Enclosure 1

(Ref. Technical Letter F500-L17-111)

MITRE

Center for Advanced
Aviation System Development

Mexico Area Control Center Enroute and New Mexico City and Toluca Terminal Maneuvering Area Airspace Redesign

Opening-Day Traffic Demand Sector Analysis

Prepared for

Grupo Aeroportuario de la Ciudad de México

October 2017

Principal Acronyms and Abbreviations

2D	Two-Dimensional
ACC	Area Control Center
AICM	Aeropuerto Internacional de la Ciudad de México
AIP	Aeronautical Information Publication
ATC	Air Traffic Control
CPL	Coordinated Flight Plan
GACM	Grupo Aeroportuario de la Ciudad de México
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
MITRE	The MITRE Corporation
MMAA	Acapulco Airport
MMAS	Lic. Jesús Terán Peredo Airport (Ciudad de Aguascalientes)
MMBT	Bahías de Huatulco Airport (Puerto de Huatulco)
MMCB	Cuernavaca Airport
MMGL	Guadalajara Airport
MMIA	Colima Airport
MMJA	El Lencero Airport (Ciudad de Xalapa)
MMLO	Del Bajío Airport (Ciudad de Guanajuato)
MMMM	Morelia Airport
MMOX	Xoxocotlán Airport (Ciudad de Oaxaca)
MMPA	El Tajín Airport (Ciudad de Poza Rica)
MMPB	Puebla Airport
MMPN	Uruapan Airport
MMPR	Lic. Gustavo Díaz Ordaz Airport (Puerto Vallarta)
MMPS	Puerto Escondido Airport
MMQT	Querétaro Airport
MMSP	Ponciano Arriaga Airport (Ciudad de San Luis Potosí)
MMTM	Tampico Airport

MMTN	Tamuín Airport
MMTO	Toluca Airport
MMVR	Veracruz Airport
MMZC	General Leobardo C. Ruiz Airport (Ciudad de Zacatecas)
MMZH	Ixtapa-Zihuatanejo Airport
MMZO	Playa de Oro Airport (Ciudad de Manzanillo)
MSL	Mean Sea Level
NAICM	Nuevo Aeropuerto Internacional de la Ciudad de México
PBN	Performance-Based Navigation
***s*E**	*sector*Evaluator
SENEAM	Servicios a la Navegación en el Espacio Aéreo Mexicano
SID	Standard Instrument Departure
SME	Subject Matter Expert
STAR	Standard Terminal Arrival Route
TMA	Terminal Maneuvering (Control) Area
U.S.	United States
VFR	Visual Flight Rules

1. Introduction

The MITRE Corporation (MITRE) is assisting, through Grupo Aeroportuario de la Ciudad de México (GACM), the aviation authorities of Mexico with the implementation of a new airport, referred to in this document as Nuevo Aeropuerto Internacional de la Ciudad de México (NAICM), to replace the current Aeropuerto Internacional de la Ciudad de México (AICM). The proposed runway layout of NAICM will allow for dual- and triple-independent arrival and departure operations.

MITRE has been assisting Servicios a la Navegación en el Espacio Aéreo Mexicano (SENEAM) in its development of an airspace design for the new Mexico City Terminal Maneuvering (Control) Area (TMA) to support NAICM. As a result of modifying the current Mexico City TMA procedures to support NAICM, the current enroute airspace for the Mexico Area Control Center (ACC) will also need to be modified.

There is an initiative within SENEAM to incorporate Performance-Based Navigation (PBN) routes for all of Mexico's enroute airspace, which affects the current Mexico ACC enroute airspace as well as the entry and exit points on the periphery of the current Mexico City TMA. SENEAM and MITRE have been working closely together to ensure that the proposed PBN routes for the Mexico ACC enroute airspace also accommodate the modifications of the routes and procedures within the new Mexico City TMA in support of NAICM.

As part of MITRE's support to the aviation authorities of Mexico, MITRE will assist SENEAM in its performance of an analysis of the enroute airspace structure that relates to the Mexico ACC in support of NAICM. This will help to identify and mitigate factors that could limit the capacity of traffic flows arriving to or departing from a new Mexico City TMA.

MITRE's overall support on Mexico ACC enroute airspace includes the following:

- Providing guidance in the analysis of the existing enroute structure to assess its ability to accommodate increased traffic levels that could conceivably be required by the (official) opening day of NAICM in 2020 (see Appendix C), to determine if there are any capacity-limiting issues
- Assisting in the determination of short-term changes required by the enroute structure to overcome any issues identified
- Assisting in the development of a long-term enroute route structure to support the ultimate runway configuration and projected traffic levels at NAICM
- Assisting in the assessment of airspace sectorization driven by any airspace redesigns performed under the above-mentioned items

The objective of this document is to present the preliminary results (i.e., preliminary in the sense that SENEAM needs to review this document) of the analyses that were conducted by MITRE for the new Mexico City TMA and the Mexico ACC enroute airspace considering SENEAM's forecasted NAICM opening-day traffic demand levels. Forecasted traffic demand levels for other airports associated with the new Mexico City TMA and Mexico ACC at the time NAICM opens, including overflights, were also considered. The forecasted traffic demand

levels were provided by SENEAM. Using this information, MITRE increased the traffic demand levels that were used in the previous baseline analyses (see Enclosure 3 referenced to MITRE Technical Letter F500-L16-059, *Mexico Area Control Center Enroute and Mexico City Terminal Maneuvering Area Airspace Redesign - Baseline Metrics Sector Analysis,* dated 26 September 2016, for additional details). The Mexico ACC, as well as the new Mexico City TMA and new Toluca TMA routes and sectors used for the analysis of opening-day traffic demand levels are based on the February 2017 and June 2017 SENEAM-MITRE airspace design workshops.

If any sector issues were uncovered, modifications were made to the TMA and enroute sectors, and the analysis was then repeated to ensure that proposed sector modifications did not introduce additional issues.

This document is divided into five sections, as follows:

- Section 1 introduces the project, structure, and scope of the work
- Section 2 describes the methodology used for the analysis of both the Mexico ACC enroute airspace and the new Mexico City and Toluca TMAs, and the data that were used for the analyses
- Section 3 describes the analysis and results of the Mexico ACC enroute sectors considering forecasted NAICM opening-day traffic demand
- Section 4 describes the analysis and results of the new Mexico City TMA and Toluca TMA sectors considering forecasted NAICM opening-day traffic demand
- Section 5 provides a summary of the results of these analyses

For the Mexico ACC, the initial opening-day traffic demand analysis considered the sectors developed by SENEAM and MITRE during the February 2017 airspace design workshop. These February 2017 enroute sectors are shown in Appendix A of this document (see Figure A-1). Some modifications were then made to the enroute sectors during the June 2017 airspace design workshop as a result of MITRE's initial opening-day traffic demand analysis results that were presented to SENEAM during that workshop. The Mexico ACC opening-day traffic demand analysis was then performed again by MITRE using the sectors that were developed during the June 2017 airspace design workshop, and the results are presented in this document. The June 2017 enroute sectors are shown in Appendix B of this document (see Figure B-1). See Enclosure 3 referenced to MITRE Technical Letter F500-L17-070: *Mexico Area Control Center - Preliminary Airspace Redesign - Informal Working Notes: Routes and Sectorization*, dated 28 June 2017, for details on the latest Mexico ACC enroute airspace design.

For the new Mexico City TMA, the initial opening-day traffic demand analysis also considered the routes and sectors developed during the February 2017 SENEAM-MITRE airspace design workshop. The initial opening-day traffic demand analysis results were presented to SENEAM during the June 2017 airspace design workshop, which resulted in further modifications being made to the TMA sectors. The new Mexico City TMA opening-day traffic demand analysis was then performed again by MITRE using the sectors that were developed during the June 2017 airspace design workshop, and the results are presented in this document. See Enclosure 2 referenced to MITRE Technical Letter F500-L17-070: *New Terminal*

Maneuvering Area - Preliminary Airspace Redesign - Informal Working Notes: Routes and Sectorization, dated 28 June 2017, for details on the latest new Mexico City TMA airspace design.

It is important to mention that while this analysis considers the increased volume of traffic that is expected once NAICM opens, as well as increases in traffic at other airports within the Mexico ACC, ongoing discussions and airspace design workshops along with future Human-In-The-Loop (HITL) simulation evaluations (to be conducted in close coordination with SENEAM), could affect the future number of sectors needed when NAICM opens.

2. Methodology

The methodology MITRE used to assess the Mexico ACC enroute structure and sectorization is described in MITRE's previously provided report, entitled *Mexico City Enroute Airspace Redesign, Methodology and Key Considerations* (see Enclosure 2 referenced to MITRE Technical Letter F500-L16-028, dated 18 March 2016). The methodology uses an iterative process where the airspace is evaluated, issues are addressed through redesign, if necessary, and then re-evaluated. This methodology is also being used to evaluate the new Mexico City TMA structure and sectorization to support the NAICM airspace design. Therefore, this document also includes the results of MITRE's opening-day traffic demand analysis of the new Mexico City TMA.

This methodology utilizes two important elements: analytical tools and domain expertise, as follows:

- MITRE-developed tools that measure the complexity and workload within a sector that, when used in conjunction with the airspace design Subject Matter Experts (SMEs), provide a data driven approach to airspace redesign
- Domain expertise includes Air Traffic Control (ATC) SMEs, specialized analysts, and, based on the scope of the project, various other experts who understand well the airspace being studied. For this project, MITRE's airspace design team complements the domain expertise of SENEAM personnel who have specific knowledge of the current airspace structure and operating procedures, as well as an understanding of specific problems and issues that should be considered.

The methodology consists of steps that assess the current airspace for issues, creates a baseline for evaluation, mitigates the identified issues, and then re-evaluates the proposed airspace. The results from the above-mentioned MITRE-developed tools, along with observations of traffic and discussions with air traffic controllers, allow the airspace design team to identify issues and create a baseline for the evaluation. The list of identified issues and the baseline metrics are used as starting points for issue mitigation, where MITRE's airspace design team can assist the SENEAM airspace design team with its redesign of the airspace. The identification and mitigation of issues is an iterative process and is repeated until the workload in all the sectors are acceptable. The results from the MITRE-developed tools also provide

indications of the severity and frequency of occurrence of an issue (e.g., number of flows merging at the same location).

MITRE's methodology started with performing the previously mentioned baseline analysis, which examined the existing Mexico ACC enroute and Mexico City TMA structure and sectors at current traffic demand levels. This analysis used SENEAM-provided Coordinated Flight Plan (CPL) data days (4 March 2016 and 22 April 2016), facility documents, and sectors from the Aeronautical Information Publication (AIP) of Mexico. A second analysis assessed the impact that the new SENEAM-proposed PBN routes have on the current Mexico ACC enroute sectors before traffic levels were increased for opening-day traffic demand levels at NAICM. This analysis was documented in a previously provided report, entitled *Mexico Area Control Center Enroute Airspace Redesign - Performance-Based Navigation Metrics: Analysis of Current Sectors* (see Enclosure 1 referenced to MITRE Technical Letter F500-L17-044, dated 23 March 2017). This analysis used the same SENEAM-provided CPL data days, facility documents, and sectors from the AIP of Mexico as those used in the above-mentioned baseline analysis. The PBN route analysis was completed for the Mexico ACC enroute airspace with the current Mexico ACC sectorization since the implementation of the SENEAM-proposed PBN routes could happen before NAICM commences operations. The analysis was done under two possible conditions: one using just the SENEAM-proposed PBN routes serving NAICM and Toluca Airport (International Civil Aviation Organization [ICAO] Code: MMTO) based on the August 2016 airspace design workshop, and the second using the SENEAM-proposed PBN routes serving all airports within the Mexico ACC. This analysis became the basis for the SENEAM-MITRE proposed sectorization that was developed during the February 2017 airspace design workshop.

A third analysis, described in this document, assessed the impact that increased traffic demand levels forecasted for opening-day at NAICM could have on the Mexico ACC and the new Mexico City TMA and Toluca TMA sectors with the new SENEAM-proposed PBN routes and proposed terminal Standard Instrument Departures (SIDs) and Standard Terminal Arrival Routes (STARs). MITRE's methodology for examining the opening-day traffic demand levels with the proposed sectorization for the Mexico ACC enroute sectors and the new Mexico City TMA and Toluca TMA is the same that was used in the above-mentioned baseline analysis and SENEAM-proposed PBN route analysis, except now it considers the proposed sectorization from the February 2017 and June 2017 airspace design workshops, separately. The analysis uses the same SENEAM-provided CPL data days (4 March 2016 and 22 April 2016), but with increased traffic demand levels based on forecasted information provided by SENEAM. The SENEAM-provided CPL data were increased to projected NAICM opening-day traffic demand levels and was then modified to reflect the modified SENEAM-proposed PBN route structure and the new SENEAM-MITRE developed routes for NAICM and MMTO based on the February 2017 airspace design workshop. See Appendix C for more detailed information on the methodology used to increase the traffic.

MITRE conducted two analyses for the February 2017 Mexico ACC airspace design that considers the expected volume of traffic on opening-day at NAICM, as well as future traffic demand levels at other airports and overflights within the Mexico ACC, as follows:

- One that assumed that all the modified SENEAM-proposed PBN routes within the Mexico ACC will be implemented (hereinafter referred to as "All Traffic"), and
- Another that assumed that only the modified SENEAM-proposed PBN routes supporting NAICM and MMTO SIDs and STARs will be implemented (hereinafter referred to as "NAICM and MMTO only"). This analysis was done for conservative planning purposes in case the other modified SENEAM-proposed PBN routes (i.e., those not supporting NAICM and MMTO SIDs and STARs) are not implemented for some reason.

MITRE's analysis of the February 2017 routes and sectorization was presented to SENEAM at the June 2017 airspace design workshop for feedback. As a result, additional modifications to both the enroute and TMA sectorizations were made during that workshop. The modifications from the June 2017 airspace design workshop were then analyzed by MITRE. The results of MITRE's Mexico ACC and new Mexico City TMA and Toluca TMA analyses considering the airspace designs from the February 2017 and June 2017 airspace design workshops are described in this document.

3. Mexico ACC Enroute Analysis Results

The Mexico ACC enroute sectors were evaluated using a collection of MITRE-developed tools that can be used alone or in concert with one another. One of those tools is MITRE-designed *sector*Evaluator (*s*E), which has received a United States (U.S.) patent, and analyzes the volume (amount of traffic a controller can work), complexity (amount of information a controller must consider in making a decision), and functionality (actions necessary to implement the decisions) of a sector design, through the application of a comprehensive set of factors that contribute to airspace design quality. This tool uses a series of factors to measure events that occur inside the sector being analyzed, and generates a workload or complexity metric for the controller.

Examples of the factors are:

- Traffic volume counts for each sector for 1-minute, 15-minute, and 60-minute intervals
- Count of and angle of flows of flights merging and crossing in the sector
- Number of flows, either uni-directional or bi-directional, in a sector and the amount of traffic on each flow

These factor values are then multiplied by a weighting schema corresponding to the difficulty in handling the event. These weighted factor values are then summed to define a score for that sector. The sector score is compared against an indicator value (a value based on SME experience in using this tool on many previous analyses) to gauge sector workability. An indicator value of 300 was used as an acceptable *s*E complexity value in a sector. For those sectors whose *s*E sector score was 300 or less, no further analysis was done; sectors whose *s*E sector score was above 300 underwent additional analysis and potential further action. The *s*E sector scores are based on the most difficult conditions a sector would experience for the day, for each of the traffic days studied. The potential mitigation can be either modification of the route

structure or modification of the sector boundaries. The daily traffic count is also provided, but only for informational purposes.

The subsections below present the results of the opening-day traffic demand analysis for each of the proposed Mexico ACC enroute sectors and any sector boundary modifications that SENEAM and MITRE made to resolve issues found in the February 2017 analysis at the June 2017 airspace design workshop. If the Mexico ACC enroute sector was not modified during the June 2017 airspace design workshop, then the results and the graphic presented are the same as the February 2017 results and graphics. The sector boundaries for the various surrounding TMAs, except for the new Mexico City TMA and Toluca TMA, and ACCs have been preserved for this analysis. However, it is important to note that the boundaries of some surrounding TMAs and ACCs may change in the future as airspace design work progresses.

The information for each sector is presented in the following order:

- A description of the February 2017 sector, including the primary anticipated functions of the sector
- A table showing the opening-day traffic demand analyses (i.e., February 2017 and June 2017) done for each sector that includes the *s*E sector scores and informational daily traffic counts for each of the two analysis days (4 March 2016 and 22 April 2016) and the two PBN route implementations (i.e., "NAICM and MMTO only" and "All Traffic"). The indicator value of 300 for the *s*E sector scores remains the same from the previous analyses, and if the *s*E sector score is over the indicator value, it is highlighted by a red box.
- Two two-dimensional (2D) views of the enroute sector showing the February 2017 sector with the SENEAM-proposed PBN routes in the sector (figure on the left) and the June 2017 sector that more appropriately accommodates the SENEAM-proposed PBN routes (figure on the right)
- A description of the modifications made to the Mexico ACC enroute sector during the June 2017 workshop, if necessary

3.1 Mexico ACC Enroute ALPHA Sector (February 2017 and June 2017)

The February 2017 ALPHA sector is located to the northeast of the new Mexico City TMA. It is bounded by the Mérida and Monterrey ACC facilities (east and north, respectively), the proposed Mexico ACC JULIETT sector (south), and the proposed Mexico ACC BRAVO sector (west). The ALPHA sector owns airspace from the surface to unlimited, excluding the airspace delegated to the Tampico TMA and Tampico Airport (ICAO Code: MMTM). There is also a towered airport, El Tajín Airport (ICAO Code: MMPA), for which the ALPHA sector controller provides air traffic control services.

The sector primarily will manage arrivals and departures for NAICM and MMPA, as well as overflights. The controller working the ALPHA sector is responsible for issuing speed restrictions and interim altitudes to provide the required arrival spacing for arrivals, and integrating departures into the traffic flow to and from NAICM and MMPA. The major flows in

the sector consist of NAICM arrival and departure traffic from/to airports in the north and northeast.

Table 1 below presents the results of the opening-day traffic demand analyses for 4 March 2016 and 22 April 2016. During the July 2017 airspace design workshop, the ALPHA sector was divided to create two new sectors, MIKE and NOVEMBER, and the resulting *s*E sector scores for the new sectors are shown in the pink values for the MIKE sector and the purple values for the NOVEMBER sector.

Table 1. Mexico ACC Enroute ALPHA Sector *s*E Sector Score and Daily Traffic Count

		s E Sector Score				Daily Traffic Counts			
Airspace Design	**Analysis**	**4-Mar-16**		**22-Apr-16**		**4-Mar-16**		**22-Apr-16**	
February 2017	NAICM and MMTO Only	244		392		436		533	
	All Traffic	262		386		440		551	
June 2017	NAICM and MMTO Only	102	157	110	257	304	295	354	382
	All Traffic	89	166	138	247	337	343	448	477

Further Examination Required

For the ALPHA sector, the 22 April 2016 *s*E sector score was above the indicator value and thus required further examination for both PBN route implementations. For the 4 March 2016 traffic day, neither of the *s*E sector scores were above the indicator value. The high *s*E sector score is due to the variable volume of traffic from the northeast to NAICM. When this traffic is high, the *s*E sector score for the ALPHA sector is high; this is what is shown by the different *s*E sector scores between the 4 March 2016 traffic day and the 22 April 2016 traffic day.

To reduce the high *s*E sector scores, MITRE proposed an option of dividing the ALPHA sector for those situations when the workload in the sector becomes unmanageable. The two new sectors, MIKE and NOVEMBER, divide the arrival and departure routes that exist in the ALPHA sector between them (see Figure 1 below), thus reducing the workload for the ALPHA sector. The MIKE sector would be responsible for the two NAICM departure routes and the initial control of UT101S and UT103, which are NAICM arrival routes. The NOVEMBER sector would be responsible for the merging of the NAICM arrival routes UT101S and UT103, and the merging of the NAICM arrival routes UT107W, UT108W, and UT109W. The responsibility for the arrivals and departures for the non-radar airport MMTM would be the responsibility of the MIKE sector.

From Table 1, above, the resulting *s*E sector scores for the new MIKE (pink values) and NOVEMBER (purple values) sectors are below the indicator value and thus considered workable. By dividing the workload between two sectors during the situations when the traffic from the northeast for NAICM is high, relief can be given to the controller working the ALPHA sector.

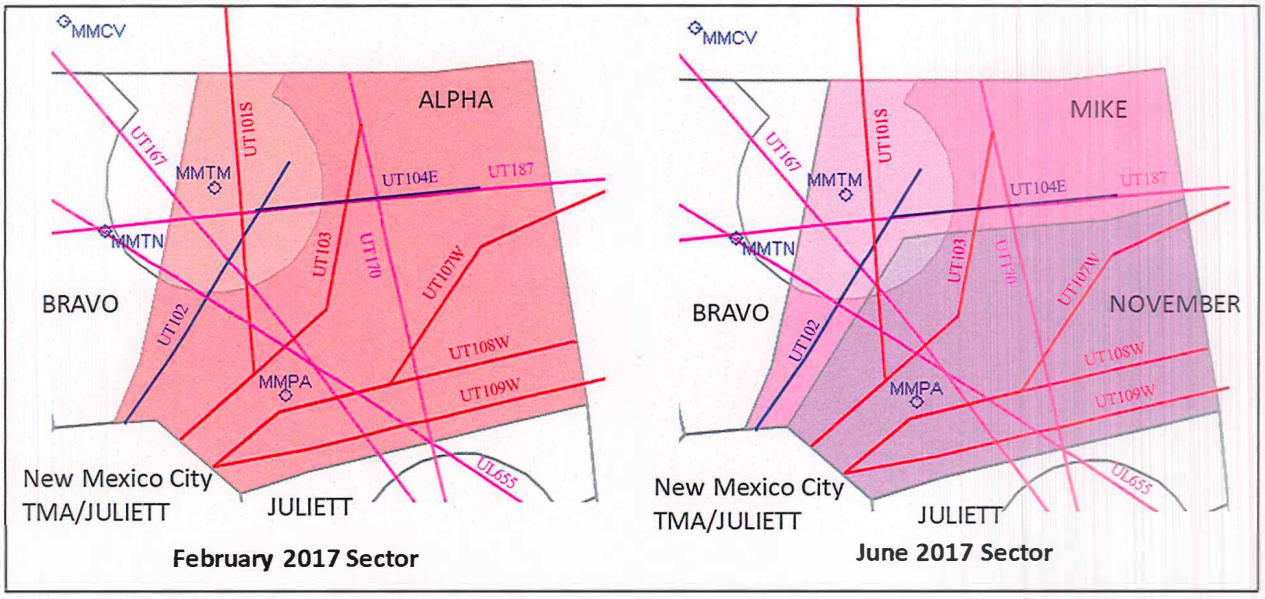

Figure 1. Mexico ACC Enroute February 2017 and June 2017 ALPHA Sector

3.2 Mexico ACC Enroute BRAVO Sector (February 2017 and June 2017)

The BRAVO sector is located to the north of the new Mexico City TMA, bounded by the proposed Mexico ACC sectors DELTA/KILO (southwest), CHARLIE (west), ALPHA (east), and JULIETT (south), and the Monterrey ACC (north). The sector owns airspace from the surface to unlimited, excluding portions of the Tampico TMA.

The sector will primarily manage departure traffic from NAICM and initial control for UT130 arrivals to NAICM, arrival and departure traffic for Querétaro Airport (ICAO Code: MMQT), Tamuín Airport (ICAO Code: MMTN), and Ponciano Arriaga Airport (ICAO Code: MMSP), as well as overflights. The controller working the BRAVO sector is responsible for issuing speed restrictions and interim altitudes to provide the required spacing for arrivals, and integrating departures into the traffic flow to and from NAICM. The major flows in the sector are NAICM and MMTO departures to the north and northwest as well as UT187.

Table 2 below presents the results of the opening-day traffic demand analyses for 4 March 2016 and 22 April 2016.

Table 2. Mexico ACC Enroute BRAVO Sector *s*E Sector Score and Daily Traffic Count

		s E Sector Score		Daily Traffic Counts	
Airspace Design	Analysis	4-Mar-16	22-Apr-16	4-Mar-16	22-Apr-16
February 2017	NAICM and MMTO Only	235	239	477	596
	All Traffic	242	221	493	631
June 2017	NAICM and MMTO Only	235	239	477	596
	All Traffic	242	221	493	631

Further Examination Required

For the BRAVO sector, there were no *s*E sector scores that exceeded the indicator value. Therefore, at opening-day traffic demand levels, there should be no issues with the sector. Figure 2 shows a depiction of the February 2017 and June 2017 designs for the BRAVO sector, which did not change in the June 2017 airspace design workshop.

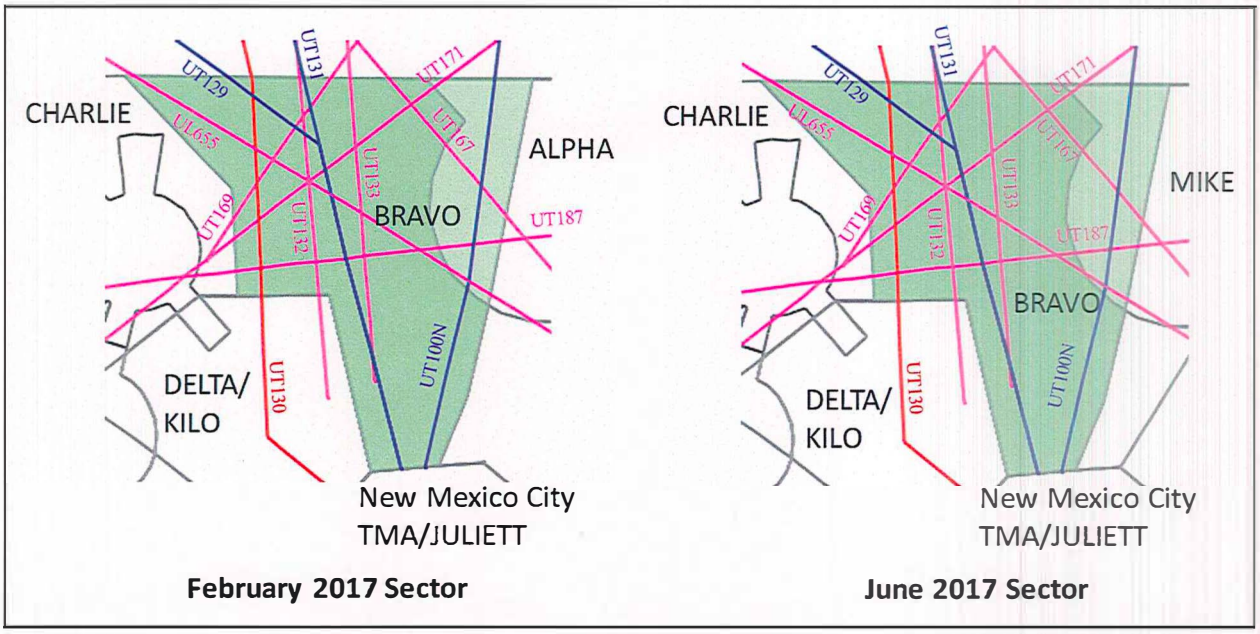

Figure 2. Mexico ACC Enroute February 2017 and June 2017 BRAVO Sector

3.3 Mexico ACC Enroute CHARLIE Sector (February 2017 and June 2017)

The CHARLIE sector is located to the northwest of the new Mexico City TMA, bounded by the proposed Mexico ACC sectors ECHO/LIMA (south/southeast), DELTA/KILO (east), and BRAVO (east), as well as the Mazatlán and Monterrey ACCs (west and north). The sector owns airspace from the surface to unlimited, excluding portions of the San Luis Potosí, Guadalajara, and León-Aguascalientes TMAs.

The sector will primarily manage arrival and departure traffic for Guadalajara Airport (ICAO Code: MMGL), General Leobardo C. Ruiz Airport (ICAO Code: MMZC, a towered airport),

MMSP, Lic. Jesús Terán Peredo Airport (ICAO Code: MMAS), and Del Bajío Airport (ICAO Code: MMLO), as well as overflights. The controller working the CHARLIE sector is responsible for issuing speed restrictions and interim altitudes to provide the required arrival spacing for arrivals, and integrating departures into the traffic flow to and from NAICM, MMTO, and MMGL. The major flows through the sector are aircraft departing MMGL to the north, arrival aircraft from the north to MMGL, and initial control of NAICM arrivals from the northwest.

Table 3 below presents the results of the opening-day traffic demand analyses for 4 March 2016 and 22 April 2016.

Table 3. Mexico ACC Enroute CHARLIE Sector *s*E Sector Score and Daily Traffic Count

		s E Sector Score		Daily Traffic Counts	
Airspace Design	Analysis	4-Mar-16	22-Apr-16	4-Mar-16	22-Apr-16
February 2017	NAICM and MMTO Only	246	269	550	599
	All Traffic	241	255	575	575
June 2017	NAICM and MMTO Only	246	269	550	599
	All Traffic	241	255	575	575

Further Examination Required

For the CHARLIE sector, there were no *s*E sector scores that exceeded the indicator value. Therefore, at the opening-day traffic demand levels, there should be no issues with the sector. Figure 3 shows a depiction of the February 2017 and June 2017 designs for the CHARLIE sector, which did not change in the June 2017 airspace design workshop.

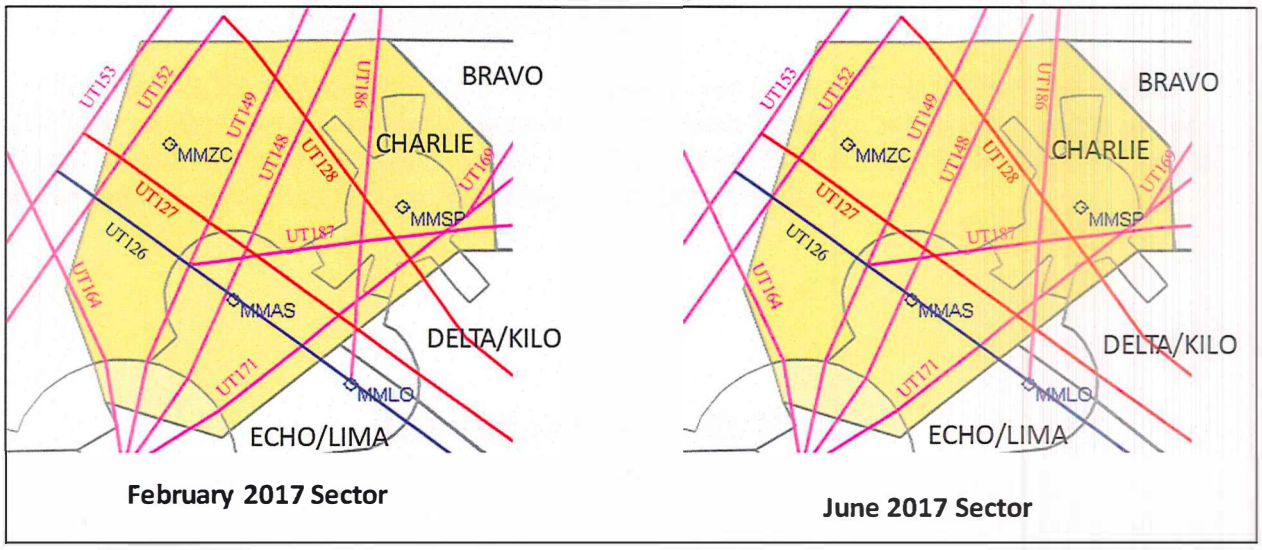

Figure 3. Mexico ACC Enroute February 2017 and June 2017 CHARLIE Sector

3.4 Mexico ACC Enroute DELTA Sector (February 2017 and June 2017)

The DELTA sector is located to the west of the new Mexico City TMA, bounded by the proposed Mexico City TMA and Toluca TMA to the southeast and south, respectively, and the proposed Mexico ACC sectors ECHO/LIMA (southwest), CHARLIE (northwest), JULIETT (southeast), and BRAVO (east). The Mexico ACC DELTA sector lies above the KILO sector, which has similar lateral boundaries (see Section 3.11). The DELTA sector owns airspace above 19,000 feet Mean Sea Level (MSL) to unlimited.

The sector will primarily manage arrival traffic to NAICM and MMTO, as well as overflights. The controller working the DELTA sector is responsible for issuing speed restrictions and interim altitudes to provide the required arrival spacing for arrivals. There are two major arrival flows from the north, UT128 and UT130, which merge at WP730, and one flow from the northwest via UT127.

Table 4 below presents the results of the opening-day traffic demand analyses for 4 March 2016 and 22 April 2016.

Table 4. Mexico ACC Enroute DELTA Sector *s*E Sector Score and Daily Traffic Count

		s E Sector Score		Daily Traffic Counts	
Airspace Design	Analysis	4-Mar-16	22-Apr-16	4-Mar-16	22-Apr-16
February 2017	NAICM and MMTO Only	165	163	411	423
	All Traffic	160	125	382	415
June 2017	NAICM and MMTO Only	165	163	411	423
	All Traffic	160	125	382	415

Further Examination Required

For the DELTA sector, there were no *s*E sector scores that exceeded the indicator value. Therefore, at the opening-day traffic demand levels, there should be no issues with the sector. Figure 4 shows a depiction of the February 2017 and June 2017 designs for the DELTA sector, which did not change in the June 2017 airspace design workshop.

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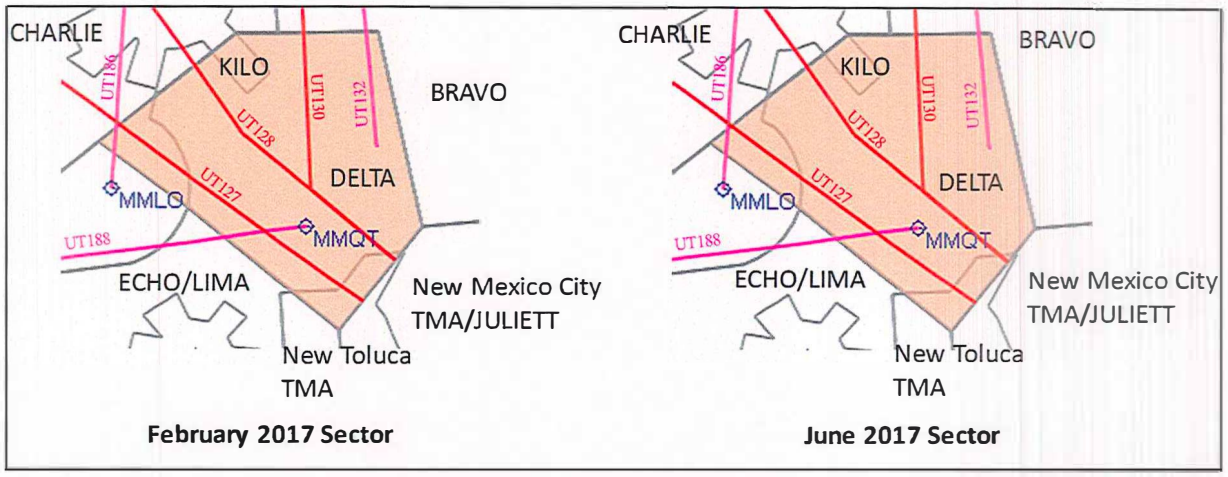

Figure 4. Mexico ACC Enroute February 2017 and June 2017 DELTA Sector

3.5 Mexico ACC Enroute ECHO Sector (February 2017 and June 2017)

The ECHO sector is located to the west of the new Mexico City TMA, bounded by the proposed Mexico ACC sectors CHARLIE (northwest), DELTA/KILO (northeast), FOXTROT HIGH (south), GOLF (west), JULIETT (east), and the new Mexico City TMA and Toluca TMA (east). The Mexico ACC ECHO sector lies above the LIMA sector, which has the similar lateral boundaries (see Section 3.12). The ECHO sector owns airspace above 23,000 feet MSL to unlimited.

The sector will primarily manage arrival and departure traffic for NAICM, MMTO, MMGL, and Lic. Gustavo Díaz Ordaz Airport (ICAO Code: MMPR), as well as overflights. The controller working the ECHO sector is responsible for issuing speed restrictions and interim altitudes to provide the required spacing for integrating departures into the traffic flow to and from NAICM, MMTO, MMGL, and MMPR. The major flows in the sector are NAICM departures and traffic from/to airports west of NAICM.

Table 5 below presents the results of the opening-day traffic demand analyses for 4 March 2016 and 22 April 2016.

Table 5. Mexico ACC Enroute ECHO Sector *s*E Sector Score and Daily Traffic Count

		s E Sector Score		Daily Traffic Counts	
Airspace Design	**Analysis**	**4-Mar-16**	**22-Apr-16**	**4-Mar-16**	**22-Apr-16**
February 2017	NAICM and MMTO Only	242	240	382	488
	All Traffic	225	197	401	507
June 2017	NAICM and MMTO Only	242	240	382	488
	All Traffic	225	197	401	507

Further Examination Required

For the ECHO sector, there were no *s*E sector scores that exceeded the indicator value. Therefore, at the opening-day traffic demand levels, there should be no issues with the sector. Figure 5 shows a depiction of the February 2017 and June 2017 designs for the ECHO sector, which did not change in the June 2017 airspace design workshop.

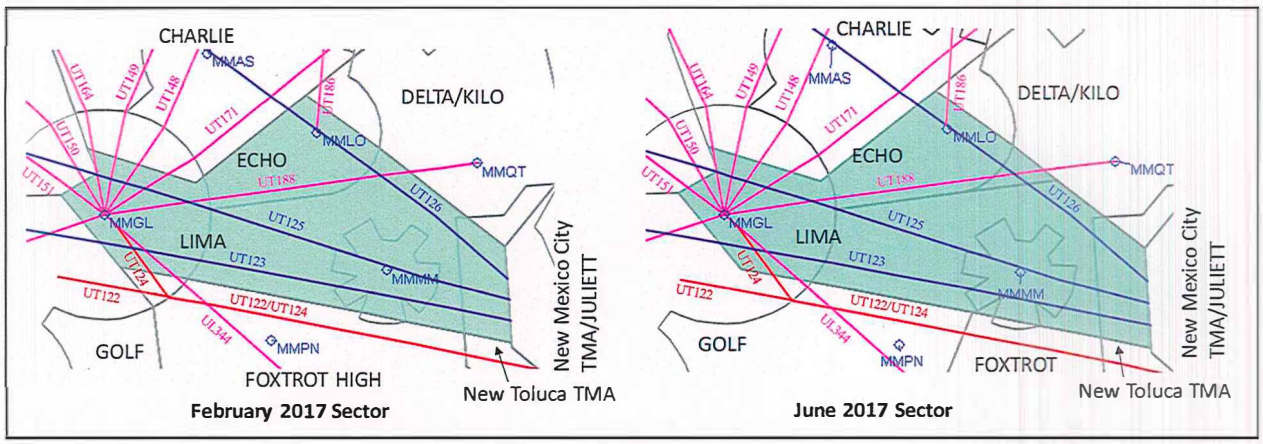

Figure 5. Mexico ACC Enroute February 2017 and June 2017 ECHO Sector

3.6 Mexico ACC Enroute FOXTROT LOW/HIGH Sectors (February 2017 and June 2017)

The FOXTROT LOW/HIGH sectors are located to the southwest of the new Mexico City TMA, bounded by the proposed Mexico ACC sectors GOLF (southwest/west), ECHO/LIMA (north), HOTEL (east), JULIETT (northeast), and the new Mexico City TMA and Toluca TMA (northeast). The FOXTROT LOW sector owns airspace from the surface to 23,000 feet MSL, excluding portions of Morelia, Toluca, Acapulco, Ixtapa-Zihuatanejo, and Guadalajara TMAs. The FOXTROT HIGH sector lies above the FOXTROT LOW sector, shares the same lateral boundaries as FOXTROT LOW, and owns airspace above 23,000 feet MSL to unlimited.

The sector will primarily manage arrival and departure traffic for NAICM, MMTO, Acapulco Airport (ICAO Code: MMAA), Ixtapa-Zihuatanejo Airport (ICAO Code: MMZH), and a towered airport Uruapan Airport (ICAO Code: MMPN) for which FOXTROT LOW provides services. The controller working sectors FOXTROT LOW/HIGH are responsible for issuing speed restrictions and interim altitudes to provide the required spacing for arrivals, and integrating departures into the traffic flow to and from NAICM, MMTO, Cuernavaca Airport (ICAO Code: MMCB), MMAA, MMPN, and MMZH. The major flows in the sector are MMAA and MMZH departures/arrivals to/from NAICM and MMTO.

In the February 2017 airspace design, there was a FOXTROT HIGH sector and a FOXTROT LOW sector, see the two pictures in Figure 6 on the left. Although the *s*E sector scores for both the 4 March 2016 and the 22 April 2016 traffic days were below the indicator value (where normally further examination would not be required), SENEAM and MITRE redesigned these sectors during the June 2017 airspace design workshop to balance the workload with the adjacent GOLF sector more evenly. The modifications to the FOXTROT HIGH and FOXTROT LOW sectors included merging these two sectors into a single sector, reducing the airspace to the west

that was owned by the two sectors, and extending the airspace to the south over the Pacific Ocean. The new FOXTROT sector will manage the NAICM arrival traffic from MMAA, the arrival and departure traffic to MMZH, the arrival traffic to MMTO and NAICM from the southwest, and the overflight traffic on UL344.

Table 6 below presents the results of the opening-day traffic demand analyses for 4 March 2016 and 22 April 2016. The light green values are for the FOXTROT LOW sector and the light blue values are for the FOXTROT HIGH sector.

Table 6. Mexico ACC Enroute FOXTROT LOW/HIGH Sector *s*E Sector Score and Daily Traffic Count

		s E Sector Score				Daily Traffic Counts			
Airspace Design	Analysis	4-Mar-16		22-Apr-16		4-Mar-16		22-Apr-16	
February 2017	NAICM and MMTO Only	149	170	191	242	163	278	201	346
	All Traffic	154	160	171	277	151	279	205	346
June 2017	NAICM and MMTO Only	188		233		297		364	
	All Traffic	178		215		296		352	

Further Examination Required

Comparing the *s*E sector scores between the FOXTROT HIGH and LOW sectors and the GOLF sector in the February 2017 airspace design, with the FOXTROT sector (i.e., FOXTROT HIGH AND LOW SECTORS merged) and GOLF sector in the June 2017 airspace designs, the *s*E sector scores are more closely aligned.

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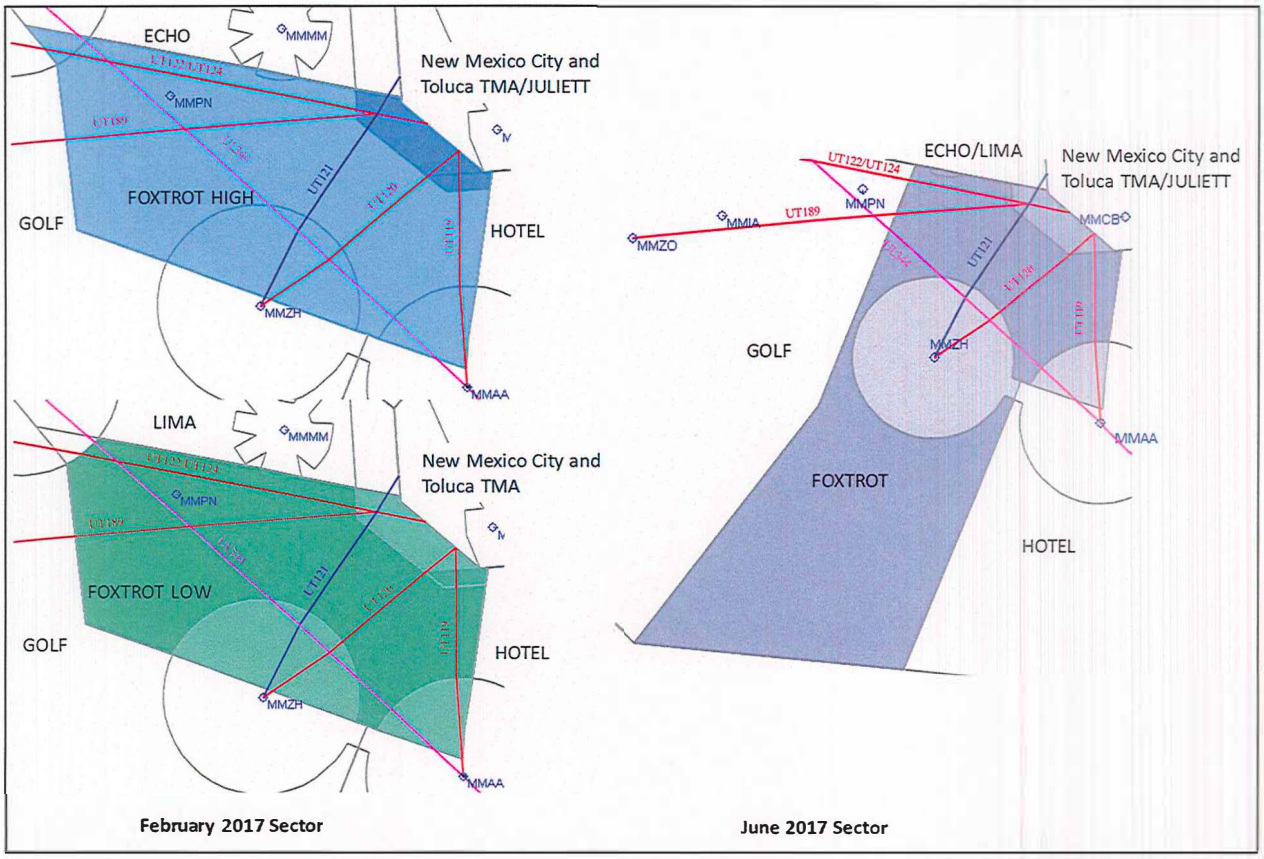

Figure 6. Mexico ACC Enroute February 2017 and June 2017 FOXTROT Sector

3.7 Mexico ACC Enroute GOLF Sector (February 2017 and June 2017)

The GOLF sector is located to the southwest of the new Mexico City TMA, bounded by the Mazatlán ACC (west), proposed Mexico ACC sectors ECHO/LIMA (north), FOXTROT LOW/HIGH (northeast), and HOTEL (east), as well as the Mazatlán Oceanic airspace (south). The GOLF sector owns airspace from the surface to unlimited, excluding portions of the Guadalajara, Playa de Oro, Lic. Gustavo Díaz Ordaz, and Ixtapa-Zihuatanejo TMAs. There is one towered airport, Colima Airport (MMIA), for which the Golf sector controller provides air traffic control services.

The sector will primarily manage arrival and departure traffic for NAICM, MMTO, MMGL, Playa de Oro Airport (ICAO Code: MMZO), MMPR, and MMIA, as well as overflights. The controller working the GOLF sector is responsible for issuing speed restrictions and interim altitudes to provide the required spacing for arrivals, and integrating departures into the traffic flow to and from NAICM, MMPR, MMGL, MMZO, MMTO, and MMIA. The major flow in the sector is NAICM arrivals on UT122 and UT124.

Table 7 below presents the results of the opening-day traffic demand analyses for 4 March 2016 and 22 April 2016.

Table 7. Mexico ACC Enroute GOLF Sector *s*E Sector Score and Daily Traffic Count

		s E Sector Score		Daily Traffic Counts	
Airspace Design	Analysis	4-Mar-16	22-Apr-16	4-Mar-16	22-Apr-16
February 2017	NAICM and MMTO Only	145	122	184	102
	All Traffic	131	106	174	98
June 2017	NAICM and MMTO Only	193	289	288	293
	All Traffic	213	229	282	294

Further Examination Required

The February 2017 GOLF sector had low *s*E sector scores for both days of traffic as well as low daily traffic counts. Nonetheless, during the June 2017 airspace design workshop, SENEAM and MITRE redesigned this sector along with the February 2017 FOXTROT HIGH and LOW sectors to balance the workload among these sectors more evenly. The airspace containing the towered airport MMPN was given to the GOLF sector and, as a result, the GOLF sector manages the NAICM and MMTO arrival traffic for a longer timeframe. In addition, part of the airspace over the Pacific Ocean was given to the June 2017 FOXTROT sector, reducing the amount of airspace that the June 2017 GOLF sector owns. These airspace changes balanced both the *s*E sector scores and the daily traffic counts for the June 2017 FOXTROT and GOLF sectors. Figure 7 shows a depiction of the February 2017 and June 2017 designs for the GOLF sector.

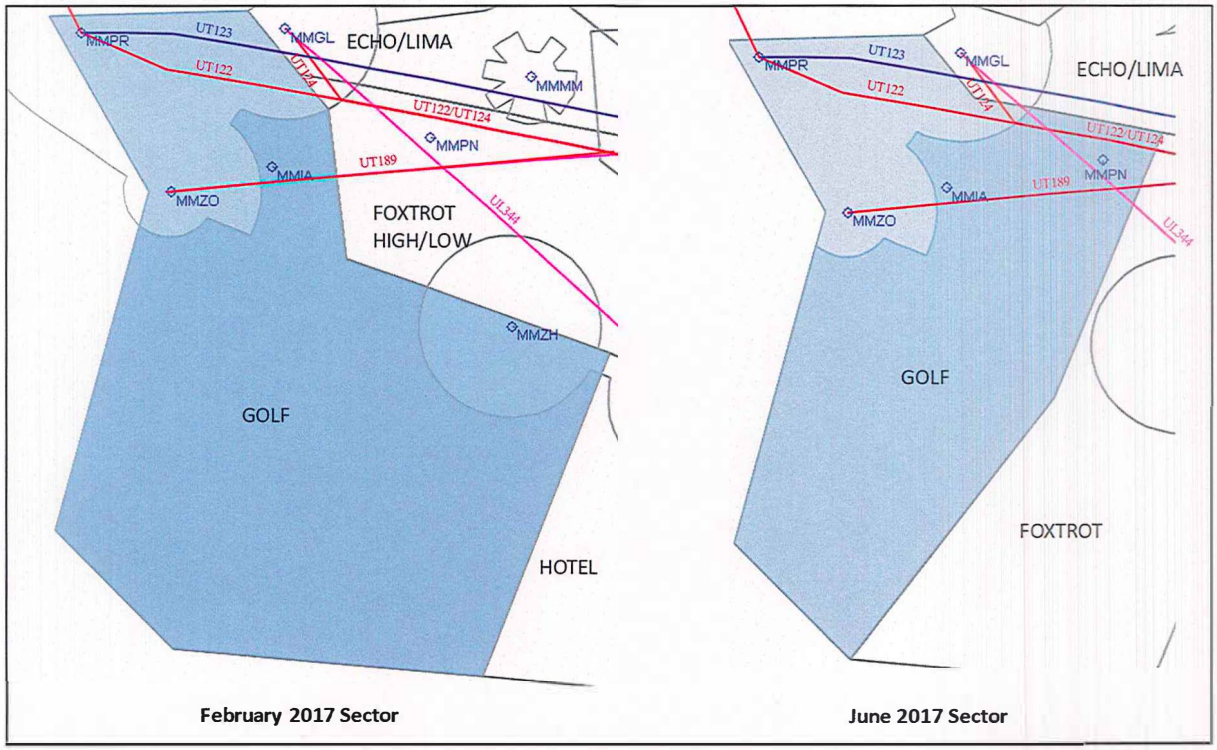

Figure 7. Mexico ACC Enroute February 2017 and June 2017 GOLF Sector

3.8 Mexico ACC Enroute HOTEL Sector (February 2017 and June 2017)

The HOTEL sector is located southeast of the new Mexico City TMA. It is bounded by the Mérida ACC (south and east), the proposed Mexico ACC sectors INDIA (northeast), FOXTROT LOW/HIGH (northwest), GOLF (west), JULIETT (north), and the new Mexico City TMA (north) sectors. The sector owns airspace from the surface to unlimited, excluding the portions of Xoxocotlán and Acapulco TMAs.

The HOTEL sector will primarily manage arrivals and departures for NAICM, MMTO, Acapulco TMA and MMAA, Xoxocotlán TMA and the Xoxocotlán Airport (ICAO Code: MMOX), MMCB, Puerto Escondido Airport (ICAO Code: MMPS), and Bahías de Huatulco Airport (ICAO Code: MMBT), as well as overflight traffic. The controller working the HOTEL sector is responsible for issuing speed restrictions and interim altitudes to provide the required spacing for arrivals, and to integrate departures into the traffic flow to and from NAICM, MMTO, MMAA, MMOX, MMCB, MMPS, and MMBT. The major flows in the sector are NAICM departures and traffic from/to airports south and southeast of NAICM.

Table 8 below presents the results of the opening-day traffic demand analyses for 4 March 2016 and 22 April 2016.

Table 8. Mexico ACC Enroute HOTEL Sector *s*E Sector Score and Daily Traffic Count

		s E Sector Score		Daily Traffic Counts	
Airspace Design	**Analysis**	**4-Mar-16**	**22-Apr-16**	**4-Mar-16**	**22-Apr-16**
February 2017	NAICM and MMTO Only	288	245	239	180
	All Traffic	279	260	236	179
June 2017	NAICM and MMTO Only	288	245	239	180
	All Traffic	279	260	236	179

Further Examination Required

For the HOTEL sector, there were no *s*E sector scores that exceeded the indicator value. Therefore, at the opening-day traffic demand levels, there should be no issues with the sector. Figure 8 shows a depiction of the February 2017 and June 2017 designs for the HOTEL sector, which did not change in the June 2017 airspace design workshop.

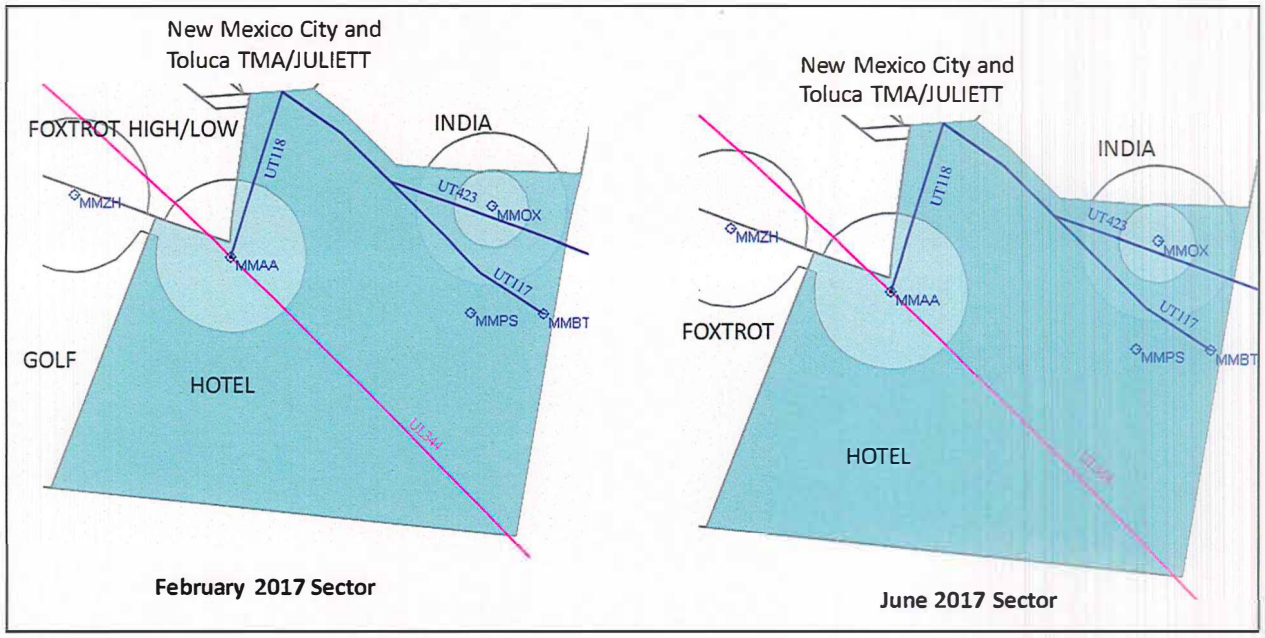

Figure 8. Mexico ACC Enroute February 2017 and June 2017 HOTEL Sector

3.9 Mexico ACC Enroute INDIA Sector (February 2017 and June 2017)

The INDIA sector is located to the east of the new Mexico City TMA, bounded by the proposed Mexico ACC sectors HOTEL (south), and JULIETT (north/west) sectors and the new Mexico City TMA (west) and Mérida ACC (east). The sector owns airspace from the surface to unlimited, excluding the Veracruz TMA and Veracruz Airport (ICAO Code: MMVR), a portion of the Puebla TMA and Puebla Airport (ICAO Code: MMPB), as well as portion of the Xoxocotlán TMA.

The sector will primarily manage arrivals for NAICM, arrivals and departures to and from MMVR, MMPB, MMOX, as well as overflights. The controller working the INDIA sector is responsible for issuing speed restrictions and interim altitudes to provide the required spacing for arrivals to NAICM, and integrating departures into the traffic flow to and from NAICM, MMVR, MMPB, and MMOX. The major flows in the sector are NAICM arrivals and traffic from/to airports southeast of NAICM.

Table 9 below presents the results of the opening-day traffic demand analyses for 4 March 2016 and 22 April 2016.

Table 9. Mexico ACC Enroute INDIA Sector *s*E Sector Score and Daily Traffic Count

		s E Sector Score		Daily Traffic Counts	
Airspace Design	Analysis	4-Mar-16	22-Apr-16	4-Mar-16	22-Apr-16
February 2017	NAICM and MMTO Only	131	153	189	231
	All Traffic	141	167	191	226
June 2017	NAICM and MMTO Only	131	153	189	231
	All Traffic	141	167	191	226

Further Examination Required

For the INDIA sector, there were no *s*E sector scores that exceeded the indicator value. Therefore, at the opening-day traffic demand levels, there should be no issues with the sector. Figure 9 shows a depiction of the February 2017 and June 2017 designs for the INDIA sector, which did not change in the June 2017 airspace design workshop.

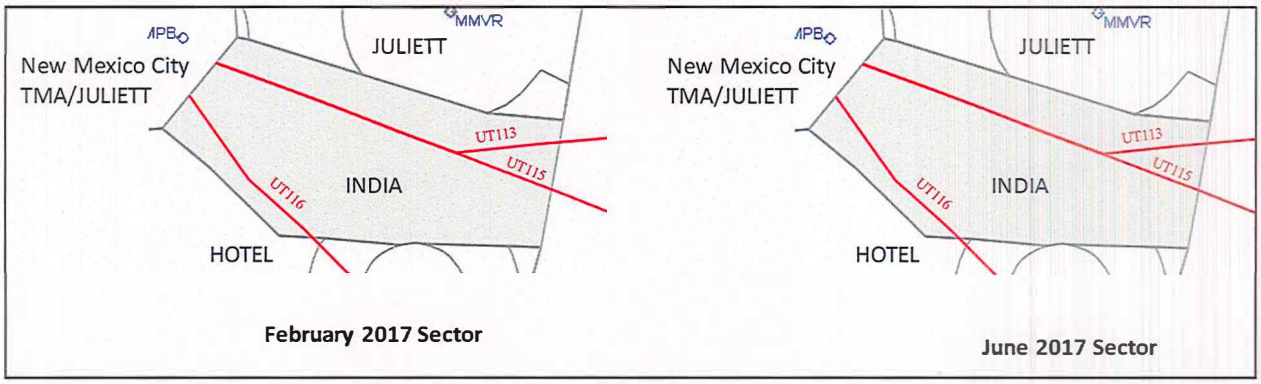

Figure 9. Mexico ACC Enroute February 2017 and June 2017 INDIA Sector

3.10 Mexico ACC Enroute JULIETT Sector (February 2017 and June 2017)

The JULIETT sector is located to the east of the new Mexico City TMA, bounded by the Mérida ACC (east), and proposed Mexico ACC sectors INDIA (south) and HOTEL (south), ALPHA (north), BRAVO (north), DELTA (northwest), ECHO (west), and FOXTROT HIGH (southwest). It is also the enroute sector that overlies the new Mexico City TMA and portions of the Toluca and Puebla TMAs. The sector owns airspace from the surface to unlimited, excluding the new Mexico City and Veracruz TMAs and MMVR.

The sector will primarily manage departures for NAICM, arrivals and departures to and from MMTO, MMVR, El Lencero Airport (ICAO Code: MMJA), and MMPB, as well as overflights. The controller working the JULIETT sector is responsible for issuing speed restrictions and interim altitudes to provide the required spacing for MMVR arrivals and integrating departures into the traffic flow to and from NAICM, MMVR, and MMPB. The major flows in the sector are NAICM departures and traffic from/to airports east of NAICM.

Table 10 below presents the results of the opening-day traffic demand analyses for 4 March 2016 and 22 April 2016.

Table 10. Mexico ACC Enroute JULIETT Sector *s*E Sector Score and Daily Traffic Count

		s E Sector Score		Daily Traffic Counts	
Airspace Design	Analysis	4-Mar-16	22-Apr-16	4-Mar-16	22-Apr-16
February 2017	NAICM and MMTO Only	145	202	255	336
	All Traffic	144	162	273	355
June 2017	NAICM and MMTO Only	145	202	255	336
	All Traffic	144	162	273	355

Further Examination Required

For the JULIETT sector, there were no *s*E sector scores that exceeded the indicator value. Therefore, at the opening-day traffic demand levels, there should be no issues with the sector. Figure 10 shows a depiction of the February 2017 and June 2017 designs for the JULIETT sector, which did not change in the June 2017 airspace design workshop.

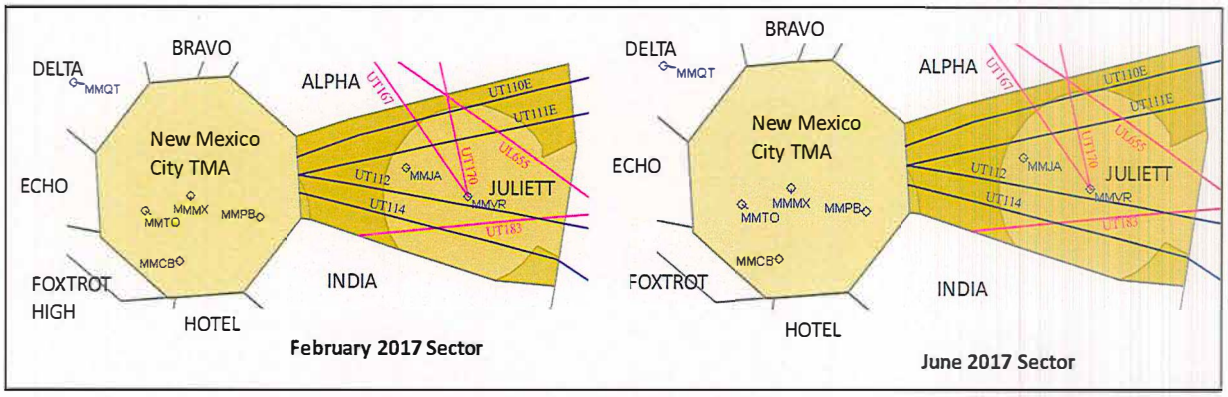

Figure 10. Mexico ACC Enroute February 2017 and June 2017 JULIETT Sector

3.11 Mexico ACC Enroute KILO Sector (February and June 2017)

The KILO sector is located to the northwest of the new Mexico City TMA and sits under the DELTA sector, which has the similar lateral boundaries (See Section 3.4). The KILO sector is bounded by the proposed Mexico ACC sectors LIMA (south), CHARLIE (north/west), and BRAVO (north/east), and the new Mexico City and Toluca TMAs (southeast). The sector owns airspace from the surface to 19,000 feet MSL excluding Toluca, San Luis Potosí, and León-Aguascalientes TMAs.

The sector will primarily manage MMQT arrival and departure traffic, as well as low performance aircraft operating from MMTO, MMSP, MMLO and MMAS. The major flows in the sector are arrivals and departures to/from MMQT via UT132, UT133, and UT188.

Table 11 below presents the results of the opening-day traffic demand analyses for 4 March 2016 and 22 April 2016.

Table 11. Mexico ACC Enroute KILO Sector *s*E Sector Score and Daily Traffic Count

		s E Sector Score		Daily Traffic Counts	
Airspace Design	**Analysis**	**4-Mar-16**	**22-Apr-16**	**4-Mar-16**	**22-Apr-16**
February 2017	NAICM and MMTO Only	149	156	141	190
	All Traffic	144	161	140	188
June 2017	NAICM and MMTO Only	156	156	160	226
	All Traffic	148	165	159	224

Further Examination Required

For the KILO sector, there were no *s*E sector scores that exceeded the indicator value. Therefore, at the opening-day traffic demand levels, there should be no issues with the sector. However, SENEAM requested that the airspace boundary between the KILO and LIMA sectors be modified to locate the UT188 PBN route completely within the KILO sector. The June 2017 airspace design reflects this change and MITRE re-evaluated the new sector. There was an increase in the daily traffic count for the KILO sector, which was expected due to the modification of the airspace. The *s*E sector scores either stayed the same or increased slightly, but remain in the range of not requiring further examination. Figure 11 shows a depiction of the February 2017 and June 2017 designs for the KILO sector.

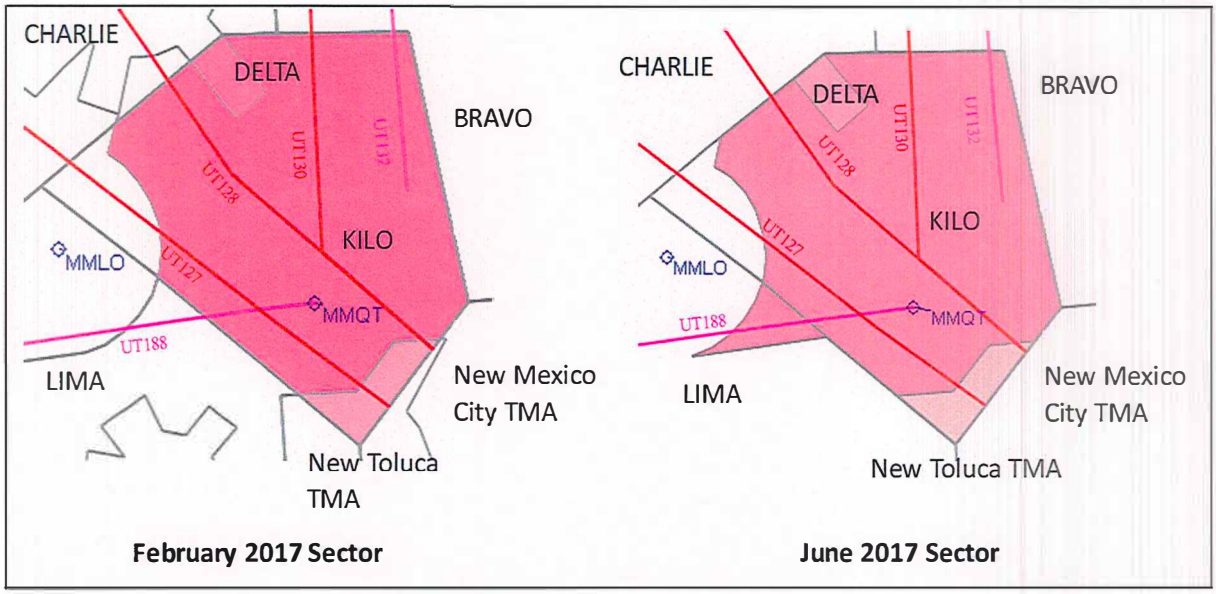

Figure 11. Mexico ACC Enroute February 2017 and June 2017 KILO Sector

3.12 Mexico ACC Enroute LIMA Sector (February 2017 and June 2017)

The LIMA Sector is located to the west of the new Mexico City TMA, bounded by proposed Mexico ACC sectors CHARLIE (northwest), DELTA/KILO (northeast), FOXTROT LOW (south), Guadalajara TMA (west) and the new Mexico City and Toluca TMAs (east). The LIMA sector owns airspace from the surface to 23,000 feet MSL, excluding portions of the Morelia, Toluca, and León-Aguascalientes TMAs. The LIMA sector sits below the ECHO sector, which has the similar lateral boundaries (See Section 3.5).

The sector will primarily manage arrival and departure traffic for MMTO, MMGL, MMLO, and Morelia Airport (ICAO Code: MMMM), as well as overflights. The controller working the LIMA sector is responsible for issuing speed restrictions and interim altitudes to provide the required spacing for integrating departures into the traffic flow to and from MMTO, MMGL, and MMMM. The major flows in the sector are MMTO departures and traffic from/to airports west and southeast of NAICM.

Table 12 below presents the results of the opening-day traffic demand analyses for 4 March 2016 and 22 April 2016.

Table 12. Mexico ACC Enroute LIMA Sector *s*E Sector Score and Daily Traffic Count

		s E Sector Score		Daily Traffic Counts	
Airspace Design	**Analysis**	**4-Mar-16**	**22-Apr-16**	**4-Mar-16**	**22-Apr-16**
February 2017	NAICM and MMTO Only	110	168	213	345
	All Traffic	106	223	222	349
June 2017	NAICM and MMTO Only	120	172	211	333
	All Traffic	106	223	217	331

Further Examination Required

For the LIMA sector, there were no *s*E sector scores that exceeded the indicator value. Therefore, at the opening-day traffic demand levels, there should be no issues with the sector. However, SENEAM requested that the airspace boundary between the KILO and LIMA sectors be modified to locate the UT188 PBN route completely within the KILO sector. The June 2017 airspace design reflects this change and MITRE re-evaluated the new sector. There was a reduction in the daily traffic count due to this modification, which was expected since airspace was given to the KILO sector. The *s*E sector scores either increased slightly or stayed the same, but are still in the range where no further examination is required. The *s*E sector scores increased due to a higher percentage of random flights climbing and descending inside the sector. Figure 12 shows a depiction of the February 2017 and June 2017 designs for the LIMA sector.

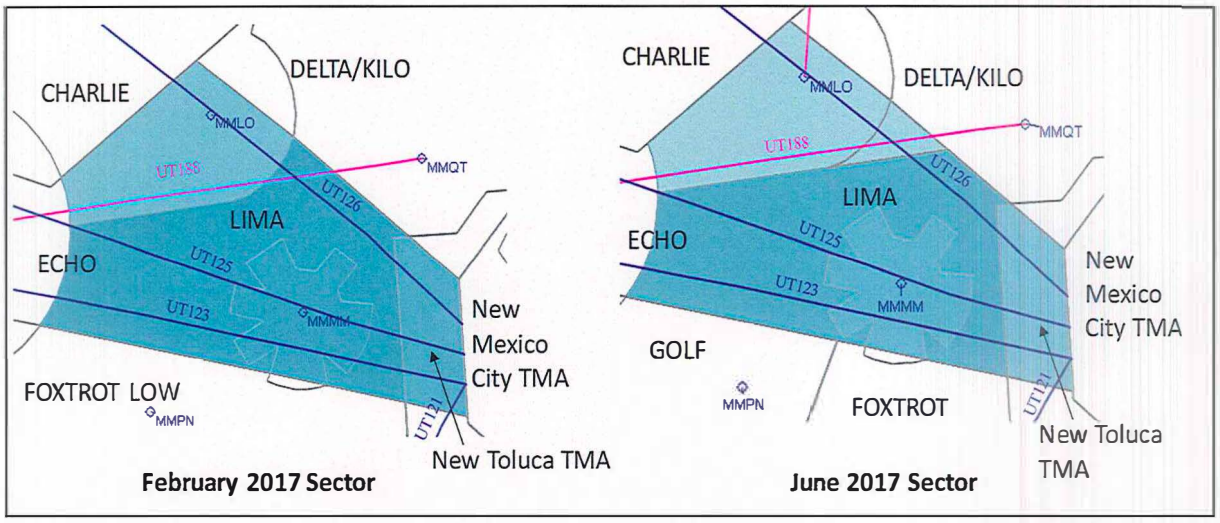

Figure 12. Mexico ACC Enroute February 2017 and June 2017 LIMA Sector

3.13 Mexico ACC Enroute Opening-Day Traffic Demand Analysis: Findings

Based on the *s*E sector scores for the opening-day traffic demand analysis, only the enroute ALPHA sector has an *s*E sector score over the indicator value, which occurs when the traffic volume from the northeast for NAICM is heavy. The resolution to this issue was to divide the ALPHA sector into two sectors, MIKE and NOVEMBER, that could be opened when the traffic situation warranted two sectors.

In addition to the modifications to the ALPHA sector, SENEAM requested modifications to the FOXTROT LOW/HIGH and GOLF sectors to balance both the traffic volume and the workload more evenly and to the KILO and LIMA sectors to place UT188 completely within the KILO sector.

4. New Mexico City TMA and Toluca TMA Analysis Results

As previously mentioned, MITRE conducted an analysis of the baseline routes and sectors of the existing Mexico City TMA. For the opening-day traffic demand analysis of the new Mexico City TMA and Toluca TMA, MITRE repeated the analysis using the SENEAM-MITRE developed SIDs, STARs, satellite corridor (the route that allows the flights from and to the satellite airports across the complex airspace between MMTO and NAICM), and the new Mexico City TMA and Toluca TMA sectors from both the February 2017 and June 2017 airspace design workshops. The baseline results were used as a guide (along with essential feedback from SENEAM) for gauging the appropriateness of the workload in each sector.

4.1 TMA Analysis

The same CPL data from 4 March 2016 and 22 April 2016 used for the Mexico ACC analysis were used for the new Mexico City TMA and Toluca TMA analyses. For both days, the primary airport operating direction for AICM was to the northeast (i.e., Runway 05L/R). For the study, it was difficult to obtain traffic information for the opposite direction at AICM (i.e., Runway 23L/R). As a result, MITRE artificially created two days of traffic operating in the Runway 23 direction at AICM. The only portion of the CPL data that was altered was the arrival or departure procedure. For instance, if in the CPL data the arrival procedure for a particular flight was Mexico 5A (an arrival for Runway 05L/R at AICM), then for the artificial Runway 23 direction traffic day the arrival procedure assigned to the flight was Mexico 3B (an arrival for Runway 23L/R at AICM), which is the same STAR, only for the other operating direction. The modification of the CPL data was necessary to allow MITRE to study both the Runway 23 and Runway 05 direction sectors and procedures for the baseline analysis.

For the opening-day traffic demand analysis, the CPL data for both runway directions were increased to the traffic demand levels predicted for when NAICM commences operations and modified to represent aircraft utilizing the SENEAM-MITRE developed NAICM and MMTO SIDs and STARs from both the February 2017 and June 2017 airspace design workshops. The Runway 05L/R traffic at AICM was modified and rerouted on the Land North Configuration procedures. Consequently, the Runway 23L/R traffic at AICM was modified and rerouted on the Land South Configuration procedures. In addition, any traffic traversing the complex airspace between NAICM and MMTO was modified and routed on the newly developed satellite corridor.

The MMTO SIDs and STARs were modified and deconflicted from the NAICM traffic by creating a separate Toluca TMA on the west side of the new Mexico City TMA and keeping this traffic in this separate TMA while departing and landing MMTO. For example, the MMTO traffic from the east is routed around the new Mexico City TMA and enters the Toluca TMA either from the north or the south. The vertical limits of the Toluca TMA (surface to 18,000 feet MSL) keep the MMTO traffic underneath the arriving and departing NAICM traffic until the traffic is in the Mexico ACC.

The metrics that were used in the new Mexico City TMA and Toluca TMA analyses heuristically analyze the sector for complexity and/or controller workload. As sector complexity and controller workload are difficult to measure directly, heuristics were used to approximate these measures. Complexity relates to the tasks or functions that a controller is required to perform within a sector where the tasks and functions are intertwined and usually dependent on each other. Controller workload is composed of the complexity and the volume of aircraft that is being handled in a sector. The metrics used for measuring sector complexity and controller workload within the SENEAM-MITRE-developed sectorization for the new Mexico City TMA and Toluca TMA include:

- **Sector Volume Count**, which measures the number of aircraft in or entering a sector for intervals of 1-minute, 15-minutes, and 60-minutes

- **Merge Count**, which measures the number of flows merging together during a 1-minute interval
- **Cross Count**, which measures the number of aircraft paths that intersect where the aircraft come within 1000 feet vertically of each other

Unlike the tool suite for the analysis of the enroute sectors, MITRE does not have a weighting schema that corresponds to the difficulty in handling the events in the TMA sectors. Therefore, the results of the analysis are reported by metric for each sector, which are then examined by MITRE SMEs and issues are identified.

The following sections describe the analysis of the new Mexico City TMA and Toluca TMA airspace design developed jointly by SENEAM and MITRE during the February 2017 and June 2017 airspace design workshops, using the above-described metrics.

4.1.1 Sector Volume Counts

Sector volume counts measure the number of aircraft that are inside a sector or enter a sector for a given time period, usually 1-minute, 15-minutes, or 60-minutes. The 1-minute counts are used as a surrogate for an instantaneous count of the number of aircraft that are on a controller's frequency at the same time. This measure is an indicator of frequency congestion and controller workload. The 15-minute count is used to measure sustained controller workload and is reported as the highest number of aircraft in the 15-minute period. A sustained high aircraft count generates more workload for the controller than a single high 1-minute peak. The 60-minute count is typically used when analyzing the sector capacity and controller workload.

The opening-day traffic demand analysis results, along with the baseline results which serve as a guide to help examine workload matters for the Land North Configuration, are shown in Table 13. The opening-day traffic demand analysis results for the Land South Configuration are shown in Table 14. These tables show the average maximum aircraft count for each of the new Mexico City TMA and Toluca TMA sectors calculated by finding the maximum count for each of the days of traffic analyzed and then averaging those values. The range of these average maximum aircraft counts for each sector is also provided to show the variation among the days. The time periods used are the 1-minute, 15-minute, and the 60-minute time periods starting at midnight local time and going through midnight of the following day.

The CPL data used for the analysis is what the aircraft was planned to fly without any controller intervention for potential loss of separation or sequencing, not the ground track of what the aircraft actually flew that day. As a result, the average sector volume counts are higher than what a controller would normally manage in the given timeframe.

Table 13. New Mexico City TMA and Toluca TMA: Land North Configuration Sector Counts

Sector	Maximum Sector Counts											
	February 2017 Airspace Design						June 2017 Airspace Design					
	1-Minute		15-Minute		60-Minute		1-Minute		15-Minute		60-Minute	
	Maximum Average	Range	Maximum Average	Range	Maximum Average	Range	Maximum Average	Range	Maximum Average	Range	Maximum Average	Range
Approach Northeast	6	4-8	10	7-12	18	14-21	5	4-5	8	7-9	17	14-19
Approach Northwest	6	6	10	9-10	23	23	6	6	10	9-10	23	23
Approach Southeast	5	4-5	8	6-10	16	15-17	5	4-5	8	6-10	16	15-17
Approach Southwest	5	4-5	7	6-8	15	13-16	5	4-5	7	6-8	15	13-16
Final Center	6	5-7	12	8-15	25	21-29	6	5-7	12	8-15	25	21-29
Final East	5	3-7	9	7-11	19	16-22	4	3-5	8	7-8	18	16-19
Final West	6	6	16	15-16	38	35-41	6	6	16	15-16	38	35-41
Departure East	7	6-8	10	8-11	18	13-22	7	6-8	10	8-11	18	13-22
Departure North	7	7	12	11-12	23	22-24	7	7	12	11-12	23	22-24
Departure South*												
Departure West	10	10	16	15-16	31	30-31	10	10	16	15-16	31	30-31
New Puebla TMA	3	2-3	4	3-4	6	5-6	3	2-3	4	3-4	6	5-6
Satellite East	2	2	4	4	6	6	2	2	4	4	6	6
Satellite West	6	4-7	8	6-10	14	11-17	6	4-7	9	7-10	15	11-17
New Toluca TMA	11	9-13	17	15-19	41	36-46	11	9-13	17	15-18	41	36-46

Baseline Maximum Sector Counts AICM Runway 05 Configuration						
Sector	1-Minute		15-Minute		60-Minute	
	Maximum Average	Range	Maximum Average	Range	Maximum Average	Range
Final	9	8-10	17	16-18	45	42-48
Approach	11	10-12	18	17-18	49	45-52
Arrival	11	11	21	19-22	50	47-52
Departure East	11	9-12	17	17	41	38-43
Departure West	7	6-8	13	12-14	28	24-31

* In the Land North Configuration, the Departure South sector does not exist, but is included in the table and grayed out for completeness.

Table 14. New Mexico City TMA and Toluca TMA: Land South Configuration Sector Counts

Sector	Maximum Sector Counts											
	February 2017 Airspace Design						June 2017 Airspace Design					
	1-Minute		15-Minute		60-Minute		1-Minute		15-Minute		60-Minute	
	Maximum Average	Range	Maximum Average	Range	Maximum Average	Range	Maximum Average	Range	Maximum Average	Range	Maximum Average	Range
Approach Northeast	6	4-8	10	7-13	20	14-26	6	4-7	8	7-8	20	14-26
Approach Northwest	6	6	10	8-11	22	20-24	6	5-6	12	11-13	22	20-24
Approach Southeast	5	4-5	9	6-11	17	15-18	6	5-6	9	6-11	17	15-18
Approach Southwest	5	4-5	9	7-10	15	12-17	5	4-5	9	7-10	15	12-17
Final Center	5	3-7	5	6-10	15	9-21	4	3-4	6	4-8	15	9-21
Final East	6	5-7	11	10-11	24	20-27	6	5-6	11	10-11	24	20-27
Final West	6	5-6	11	10-11	24	23-25	5	5	11	10-11	24	23-25
Departure East	7	6-8	9	8-10	16	12-20	7	6-8	9	8-10	16	12-20
Departure North	9	8-9	13	12-13	28	27-28	9	8-9	13	12-13	28	27-28
Departure South	5	4-6	7	6-7	11	9-12	5	4-6	7	6-7	11	9-12
Departure West	8	7-8	11	10-11	23	21-24	8	7-8	11	10-11	23	21-24
New Puebla TMA	3	2-3	4	3-4	6	5-6	3	2-3	4	3-4	6	5-6
Satellite East	2	2	4	3-4	6	6	2	2	4	3-4	6	6
Satellite West	6	4-7	8	5-10	14	10-17	6	4-7	8	6-10	14	11-17
New Toluca TMA	11	9-13	17	14-19	41	36-46	11	9-13	16	14-18	41	36-46

Baseline Maximum Sector Counts AICM Runway 23 Configuration						
Sector	1-Minute		15-Minute		60-Minute	
	Maximum Average	Range	Maximum Average	Range	Maximum Average	Range
Final	9	8-9	17	16-17	46	43-48
Approach	10	8-12	16	14-17	48	46-49
Arrival	11	10-12	21	19-22	52	50-54
Departure East	8	8	16	15-17	39	37-41
Departure West	9	9	14	13-14	31	28-34

The resulting February 2017 and June 2017 sector count values are similar to those observed in TMA sectors at large-high volume airports. The average maximum 1-minute aircraft counts range from 6 to 11 with the larger numbers observed in the approach and departure sectors. The 1-minute, 15-minute, and 60-minute aircraft counts for both the February 2017 and June 2017 analyses are lower or equal to the baseline analysis values. The ranges for the 1-minute, 15-minute, and 60-minute time intervals show the range of values over the two days of data.

The New Toluca TMA and New Puebla TMA sectors handle both arrivals and departures for MMTO and MMPB, respectively, unlike the other sectors which handle only one type of traffic, either arrivals or departures. The initial sequencing for MMPB is primarily done by the Satellite East sector unlike the New Toluca TMA, which does all the initial and final sequencing for MMTO inside the New Toluca TMA.

During the June 2017 airspace design workshop, these results were presented to SENEAM, who requested that the design of the New Toluca TMA be re-examined due to the high 60-minute sector count determined by MITRE's initial analysis. The result of the re-examination was to create a final approach module for the New Toluca TMA sector that can be opened as another sector to offload the workload associated with the final sequencing of aircraft to land at MMTO. Although the New Toluca TMA will handle the same quantity of aircraft as before, the workload would be less when the final approach sector is open due to removing the requirement for that sector to sequence aircraft onto final.

The Departure South sector in the Land South Configuration was developed with the intent that this airspace would be combined with either Departure East or Departure West depending on the traffic volume and complexity of those sectors. It would not be a separate sector that would need to be staffed. For the analysis, MITRE treated it as a separate sector to show the amount of traffic that is in this airspace.

4.1.2 Merge Count

A merge occurs where two or more aircraft flows come together to create a single flow, which can require controller intervention. Workload at these merge points is generated by the need for the controller to sequence the aircraft and maintain the minimum separation distance between the two aircraft. The identification of these merge points in the increased and modified SENEAM-provided CPL data allows the airspace design team to determine if additional sector modification is necessary, by identifying the number of flows to be merged at any one time and determining if the workload associated with the merging aircraft is balanced or not.

The TMA airspace design team examined two days of data to identify the merge points to obtain a more comprehensive view of merging within the new Mexico City and Toluca TMAs. The team identified the number of merge instances and their locations, as well as the maximum count of aircraft that could potentially be merged for that occurrence. The count of merge instances shows how many times the controller might need to intervene in a sector. The team then examined the traffic to determine how many aircraft would have required controller intervention and were merged. The number of aircraft found is reported using the merge instance maximum aircraft count. Both are indications of controller workload that is being done either by the sector where the merge is physically located or by the previous sector, depending on the location.

Figure 13 shows the depiction of the AICM Runway 05 baseline with merge point locations identified with red circles (left side) and the NAICM opening-day traffic demand airspace design with merge point locations identified with black numbered circles for the Land North Configuration (right side). The numbered circles in Figure 13 are to aide in the identification of the merge locations with the results in Table 15 and are not a ranking of the severity of the merge location. Figure 14 shows the depiction of the AICM Runway 23 baseline with merge point locations identified with red circles (left side) and the NAICM opening-day traffic demand airspace design with merge point locations identified with black numbered circles for the Land South Configuration (right side). The numbered circles in Figure 14 are associated with Table 15.

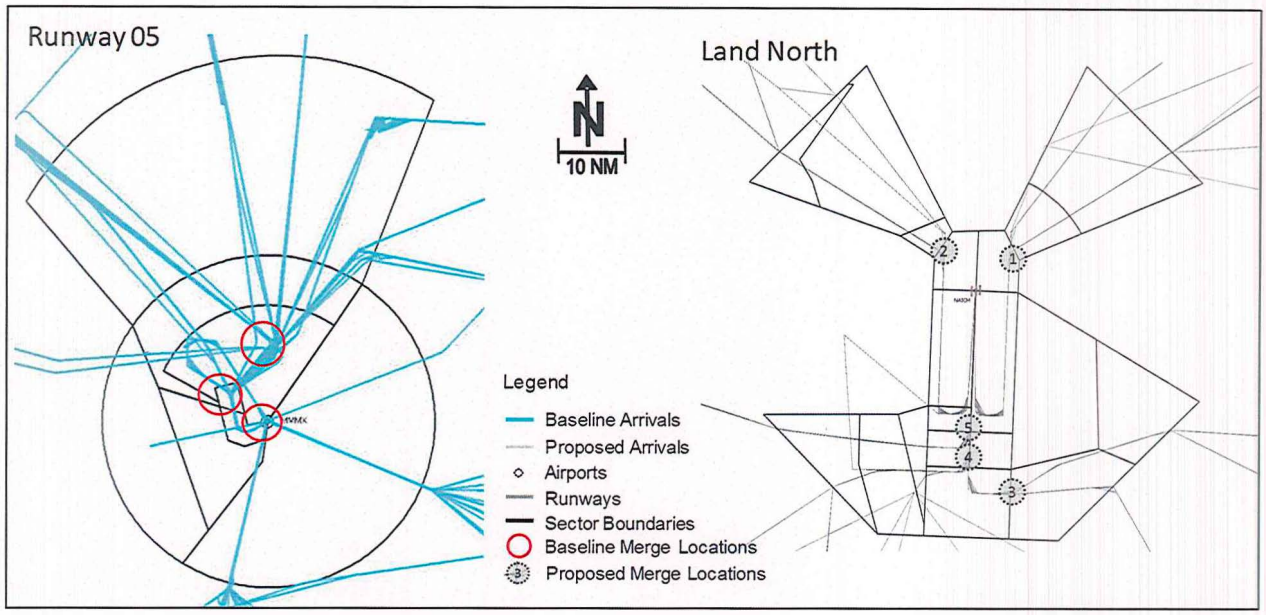

Figure 13. Merge Instance Locations for AICM Runway 05 (Baseline) and NAICM Land North Configuration

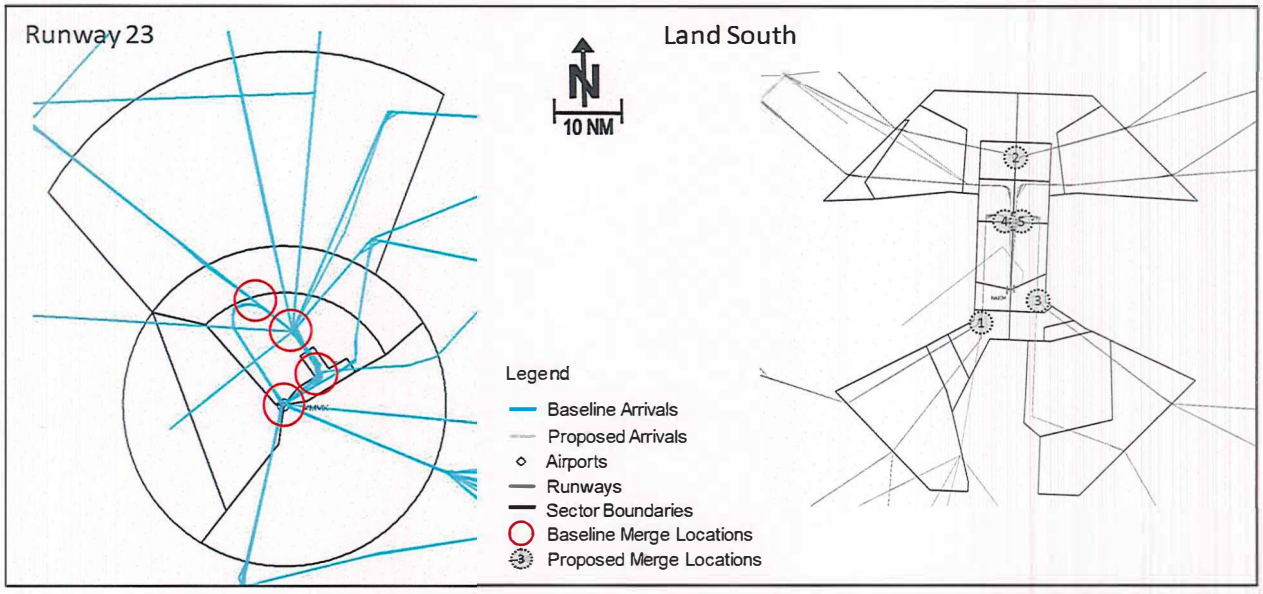

Figure 14. Merge Instance Locations for AICM Runway 23 (Baseline) and NAICM Land South Configuration

Table 15 provides the count of the merge instances (potential merges) and merge instance maximum count of aircraft (count of required controller interventions) that are being merged during a 1-minute period occurring in each of the new Mexico City TMA and Toluca TMA sectors for both the Land North Configuration and the Land South Configuration, by analysis day (i.e., 4 March 2016 and 22 April 2016).

Table 15. New Mexico City and Toluca TMAs: Merge Instance Count and Merge Instance Maximum Aircraft Count

	Merge Location	Sector	Merge Instance Count		Merge Instance Maximum Aircraft Count	
			4-Mar-16	22-Apr-16	4-Mar-16	22-Apr-16
Land North	1	Approach Northeast	16	30	1	1
	2	Approach Northwest	12	22	1	1
	3	Approach Southeast	4	18	1	1
	4	Final Center	6	10	1	1
	5	Final Center	38	77	1	2
Land South	1	Approach Southeast	6	16	1	1
	2	Final Center	4	32	1	1
	3	Approach Southeast	1	11	1	1
	4	Final West	44	34	2	1
	5	Final East	29	54	1	2

As expected with the Final Center, Final West, and Final East sectors for both days, there are high counts of merge instances. These are the sectors that have the responsibility to merge the arrival aircraft into three single flows for landing on each of the three runways. The merge instance count for the 22 April 2016 day of traffic is much higher than the 4 March 2016 day due to a higher overall arrival traffic count that existed in the 22 April 2016 day of traffic.

Table 16 gives the same information as provided in Table 15, but for the baseline traffic and sectors for the Runway 05 and Runway 23 directions at AICM and is used for comparison purposes. As can be seen in Table 16, the merge instance count for the baseline sectors are higher in the Final and Approach sectors than those reported in the opening-day traffic demand analysis shown in Table 15. The maximum number of aircraft merging at a merge instance is 2 in Table 15, which is either equal to or below the merge instance maximum aircraft count for the baseline sectors in Table 16 except for the Final sector for Runway 23 on 4 March 2016.

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Table 16. AICM Baseline: Merge Instance Count and Merge Instance Maximum Aircraft Count

	Sector	Merge Instance Count		Merge Instance Maximum Aircraft Count	
		4-Mar-16	22-Apr-16	4-Mar-16	22-Apr-16
Runway 05	Final	64	85	4	4
	Approach	67	72	4	4
	Arrival	5	6	3	2
Runway 23	Final	0	7	0	4
	Approach	92	100	4	5
	Arrival	4	5	2	2

There are three possible STARs that enter the new Mexico City TMA through the Approach Southeast sector in a Land North Configuration, as follows (see Figure 15 on the left):

- NAICM_STAR_SE1_Land_North_R6, which routes traffic to the north of the Popocatépetl volcano
- NAICM_STAR_SE1_Land_North_R3_South, which routes traffic to the south of Popocatépetl volcano
- NAICM_STAR_SE2_Land_North_R3, which serves traffic arriving from the south

In the Land South Configuration, there are also three possible STARs that enter the Approach Southeast sector, as follows (see Figure 15 on the right):

- NAICM_STAR_SE1_Land_South_R6, which routes traffic to the north of the Popocatépetl volcano
- NAICM_STAR_SE1_Land_South_R6_South, which routes traffic to the south of Popcatépetl volcano
- NAICM_STAR_SE2_Land_South_R6, which serves traffic arriving from the south

In the cases where traffic uses the NAICM_STAR_SE1_Land_North_R3_South, which routes the traffic to the south of the Popocatépetl volcano, there would be a potential merge with NAICM_STAR_SE2_Land_North_R3. This also happens when NAICM is in a Land South Configuration with the NAICM_STAR_SE1_Land_South_R6_South and NAICM_STAR_SE2_Land_South_R6.

The preferred routing in the Land South Configuration is for aircraft to use NAICM_STAR_SE1_Land_South_R6 due to a shorter flying distance, but if the Popocatépetl volcano is active and the ash is blowing to the east, then the southern STAR, NAICM_STAR_SE1_Land_South_R6_South, would be used, creating another potential merge

location. The preferred routing in the Land North Configuration is for aircraft to use the NAICM_STAR_SE1_Land_North_R3_South, also due to a shorter flying distance.

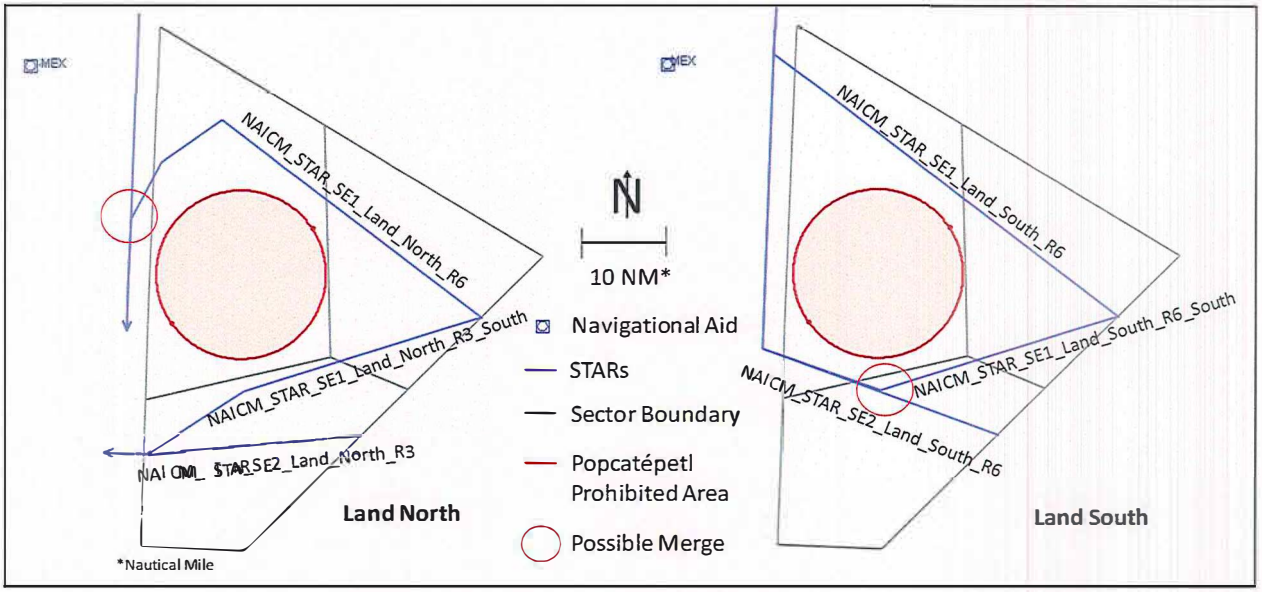

Figure 15. Potential Additional Merges for NAICM Land North and Land South Configurations

4.1.3 Cross Count

A cross occurs where two flows of aircraft intersect less than 1000 feet vertically and within a 1-minute time period, requiring controller intervention. Workload at these cross points is generated by the need for the controller to separate the aircraft vertically to maintain the minimum separation requirements. The identification of these cross points in the increased and modified SENEAM-provided CPL data can aid the airspace design team in determining if additional sector modification is necessary, by identifying the number of aircraft that cross at any one time and by determining if the workload associated with the cross points is balanced. Inside the TMA, it is unavoidable for procedures not to cross, but ideally the aircraft flying on those procedures are separated by more than 1000 feet vertically when they do cross.

The increased and modified SENEAM-provided CPL data for the analysis days were examined to identify the cross points to provide a more comprehensive view of aircraft crossing within the new Mexico City TMA and Toluca TMA. The MITRE team identified and counted the cross-point locations by sector, which provided information on the current sector workload. See Figure 16 for the Land North Configuration and Figure 17 for the Land South Configuration.

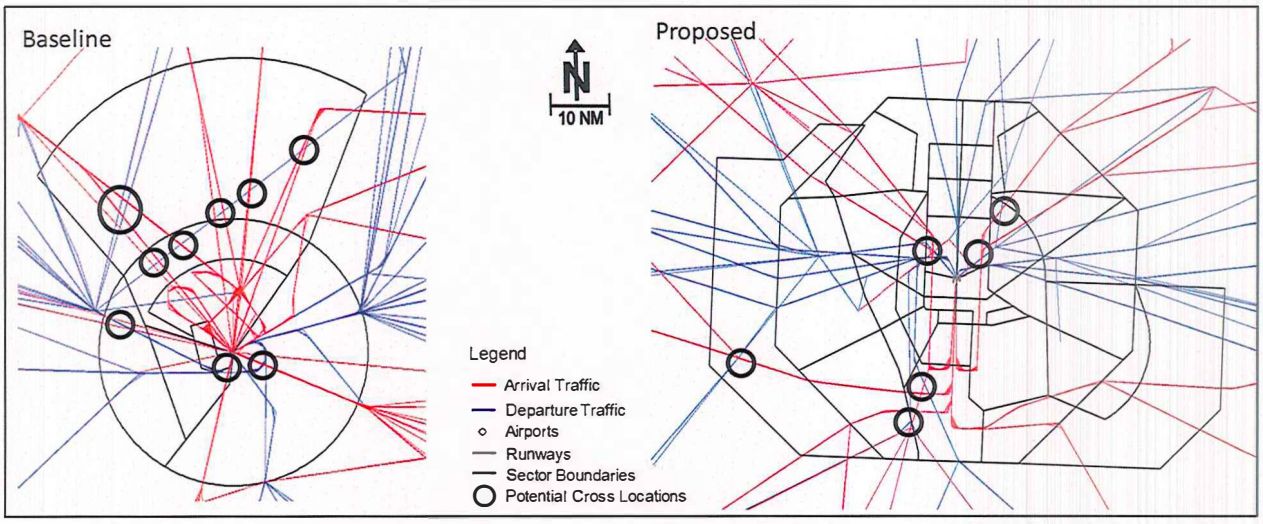

Figure 16. Potential Cross Locations for AICM Runway 05 (Baseline) and NAICM Land North Configuration (Proposed)

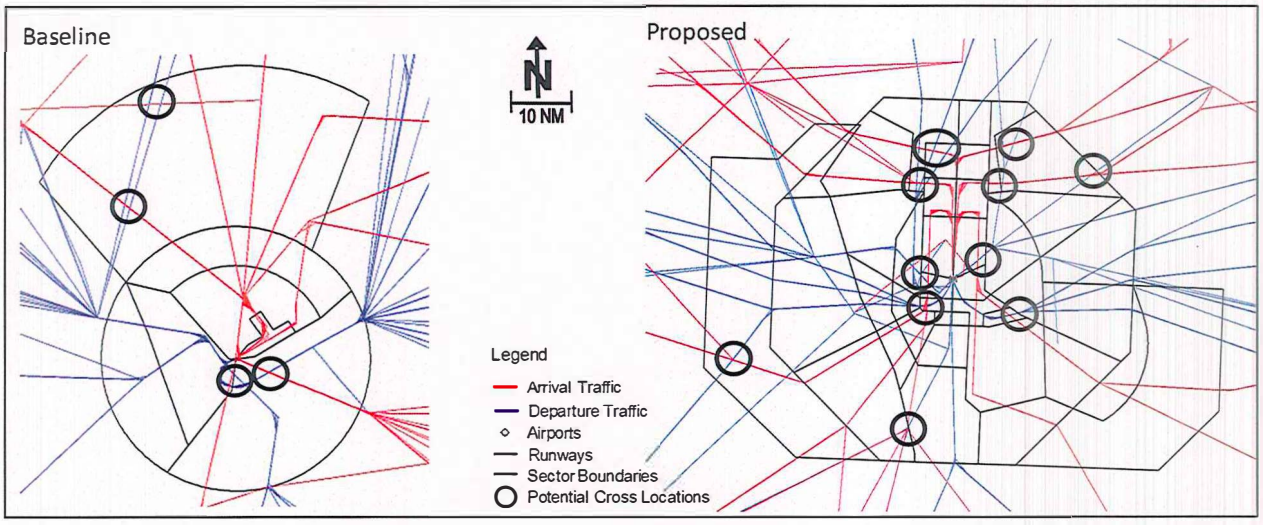

Figure 17. Potential Cross Locations for AICM Runway 23 (Baseline) and NAICM Land South Configuration (Proposed)

Of the sectors that were identified to have possible crossing point locations, Table 17 gives the count of the actual cross points found where aircraft are less than 1000 feet vertically apart for both the Land North Configuration and Land South Configuration.

Table 17. New Mexico City TMA and Toluca TMA: Crossing Points Less than 1000 Feet Vertically

	Sector	Number of Actual Crossing Points	
		4-Mar-16	22-Apr-16
Land North	New Toluca TMA	0	0
	Approach Northwest	0	0
	Approach Northeast	0	0
	Approach Southwest	0	0
	Approach Southeast	0	0
	Departure West	0	0
	Departure East	0	0
Land South	New Toluca TMA	0	0
	Approach Northwest	0	0
	Approach Northeast	0	0
	Approach Southwest	0	0
	Approach Southeast	0	0
	Departure North	0	0
	Departure East	0	0
	Departure South	0	0

For the sectors where possible cross point locations were identified in the AICM baseline analysis, Table 18 shows the actual crossing point counts for the sectors in both the Runway 05 and Runway 23 directions where aircraft are less than 1000 feet vertically apart.

Table 18. AICM Baseline: Actual Crossing Points Less Than 1000 Feet Vertically

	Sector	Number of Actual Crossing Points	
		4-Mar-16	22-Apr-16
Runway 05	Final	0	0
	Approach	0	0
	Arrival	0	0
	Departure East	0	0
	Departure West	0	0
Runway 23	Final	0	0
	Approach	0	0
	Arrival	0	0
	Departure East	0	0
	Departure West	0	0

The analyses found no locations in either the baseline or the proposed new Mexico City TMA and Toluca TMA sectors where the aircraft crossed within 1000 feet vertically. All the potential crosses were separated by more than the 1000 feet for which the controller would not have to intervene.

4.2 New Mexico City TMA and Toluca TMA Sector Opening-Day Traffic Demand Analysis: Findings

Comparison of the new Mexico City TMA and Toluca TMA opening-day traffic demand metrics with the baseline metrics shows that some of the sector counts were slightly higher in the opening-day traffic demand analysis; however, since the traffic volume was increased this was expected. The opening-day traffic demand merge and crossing point metrics were generally either equal to or less than the same metrics in the baseline analysis.

Based on the new Mexico City TMA and Toluca TMA opening-day traffic demand metrics from the TMA analysis, only one issue with the proposed airspace design for the new Mexico City TMA and Toluca TMA was identified. The issue identified was pertaining to the high 60-minute sector count for the New Toluca TMA sector. SENEAM requested that this be re-examined, and at the June 2017 airspace design workshop it was agreed to add in a final approach module to the New Toluca TMA sector that could be opened as a separate sector when necessary. The final approach sector would reduce the sequencing workload in the New Toluca TMA sector by eliminating the need for both the initial and the final sequencing to be done by one sector. Although the same amount of traffic would fly through the sector, the controller workload would be reduced.

5. Summary

As the Mexico ACC, new Mexico City TMA, and Toluca TMA airspace designs progress towards eventual implementation by SENEAM, the results of these analyses will provide airspace designers with insight into the workload that could be expected with the new procedures, routes, and sectorizations. This information is useful in the redesign by ensuring that the airspace will operate as efficiently as possible.

For the enroute analysis, Table 19 summarizes the *s*E sector scores for both the February 2017 and the June 2017 airspace designs for both PBN route implementation possibilities and the two traffic days. In addition to the *s*E sector scores, the daily traffic counts for the sectors have been included for information purposes.

The ALPHA sector is the only sector in the Mexico ACC enroute airspace that required further examination due to the *s*E sector scores. This sector manages heavy arrival flows from the northeast to NAICM and a single departure flow to the northeast. On days when the NAICM northeast traffic is not heavy, the situation is manageable, but as traffic increases the issue will become significant and a new sector would need to be opened to relieve the excessive workload. Therefore, SENEAM and MITRE developed two new sectors in the June 2017 airspace design, MIKE and NOVEMBER, to replace the February 2017 ALPHA sector. The MIKE sector would be responsible for the two NAICM departure routes and the initial control of two of the NAICM

arrival routes. In addition, the MIKE sector would handle the arrivals and departures for the non-radar airport, MMTM. The NOVEMBER sector would be responsible for the merging of NAICM arrival routes from the northeast for the two entry fixes on the new Mexico City TMA boundary.

SENEAM requested additional changes to the February 2017 airspace, which were incorporated into the June 2017 airspace design. These changes were combining the FOXTROT HIGH and LOW sectors and then adjusting the sector boundary between the new FOXTROT and GOLF sectors to better balance the workload in both sectors. Another change was to the airspace boundary between the KILO and LIMA sectors to locate UT188 completely within the KILO sector, eliminating the short time aircraft on this PBN route would be in the LIMA sector.

The opening-day traffic demand analysis for the new Mexico City and Toluca TMAs used three metrics to analyze the sectors and traffic inside the new Mexico City and Toluca TMAs: sector volume counts, merge counts, and cross counts. High sector counts along with workload associated with sequencing arrival traffic to MMTO caused concern with the airspace design team. The resolution was to develop a final approach sector to be opened when needed to offload the workload associated with the final sequencing of traffic to land at MMTO. Although the traffic volume would remain either the same or slightly less, the workload would drop, which would allow the controllers to handle more traffic.

The same metrics used for the baseline and opening-day traffic demand sector evaluations will be used for the future analyses of the proposed route and sector configuration, which allows for a comparison to be made regarding the effectiveness of the design at resolving the identified issues.

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Table 19. Summary of *s*E Sector Scores and Daily Traffic Counts

Sector	Airspace Design	Analysis	*s* E Sector Score				Daily Traffic Counts			
			4-Mar-16		22-Apr-16		4-Mar-16		22-Apr-16	
ALPHA	February 2017	NAICM and MMTO Only	244		392		436		533	
		All Traffic	262		386		440		551	
MIKE and NOVEMBER	June 2017	NAICM and MMTO Only	102	157	110	257	304	295	354	382
		All Traffic	89	166	138	247	337	343	448	477
BRAVO	February 2017	NAICM and MMTO Only	235		239		477		596	
		All Traffic	242		221		493		631	
	June 2017	NAICM and MMTO Only	235		239		477		596	
		All Traffic	242		221		493		631	
CHARLIE	February 2017	NAICM and MMTO Only	246		269		550		599	
		All Traffic	241		255		575		575	
	June 2017	NAICM and MMTO Only	246		269		550		599	
		All Traffic	241		255		575		575	
DELTA	February 2017	NAICM and MMTO Only	165		163		411		423	
		All Traffic	160		125		382		415	
	June 2017	NAICM and MMTO Only	165		163		411		423	
		All Traffic	160		125		382		415	
ECHO	February 2017	NAICM and MMTO Only	242		240		382		488	
		All Traffic	225		197		401		507	
	June 2017	NAICM and MMTO Only	242		240		382		488	
		All Traffic	225		197		401		507	
FOXTROT HIGH and LOW	February 2017	NAICM and MMTO Only	149	170	191	242	163	278	201	346
		All Traffic	154	160	171	277	151	279	205	346
FOXTROT	June 2017	NAICM and MMTO Only	188		233		297		364	
		All Traffic	178		215		296		352	
GOLF	February 2017	NAICM and MMTO Only	145		122		184		102	
		All Traffic	131		106		174		98	
	June 2017	NAICM and MMTO Only	193		289		288		293	
		All Traffic	213		229		282		294	
HOTEL	February 2017	NAICM and MMTO Only	288		245		239		180	
		All Traffic	279		260		236		179	
	June 2017	NAICM and MMTO Only	288		245		239		180	
		All Traffic	279		260		236		179	
INDIA	February 2017	NAICM and MMTO Only	131		153		189		231	
		All Traffic	141		167		191		226	
	June 2017	NAICM and MMTO Only	131		153		189		231	
		All Traffic	141		167		191		226	
JULIETT	February 2017	NAICM and MMTO Only	145		202		255		336	
		All Traffic	144		162		273		355	
	June 2017	NAICM and MMTO Only	145		202		255		336	
		All Traffic	144		162		273		355	
KILO	February 2017	NAICM and MMTO Only	149		156		141		190	
		All Traffic	144		161		140		188	
	June 2017	NAICM and MMTO Only	156		156		160		226	
		All Traffic	148		165		159		224	
LIMA	February 2017	NAICM and MMTO Only	110		168		213		345	
		All Traffic	106		223		222		349	
	June 2017	NAICM and MMTO Only	120		172		211		333	
		All Traffic	106		223		217		331	

Further Examination Required

Appendix A

February 2017 Mexico ACC Enroute Sectors

Figure A-1 shows the Mexico ACC enroute sectors from the February 2017 SENEAM-MITRE airspace design workshop.

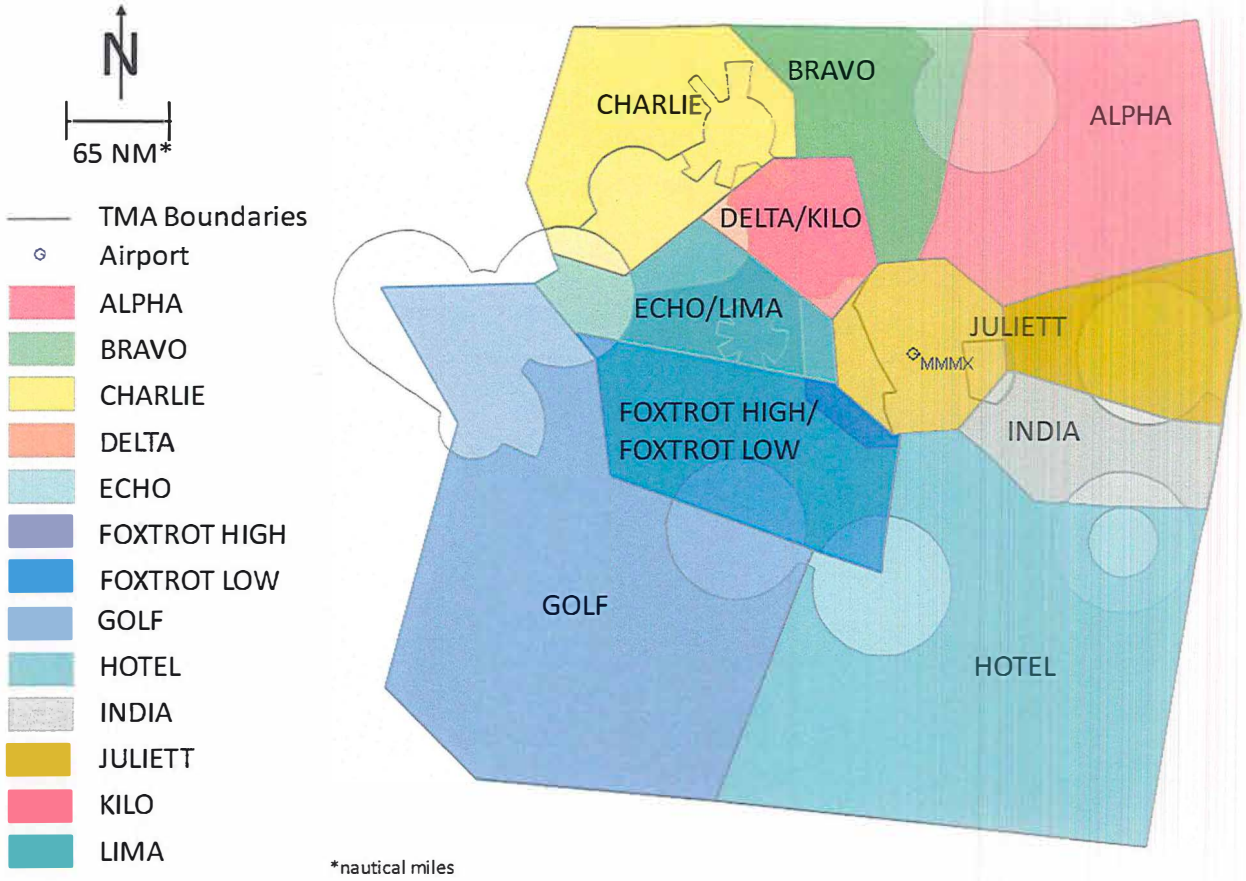

Figure A-1. February 2017 Mexico ACC Enroute Sectors

Appendix B

June 2017 Mexico ACC Enroute Sectors

Figure B-1 shows the Mexico ACC enroute sectors from the June 2017 SENEAM-MITRE airspace design workshop.

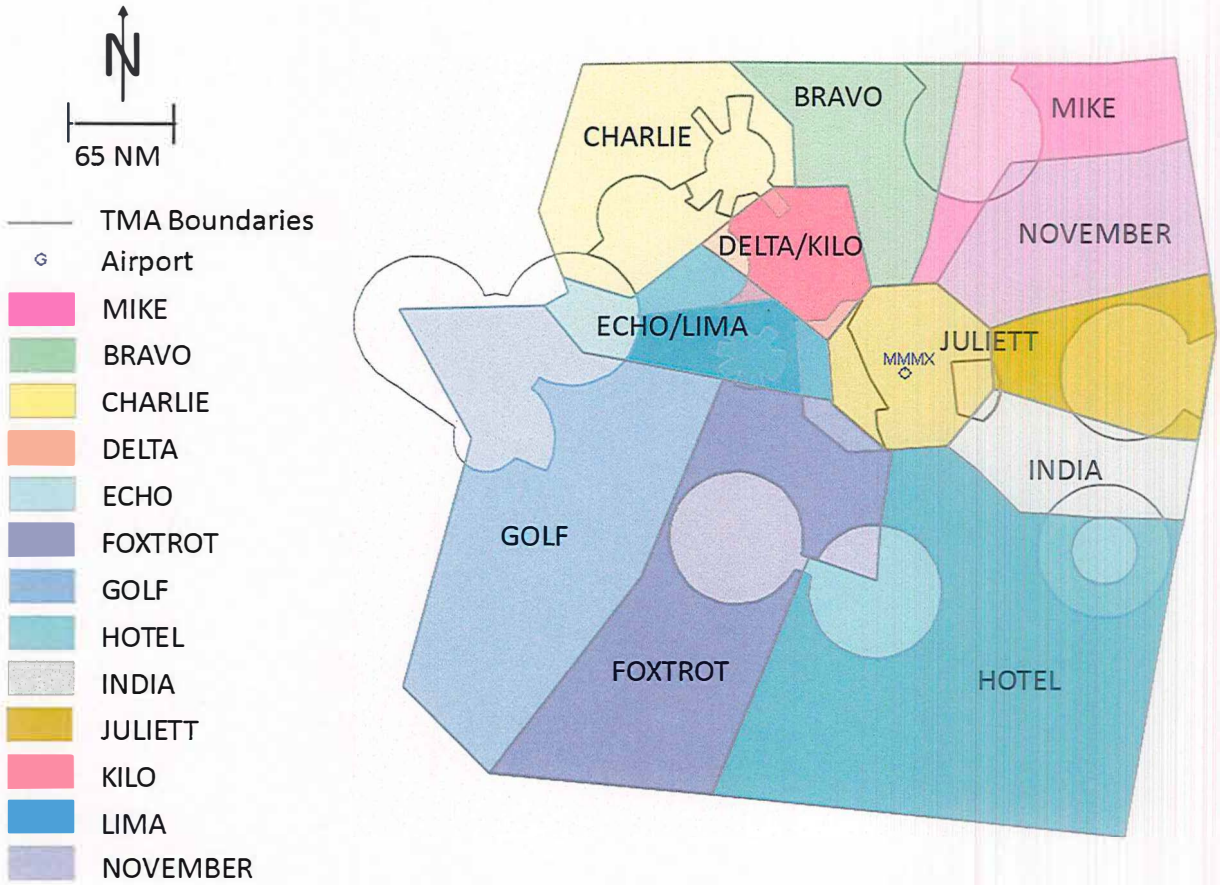

Figure B-1. June 2017 Mexico ACC Enroute Sectors

Appendix C

Determination of Opening-Day Traffic Demand

The opening-day traffic demand analyses of the Mexico ACC, as well as the new Mexico City TMA and Toluca TMA needed to increase the traffic to the year that NAICM is expected to commence operations, which is (officially) currently planned for 2020. MITRE started with the SENEAM-provided CPL data used for the previous baseline analyses and then increased the number of flights to match the forecasted traffic levels. For the 2020 forecasted traffic demand levels, MITRE used information provided by SENEAM (file name "Pronósticos de Tránsito [2016].xls" received via e-mail on 3 March 2017) for each of the airports inside the Mexico enroute airspace. The assumptions and methodology used by MITRE to increase the traffic for its analytical purposes, which was discussed and agreed upon with SENEAM, are described below.

To increase the SENEAM-provided CPL data to support the above-mentioned opening-day traffic demand analyses, MITRE had to make some assumptions and obtain from SENEAM the forecasted traffic demand level to be used in the analyses. The assumptions that MITRE used are as follows:

- The increase in the traffic only considers Instrument Flight Rules (IFR) traffic that is represented in the CPL data. Visual Flight Rules (VFR) traffic is not considered in the analyses, as this traffic is not represented in the two traffic files and is variable and unpredictable, normally flies at lower altitudes underneath the IFR traffic.
- To develop an increased traffic data set for NAICM and the other airports within the Mexico ACC, as well as overflights, MITRE used as a starting point the data contained in the SENEAM-provided CPL data for 22 April 2016, as the traffic count for this day was higher than the traffic count on 4 March 2016. Also, MITRE assumes that 22 April 2016 represents a typical/normal operational day within the Mexico ACC (not too high, not too low), during the month of April, and is an appropriate starting point day for use by MITRE in its analyses. Since the traffic data are from the same season, no seasonal affects are considered.
- For NAICM, MITRE assumed an opening-day traffic demand level of 550,000 IFR operations.
- For other relevant airports within the Mexico ACC, MITRE used traffic demand forecasts through 2020 provided by SENEAM. For conservative planning purposes, MITRE used the highest predicted number of flights between 2017 and 2020 (the last actual operations data was for the year 2016), regardless of the year in which the highest number of flights was expected to occur. In other words, for any airport projected to experience a decrease in traffic by 2020, MITRE used the highest traffic demand level provided between the 2017 and 2020 timeframe or the actual annual count in 2016.

- Overflights through the Mexico ACC contained within the above-mentioned CPL data were also considered and increased to projected 2020 traffic levels, based on traffic demand forecast information provided by SENEAM. MITRE used the highest predicted number of flights between 2015 and 2020 (the last actual operations data was for the year 2014 that was provided by SENEAM), regardless of the year in which the highest number of flights was expected to occur.
- For every increased departure movement into a Mexico ACC airport, there is a corresponding increased arrival movement to the same airport where the flight originated. For example, if a flight from AICM that arrives at Los Angeles was added to the data file, there will be a corresponding departure from Los Angeles to AICM that will also be added.
- The additional flights added to the flight plan file will depart +/- one hour from their original departure time in the above-mentioned CPL data. The corresponding arrival time of the flight to its destination will be based on modeling the traffic which is expected to be +/- one hour from their original arrival time.
- If the increase in traffic results in a partial aircraft, MITRE will round up to make the increase an integer value or a whole aircraft operation.
- The increase in traffic will only be applied to RNAV flight plans that exist in the CPL data of days. The amount of non-RNAV equipped flights using conventional navigation will remain constant.
- By the time NAICM opens, SENEAM has indicated that there will be a radar located at MMQT with radar service provided and a TMA will be developed. The resulting Querétaro TMA is expected to have the lateral dimensions of a 30-nautical mile arc from the airport, except in the south where it will follow the Toluca TMA boundary, and have a vertical boundary of 18,000 feet MSL.
- The fleet mix and city-pair flight combinations remain the same as what is in the 4 March 2016 and 22 April 2016 traffic days.

As previously mentioned, the methodology MITRE used to increase the traffic starts with the SENEAM-provided CPL data for 4 March 2016 and 22 April 2016. The arrival city-pair information was extracted from this data for each of the airports within the Mexico ACC and was mapped to a cardinal direction (i.e, northeast, east-north, east-south, southeast, etc.) for that airport. This mapping was used to determine the traffic distribution for each of the Mexico ACC airports serving as a basis for the distribution of the additional flights.

For determining the increase in traffic to be analyzed, forecasted yearly traffic demand levels were obtained from SENEAM for each airport within the Mexico ACC (for the years from 2017 to 2020), as well as the overflight traffic (for the years from 2015 to 2020). The overflight traffic is defined as those flights that do not arrive or depart from the Mexico ACC airports. This forecasted information was for the total number of flights for each airport, which included future VFR and local flights. As a result, the airports with high VFR and local flight traffic, but low IFR traffic (e.g., MMCB), received a disproportionate increase in the IFR traffic since only IFR

traffic was used in the analysis and the total percentage increase was applied. This disproportionate increase in IFR traffic is, therefore, a conservative increase for these airports.

The methodology used to create a forecasted 2020 traffic file is as follows:

1. Determine the total number of flights for each Mexico ACC airport and the total number of overflights for each of the two traffic days (the SENEAM-provided CPL data for 4 March 2016 and 22 April 2016).
2. Choose the largest forecasted annual number of flights between 2016 and 2020 for the Mexico ACC airports and between 2015 and 2020 for the overflights.
3. Calculate the average daily flight increase by determining the difference between the actual annual number of flights for 2016 for the Mexico ACC airports and 2014 for the Mexico ACC overflights from the Pronósticos de Tránsito (2016) file and the largest forecasted annual number of flights and then divide that amount by 365. This calculation was necessary as the forecast increase was applied to a single day of traffic.
4. Determine the traffic distribution by cardinal direction for each Mexico ACC airport based on the CPL data.
5. Distribute the average daily flight increase (from Step 3) per the flight plan distribution for each Mexico ACC airport for both the 4 March 2016 and 22 April 2016 data days by multiplying the decimal equivalent of the traffic distribution percentage by the average daily flight increase.

This methodology was used for both traffic days (i.e., 4 March 2016 and 22 April 2016) to account for the potential differences in city-pairs and number of flights for each day. If there was no information on the projected number of flights for an airport, then the number of flights in the traffic file remained the same.