

Enclosure 1

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MITRE

**Center for Advanced
Aviation System Development**

Helicopter Operations at Santa Lucía Military Base in Conjunction with NAICM Operations

Preliminary Report

Prepared for

Aeropuertos y Servicios Auxiliares

March 2014

1. Introduction

In mid-February 2014, Aeropuertos y Servicios Auxiliares (ASA) requested that MITRE perform a feasibility analysis for continued Visual Flight Rules (VFR) helicopter operations at Santa Lucía Military Base (Santa Lucía), while operating, without affecting its air traffic capacity, the proposed Nuevo Aeropuerto Internacional de la Ciudad de México (NAICM) in nearby Texcoco. While this constitutes out-of-scope work under the ASA-MITRE Agreement, MITRE understood the importance of the request, accepted it, and selected an engineering team that has worked during the past month-and-a-half on the feasibility analysis.

The objective of this analysis is to determine whether or not Santa Lucía VFR helicopters can arrive to and depart from the base without interfering with Instrument Flight Rules (IFR) operations at NAICM. For example, is it feasible to establish VFR helicopter routes and/or entry/exit points that would allow departures from and arrivals to Santa Lucía independent of NAICM operations? The intent of this report is to describe MITRE's approach to conducting the analysis and provide a preliminary answer.

Section 2 provides the background to this task and the reasons for conducting the analysis. Section 3 provides a description of the methodology used to perform the work. Section 4 lists major assumptions, as well as important limitations. Section 5 presents MITRE's analysis of future helicopter operations at Santa Lucía considering NAICM traffic. Section 6 discusses additional considerations that could affect the feasibility of VFR helicopter operations at Santa Lucía. Finally, Section 7 summarizes MITRE's findings.

2. Background

MITRE has been working closely with the Secretaría de Comunicaciones y Transportes (SCT) of Mexico over the past decade to establish the feasibility of developing a new large, multi-runway airport at the NAICM site. MITRE examined throughout the years a large number of runway orientation scenarios, which considered interactions between operations at NAICM and Santa Lucía. MITRE also developed a feasible airspace design that would enable NAICM to operate at its maximum capacity, while also allowing operations at Toluca Airport and other airports surrounding the Mexico City area without imposing any capacity-limiting constraints on NAICM. In conjunction with the airspace design work, a revised Minimum Vectoring Altitude Chart was developed for the future Mexico Terminal Maneuvering Area (TMA) to support operations at NAICM. This was done to determine the minimum altitudes IFR aircraft could safely be radar-vectorized to NAICM. All of this work was coordinated closely with experts from Servicios a la Navegación en el Espacio Aéreo Mexicano (SENEAM) and other aviation officials.

Early in the project, it became apparent to MITRE's procedure and airspace design experts that despite solid efforts to avoid restriction to the base, Santa Lucía's fix-wing operations would need to be relocated before the new airport opens. Its existence, including its Special Use Airspace (SUA), which is only 13 km from the NAICM runways, as shown in Figure 1 (SUA shown in green), while operating at the same time as NAICM, would create a highly complex

airspace environment (with all the safety issues that arise with that) and would adversely impact runway capacity, thus reducing the overall benefit of NAICM.



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Figure 1. NAICM and Santa Lucía

After an intensive investigation, MITRE determined that operations at Santa Lucía could not continue without interfering with IFR operations at NAICM. Operations at Santa Lucía would cause severe interruptions in traffic flows at NAICM. A single operation at Santa Lucía would require NAICM to stop approach and/or departure operations for a period of time, causing significant disruption to traffic flows to and from NAICM, reducing runway capacity, and increasing delays which could cause a system-wide ripple effect. In the end, it was agreed that Santa Lucía's fix-wing operations, along with its associated SUAs need to be relocated. The helicopter operation was not fully analyzed initially.

In late January 2014, MITRE hosted a visit by Lic. Manuel Ángel Núñez, Ing. Jorge Nevárez, and five officials from the Fuerza Aérea Mexicana (FAM) to its facilities in McLean, Virginia. During that visit, important discussions were held regarding the closing of Santa Lucía's runway, as well as the potential new airport sites being considered in the State of Hidalgo for the development of a joint civil/military airport to replace Santa Lucía. Following

that visit, in mid-February a team of MITRE engineers visited Santa Lucía to conduct further discussions with FAM officials.

The above-mentioned discussions resulted in the following understandings:

1. All Santa Lucía helicopter operations (including helicopter maintenance) are to remain at the base, pending a MITRE analysis. This report presents the preliminary findings of that analysis.
2. All Santa Lucía helicopter training is to relocate to a FAM-recommended area that MITRE will analyze. FAM was to send to MITRE the coordinates of that area by 25 February for MITRE's immediate analysis. MITRE, however, never received the information nor has received an explanation as to why the information was not sent.
3. The Santa Lucía runway is to be closed. As a result, all fixed-wing operations will cease. These operations will be relocated as follows:
 - Fixed-wing maintenance and training operations are to relocate, along with its support facilities, to another airport, possibly Querétaro Airport or a new airport in Hidalgo.
 - Fixed-wing transport operations are to relocate to NAICM, along with its support facilities. MITRE suggests that the eastern-most runway is used to that affect.
4. All SUAs associated with Santa Lucía operations are to be eliminated

It is important at this juncture to emphasize that the need to close the Santa Lucía runway has been studied for several years, its importance has been solidly proven, and its connection to crucial aspects of safety and capacity established beyond doubt. Leaving that runway open for a theoretically low number of operations not only is not advisable from a safety and capacity point of view, but a proposed fixed-wing maintenance base for Santa Lucía can still be constructed either at Querétaro Airport or at a new airport in Hidalgo.

MITRE wishes to express its strongest concern about continuing efforts to leave that runway open, as MITRE does not want to be associated with a decision that could cause serious air traffic problems.

3. Approach/Methodology

MITRE approached this analysis through the following multi-step process:

- **Step One:** Determine the different aspects that need to be studied and establish various operational scenarios. Of primary importance was the necessity to avoid introducing any capacity-limiting interactions with aircraft operations at NAICM. MITRE therefore based its analysis on work previously conducted on developing a feasible airspace design to support multi-parallel-runway operations at NAICM.

- Step Two: Determine the minimum acceptable vertical and horizontal distances necessary to keep helicopter operations at a suitable distance from IFR flights operating to and from NAICM. MITRE determined a distance of 1000 ft vertically or 3 NM laterally as the minimum required distance. This is based on minimum vertical and horizontal distance thresholds below which the Traffic Alert Collision Avoidance Systems (TCAS) onboard commercial civil aircraft could create nuisance alerts and Resolution Advisories (RAs). These RAs on the flight deck require that pilots respond by breaking away from their assigned flight procedure and conduct an evasive maneuver. This could have a ripple effect, causing other aircraft on adjacent approach or departure procedures to also break off their assigned routes or instrument approaches causing major disruption to traffic flows around NAICM.
- Step Three: Determine the area (denoted in this report as the “Interaction Zone”) where any VFR helicopter operations would potentially be in close proximity to commercial IFR flights that are in the process of landing or taking off at NAICM, and could therefore create an interaction. VFR helicopter operations outside this area could safely be permitted to operate at or below pre-determined specific altitudes, as described below, in Step Four.
- Step Four: Determine the maximum permissible altitudes outside the area defined in Step Three where helicopters can safely operate at while maintaining the prescribed distances from flights operating to and from NAICM. These altitudes are based on the following:
 - Helicopters being at least 1000 ft below the applicable altitude in the SENEAM-MITRE developed MVAC, which is at least 1000 ft below the minimum altitude at which IFR aircraft are being radar-vectorred, and
 - Helicopters being at least 1000 ft below NAICM aircraft on defined arrival and departure procedures.
- Step Five: Based on the completion of the previous steps, assess the potential for permitting the following:
 - VFR helicopter arrival and departure operations overhead and in the immediate vicinity of Santa Lucía
 - VFR helicopter arrivals to and departures from the Santa Lucía Local Area. For the purpose of this analysis, the Local Area was considered to be within 10 NM of Santa Lucía’s runway area.
- Step Six: Assess the impact of terrain on VFR helicopter operations at or below the maximum permissible altitudes. MITRE conducted a two-part assessment. The first part was to determine if there was any terrain within a sector that was above

the maximum permissible altitude shown for that sector. Where terrain was found to be above the maximum permissible sector altitude, it could make a sector unfeasible for helicopter operations. The second part was to determine if terrain came within 1000 ft of the maximum permissible altitude shown for that sector. In this case helicopters would have to operate with less than 1000 ft terrain clearance.

4. Assumptions and Limitations

The analysis required making a number of assumptions concerning the kinds of operations conducted by VFR helicopters.

NAICM operations were considered of primary importance. Very high traffic densities can be expected to be operating at this airport from opening day, involving dual- and triple-independent arrival and departure operations to achieve maximum runway capacity using minimum separation between aircraft. This requires Air Traffic Control (ATC) positions and frequencies that are dedicated solely to aircraft arriving or departing NAICM. MITRE considers that it is not operationally acceptable to require busy NAICM air traffic controllers to be in radio contact with pilots of FAM VFR helicopters that are arriving to or departing from Santa Lucía, nor should NAICM controllers be required to pass traffic information on such operations to pilots of IFR flights.

Only normal operations at NAICM were considered in this analysis. Irregular operations, such as deviations from defined flight tracks due to weather avoidance, and emergency situations, such as an engine failure on takeoff, were considered to be outside the scope of this analysis.

MITRE only analyzed the feasibility of VFR helicopter operations departing from and arriving to Santa Lucía. No other types of operations, including training or any IFR operations are expected to be conducted at the base as they would not be compatible with NAICM operations.

MITRE considered an area within 10 NM of Santa Lucía's runway area to be the Local Area where VFR helicopters need to be in communication with, and under the control of the Santa Lucía Control Tower. Therefore, MITRE's analysis concentrated on determining if VFR helicopter operations departing from and arriving to Santa Lucía were feasible in this area.

Terrain was also considered as part of this study. However, MITRE considered that it was outside the scope of this study to determine whether such terrain impacted feasibility. The FAM will need to determine if terrain is an operational factor. Figures showing terrain penetrations are provided as part of this report for informational purposes only. Furthermore, MITRE did not consider man-made obstacles (e.g., antennas, tall buildings, etc.) in this assessment as that information was not available.

Finally, it is important to note that the development of a new airport in the State of Hidalgo is under consideration. Several sites are being studied to determine initial feasibility prior to conducting more thorough examinations of preferred sites. This analysis has not considered the location of a new airport in the State of Hidalgo. Such an airport, depending on its location, could affect the findings of this analysis and make the operation of VFR helicopters at Santa

Lucía more complex. Further analysis will need to be conducted to determine if and how a new airport in the State of Hidalgo impacts helicopter operations at Santa Lucía.

5. Analysis of Future Helicopter Operations at Santa Lucía

MITRE examined the airspace in the vicinity of NAICM and Santa Lucía and determined the lateral dimensions of various sectors of airspace around the two airports, and the maximum permissible altitude within the sectors where VFR helicopters could be allowed to operate safely. Figure 2 shows the results of that analysis.

The figure shows the Interaction Zone within which MITRE has determined that VFR helicopter operations would create an extremely complex airspace environment. VFR helicopter operations in this zone are considered either not feasible, or will require additional analysis to be conducted before making any determination concerning feasibility.

The continuous black line in Figure 2 shows the boundary of the Santa Lucía Local Area.

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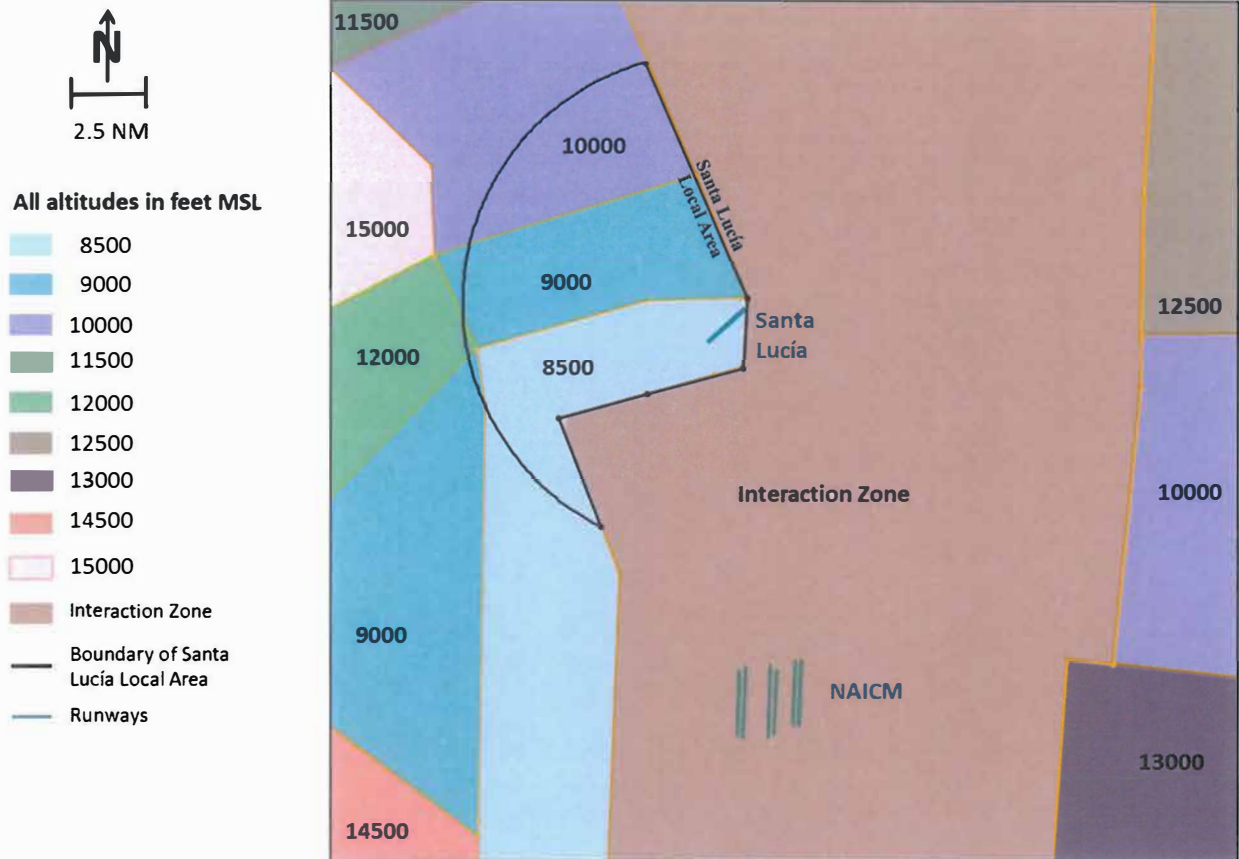


Figure 2. VFR Helicopter Airspace Sectors and Altitudes

Figure 3 shows similar information as Figure 2, but with the addition of terrain penetrations affecting some of the sectors. Two colors are used to indicate areas of terrain. The dark gray areas show areas of terrain that penetrate above the maximum permissible altitude for that sector. The pale gray areas show areas of terrain that are less than 1000 ft below the maximum permissible altitude for that sector and therefore may be a factor in determining if that sector of airspace is usable by VFR helicopters.

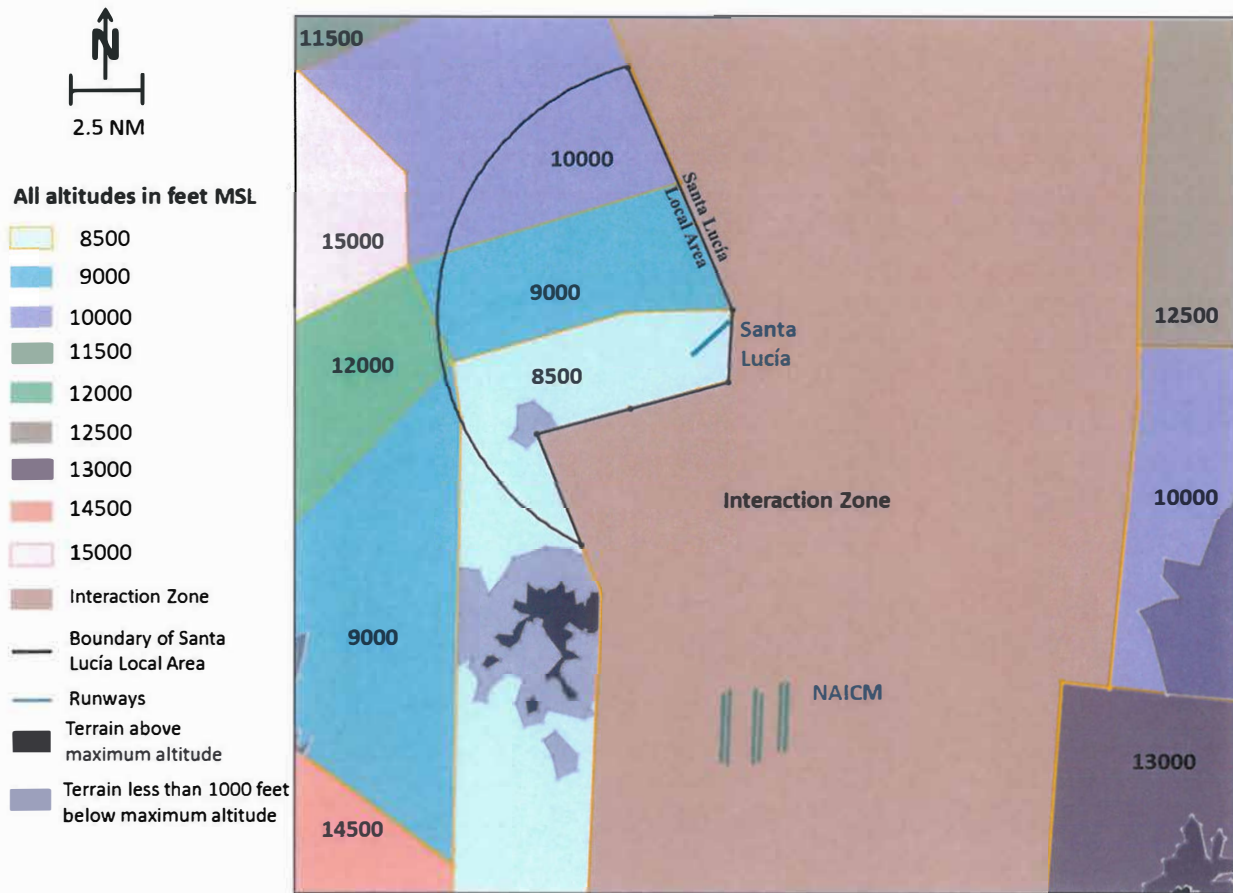


Figure 3. VFR Helicopter Airspace Sectors and Altitudes (with terrain penetrations)

5.1 Arrival and Departure Operations Overhead Santa Lucía

MITRE determined that it is only feasible to permit VFR helicopters to operate to the immediate west of the current runway. VFR helicopter operations to the immediate west of the current runway at Santa Lucía should be feasible up to a maximum altitude of 8500 ft MSL (approximately 1100 ft above airfield elevation), as indicated in Figure 2. Terrain is not a factor within this area.

5.2 Arrival and Departure Operations Within the Santa Lucía Local Area

MITRE determined that it should be feasible to establish VFR helicopter routes and/or entry/exit points to permit VFR helicopters to fly to the west and northwest at or below the altitudes indicated in Figure 2. These altitudes vary from 8500 ft MSL to 10,000 ft MSL within the Santa Lucía Local Area. There is a small area to the west-southwest of Santa Lucía (see Figure 3) where helicopters may be affected by terrain. Additionally, to the southwest, immediately outside the Santa Lucía Local Area and to the west of the Interaction Zone is an area of higher terrain, some of which penetrates above the maximum permissible sector altitude.

This may be a factor affecting the feasibility of VFR helicopter operations that need to depart to the southwest of Santa Lucía towards Mexico City itself.

As can be seen in Figures 2 and 3, the Interaction Zone is located to the south, east, and northeast of Santa Lucía. MITRE has determined that VFR helicopter operations within this zone would create an extremely complex airspace environment. VFR helicopter operations in this zone are considered either not feasible, or would require additional analysis to be conducted before making any determination concerning feasibility.

6. Other Considerations

Numerous factors need to be considered as part of the planning for the opening of NAICM. Some of these factors affect the feasibility of VFR helicopter operations at Santa Lucía. This section discusses two of the most significant factors: airspace classification changes and weather criteria for helicopter operations.

6.1 Airspace Classification Changes

As part of the planning and implementation of NAICM a total redesign of the airspace in and around the Mexico City basin will be required. As part of that process it will be necessary to consider the reclassification of the airspace in and around NAICM. Consideration must be made of the need to protect the busy IFR operation around NAICM with a known-traffic environment. All relevant stakeholders must consider what would be the most appropriate airspace classification for the different airspace structures necessary to support NAICM operations. Such new airspace structures (e.g., Control Zones, Control Areas) will need to be defined with appropriate dimensions (lateral and vertical) and appropriate classifications. Use of higher airspace classifications (e.g., Class A, B or C) can exclude VFR operations totally, or place additional requirements on air traffic controllers, such as requiring controllers to provide vertical and lateral separation from other VFR flights as well as from IFR flights. Such airspace classifications can also impose minimum communication requirements between pilots and ATC, the use of Secondary Surveillance Radar transponders, and the prior filing of flight plans and receipt of ATC clearances.

6.2 Weather Criteria for VFR Helicopter Operations

Associated with any VFR operation are minimum weather limits below which VFR operations are not permitted. Aircraft wishing to fly below these weather limits must either fly IFR, or if regulations permit, operate under Special VFR.

In Mexico, current procedures for VFR helicopter flights in the Mexico TMA require that pilots comply with certain weather minima and velocities to adequately see and avoid terrain and man-made obstacles, as well as other aircraft. Relevant Mexican stakeholders will need to determine what future procedures and operating requirements are appropriate in and around NAICM and Santa Lucía. This may include whether VFR helicopter routes (if they are established) should be used as one-way or two-way routes, as well as when VFR operations must be terminated.

Once decisions have been made regarding the above-mentioned factors by the aviation authorities of Mexico their potential affect on the feasibility of VFR helicopter operations will have to be examined.

7. Summary

MITRE has determined that VFR helicopter arrival and departure operations at Santa Lucía are feasible with the following restrictions:

- VFR helicopter operations in the immediate vicinity of Santa Lucía (i.e., overhead the base) that remain to the west of the current runway could operate up to a maximum altitude of 8,500 ft MSL (approximately 1100 ft above airfield elevation). Terrain in this area is not a factor.
- VFR helicopter operations to and from the west and northwest of Santa Lucía should be feasible, provided that the maximum permissible altitude restrictions are observed (see Figure 2).
- Terrain issues to the west-southwest and farther southwest of Santa Lucía may be a problem (See Figure 3).
- VFR helicopter operations in any other direction (other than west or northwest) within the Interaction Zone shown in Figure 2 are considered either not feasible, or will require additional analysis to be conducted before making a determination concerning feasibility.
- MITRE is currently investigating the possibility of establishing prescribed helicopter routes to the south and southeast of Santa Lucía for the sole purpose of allowing VFR helicopters to fly between NAICM and Santa Lucía. This work is ongoing and results will be reported separately.
- Other factors, such as the likely modification of the airspace classification around NAICM and weather limits for VFR operations, could also affect the feasibility of VFR helicopter operations, and will have to be taken into account as part of the implementation planning for NAICM. Once decisions have been made regarding these and other factors, their impact on VFR helicopter operations should be examined.