of the scope

Identification of the scope for the purpose of a particular data specification
Example: Terrain scope.

3.2.2. Level

The code that identifies the hierarchical level of the data specified by the scope. The MD_ScopeCode numbering of ISO 19115 is used. For a general scope of application, it is assumed to refer to the level of the series. Another level that may be useful within the context of terrain data is the feature type (terrain data).
Example: 006 – series.

3.2.3. Name of level

Name of the hierarchical level of the data specified by the scope of application.
Example: Detail valid for the terrain data of <country>, in accordance with the specifications of ICAO Annex 15.

3.2.4. Extension

Information about spatial, vertical, and temporal extension of the data specified by the scope of application. Information shall be provided only on the horizontal measure of terrain data. A simple description can also be provided,.
Example: The area of <country> and of the adjacent areas, if necessary, for full coverage of Area 2.

3.2.5. Description of the level

Detailed description of the level of the data specified by the scope of application.
Example: The "terrain" level defines the requirements specific to terrain data, and thus deviate from the "general scope".

3.2.6. Coverage

Coverages to which the information applies.
Example: General scope.

3.3. Identification of the product

The examples given for product identification are independent from whether it refers to terrain or an obstacle. For each data application that goes beyond the topographic measurement of a single obstacle, the geographic extension must be documented in this section. Although certain definitions can only be validated by one part of the complete data set, it is proposed that more than one product identification be defined.

3.3.1. Title

The title of the data product.
Example: Terrain data for <país> in accordance with Annex 15.

3.3.2. Alternative title

Another name used for the data product.

3.3.3. Abstract

A brief narrative summary of the content of the data product.
Example: The product contains a terrain data set that meets the requirements established in ICAO Annex 15 (Amendment 36).

3.3.4. Purpose

A summary of the reason for developing the data product.
Example: The purpose of the data product appears in the introduction to Annex 15, Chapter 10, foreseeing the possible use of the data. The user is responsible for determining if the data product meets its needs.

3.3.5. Category of the topic

Specifies to what main topic(s) the data product belongs.
Example: 006 - Elevation
018 - Transportation.

3.3.6. Type of spatial representation

Form of spatial representation.
Example: 002 – grid

3.3.7. Spatial resolution

Factor that provides a general understanding of the density of spatial data in the data set.

3.3.8. Geographical description

Description of the geographical area for which the data are made available. The DPS permits the definition of the geographical extension in a number of different ways, such

as polygons (using Geography Markup Language - GML), selection conditions, or by a geographical identifier (which could be the ISO country code).
Example: SI - Slovenia.

The junction box may be expressed as a polygon coded in GML.
Example:

```
<gml:PolygonsrsName="EPSG:4326">
        <gml:LinearRing>
                <gml: "." coordinates decimal = cs = "," ts = "">
                        119,593002319336, -31,6695003509522
                        119,595306396484, 31,6650276184082
                        119,600944519043, -31,6658897399902
                        119,603385925293, -31,669527053833
                        119,60050201416, -31,6739158630371
                        119,595664978027, -31,6728610992432
                        119,593002319336, 31,6695003509522
                </ gml: coordinates>
        </ gml: LinearRing>
</ gml: Polygon>
```

3.3.9. Supplementary information

Any other descriptive information about the data set

3.4. Data content and structure

This section contains the terrain data model that is required to comply with the SARPs. The terrain information conceptual model (TICM) is a formal representation of terrain data requirements described in ICAO Annex 15, expressed as a set of UML diagrams. Terrain data are modelled in accordance with the coverage scheme of ISO 19123. Terrain model attribute requirements are provided and explained in detail in Annex 15, Appendix 8.

3.4.1. Description of coverage

Technical description of coverage.

3.4.2. Type of coverage

Type of coverage.

3.4.3. Specification (name of role)

Information on additional coverage.

3.5. Reference systems

The spatial reference system used must be a reference coordinate system, as defined in ISO 19111. In accordance with Annex 15, the horizontal datum horizontal is WGS-84, and the

vertical datum is MSL using the appropriate geoid model, such as EGM-96. The Gregorian calendar and coordinated universal time (UTC) shall be used as the temporal reference system.

3.5.1. Spatial reference system

Identifier of the spatial reference system

3.5.2. Temporal reference system

Identifier of the temporal reference system

3.6. Quality of data

Information on the quality of available terrain data sets is vital for the data set selection process, where the data value is directly related to their quality. In order to assess the quality of a data set, clearly defined procedures must be used in a consistent manner. The full description of the quality of a data set will promote the exchange and use of the appropriate geographical data sets.

Annex 5, Appendix 8, contains a set of terrain attributes:

Area of coverage
Data originator identifier
Obstacle identifier
Horizontal accuracy
Horizontal confidence level
Horizontal position
Horizontal resolution
Horizontal extension
Horizontal reference system
Elevation
Elevation reference
Vertical reference system
Vertical resolution
Vertical accuracy
Vertical confidence level
Surface type
Recorded surface
Penetration level
Known variations
Integrity
Date and time stamp
Unit of measurement used

3.6.1. Quality of data

Quality of the information on the data product

3.7. Data capture

The DPS defines the attributes and metadata resulting from the terrain data capture methods that must be communicated. Likewise, data on real life geospatial phenomena and their features must be specified. Data included in this chapter on DPS must include a general description of the data capture process.

Quality conformity levels for intermediate levels that may be necessary for data production may be required.

3.7.1. Scope of capture

Scope of terrain.

3.7.2. Capture description

General description of the data capture procedure.

Example:

The USGS has collected the data set on the national elevation established for public mapping and the use of models in a variety of applications, aviation security being one of them. Terrain data were originally converted from mapping material and aerial photography sobre. The terrain data coordinates were converted from the North American Datum 1983 (NAD-83) to the WGS-84, and were then merged, resampled, quality controlled, and reformatted in the USGS DEM format for delivery.

3.8. Data maintenance

Terrain data sets are increasingly used in dynamic environments for the exchange, sharing, and use for purposes that require both precision and the temporal variable. Ongoing maintenance and updating of specific terrain databases are vital for the applications of the end user.

3.8.1. Frequency of maintenance and updating

Frequency with which changes or additions are made to the product.

3.9. Representation

The terrain DPS provides information on how the products will be presented as graphical output.

3.9.1. Reference to the representation catalogue

Bibliographic reference to the catalogue

3.10. Provision of the product

The DPS does not contain specific requirements for the delivery of data products; however, a DPS implementation will identify the following elements: name of format, version, specification, file structure, language, set of characters, delivery units, transfer size, middle name, and delivery information.

Information on data set formats:

3.10.1. Name of format
Name of the data format

3.10.2. Version
Version of the format (date, number, etc.)

3.10.3. Specification
Name of a subset, profile, or format specification

3.10.4. File structure
Structure of the deliverable file

3.10.5. Language
Language(s) used in the data set

3.10.6. Set of characters
Full name of the character coding standard use for the data set

Information about the medium of the data set to be delivered:

3.10.7. Delivery units
Description of the delivery units (for example, layers, geographical areas)

3.10.8. Transfer size
Estimated size of one unit in the specified format, expressed in Mbytes.

3.10.9. Name of the medium
Name of the medium for the data

3.10.10. Other information for the delivery
Other information relatd to data delivery

3.11. Additional information

This chapter of the DPS may include other aspects of the data product that are not mentioned in any part of the specifications.

3.12. Metadata

The metadata requirements for terrain data products are derived from ISO 19115. metadata are classified as identification information, quality information, maintenance information, spatial representation information, reference information of the information distribution system, measurement information, and reference information.

4. Obstacle specifications

The items that must be included in obstacle specifications are described below.

4.1. Introduction to the product

4.1.1. DPS metadata

Title of the data set
The title of the data set. Alignment with the national infrastructure of spatial data may be required.
Example: Obstacles in accordance with the data contained in ICAO Annex 15 for <country>.

Date of the reference data set
Date in which the DPS was published.
Example: 23/08/2012.

Responsible for the data set
The party that is responsible for the creation of the DPS.
Example: <Name of the organisation>
<Address>
<Telephone>
<Fax>
<email >
<URL>

Language of the data set
The language in which the DPS and the data set are published.
Example: Spanish.

Data set category
A data set classification in accordance with the numbering list contained in MD_TopicCategoryCode of ISO 19115, optionally supported by the domain.
Example: 018 - Transportation (Aviation).

4.1.2. Terms and definitions

Important terms used in the DPS may be described in this section. The target audience of the DPS must be taken into account when compiling the list of terms (for example, there is no need to explain a geoid to inspectors).
Example: Integrity, obstacle, terrain data set, traceability.

4.1.3. Abbreviations

All abbreviations used in the DPS are described in this section.
Example: AIP, AIXM, CRC, ICAO.

4.1.4. Informal description of the product

Given the importance of clearly defining the area for obstacle data collection, it will be beneficial to include a detailed description thereof; it would even be advisable to include a graph like those shown in Annex 15, Appendix 8, or those deemed more appropriate.

4.2. Field of application of the specifications

Taking into account item 3.2 of this document, which contains a diagrame that is also valid for obstacles, the following scenarios shall be taken into account for defining them:

4.2.1. Scope identification

Identification of the scope for a given data specification
Example: Scope of obstacles.

4.2.2. Level

The code that identifies the hierarchical level of the data specified in the scope. ISO 19115 MD_ScopeCode numbering is used. For general application, it is assumed that it refers to the series level. Another level that may be useful within the context of terrain data is the feature type (Area 1 obstacle).
Example: 006 – series.

4.2.3. Level name

Name of the hierarchical level of the data specified by the scope.
Example: Detail valid for terrain data for <country>, as specified in ICAO Annex 15

4.2.4. Extension

Information about the spatial, vertical, and temporal extension of the data specified by the scope. The information will be provided only on the horizontal measure for terrain data. A simple description may also be provided.
Example: The area of <country> that defines Area 1.

4.2.5. Description of the level

Detailed description of the level of the data specified by the scope.
Example: "Obstáculo Área 1" scope level defines the requirements that are specific for obstacles in Area 1 and, thus, deviate from the "General Scope" and the "obstacle scope ".

4.2.6. Coverage

Coverages to which this information applies:
General scope.

4.3. Product identification

As indicated in 3.3, this section is independent from whether it is terrain or obstacle data. Accordingly, it shall be used as follows:

4.3.1. Titile

Title of the data product.
Example: Terrain data for <country> in accordance with Annex 15.

4.3.2. Alternative title

Another name by which the data product is known.

4.3.3. Abstract

A brief narrative summary of the content of the data product.
Example: The product contains a terrain data set that meets the requirements established in ICAO Annex (Amendment 36).

4.3.4. Purpose

A summary of the idea behind the development of the data product.
Example: The purpose of the data product is described in the introduction to Annex 15, Chapter 10, which indicates the possible uses of the data. The user is responsible for determining whether the data product meets its needs.

4.3.5. Topic category

Specifies what main topic(s) the data product belongs to.
Example: 006 - Elevation
018 - Transportation.

4.3.6. Type of spatial representation

Form of spatial representation.
Example: 002 – Grid

4.3.7. Spatial resolution

Factor that provides a general understanding of the density of spatial data in the data set.

4.3.8. Geographical description

Description of the geographical area for which data are made available. DPS permits the definition of the geographical extension in a number of different ways, such as polygons (using Geography Markup Language - GML), selection conditions, or by a geographical identifier (which could be an ISO country code).
Example: SI - Slovenia.

The junction box may be expressed as a polygon, coded in GML.
Example:

```
<gml:PolygonsrsName="EPSG:4326">
        <gml:LinearRing>
                <gml: "." coordinates decimal = cs = "," ts = "">
                        119,593002319336, -31,6695003509522
                        119,595306396484, 31,6650276184082
                        119,600944519043, -31,6658897399902
                        119,603385925293, -31,669527053833
                        119,60050201416, -31,6739158630371
                        119,595664978027, -31,6728610992432
                        119,593002319336, 31,6695003509522
                </ gml: coordinates>
        </ gml: LinearRing>
</ gml: Polygon>
```

4.3.9. Supplementary information

Any other descriptive information about the data set

4.4. Data content and structure

The exchange of obstacle data must comply with the application model and the object catalogue shown below.

4.4.1. Application model - Obstacles

The application model provides the common data model for obstacle data products and complies with ISO 19109

This model reflects the requirements specified in Annex 15 and, thus, may be used by system implementers to establish conforming data exchange processes and formats. However, the application model is not intended to impose a particular model but rather to identify and standardise all common obstacle features and attributes, thus allowing the exchange of standard information.

The use of the ISO 19100 series for geographical information as a frame of reference for data modelling implies adhering to a common methodology to ensure interoperability.

Therefore, the types available in ISO 19100 will be used as required. Furthermore, in the case of metadata, the data structure has been derived from the abstract metadata specification contained in ISO 19115.

The application scheme has been structured in two higher-level packages: object types and metadata types. Object types reflect obstacle features and use the attribute types and the types of ISO 19100 to define attributes and geometries.

4.4.2. Object catalogue - Obstacle

This catalogue was developed in accordance with ISO 19110 and provides the minimum required set of attributes to be used. Attribute values, both the label and the code, must be provided in the file to be exchanged.

4.4.3. Supplementary objects

The object catalogue provides the optional and mandatory features and the attributes that may be included in a data set. Although it is expected that they will meet most applications, more attributes and supplementary attributes may be added.

In order to use supplementary attributes, specific standards related to the denomination convention and function of the mandatory information will be used. Each supplementary attribute may be described in a data exchange report file. In the event of using supplementary attributes, the following information must be used: attribute name, attribute description, geometry type, derivation method, and the data capture rule.

In order to use supplementary attributes and new attributes, the object catalogue must be modified using ISO 19131.

4.4.4. Supplementary object attributes

In case of using supplementary attributes, the following must be provided:

4.4.4.1. Object type
Textual description of the object type

4.4.4.2. Obstacle identification
Function-specific identifier

4.4.4.3. Data originator identifier
Name of the entity or organisation where the data provided originates. In the case of data being originated for the first time, the name of the author of the data shall be included.

4.4.4.4. Geometry
Characteristics of the point, line, or polygon, respectively

4.4.4.5. Elevation
Maximum elevation of the top of the object

4.4.4.6. Height
The maximum height of the top of the object

4.4.4.7. Horizontal extension
Radius of the circle around the centre of the object, including the object body and the associated structures, such as tensioning cables.

4.4.4.8. Horizontal precision

Horizontal precision of the recorded position

4.4.4.9. Horizontal confidence level

The probability that the recorded value falls within the stated horizontal accuracy of the actual value

4.4.4.10. Vertical precision

The vertical accuracy of the object elevation

4.4.4.11. Vertical confidence level

The probability that the recorded value falls within the stated vertical aaccuracy of the actual value

4.4.4.12. Integrity

Data integrity is the degree of certainty that the data and their value have not been lost or altered since their origination or modified without authorisation.

4.4.4.13. Date-hour

Date or origination or last revision of the data

4.4.4.14. Effectiveness

Date-hour of construction, assembly, disassembly, or elimination

Attributes other than the aforementioned may be added. They shall be referenced to ISO 19131.

4.5. Reference systems

The spatial reference system used must be a reference coordinate system as defined in ISO 19111. In accordance with Annex 15, the horizontal datum is WGS-84, and the vertical datum is MSL, using the appropriate geoid model, such as EGM-96. The temporal reference system will be the Gregorian calendar and coordinated universal time (UTC).

4.5.1. Spatial reference system

Spatial reference system identifier

4.5.2. Temporal reference system

Temporal reference system identifier

4.6. Data quality

Information about the quality of obstacle data sets is vital for the data set selection process, in which the value of the data is directly related to its quality. In order to assess the

quality of a data set, clearly defined procedures must be used consistently. The full description of the quality of a data set will encourage the exchange and use of the appropriate geographical data sets.

Annex 5, Appendix 8, contains a set of obstacle attributes:

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

4.6.1. Quality of data

Quality of the information about the data product

4.7. Data capture

The DPS defines the attributes and metadata whereby the results of the obstacle data capture methods may be communicated. Likewise, the data on real-world geospatial phenomena and their characteristics must be specified. The information contained in this DPS chapter must include a general description of the data capture process.

The quality conformity levels of intermediate data that may be required for data production may be required.

4.7.1. Capture scope

Obstacle scope

4.7.2. Description of the capture

General description of the obstacle capture procedure.

Example:

The global obstacle data set uses updated data received electronically, as well as digitalised data from updated mapping sources.

4.8. Data maintenance

Obstacle data sets are increasingly used in dynamic environments: for the exchange, sharing, and utilisation for purposes that require both precision and temporal variable relevance. Ongoing maintenance and updating of specific terrain databases is vital for the application process of the end user.

4.8.1. Maintenance and updating frequency

Frequency with which changes and additions are made to the product

4.9. Representation

The obstacle DPS provides information about how data will be presented as a graphical output.

4.9.1. Reference to the representation catalogue

Bibliographic reference in the representation catalogue

4.10. Product delivery

The DPS does not contain specific requirements for the delivery of data products. However, a DPS implementation will identify the following elements: name of the format, version, specification, file structure, language, character set, delivery units, transfer size, middle name, and delivery information.

Information about the format of the data set to be delivered:

4.10.1. Name of the format
Name of the data format

4.10.2. Version
Format version (date, number, etc.)

4.10.3. Specification
Name of a format subset, profile, or specification

4.10.4. File structure
Structure of the deliverable file

4.10.5. Language
Language(s) used in the data set

4.10.6. Set of characters
Complete name of the character coding standard used for the data set

Information about the medium of the data set to be delivered:

4.10.7. Delivery units
Description of the delivery units (*e.g.,* layers, geographic areas)

4.10.8. Transfer size
Estimated size of a unit in the specified format, expressed in Mbytes

4.10.9. Name of the medium
Name of the medium for the data

4.10.10. Other information about the delivery
Other information related to data delivery

4.11. Additional information

This chapter of the DPS may include other aspects of the data not contained in any other part of the specifications.

4.12. Metadata

Metadata requirements of obstacle data products are derived from ISO 19115. Metadata are classified as identification information, quality information, maintenance information, spatial representation information, reference information of the information distribution system, measurement information, and reference information.

Appendix 1 – ISO 19131:2007 – Geographical information. Data product specifications

This international standard describes the specification requirements for geographical data products, based on the concepts contained in other ISO 19100 international standards. It describes the content and structure of a data product specification. It also provides assistance for the creation of data product specifications so that they may be easily understood and customised as required.

A data product specification is a detailed description of a data set or a series of data sets, with additional information on its creation, provision, and use. It is a precise technical description of the data product in terms of the requirements it will or might meet. It serves as the basis for data production or acquisition. It may also assist possible users in the assessment of the data product in order to determine its useability.

The specification information about the data product may be used to create metadata for a particular data set that is created in accordance with the data product specification. However, the information contained in a data product specification is different from that contained in the metadata. Metadata provide information about a physical data set in particular; the data product specification only defines how the data set should be. For various reasons, some implementation adjustments may be required.

Metadata related to the product data set should reflect the current status of the product data set.

A data product specification may be created and used on various occasions, by different parties, and for various reasons. For example, it may be used for the original data collection process as well as for products derived from existing data. It may be created by producers to specify their product or by users to determine their requirements.

A data product specification does not need to describe the production process, but only the resulting data product. However, it may include production and maintenance aspects if deemed necessary to describe the data product.

A data product specification contains main sections that cover the following aspects of the data product:

- General — Clause 7
- Scope of the specification — Clause 8
- Data product identification — Clause 9
- Data content and structure — Clause 10
- Reference systems — Clause 11
- Quality of data — Clause 12
- Metadatos — Cláusula 18.

A data product specification may also contain sections covering the following aspects of the data product:

- Data capture — Clause 13
- Data maintenance — Clause 14
- Graphic representation — Clause 15
- Additional information — Clause 17.

The minimum description of a data product contains mandatory elements in each section.

APPENDIX C

SAM Region	**PROJECT DESCRIPTION (DP)**	DP N° G1	
Programme	**Project Title**	**Start date**	**End date**
AIM (ICAO programme coordinator: Roberto Arca Jaurena)	Developments for the provision of electronic terrain and obstacle data (e-TOD) (SAM) Project coordinator: Juan González (Uruguay) Experts contributing to the project: SAM/AIM IG	26/09/11	31/12/15
Objective	Support the implementation of e-TOD provision by SAM States, and provide them with guidance for the acquisition and management of a GIS.		
Scope	The scope of the project contemplates the assessment and identification of implementation levels associated to the provision of electronic terrain and obstacle data. It contemplates the drafting of an action plan and e-TOD implementation guides to support the provision of electronic terrain and obstacle data for the evolution of digital terrain models (DTM) to gradually enhance electronic aeronautical charts and other similar products supported by tools such as geographic information systems (GIS).		
Metrics	Number of States that have acquired and are operating a GIS. Number of experts trained in GIS. Number of States that have implemented an action plan for the e-TOD standard. Number of States that establish SLAs.		

Strategy	Project activities will be coordinated through communications amongst project members, the project coordinator, and the programme coordinator, mainly through teleconferences (GoToMeeting application), and meetings held from time to time concurrently with events envisaged in the work programme. The project coordinator will coordinate with the programme coordinator the incorporation of additional experts as may be required for the tasks to be performed. The results of the work done will be submitted to the consideration and review of State experts in the form of a final consolidation document for analysis, revision, and approval, and subsequent submittal to the GREPECAS PPRC by the programme coordinator.
Justification	Compliance with the SARPs contained in Annex 15 and Annex 4 to expedite the implementation of performance-based air operations and move forward with the AIS-to-AIM Roadmap. Close connection with other projects is required to collect the operational requirements needed by the aforementioned applications and their respective tentative implementation dates.
Related projects	It is related to Project G2 " Aeronautical information/data management" and Project G3 "Assessment and development of the AIM QMS in SAM States."

Project deliverables	**Relationship with the regional performance-based plan (PFF)**	**Responsible party**	**Status of implementation***	**Delivery date**	**Remarks**
Questionnaire on e-TOD status of implementation	PFF: SAM AIM/02	Juan González Uruguay		30/11/2011	Completed on schedule.
Generate e-TOD implementation report	PFF: SAM AIM/02	Juan González Uruguay		30/04/2012	Completed on schedule.

Draft the Guidance Document containing the objectives of the e-TOD project	PFF: SAM AIM/02	Juan González Uruguay		03/09/2012	Completed on schedule. Delivered: 03/09/2012
Define the technical specifications of the e-TOD project	PFF: SAM AIM/02	Juan González Uruguay		03/09/2012	Completed on schedule. Delivered: 03/09/2012
Draft the document with the e-TOD technical specifications	PFF: SAM AIM/02	Juan González Uruguay		03/09/2012	Completed on schedule. Delivered: 03/09/2012
Develop a training programme and the documentation for e-TOD operators	PFF: SAM AIM/02	Juan González Uruguay		Start: 01/08/12 End: 17/10/12	
Compile the required operational concepts in a document	PFF: SAM AIM/02	Juan González Uruguay		Start: 04/09/12 End: 02/11/12	
Prepare the financial documentation	PFF: SAM AIM/02	Juan González Uruguay		Start: 02/05/13 End: 02/05/13	
Guide for the procurement of a geographic information system (GIS)	PFF: SAM AIM/01	Juan González Uruguay		09/03/2012	Completed on schedule.
GIS implementation manual	PFF: SAM AIM/01	Juan González Uruguay		09/03/2012	Completed on schedule.
Develop a training programme and documentation for GIS/AIXM operators	PFF: SAM AIM/01	Juan González Uruguay		Start: 01/08/12 End: 17/10/12	

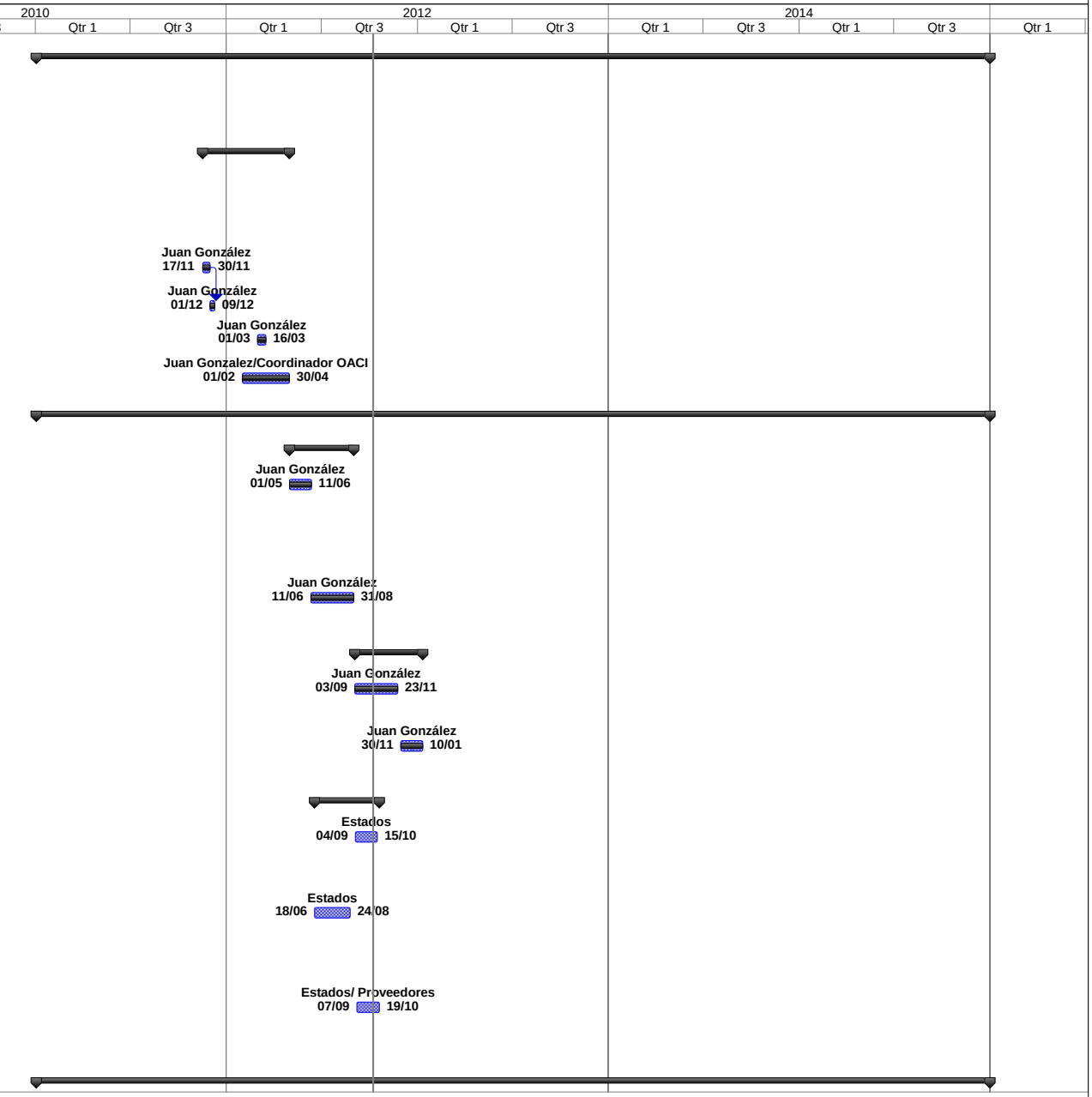
Define GIS operational concepts	PFF: SAM AIM/01	Juan González Uruguay		Start: 28/02/13 End: 28/02/13	The designation of an expert for completing this activity is pending. Foreseen start: 28/02/13
Compile the required GIS operational concepts in a document	PFF: SAM AIM/01	Juan González Uruguay		Start: 01/07/13 End: 29/08/13	The designation of an expert for completing this activity is pending. Foreseen start: 01/07/13
Necessary resources	Designation of experts for the execution of some of the deliverables. More commitment by States in supporting coordinators and experts conducting the work.				

**Grey* *Task not started yet*
Green *Activity underway as scheduled*
Yellow *Activity started with some delay but expected to be completed on schedule*
Red *This activity has not been implemented as scheduled; mitigation measures are required*

Timetable in MS Project, with tasks, sub-tasks, deliverables, and responsible parties

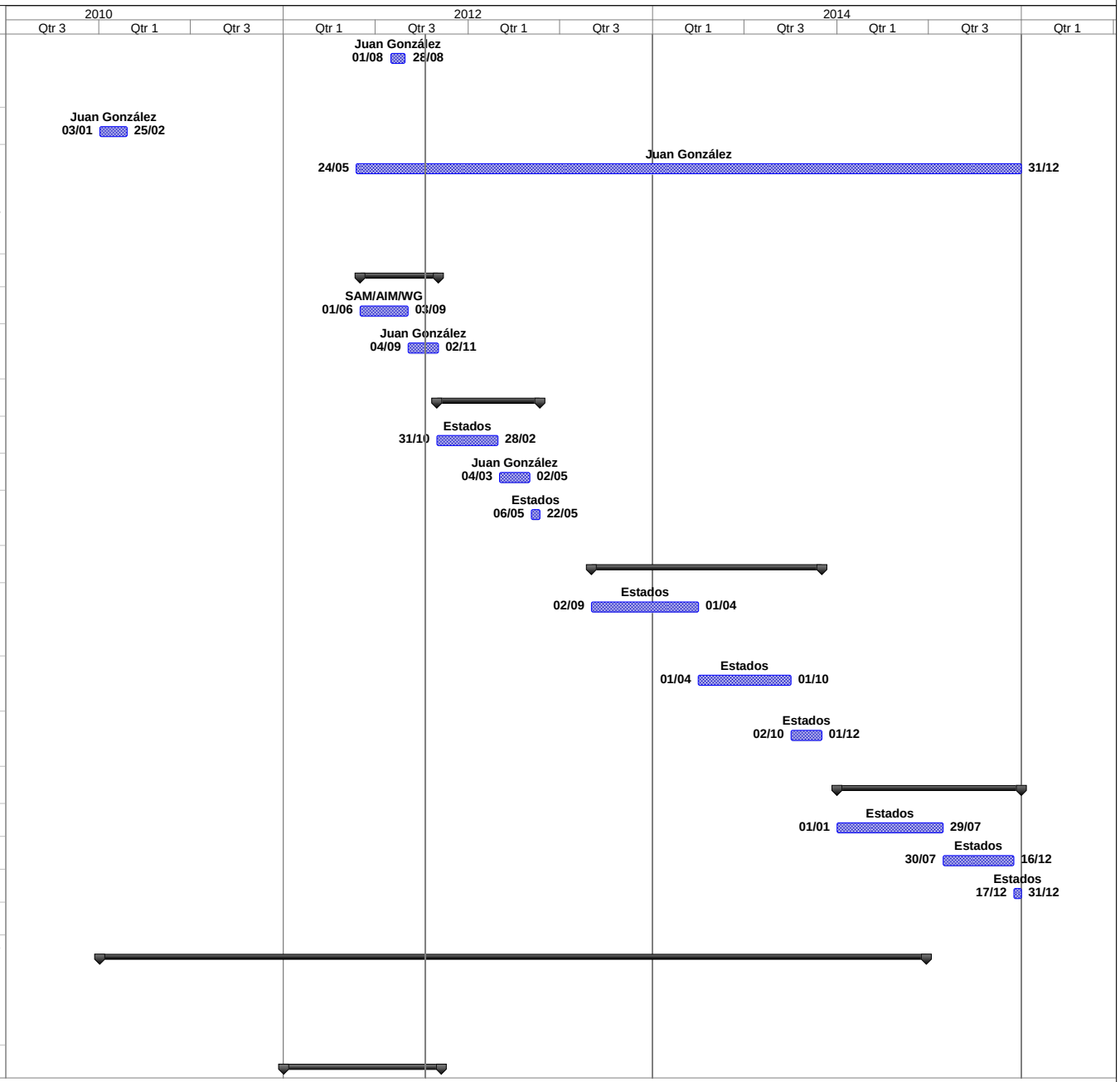
Desarrollos para el suministro de los datos electrónicos sobre el terreno y los obstáculos (e-TOD) en los Estados SAM + GIS/Development for the provision of terrain and obstacle electronic data (e-TOD) in SAM States + GIS

ID	Nombre de tarea
1	**Desarrollos para el suministro de los datos electrónicos sobre el terreno y los obstáculos (e-TOD) en los Estados SAM + GIS/Development for the provision of terrain and obstacle electronic data (e-TOD) in SAM States + GIS**
2	**Identificar el nivel de implantación de la Norma para la provisión de datos electrónicos sobre el terreno (e-TOD) para el Área 1 (Anexo 15, 10.1.3)/Identify the level of implementation of the Regulation for the provision of electronic terrain data (e-TOD)**
3	Generar Formulario de Consulta/Generate survey form
4	Circular a los Estados/Circulate to States
5	Reunir información de los Estados/Gather information from States
6	Generar Informe de Implantación/Generate implementation report
7	**Plan de acción e-TOD/e-TOD action plan**
8	**Objetivos/Objectives**
9	Establecer y priorizar objetivos del proyecto de implantación del e-TOD (tareas, costos, plazos de ejecución, riesgos del proyecto)/Establish and prioritise objectives of e-TOD implementation project (tasks, costs, impl. Target dates, project risks
10	Elaborar el Documento Guía con los objetivos del proyecto/Prepare guidance document with project objectives
11	**Especificaciones técnicas/Technical specifications**
12	Definir las especificaciones técnicas y del proyecto/Define technical specifications of the project
13	Elaborar el documento con las especificaciones técnicas/Prepare the document with technical specifications
14	**Realizar Acuerdos/Carry out agreements**
15	Definir cláusulas contractuales para el uso de la información (protección, almacenamiento, distribución, etc)/Define contract clauses for use of information, storage, distribution, etc)
16	Firmar cartas de acuerdos, socializando los datos electrónicos de terreno y de obstáculos en las áreas comunes entre las fronteras de los Estados/Sign LOAs socialising e-TOD in common areas between States' boundaries
17	Firmar acuerdo de nivel de servicio (SLA) entre proveedores y servicio AIS/Sign service agreement - SLA between providers and AIS service
18	**Capacitación/Training**



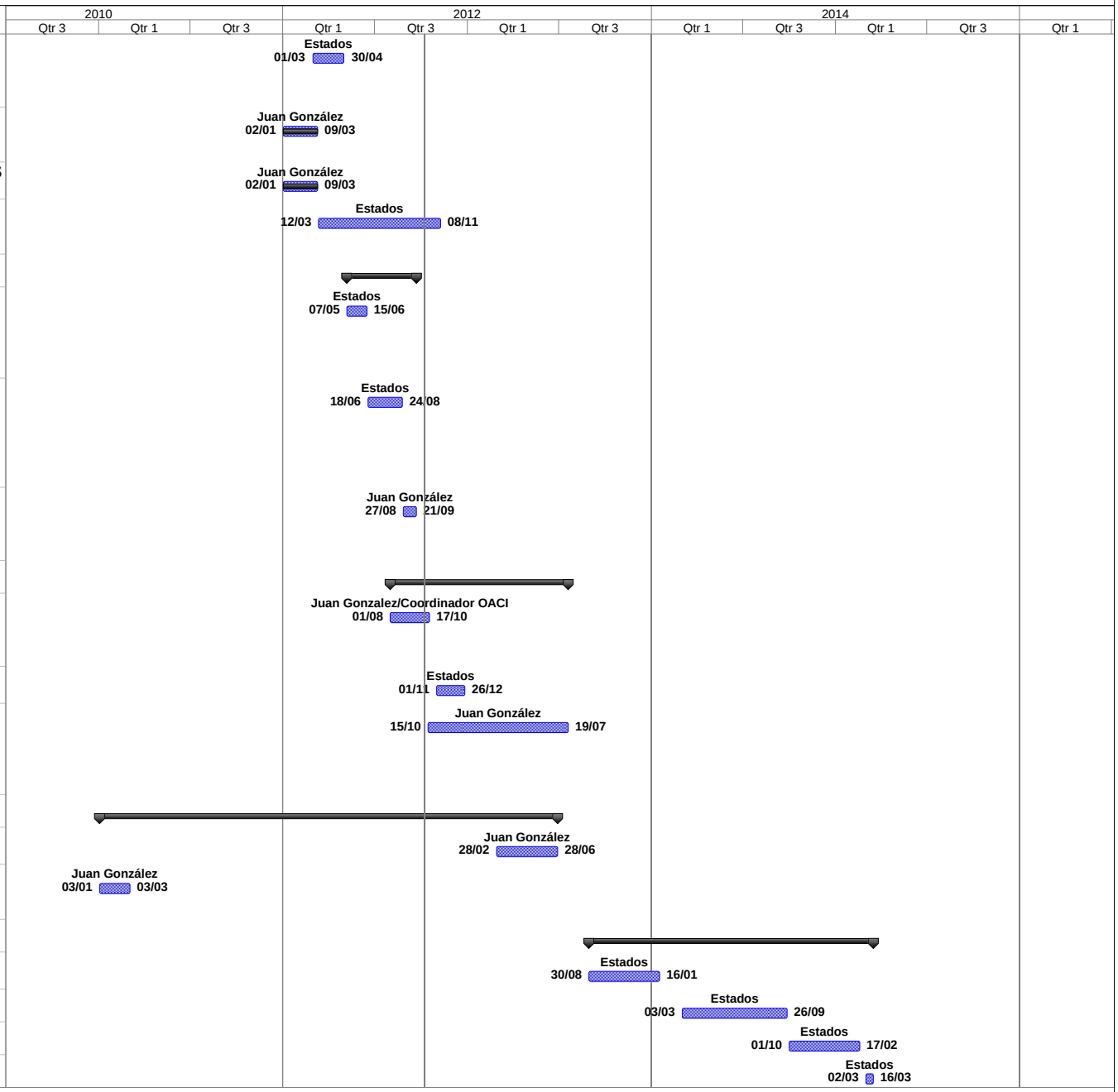
Desarrollos para el suministro de los datos electrónicos sobre el terreno y los obstáculos (e-TOD) en los Estados SAM + GIS/Development for the provision of terrain and obstacle electronic data (e-TOD) in SAM States + GIS

ID	Nombre de tarea
19	Desarrollar un programa de capacitación y la documentación para operadores de e-TOD/Develop training programme and documentation for e-TOD operators
20	Conducir programas de capacitación/Conduct training programmes
21	Realizar seminarios orientados a los especialistas e-TOD, indicando los planes y los beneficios operacionales y económicos esperados/Hold seminars oriented towards e-TOD experts, indicating plans and operational and economical benefits expected.
22	**Conceptos Operacionales/Operational concepts**
23	Definir los conceptos operacionales/Define operational concepts
24	Compilar en un documento los conceptos operacionales necesarios/Compile in a doucment necessary operational concepts
25	**Análisis de requerimientos tecnológicos / Technological requirements analysis**
26	Evaluación de costos del proyecto en general/General project cost assessment
27	Elaborar la documentación financiera/Draft financial documentation
28	Presentar a la alta gerencia del documento final para su aprobación/Present the High Level Management the final document for approval
29	**Adquisición de herramientas tecnológicas/Acquisition of technological tools**
30	Adquirir los software, hardware y aplicativos de última tecnología/Acquire software and hardware and applications of state-of-the-art technology
31	Instalar y poner en funcionamiento de las herramientas tecnológicas adquiridas/Install and put into operation technology tools acquired
32	Entrenar al personal especializado en el manejo de estas herramientas/Train specialised personnel in handling these tools
33	**Implantación propiamente dicha (bajo GIS)/Implementation itself (under GIS)**
34	Carga de datos/Loading of data
35	Verificación de carga/Check data loading
36	Análisis de resultados/Analysis of the results
37	
38	**Desarrollo del GIS en Estados SAM para gestión de datos e-TOD, y gestionar info requerida para apoyar aplicaciones de nav aérea definidas/Development of GIS in SAM States for e-TOD and manage info required to support air nav applications**
39	**Diagnóstico/Diagnosis**



Desarrollos para el suministro de los datos electrónicos sobre el terreno y los obstáculos (e-TOD) en los Estados SAM + GIS/Development for the provision of terrain and obstacle electronic data (e-TOD) in SAM States + GIS

ID	Nombre de tarea
40	Evaluación: costo beneficio, personal especializado, equipamiento de hardware y software/Cost-benefit assessment, specialised personnel, hardware and software
41	Guía para la adquisición de un sistema de información geográfica/Guidance material for acquisition of a GIS
42	Manual Guía Implantación de un GIS/Guidance for GIS implementation
43	Selección y adquisición de software y hardware más adecuado/Selection and acquisition of most adequate software
44	**Realizar Acuerdos/Carry out agreements**
45	Definir cláusulas contractuales para uso de información (protección, almacenamiento, distribución, etc)/Define contracting clauses for use of information (protection, storage, distribution, etc)
46	Firmar cartas de acuerdos, socializando los datos electrónicos de terreno y de obstáculos en las áreas comunes entre las fronteras de los Estados/Sign LOAs socialising e-TOD in common areas between States' boundaries
47	Firmar acuerdo de nivel de servicio (SLA) entre proveedores y servicio AIS/Sign service level agreement - SLA, between AIS service providers
48	**Capacitación/Training**
49	Desarrollar un programa de capacitación y documentación para operadores de GIS + AIXM/Develop a training programme and documentation for ooperators of GIS + AIXM
50	Conducir programas de capacitación/Conduct training programmes
51	Realizar seminarios orientados a los especialistas e-TOD, indicando los planes y los beneficios operacionales y económicos esperados/Make seminars oriented to e-TOD experts indicating plans and operational and economic benefits expected
52	**Conceptos Operacionales/operational concepts**
53	Definir los conceptos operacionales/Define operational concepts
54	Compilar en un documento los conceptos operacionales necesarios/Compile in one document necessario operational concepts
55	**Generar base de datos/Generation of data bases**
56	Definición de bases de datos/Definition of data bases
57	Carga de datos/Data loading
58	Verificación de carga/Chek data loading
59	Análisis de resultados/Analysis of results



Desarrollos para el suministro de los datos electrónicos sobre el terreno y los obstáculos (e-TOD) en los Estados SAM + GIS/Development for the provision of terrain and obstacle electronic data (e-TOD) in SAM States + GIS

ID	Nombre de tarea	2010			2012				2014				
		Qtr 3	Qtr 1	Qtr 3	Qtr 1	Qtr 3	Qtr 1	Qtr 3	Qtr 1	Qtr 3	Qtr 1	Qtr 3	Qtr 1
60	**Generación AIXM/AIXM Generation**												
61	Generar productos basados en AIXM/Generate AIXM-baed products										Estados 04/05 26/06		