

Enclosure 4

(Ref. Technical Letter F063-L08-040)



**Center for Advanced
Aviation System Development**

Specifications for the Survey of the Texcoco Area and its Surroundings

The survey described in this document is requested by Friday 28 November 2008. The data should be shipped via FedEx. Please include with the delivery a Table of Contents that references in a clear manner the various parts of this request. Likewise, please describe in detail any differences, if any, between the request and what is being delivered.

Please contact Ing. Kleinhans no later than **Monday 30 June 2008** if there are any issues or concerns with providing the requested survey data on time, as MITRE needs to allocate staff in a most efficient manner.

Prepared for

**Dirección General de Aeronáutica Civil
Secretaría de Comunicaciones y Transportes**

6 June 2008

1.0 Introduction

MITRE is supporting Mexico's Dirección General de Aeronáutica Civil (DGAC) in its decision regarding plans to construct a new metropolitan airport for Mexico City in the Texcoco area. Having comprehensive, accurate and current survey data with which to site runways, evaluate instrument approach and departure procedures, and support other tasks, such as the analysis of noise impact, is crucial. The survey data will be used by MITRE to examine the topography and characteristics of the Texcoco area in order to identify potential locations for runways, and assist in identifying any existing terrain and other obstacles (e.g., trees, buildings, towers, etc.) that may complicate aeronautical operations. Furthermore, these data will be used to develop a three-dimensional (3D) simulation and visualization model of the site and the surrounding areas.

The intent of this document is to provide the DGAC with specifications regarding survey information that MITRE needs in order to accomplish the above-mentioned tasks. Specifications for a photogrammetric survey of the Texcoco area, as well as a sample aerial photograph that matches the level of quality and resolution required by MITRE, are provided. Additionally, specifications for an additional survey of terrain and other obstacles (e.g., trees, buildings, towers, etc.) surrounding the Texcoco area, beyond the area of the photogrammetric survey, are included. See Section 2.0, Background, for additional information on general survey requirements for aviation-related purposes.

The surveys described herein are requested by Friday 28 November 2008. Please see the note concerning other deadlines on the front cover of this document.

A survey is a time- and labor-intensive effort that requires a significant amount of coordination. Therefore, to meet the **Friday 28 November 2008** date, it is important that the DGAC plan and coordinate the development of the survey of the Texcoco area and its surroundings as soon as possible. MITRE also recommends that interim survey information and work status reports be periodically submitted (e.g., monthly) to MITRE for review so that early feedback can be provided.

Due to the complexity of this tasking, MITRE proposes to assist the DGAC during the survey technical proposal review process. This effort on MITRE's part is limited. However, MITRE would still like to review the technical proposals being submitted to the DGAC by survey companies to ensure that they are complete and appropriate. Furthermore, for purposes of efficiency, MITRE requests that an experienced technical representative from the company that is selected to perform the survey contact MITRE to discuss work and schedules.

All inquiries concerning the survey request should be addressed to Ing. Robert W. Kleinhans, Project Leader, at rkleinha@mitre.org, explaining in detail, and in English, the inquiry in question. The survey data should be shipped (please via FedEx) to the following address:

Ing. Robert W. Kleinhans
The MITRE Corporation
7515 Colshire Drive
McLean, VA 22102
U.S.A.

2.0 Background

The International Civil Aviation Organization (ICAO) provides survey standards for aviation-related purposes through ICAO Annex 15, Aeronautical Information Services.¹ ICAO Annex 15 defines how aeronautical information data shall be obtained and distributed. The scope of information covered by ICAO Annex 15 includes, but is not limited to, the Aeronautical Information Publication (AIP), Notice to Airmen (NOTAM), pre-flight and post-flight data, as well as electronic terrain and obstacle data.

MITRE's specifications consider *some* of the relevant guidelines contained in ICAO Annex 15, but are not intended to be used for the development of an ICAO Annex 15 compliant survey. The specifications herein are intended to provide MITRE with appropriate data in order to determine the aeronautical feasibility of the Texcoco area to accommodate a large metropolitan airport. Therefore, it may be necessary for the DGAC to conduct additional surveys once the final location of runways have been determined in order to meet appropriate survey standards. For example, additional surveys of the airfield and other critical areas near the new runways once they are constructed may be required.

The following two Sections (3.0 and 4.0) describe the two surveys that are required. It is important to state that MITRE was generally conservative in its interpretation of ICAO Annex 15 standards (wherever such standards were utilized) due to the fact that the exact location of future runways is not known at this point. "Conservative" means that MITRE engineers sided towards the identification of more obstacles over larger areas rather than less.

Survey information should be sent in electronic format compatible with AutoCAD Map 3D 2008. All data should be provided with 3D values (that is, z-values). In the case of elevations, these should be provided in meters above Mean Sea Level (MSL). All coordinates are to be provided on the basis of the Universal Transverse Mercator (UTM)/World Geodetic System 1984 (WGS 84) coordinate system.

¹ The United States Federal Aviation Administration (U.S. FAA) also provides survey standards for aviation-related purposes through U.S. FAA No. 405, Standards for Aeronautical Surveys and Related Products.

3.0 Photogrammetric Survey of the Texcoco Area

This section describes the area to be included in the photogrammetric survey of the Texcoco area as well as data requirements. As previously mentioned, a detailed photogrammetric survey of the Texcoco area is required to appropriately examine the topography and characteristics of the area and to identify any existing terrain and other obstacles (e.g., trees, buildings, towers, etc.) that may complicate aeronautical operations. As a result, runway siting and instrument approach and procedure designs can be more accurately conducted.

3.1 Photogrammetric Survey Area

As per the DGAC-MITRE contract, the coordinates of the area within which MITRE can locate new parallel runways and associated safety areas in the Texcoco area will be provided by the DGAC. This was separately requested (see Enclosure 3 to Ref. F063-L08-040, dated 6 June 2008, delivered at the same time as this paper). MITRE has not yet received the coordinates of the official site boundaries from the DGAC. MITRE has, however, received some information regarding possible boundaries for the new airport site in the Texcoco area from Servicios a la Navegación en el Espacio Aéreo Mexicano (SENEAM). This information was contained in a document titled “Preliminary Design of Feasibility Airspace for the New Mexico City Airport Project”, dated December 2007. See Figure 1.

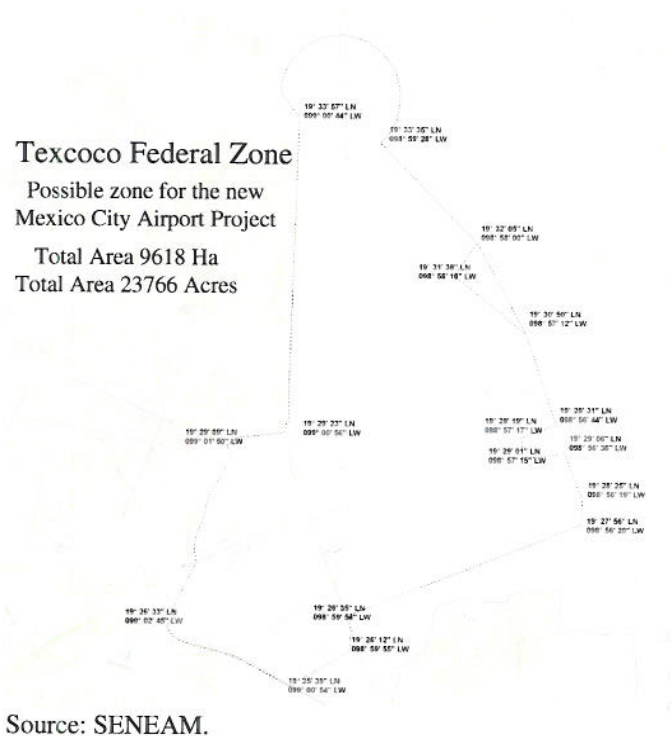
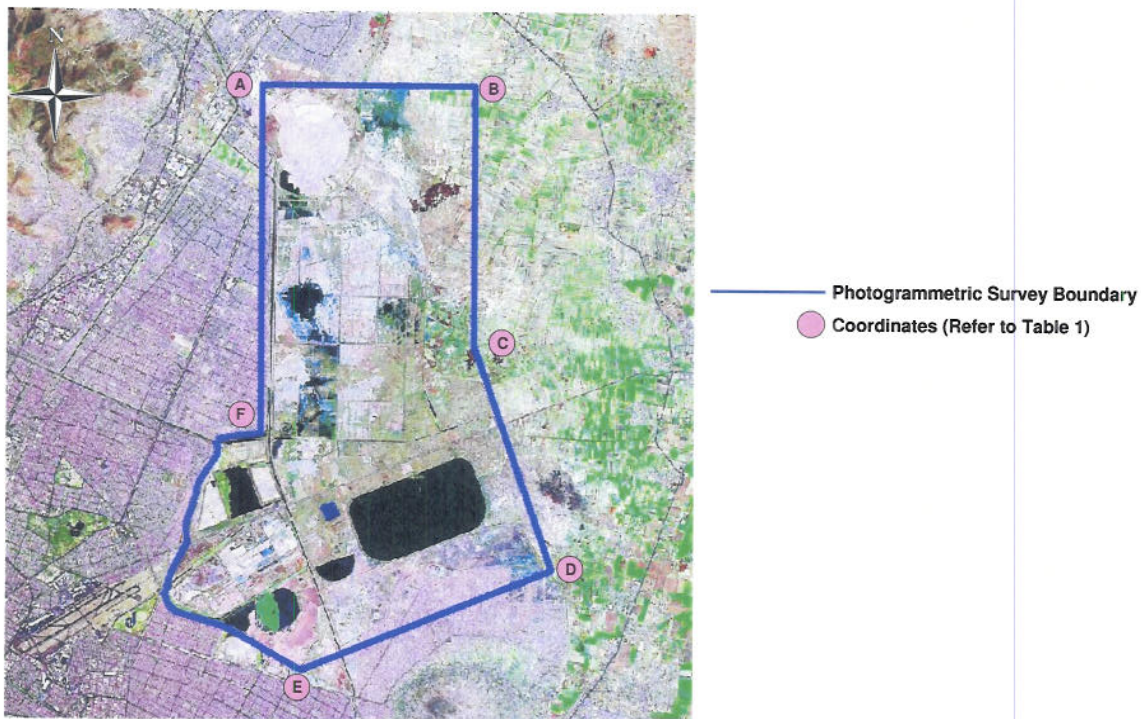


Figure 1. Texcoco Area Federal Zone Boundaries (as per SENEAM)

MITRE does not consider the SENEAM boundary coordinate information shown in Figure 1 as being final, since the official information still needs to be provided by the DGAC. *However, in the interest of saving time, MITRE has taken the liberty of defining a photogrammetric survey area based on the information provided by SENEAM, as well as estimated parallel runway spacing requirements, potential locations for future parallel runways, noise sensitive areas, and other considerations. If the DGAC desires to amend the photogrammetric survey area being proposed by MITRE, please inform MITRE as soon as possible so that appropriate changes can be made. All coordinates being provided by MITRE are based on UTM/WGS 84.*

The photogrammetric survey area being proposed by MITRE is shown in Figure 2. Coordinate information is contained in Table 1.



Note: the background imagery is provided for general visual reference and orientation purposes only.

Figure 2. MITRE-Proposed Photogrammetric Survey Boundary

Intentionally Left Blank

Table 1. MITRE-Proposed Photogrammetric Survey Boundary Coordinates

Point	UTM Coordinates (meters)	Latitude/Longitude (WGS 84)
A	498187.1651 / 2165698.7347	19° 35' 10.6"N / 99° 01' 02.2"W
B	504896.0000 / 2165698.7347	19° 35' 10.6"N / 98° 57' 11.9"W
C	504896.0000 / 2157690.0000	19° 30' 50.0"N / 98° 57' 12.0"W
D	507361.6431 / 2150681.9341	19° 27' 02.0"N / 98° 55' 47.5"W
E	499489.3857 / 2147538.8353	19° 25' 19.8"N / 99° 00' 17.5"W
Roadways (located between Points E and F)	From Point E proceed northwest along FFCC del Sur (México-Cuautla) to Av. Río Churubusco and Anillo Periférico; then, proceed north to Boulevard Río de los Remedios; and then proceed east to Point F. The entire roadway should be included in the survey. This is only an approximate description.	
F	498187.1651 / 2154892.8217	19° 29' 19.2"N / 99° 01' 02.2"W

The coordinates provided in Table 1 should be plotted on a map by the surveyor and sent to MITRE to confirm their appropriateness prior to starting any work.

3.2 Photogrammetric Survey Requirements

The photogrammetric survey should include the following items (and any other topographic features normally found on engineering-related survey drawings):

- All natural features
 - Hills, rivers, lakes, trees, etc.
- All man-made objects and structures
 - Roads, highways, secondary roads, overpasses, railroad tracks, etc.
 - Bridges and power line towers
 - Residential, commercial, industrial, recreational areas, etc.
- The boundaries, including coordinates, of the DGAC-determined area within which MITRE can locate new parallel runways and associated safety areas

The following specifications should be considered:

- Contour lines in one-meter intervals
- Spot elevations in discernable locations (e.g., peaks of mountains and hills, roadways, overpasses, etc.)
- North arrow showing magnetic declination
- All major items should be labeled or identified through symbols provided in a legend
- Typical drawing/drafting standards (e.g., legend, line types, colors, text styles, etc.) for engineering/survey type AutoCAD drawings should be used. However, line types and properties to be used for specific items are listed below:

- Contour lines - 3D polylines with z-values
- Spot elevations - 3D circle (30-m radius) with z-value
- Buildings, towers, and other structures, including power lines, road pavement edges, etc. - 3D polylines with z-values for each vertex
- Tree lines - 3D polylines with z-values
- Individual trees - 3D circle (10-m radius) with z-value
- Poles, posts, antennas, etc. - 3D circle (10-m radius) with z-value

A digital drawing containing all of the combined surveyed data should be provided. The individual AutoCAD files used to create the combined survey drawing should also be provided. Finally, a technical report describing the overall development of the survey, including a list of all survey control points should be submitted.

3.3 Aerial Photograph

One color aerial photograph mosaic of the entire surveyed area should be provided, both on paper and electronically. The color mosaic should be geo-registered (e.g., Geo-TIFF file) so that when inserted into Autodesk Map 3D 2008 it is aligned with the photogrammetric survey. A sample of the quality and resolution of the color mosaic that MITRE is expecting is shown in Figure 3.



Figure 3. Sample Aerial Photograph

4.0 Additional Survey

As previously mentioned, terrain and obstacle data are critical to many of the analyses that MITRE will be conducting of the Texcoco area and its surroundings. Therefore, MITRE requests that the DGAC provide a survey of both terrain and obstacles other than terrain (e.g., trees, buildings, towers, etc.), referred to as “other obstacles”. This section describes areas to be surveyed, as well as information on obstacle types, obstacle identification methodology, and data accuracy requirements.

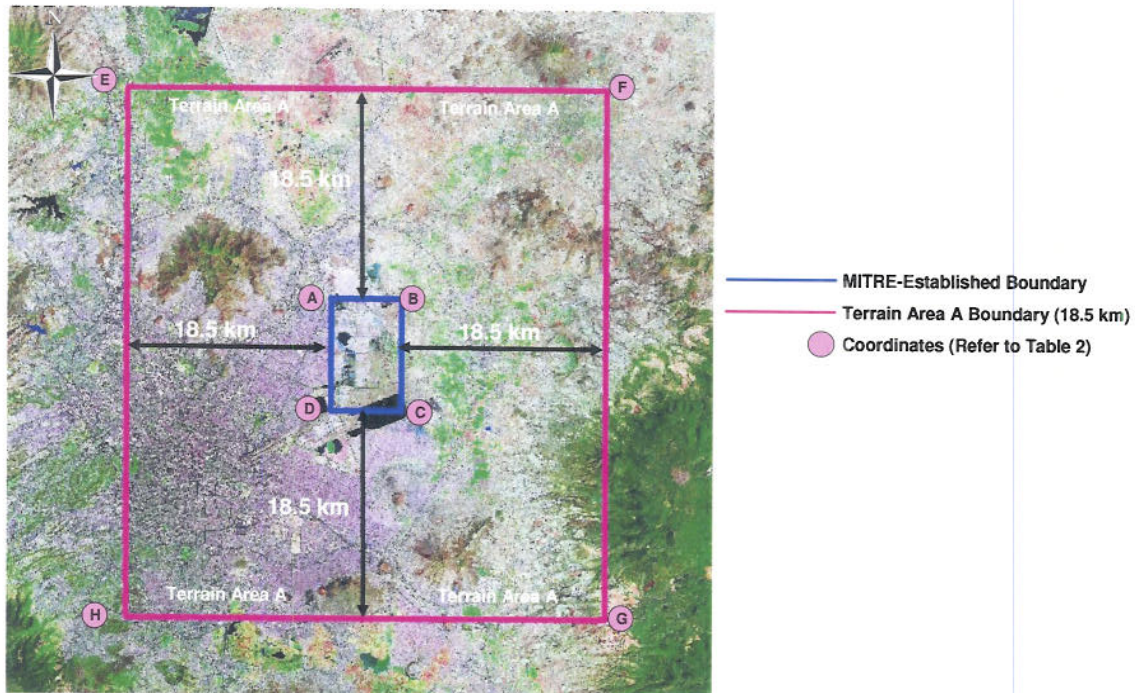
MITRE plans to obtain and use NASA’s Shuttle Radar Topography Mission (SRTM) Digital Terrain Elevation Data (DTED) for areas beyond the one covered by the survey of Section 3.0. However, despite its accuracy and reliability, SRTM data contains some “blind” spots and also does not include man-made information. For that reason, MITRE requires this additional survey.

Again, due to the complexity and critical timing of such an undertaking MITRE strongly recommends that an experienced technical representative from the company performing the survey contact MITRE’s lead representative to discuss this matter prior to starting work. This will help all parties clearly understand the requirements and expected standards of the survey, and ensure a satisfactory and realistic product is produced.

MITRE requires that four additional areas be surveyed to complement the SRTM data; two for terrain (Terrain Areas A and B) and two for other obstacles (Other Obstacle Areas A and B). It is important to note that these four areas have different dimensions and the Terrain Areas partially overlap with the Other Obstacle Areas. The areas and their coordinates are shown as follows:

- Terrain Area A is shown in Figure 4 and its coordinates are provided in Table 2. Terrain Area A starts from a rectangular MITRE-established boundary (shown in blue).
- Terrain Area B is shown in Figure 5 and its coordinates are provided in Table 3.
- Other Obstacle Area A is shown in Figure 6 and its coordinates are provided in Table 4. Other Obstacle Area A also starts from the same rectangular MITRE-established boundary mentioned above.
- Other Obstacle Area B is shown in Figure 7 and its coordinates are provided in Table 5.

Intentionally Left Blank



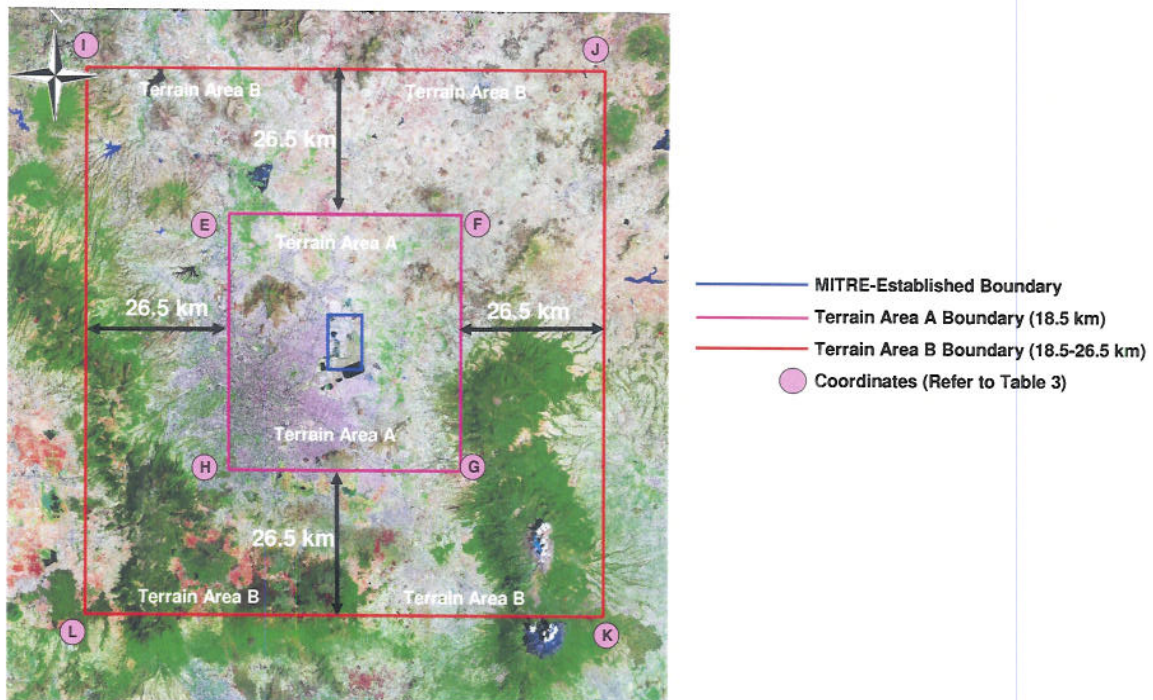
Note: the background imagery is provided for general visual reference and orientation purposes only.

Figure 4. Terrain Area A

Table 2. Terrain Area A Coordinates

Point	UTM Coordinates (meters)	Latitude/Longitude (WGS 84)
A	498579.5799 / 2162665.8372	19° 33' 31.9"N / 99° 00' 48.7"W
B	504896.0000 / 2162665.8372	19° 33' 31.9"N / 98° 57' 12.0"W
C	504896.0000 / 2152668.7725	19° 28' 06.6"N / 98° 57' 12.1"W
D	498579.5779 / 2152668.7725	19° 28' 06.6"N / 99° 00' 48.7"W
E	480079.5799 / 2181165.8372	19° 43' 33.3"N / 99° 11' 24.4"W
F	523396.0000 / 2181165.8372	19° 43' 33.3"N / 98° 46' 36.2"W
G	523396.0000 / 2134168.7725	19° 18' 04.3"N / 98° 46' 38.3"W
H	480079.5799 / 2134168.7725	19° 18' 04.3"N / 99° 11' 22.6"W

The coordinates provided in Table 2 should be plotted on a map by the surveyor and sent to MITRE to confirm their appropriateness prior to starting any work.



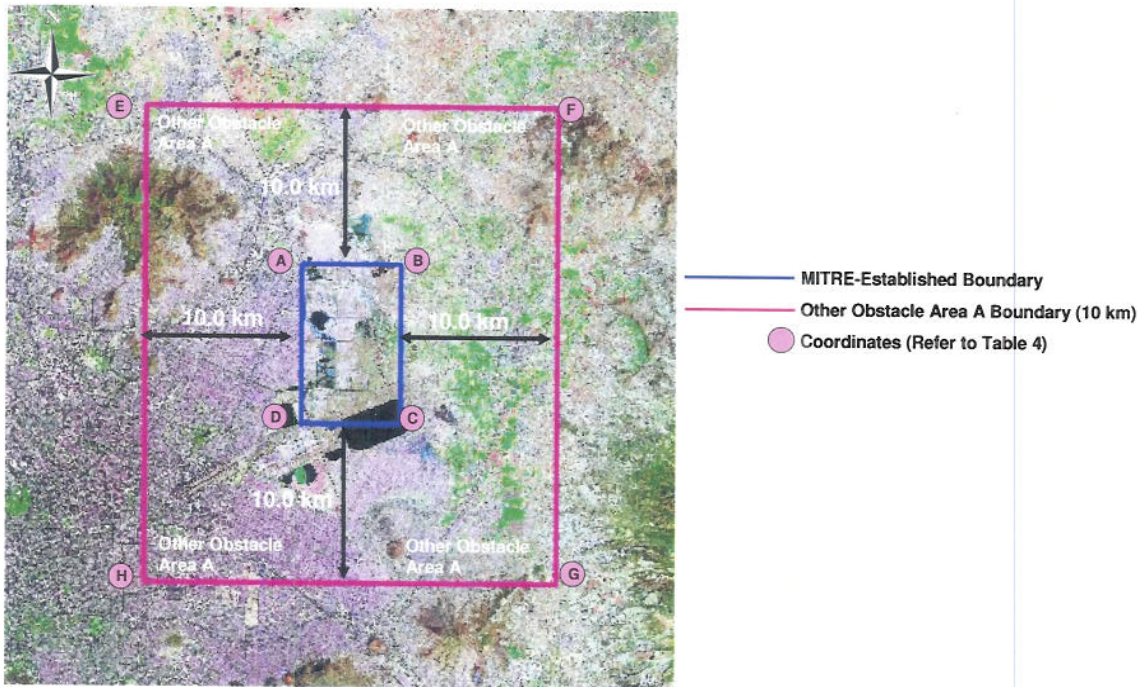
Note: the background imagery is provided for general visual reference and orientation purposes only.

Figure 5. Terrain Area B

Table 3. Terrain Area B Coordinates

Point	UTM Coordinates (meters)	Latitude/Longitude (WGS 84)
E	480079.5799 / 2181165.8372	19° 43' 33.3"N / 99° 11' 24.4"W
F	523396.0000 / 2181165.8372	19° 43' 33.3"N / 98° 46' 36.2"W
G	523396.0000 / 2134168.7725	19° 18' 04.3"N / 98° 46' 38.3"W
H	480079.5799 / 2134168.7725	19° 18' 04.3"N / 99° 11' 22.6"W
I	453579.5799 / 2207665.8372	19° 57' 53.9"N / 99° 26' 37.2"W
J	549896.0000 / 2207665.8372	19° 57' 53.6"N / 98° 31' 23.2"W
K	549896.0000 / 2107668.7725	19° 03' 40.4"N / 98° 31' 32.7"W
L	453579.5799 / 2107668.7725	19° 03' 40.7"N / 99° 26' 28.3"W

The coordinates provided in Table 3 should be plotted on a map by the surveyor and sent to MITRE to confirm their appropriateness prior to starting any work.



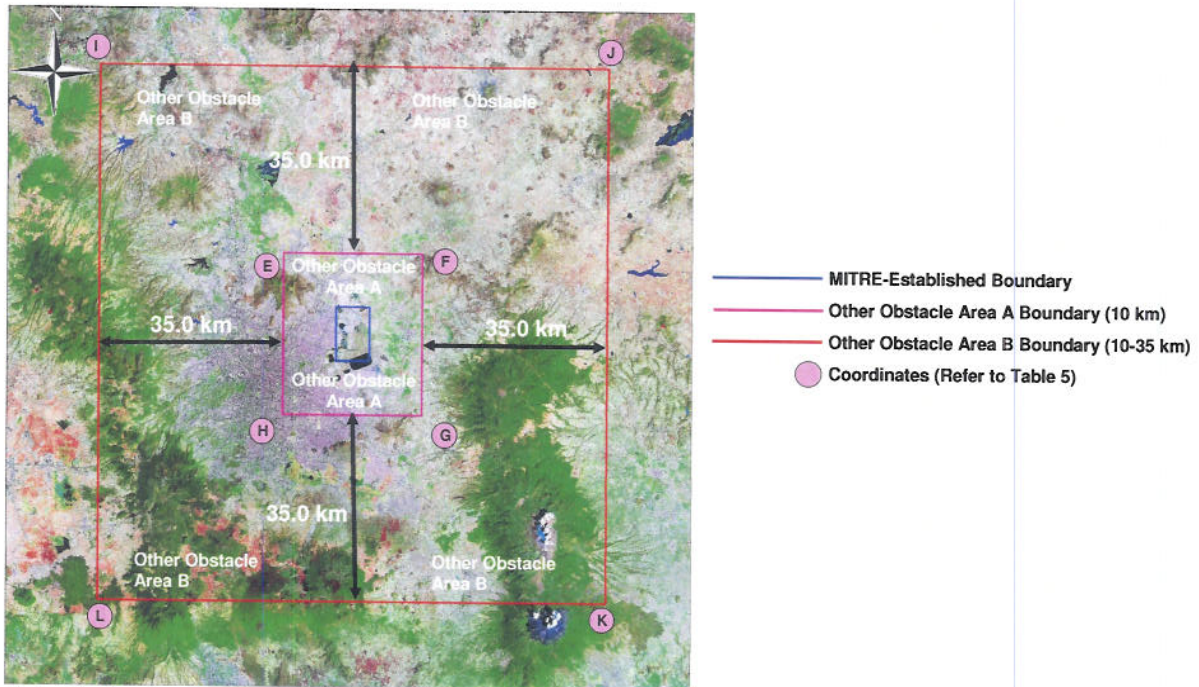
Note: the background imagery is provided for general visual reference and orientation purposes only.

Figure 6. Other Obstacle Area A

Table 4. Other Obstacle Area A Coordinates

Point	UTM Coordinates (meters)	Latitude/Longitude (WGS 84)
A	498579.5799 / 2162665.8372	19° 33' 31.9"N / 99° 00' 48.7"W
B	504896.0000 / 2162665.8372	19° 33' 31.9"N / 98° 57' 12.0"W
C	504896.0000 / 2152668.7725	19° 28' 06.6"N / 98° 57' 12.1"W
D	498579.5779 / 2152668.7725	19° 28' 06.6"N / 99° 00' 48.7"W
E	488579.5799 / 2172665.8372	19° 38' 57.1"N / 99° 06' 32.2"W
F	514896.0000 / 2172665.8372	19° 38' 57.0"N / 98° 51' 28.5"W
G	514896.0000 / 2142668.7725	19° 22' 44.1"N / 98° 51' 29.3"W
H	488579.5799 / 2142668.7725	19° 22' 41.2"N / 99° 06' 31.5"W

The coordinates provided in Table 4 should be plotted on a map by the surveyor and sent to MITRE to confirm their appropriateness prior to starting any work.



Note: the background imagery is provided for general visual reference and orientation purposes only.

Figure 7. Other Obstacle Area B

Table 5. Other Obstacle Area B Coordinates

Point	UTM Coordinates (meters)	Latitude/Longitude (WGS 84)
E	488579.5799 / 2172665.8372	19° 38' 57.1"N / 99° 06' 32.2"W
F	514896.0000 / 2172665.8372	19° 38' 57.0"N / 98° 51' 28.5"W
G	514896.0000 / 2142668.7725	19° 22' 44.1"N / 98° 51' 29.3"W
H	488579.5799 / 2142668.7725	19° 22' 41.2"N / 99° 06' 31.5"W
I	453579.5799 / 2207665.8372	19° 57' 53.9"N / 99° 26' 37.2"W
J	549896.0000 / 2207665.8372	19° 57' 53.6"N / 98° 31' 23.2"W
K	549896.0000 / 2107668.7725	19° 03' 40.4"N / 99° 31' 32.7"W
L	453579.5799 / 2107668.7725	19° 03' 40.7"N / 99° 26' 28.3"W

The coordinates provided in Table 5 should be plotted on a map by the surveyor and sent to MITRE to confirm their appropriateness prior to starting any work.

The following sections describe the survey requirements for terrain and other obstacles.

4.1 Survey Requirements for Terrain Areas A and B

This section specifically deals with terrain spot elevations and “peak” points. Spot elevations are identified and labeled at specific locations to depict terrain features such as

the top of hills. Peak, is a term MITRE uses to identify terrain points at the top of a hill or an intermediate high terrain point on an upward sloping area (e.g., the side of a mountain) that has not been identified and labeled as a spot elevation. These peak points are helpful to determine the overall land form of the terrain landscape.

Terrain Areas A and B, shown in Table 6, have the same accuracy standards.

Table 6. Terrain Data Accuracy Requirements

	Terrain Areas A and B Accuracy Standards
Vertical accuracy	3 m
Vertical resolution	0.1 m
Horizontal accuracy	5 m

In the case of Terrain Area A, all spot elevations and peak points, regardless of elevation, should be identified.

In the case of Terrain Area B, not all terrain features need to be identified. In this case, a 120-m horizontal surface above the lowest surveyed elevation in the Section 3.0 photogrammetric survey should be established to identify only spot elevations and peak points that penetrate the 120-m horizontal surface.

In both Terrain Areas A and B, wherever groupings of spot elevations and/or peak points are encountered, it is acceptable to identify the highest terrain point within a 100-m radius of the center of the grouping.

4.2 Survey Requirements for Other Obstacle Areas A and B

This section specifically deals with obstacles other than terrain (e.g., trees, buildings, towers, etc.), referred to as “other obstacles”.

The standards on accuracy for the survey of other obstacles for Other Obstacle Areas A and B are shown in Table 7. Notice that in this case accuracy standards are different for each area.

Table 7. Other Obstacle Data Requirements

	Other Obstacle Area A Accuracy Standard	Other Obstacle Area B Accuracy Standard
Vertical accuracy	3 m	30 m
Vertical resolution	0.1 m	1 m
Horizontal accuracy	5 m	50 m

In the case of Other Obstacle Area A, all obstacles other than terrain that penetrate a sloping surface should be identified. The surface slopes upward and outward from a MITRE-established boundary (see Figure 6) at 1.2 percent until reaching 120 m above the lowest surveyed elevation in the Section 3.0 photogrammetric survey (the slope starts at that same lowest surveyed elevation).

In the case of Other Obstacle Area B, all obstacles other than terrain that penetrate a horizontal surface 120 m above the lowest surveyed elevation in the Section 3.0 photogrammetric survey should be identified.

In both Other Obstacle Areas A and B, wherever groupings of obstacles other than terrain are encountered, it is acceptable to identify the highest obstacle within a 100-m radius of the center of the grouping.

Figure 8 illustrates the sloping surface and 120-m horizontal surface mentioned above.



**Figure 8. Other Obstacle Areas A and B
(Sloping Surface and 120-m Horizontal Surface, Respectively)**

4.3 Other Requirements

A single digital drawing containing all of the terrain and other obstacle data should be provided in Autodesk Map 3D 2008 format. The individual AutoCAD files used to create the combined survey drawing should also be provided. A technical report describing the overall development of the survey, including a list of all survey control points should be submitted.

Additionally, a listing of all terrain and other obstacle data should be provided in Excel format. The list should include the following information for each obstacle in separate columns:

- Obstacle type (hill, antenna, tree, building, etc.)

- Latitude (based on WGS 84)
- Longitude (based on WGS 84)
- UTM coordinates (in meters)
- Elevation (in meters above MSL)

Finally, if the survey company intends to use aerial photography or satellite imagery to conduct the surveys, please provide one color mosaic of the entire surveyed area, both on paper and electronically. The color mosaic should be geo-registered (e.g., Geo-TIFF file) so that when inserted into Autodesk Map 3D 2008 it is aligned with the terrain and other obstacle data.