EXECUTIVE SUMMARY

OCTOBER 2022

AIRPORT MASTER PLAN UPDATE

Lawrence Municipal Airport

Stantec

Forward

Under a contract with the City of Lawrence, MA, Stantec Consulting Services prepared a master plan update of the Airport's 2004 master plan.

The study was based on a scope of work approved by the Airport, the Federal Aviation Administration (FAA), and the Massachusetts Department of Transportation, Aeronautics Division (MassDOT). Funding for the project was provided through a grant by the FAA under the Airport Improvement Program, which includes 90% of costs. The balance was funded equally through a grant from MassDOT and the Airport's local share.[1]

The study followed the prescribed FAA guidelines for master plan preparation, specifically Advisory Circular (AC) 150/5370-6B, Airport Master Plans, and FAA Standard Operating Procedure (SOP) 2.00, Airport Layout Plan Checklist. The deliverables (documentation) included a technical report that reflected the analysis conducted to prepare an Airport Layout Plan (ALP). This Executive Summary recaps the findings of the technical report and ALP.

[1] AIP Grant # 3-25-0026-039-2018

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Introduction

This update focused on several key elements, primarily the future of general aviation activity from small recreational aircraft to business jets in terms of growth and demand for airport facilities. As part of this evaluation, the study examined the demand for aircraft parking on open apron tiedown spaces and hangars. In addition, the land uses in the airport's Runway Protection Zones was examined.

The two primary components of the project were the Airport Layout Plan (ALP) and a Capital Improvement Program (CIP). The ALP, signed by the airport commission chair, the director of planning for the MassDOT (Bureau of Aviation), and the FAA, depicts existing and proposed facilities and is an essential document for future federal and state funding.

What is An Airport Master Plan

An airport master plan projects an airport's potential development over the long term. This plan is documented and approved by the local governmental agency or authority (in this case, the City of Lawrence), which owns and operates the airport. The city is considered the airport's sponsor. A master plan outlines the data and the logic upon which the development plan is based. It also provides development concepts graphically in drawings called an Airport Layout Plan (ALP). Airport master plans are regularly updated to reflect the needed maintenance, development, expansion, and modernization of existing airports, and to justify the construction of additional airports that may be needed to accommodate increased demand for local, regional, or national aviation services.

Providing a vision and planning for an airport's future is a significant responsibility for an airport sponsor. Generally, airport planning looks at airport operations, facility designs, airfield configurations, financial allocations and revenues, environmental impacts, and organizational structures. There are a wide variety of planning studies within the spectrum of airport planning, ranging from project level to local level to aviation system level.

Master plans are statements of intention and not guarantees of action by an airport. The results of the master plan are based on the Airport's stated goals and objectives and what is expected to transpire during the planning period. Changes occur; therefore, the goals and objectives of an airport may change over time. Goals and objectives should be subject to annual scrutiny to insure they are still valid. Changes should be made only when there are clear indications that a stated goal or objective is no longer valid and in the best interests of the Airport. The goals and objectives should not be changed merely due to political considerations or populist sentiment.

Airport planning at the local or airport level begins with the airport master plan. At its core, an airport master plan is a comprehensive analysis that describes the short, medium, and long-term actions needed to meet future aviation demand at the airport. The elements of a master planning process vary in complexity and detail, depending on the individual airport's size, function, issues, and conditions. However, all airport master plans capture the research, process, and logic from which the ultimate development plan evolved and present that plan in a document that effectively communicates the plan's results to the reader.

Planning Process

An airport master plan guides an airport's future development over a specified period, usually 20 years. Planning projects funded by the FAA typically follow a systematic building-block process, as illustrated in Figure 1. Development of the master plan and accompanying ALP begins with the pre-planning stage and ends with delivering both a technical report and airport drawings. These vital steps require input and approval from the various stakeholders involved in the preparation of these documents. As the airport's sponsor, the City of Lawrence is responsible for the final product and should, therefore, act with due diligence in reviewing each component of the report and plan.

Figure 1. The Planning Process

Executive Summary Contents

This Executive Summary overviews the technical report and covers each key topic. These include:

- **Inventory of Existing Facilities**. The inventory describes the Airport as it existed when the project began. In addition, it includes a discussion of the airside and landside infrastructure and aircraft activity.
- **Forecast of Aviation Activity.** Forecasts project the baseline activity, physical aircraft and those that use the Airport, and the number and types of aircraft operations.
- F**acility Requirements.** This section examines the Airport's facilities to determine if the Airport can meet existing and future demand.
- **Alternatives Analysis.** The alternatives analysis considers the existing and forecast demand and evaluates the need for changes to the infrastructure.
- **Airport Layout Plan**. The ALP chapter is a formulation of a set of plans that comprises 13 sheets.
- F**inancial/Implementation Plans**. The final chapter provides the airport and funding agencies with a capital plan that provides a systematic schedule of development projects, including estimated costs and the phasing or implantation schedule.

Public Awareness Program

Throughout the project, numerous meetings and presentations took place that included briefings with the Airport, FAA, and MassDOT, meetings with an ad hoc committee established to review the project throughout the various stages (Planning Advisory Committee), and presentations regularly with the Lawrence Municipal Airport Commission (LMAC). Also, three public information meetings were held that provided the public with regular updates of the project including its outcome. Except for several formal and informal meetings with the airport staff and one PAC meeting, all the meetings were held virtually via a combination of Zoom and Microsoft TEAMS.

Review Process

The FAA and MassDOT thoroughly reviewed the study throughout the process. As each chapter of the report was finished, the airport manager reviewed the work and made recommendations, which were completed. Then they were forwarded to the funding agencies for review. The review included a virtual meeting where Stantec provided an overview of the contents, which were then revised and formed the final draft report. After completing the first draft, a final draft was compiled and submitted for a second review following the same process (manager, then onto the agencies). The changes and recommendations from the second review formed the final technical report. The exact method was used to prepare the ALP. In total, twenty-three meetings and presentations were conducted.

Inventory of Existing Conditions

The Lawrence Municipal Airport, FAA identifier LWM, is a general aviation airport classified as a reliever facility under the National Plan of Integrated Airports System (NPIAS). A general aviation airport is a facility with no scheduled air carrier service, such as American, Delta, Southwest, United Airlines, etc. And a reliever airport, a subset of a general aviation facility provides "relief" to a nearby commercial service airport, Boston-Logan Airport (BOS) in this case, by providing an alternative landing facility designed to reduce congestion at the larger Airport. LWM is one of several designated as a reliever to BOS.

The Airport is in North Andover, MA, but is owned and operated by the City of Lawrence, the Airport's sponsor concerning legal authority with the FAA. As shown in Figure 2, the field is on the eastern side of the Merrimack River, covering 420 acres and sits at an elevation 147.7 feet above mean sea level.

Figure 2. LWM Site Location Photograph

Runways

The Lawrence Municipal Airport has two runways, a primary and a crosswind. As illustrated in Figure 3, Runway 5-23 is the primary runway because of its length, markings, lighting, and the availability of instrument approach procedures to both runway ends. The paved runway is 5,001 feet long and 100 feet wide and designated as a precision runway because of the instrument landing system (ILS) approach to Runway 5. The runway was reconstructed in 2019 when both thresholds were relocated to permit FAA standard safety areas. During the project, the runway edge lights were replaced with LED units.

Runway 14-32 is designated as a crosswind runway. It is primarily available for aircraft when wind conditions are too strong to permit using the primary runway, although aircraft use it as required by the pilot in command. The runway is also paved and marked as a non-precision runway. It is 3,654 feet long and 100 feet wide. It has incandescent lights and is in poor condition and is slated for reconstruction in 2029.

Figure 3. LWM Airport Layout

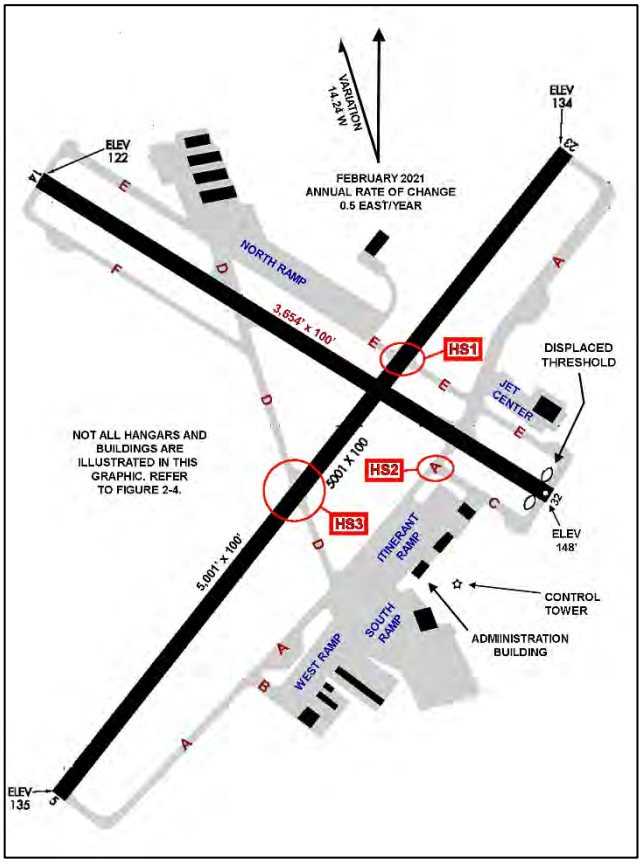


Figure 3 illustrates the runway and taxiway layout and other features used by pilots for navigation and information purposes. The graphic also shows the location of three FAA-identified Hot Spots.[2]

Taxiways

As illustrated in Figure 2, the taxiway system consists of two full-length parallel taxiways, a partial parallel, and several interconnecting taxiways.

- Taxiway A is a 50-foot-wide full-length pavement serving Runway 5-23. As shown, it is not a true parallel, an issue addressed in the study.
- Taxiway B is a short stub taxiway that connects Taxiway A with the West Ramp. There are no current plans to modify or change this taxiway, but its use and configuration were studied as part of the project.

[2] A hot spot is a location in an airport movement area with a history of the potential risk of collision or runway incursion and where heightened attention by pilots and drivers is necessary.

- Taxiway C is a short 50-foot-wide partial parallel taxiway on the west side of Runway 14-32. This taxiway is scheduled for realignment and reconstruction in 2023, when it will connect with Taxiway F.
- Taxiway D is a 35-foot-wide pavement crossing the Airport on a diagonal to the two runways, connecting Runway 5-23 with Taxiway F. This taxiway intersects at an acute angle with Runway 5-23. This design creates what the FAA refers to as a Hot Spot.[3] The location where it crosses the runway is also problematic because of its location in what the FAA refers to as a high-impact area (the middle third of the runway) where landing and departing aircraft are moving at high speed. This taxiway will be removed as part of the Taxiway C-F project in 2023.
- Taxiway E is a 35-foot-wide full-length parallel on the east side of Runway 14-32. There are no plans to modify this taxiway other than routine maintenance.
- Taxiway F is another 35-foot-wide partial parallel on the west side of Runway 14-32. There are plans to realign and connect Taxiway F with Taxiway C in 2023.

Aircraft Parking

The Airport has five separately designated aircraft parking aprons and 37 hangar buildings.

The Airport's aircraft parking aprons are designed as the North Ramp, West Ramp, East Ramp, South Ramp, and Terminal Ramp (see Figure 3, page 6). The combined aprons cover approximately 50,000 square yards with room for 90-100 aircraft. Twenty percent of based aircraft are parked on open ramps.

The Airport's 37 hangar facilities have a combined capacity of approximately 127 aircraft, depending on the size and parking configuration, which is at its current capacity. About 80% of based aircraft are stored in hangars. This represents a significant change over the past 20 years when the percentage of aircraft in hangars versus open aprons reversed with the construction of hangars. Figure 4 shows annotated aerial photographs of the north and the south and west hangar and apron areas where most airplanes are housed at LWM.

[3] A hot spot is a location on an airport movement area with a history of the potential risk of collision or a runway incursion and where heightened pilot attention by pilots and airfield operators is necessary. Figure 1 shows the three identified hot spots. Only Hot Spot 3 will be rectified with the removal of Taxiway D. Resolving the other two is impossible because of the airfield layout and traffic circulation between the north and south side of the airport.

Figure 4. LWM Hangar Complexes

Above: North Apron and Hangar Complex

Below: South and West Aprons and Hangar Complex

Based Aircraft

Based aircraft are those where the owners elect to park their aircraft at the Airport for most of the year and pay a corresponding fee. As shown in Figure 4, the fleet mix is primarily single-engine piston airplanes. The number of aircraft based at LWM has varied little over the past 10-20 years, averaging about 200 (Figure 6).

The number and type of based aircraft help plan the size and spacing of aircraft parking aprons and hangars.

Figure 5. Based Aircraft Fleet Mix

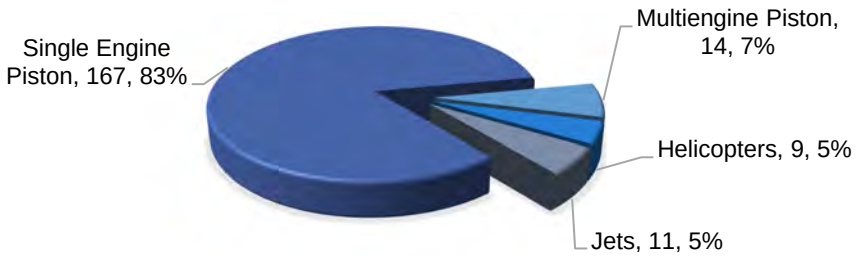
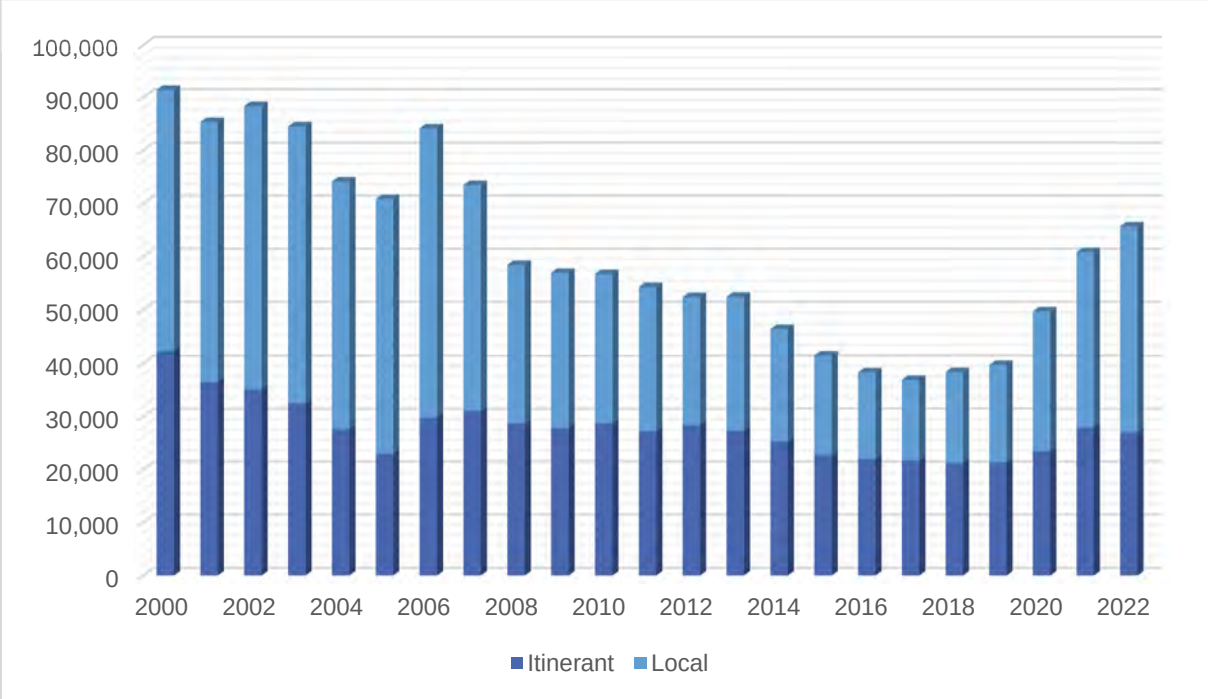


Figure 6. Historic Based Aircraft (2000-2022)

Aircraft Operations

Aircraft operations refer to the number of landings and takeoffs, each counting as one operation. For example, in the 20 years between 2000 and 2022, the Airport averaged approximately 60,900 takeoffs and landings per year.[4] Figure 7 shows the operations between 2000 and 2022 broken out by itinerant and local traffic.[5]

Figure 7. LWM Aircraft Operations (2000-2022)



Source: FAA Operations Network (OPSNET)

Data for 2022 is estimated

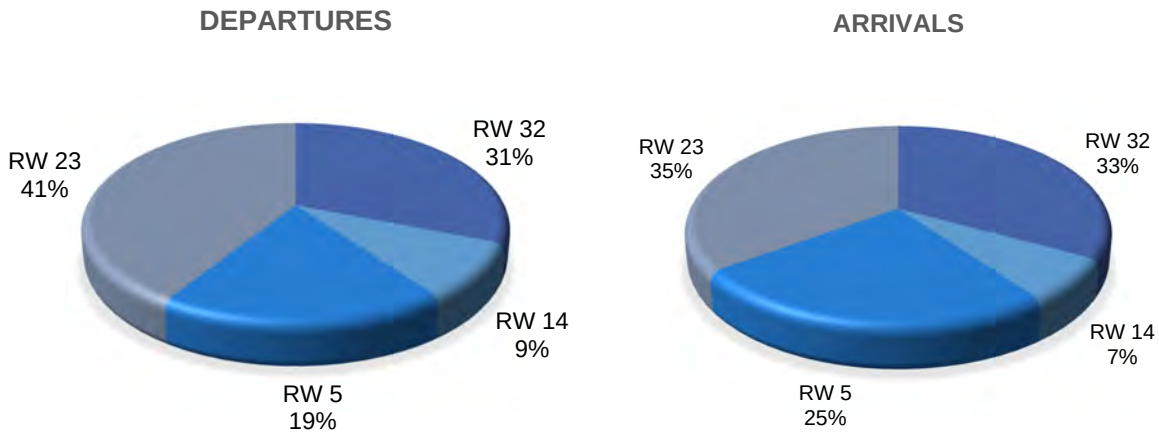
[4] 2022 data based on operations between January and September extrapolated through December.

[5] Local operations are those flights that remain in the traffic pattern and do not leave the area, taking off and landing at LWM, whereas itinerant operations are flights do not originate and end at LWM on the same flight.

Runway Usage

Runway usage closely mirrors the Airport's wind coverage, with Runway 23 the most used runway end and Runway 14 the least used for both takeoffs and landings. Figure 8 illustrates this pattern for both departing aircraft (left pane) and arrivals (right pane). This data is used to justify the need for runway and taxiway infrastructure and lighting systems.

Figure 8. Runway Usage by Runway (Departures & Arrivals)



Design Aircraft and Design Coding

The Airport's critical design aircraft is a single or group of airplanes with the longest wingspan and fastest landing speed with at least 500 annual operations. These measurements are the Aircraft Approach Category (AAC) based on the aircraft approach landing speed and the Airplane Design Group (ADG) based on the aircraft wingspan. This data is cross-referenced to FAA design criteria and forms the basis for dimensional standards such as the width of runways and taxiways and the separation of runways from taxiways and aircraft parking aprons, buildings, and other related airport features.[6] This is a critical decision because the Airport may be over or under-designed with the wrong selection, which leads to expensive development or safety issues.

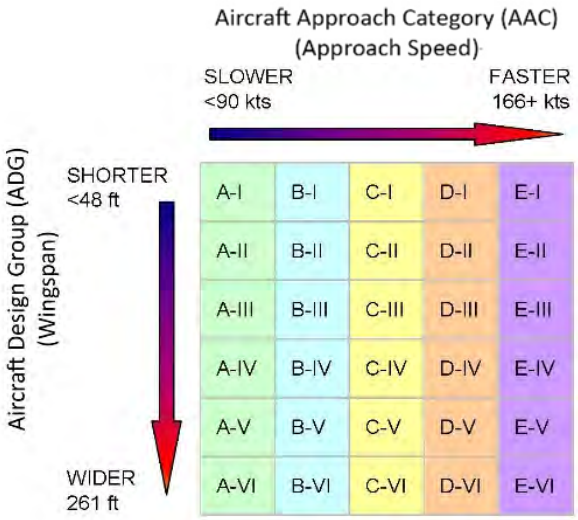
The critical design aircraft forms the basis of the FAA's design standards, referred to as the Airport Reference Code (ARC). This two-part coding system uses the Aircraft Approach Category (a letter between A and E) and the Aircraft Design Group (a Roman numeral between I and VI). The matrix in Figure 9

[6] FAA Advisory Circular (AC) 150/5300-13B, Airport Design.

illustrates the airport reference code concept, where the AAC and ADG data is based on a range of speeds and wingspan length.

FAA data were obtained and analyzed, which indicated that the ARC for the Lawrence Municipal Airport fell easily into the B-II range, meaning the crucial design aircraft had an approach speed between 91 and 121 knots (105 and 139 mph) and a wingspan between 49 and 78 feet (15 and 24 meters). This data was cross-referenced to several airplanes that fell within the two parameters, and the Cessna Citation CJ3 was selected.[7] Figure 10 is a photograph of the CJ3.

Figure 9. Airport Reference Code Matrix



Because a "one size fits all" approach would not work because of the shorter crosswind runway and the need to park smaller class airplanes on some of the aircraft ramps and in hangars, two additional critical design airplanes were selected. A slightly smaller version of the CJ3, the CJ2, was chosen as the design airplane for the shorter, crosswind runway, 14-32. And another even smaller aircraft, the Cirrus SR-22, was selected and the design airplane for the airplane parking aprons that are used exclusively for smaller recreational airplanes that the larger jets do not use. One other design standard, the Taxiway Design Code (TDG), is used to size taxiways and taxilanes.

Table 1 lists the three design airplanes, their dimensions, ARC, RDC, and TDG, and the applicable areas where each applies. Table 2 (page 16) lists each runway's current airport design standards and the small aircraft parking aprons and taxilanes.

Figure 10. Design Aircraft - Cessna Citation CJ3

[7] Aircraft use data were obtained from the FAA's Traffic Flow Management Systems Count (TFMSC).

Table 1. Airport Design Aircraft and Reference Codes

AIRCRAFT	AS	SW	TH	MGTOW	ARC/RDC	TDG	APPLICABLE INFRASTRUCTURE
Cessna Citation CJ3	108	53.3'	15.2'	13,870	B-II	2	Runway 5-23, All Taxiways, Itinerant and East Ramps and selected hangar areas
Cessna Citation CJ2	114	40.8'	14.0'	12,500	B-II Small	2	Runway 14-32
Cirrus SR22	78	38.4'	8.9'	2,358	A-I	1A	Small aircraft hangars, west and south ramps, all taxilanes
Legend							
AS – Approach Speed in knots was – Wingspan in feet-inches TH – Tail height in feet-inches ARC – Airport Reference Code				MGTOW – Maximum gross takeoff weight in pounds RDC – Runway Design Code TDG – Taxiway Design Code			

As listed, both runways are wider than required under existing design standards. This condition was studied as part of the master plan update and as noted in the facility requirements section, the future width of both runways should be 75 feet. However, the decision to narrow one or both runways will be made when they are scheduled for rehabilitation or reconstruction.[8]

[8] Rehabilitation refers to the removal and replacement of the asphalt without disturbing the subbase, whereas reconstruction involves the removal of all or a portion of the subbase.

Table 2. Design Standards

STANDARD	RUNWAY APPROACH END				Taxiways	Small Aircraft Parking Aprons
	5	23	14	32		
AAC-ADG	B-II	B-II	B-II Small	B-II Small		
Visibility Minimums	¾ mile	1-3/8 miles	3 miles	3 miles		
Runway Design Code	B-II-4000	B-II-4000	B-II-VIS	B-II-VIS		
Runway Width	75' [100']	75' [100']	75' [100']	75' [100']		
Runway Centerline to: Holding position Parallel taxiway centerline	200' [250'] 240' [300']	200' [250'] 240' [300']	125'' 240'	200' 200' [240']		
Runway/Taxiway Safety Area (RSA) Width Length beyond the departure end Length before threshold	150' 300' 300'	150' 300' 300'	150' 300' 300'	150' 300' 300'	79'	
Runway/Taxiway/Taxilane Object Free Area (OFA) Width Length beyond the departure end Length before threshold	500' 300' 300'	500' 300' 300'	500' 300' 300'	500' 300' 300'	124'	79'
Runway Obstacle Free Zone (OFZ) Width Length beyond the runway end	400' 200'	400' 200'	400' 200'	400' 200'		
Runway Protection Zone Length Inner width Outer width Acres	1,700' 1,000' 1,510' 48.98	1,000' 500' 700' 13.77	1,000' 250' 450' 8.035	1,000' 250' 450' 8.035		

Number in [brackets] represent the actual dimensions.

RPZ dimensions are the same for both Runway 32 approach and Runway 14 departure.

Taxiway A separation from Runway 5-23 varies from 300-ft to 500-ft

Source: FAA AC 5300-13B

Administration Building

Constructed in 1957, the airport administration building is a 4,100 square-foot single-story structure located in the southwest quadrant of the Airport and accessed from Terminal Road (Figure 11). The building houses the Airport's administration offices, including a conference room, two restrooms, a restaurant, a small lobby area that doubles as part of the restaurant seating area, and a small, leased office area. The building is scheduled for replacement in 2023-2024, pending state funding.

Figure 11. Airport Administration Building

Runway Protection Zones

A runway protection zone (RPZ) is an area off the end of a runway designed to protect people and property. The size of the RPZ varies based on the type of runway operations and approach visibility. The FAA recommends that the area is under airport control, covered by an easement or zoned by the local municipality that prevents incompatible use. The Runway 14 and 23 RPZs are clear of conflicting uses. They are located either on airport property (Runway 23) or in an area where development is not likely (Runway 14). However, Runways 5 and 23 RPZs are in high-density residential and commercial use areas that present a hazard to the occupants because of low flying aircraft and noise considerations.

Forecasts of Aviation Activity

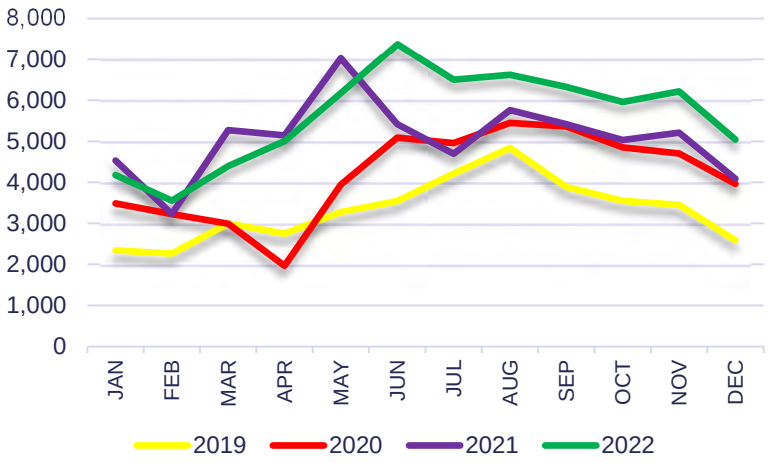
The forecasting effort in the master plan looked forward in five, ten, and 20-year increments, out to 2041, with each covering a specific assessment of capital needs (see Figure 12). Short-term forecasts, for up to five years, are used to justify near-term development and support operational planning and environmental improvement programs and are used by the FAA and MassDOT in formulating funding priorities. Medium-term forecasts (a 6- to 10-year time frame) are typically used in planning capital improvements and long-term forecasts (beyond 10 years) are helpful in general planning.

Figure 12. Planning Horizons

COVID-19 Impact on Airport Activity

Historically, the general aviation industry has been highly cyclical, exhibiting vigorous growth during economic expansions and negative growth during economic uncertainty. This was particularly true in 2020 because of the COVID-19 virus. This pandemic had financial and operational impacts across all aviation spectrums, from the largest commercial service airports to the smallest general aviation facilities. However, the effect on LWM was nonexistent. Following a brief downturn in operations, aircraft activity exceeded the previous three-year average. Figure 13 illustrates this point. As expected, operations declined noticeably following the Massachusetts governor's COVID-19 emergency declaration on March 10, 2020. In April 2020, total aircraft operations declined by 45% from April 2018 and 28% from April 2019. But surprisingly, by the end of 2020, airport activity had increased by 26% over the previous year. And the number of operations in May 2021 exceeded 7,000. Furthermore, operations in 2022 are going to surpass the last three years.

Figure 13. Comparison of Operations Pre and Post COVID-19



Source: FAA Operations Network (OPSNET)

September – December 2022 Operations are estimated

Data Sources & Methodology

Data for the LWM forecasts were obtained from several sources, including airport management, the FAA Terminal Area Forecasts (TAF), FAA Aerospace Forecasts (2020), the 2019 Massachusetts Statewide Airport Economic Impact Study, regional studies such as the Merrimack Valley Planning Commissions 2018 Comprehensive Economic Development Strategy, and economic data provided by Woods & Poole Economics, Inc.

Socioeconomic data for the Merrimack Valley region, including population, income, employment, and unemployment, along with the airports' historical activity, such as based aircraft and operations, were compared to the FAA Aerospace Forecasts. From this, a statistical trend was prepared that compared the Airport and region to FAA projections for general aviation activity across the United States. The findings indicated that LWM would match and, sometimes, exceed national growth trends. From this, three growth scenarios were prepared, a low-growth, medium-growth, and high-growth development, for aircraft operations and based aircraft.

The forecasts indicated that aircraft operations would increase at a modest rate of between 6.9% and 12.6% over 20 years, with the high growth scenario selected as the preferred forecast. Based aircraft are forecast subject to national trends impacting the number of single-engine piston aircraft in the market, which are projected to decline in the United States. This was weighed against the entire economic picture in the Merrimack Valley and the Airport. As a result, the low growth scenario suggests a possible 1.7% decline in total aircraft. Whereas, the medium growth projections indicate a potential 4.6% increase, and the high-growth scheme could see upwards of 15.3%. In the end, the medium growth setting for based aircraft was selected.

LWM Forecasts

The based aircraft and aircraft operations forecasts are used to determine what types of facilities the Airport needs or does not need moving foRWYard. In addition, the critical design aircraft and associated reference codes were also forecast. After examining the potential growth in operations and aircraft, the design aircraft for the Airport and the design codes will remain unchanged throughout the 20-year planning period.

Figure 14 shows the historic number of aircraft operations between 2010 and 2020 and the three growth scenarios through 2041. Figure 15 presents the exact data for based aircraft.

The FAA approved the forecasts on January 11, 2021.[9]

[9] Email – Michelle Ricci, FAA, to Ervin Deck, Stantec Project Manager

Figure 14. Aircraft Operations Three Growth Scenarios

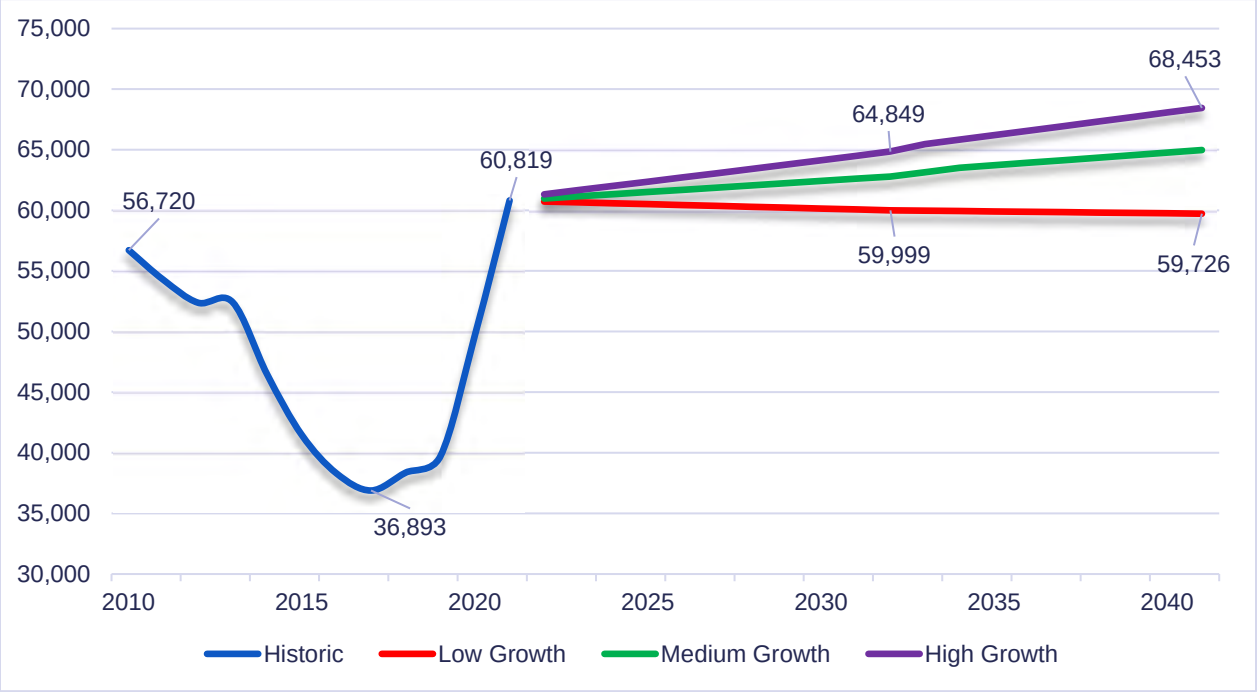
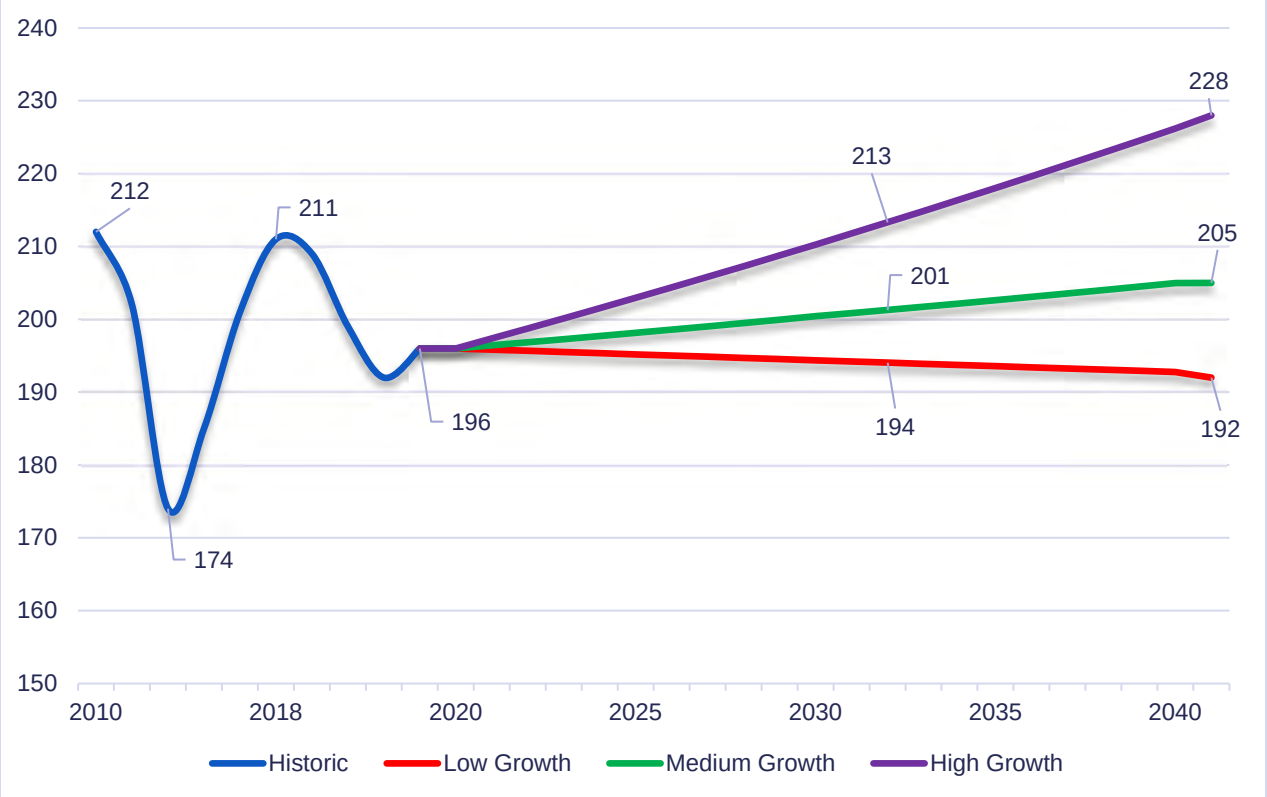


Figure 15. Based Aircraft Three Growth Scenarios



Facility Requirements

The facility requirements process identifies the Airport's facility needs over the 20-year planning horizon. As approved by the FAA, the preferred aviation activity forecast was used to determine these facility needs.

Before the facility requirements for LWM could be determined, it was necessary to establish Planning Activity Levels (PALs) based on the preferred forecasts, the design aircraft family, and the appropriate Airport, runway, and taxiway classifications with FAA design standards.

Since aviation activity is highly susceptible to fluctuations in economic conditions and industry trends, identifying the timing of recommended facility improvements can be challenging. The timeline associated with the preferred forecast is linked to the anticipated timing of demand (in five-year increments starting with 2026, then 2031, 2036, and 2041). But the exact timing of demand can vary because airport facility needs never follow a linear schedule. Therefore, PALs identify specific demand thresholds that trigger facility improvement based on operation levels and aircraft numbers.

Table 3 lists the PALs used for this study, which correspond with the preferred aviation activity forecast for the base year 2020 and the planning horizon years 2026, 2031, 2036, and 2041.

Table 3. Planning Activity Levels (PALs)

ACTIVITY	CURRENT (2021)	PAL1 (2026)	PAL2 (2031)	PAL3 (2036)	PAL4 (2041)
Operations					
Local	27,900	28,800	29,600	30,500	31,400
Itinerant (including air taxi and military)	32,900	33,900	34,900	36,000	37,000
Total Operations (Rounded)	60,800	62,700	64,500	66,500	68,400
Based Aircraft	196[10]	199	200	203	205
Design Aircraft					
Airport	Cessna CJ3				
Runway 5-23	Cessna CJ3				
Runway 14-32	Cessna CJ2				
Small Aircraft Aprons	Cirrus SR-22				
Airport Reference Code (ARC)	B-II				
Runway 5-23 Design Code (RDC)	B-II-5000				
Runway 14-32 Design Code (RDC)	B-II-VIS				
Taxiway Design Group (TDG)					
All Taxiways	TDG-2				
Based Aircraft Apron	TDG-1A				

Facility Needs

The analysis determined that the Airport could use several improvements or modifications to comply with FAA standards to improve its efficiency and safety. In some cases, the recommended changes involve the elimination of facilities or their removal.

- **Runway Protection Zones.** The biggest safety issue noted in the study was the need to address incompatible land use in two of the Airport's four RPZs. The Runways 5 and 32 RPZs contain uses that present an unsafe environment for people living, working, and using private residences and businesses. Therefore, the recommendation is, through a combination of land purchases of existing homes and businesses and the purchase of a development easement over undeveloped land on both RPZs.

- **Runway Length.** A runway length analysis was performed using data from the existing fleet of aircraft that use the Airport regularly.[11] The investigation determined that both runways are long enough to support most aircraft operations. While some large jets could use a longer runway, pilots may elect, at their discretion, to operate from LWM under conditions suitable for their operational needs, such as operating at less than maximum takeoff or landing weight or during periods of cooler temperatures, which requires a shorter runway. Whether some operators would use LWM if the runways were longer is unknown. Therefore, the recommendation is not to extend or shorten either runway.

- **Runway Width.** Both runways are currently 100 feet wide. However, current design standards only require a 75-foot-wide runway. Therefore, the recommendation is to reduce the width of both runways in the subsequent rehabilitation or reconstruction phase, but only after reassessing the runway design code (RDC).

- **Taxiway Requirements.** The Airport has six taxiways, designated A, B, C, D, E, and F. The taxiway design group is TDG-2, which requires a 35-foot-wide pavement. And the required runway to taxiway separation for both runways is 240 feet.

    - **Taxiway A.** This is the primary parallel taxiway serving Runway 5-23. The taxiway meets dimensional standards (35-ft-wide). However, the eastern third (from Taxiway E to the Runway 23 end) exceeds the standard with a pavement width of 75-ft. The runway to taxiway separation ranges from 350-ft on the eastern end to 525-ft near the Runway 14-32 intersection. The standard is 240-ft. This variation is a design issue, and the recommendation is to realign the taxiway as a true parallel.

    - **Taxiway B.** This short taxiway connects the west ramp to Taxiway A. The recommendation is to extend "B" to the realigned "A".

[11] Regular basis for this analysis was at least one flight per month.

- **Taxiway C.** This critical taxiway is slated for realignment and reconstruction in 2023 when it will be extended across Runway 5-23 to connect with Taxiway "F" forming a full-length parallel along the west side of Runway 14-32.
- **Taxiway D.** This taxiway, which connects Taxiway F with Taxiway A at a diagonal across Runway 5-23, forms a critical hot spot because of its location, the angle it crosses the runway, and is slated for removal as part of the Taxiway C extension project.
- **Taxiway E.** No changes to Taxiway E are recommended.
- **Taxiway F.** Taxiway F is scheduled for reconstruction in 2023 as part of the Taxiway C project, where it will form a full-length parallel and will be redesignated as "C".
- **Taxiway Designations.** At LWM, only the main taxiways are designated but not the stub taxiways that connect them with the runways. The recommendation is to define all taxiways per FAA guidance.[12]

- **Navigation Aids.** Navigational aids (NAVAIDs) are any visual or electronic devices, airborne or on the ground, that provide point-to-point guidance information or position data to pilots. The type, mission, and volume of activity, along with meteorological, airspace, and capacity considerations, determine an airport's eligibility and need for various NAVAIDs. Various types of aids are in use at LWM, each serving a particular purpose. Several recommendations are offered.
  - **Convert from Incandescent to LED.** Runway 5-23 is equipped with LED edge lights, otherwise, most lights are still incandescent. The recommendation is to convert Runway 14-32, all taxiways, and all signage with LED lights at the next replacement cycle.
  - **PAPI and REIL.** Runway 5-23 and Runway 32 are equipped with Precision Approach Path Indicator (PAPI) and Runway End Identifier Lights (REIL). The recommendation is to install PAPI and REIL on the Runway 14 end.
  - **Approach Lights.** The Airport does not have an approach lighting system (ALS). The recommendation is to study the possibility of an ALS on both ends of Runway 5-25. The ALS provides a significant safety advantage and a possible reduction in approach visibility minimums.
- **Apron Demand.** An analysis determined that apron capacity exceeds demand by a wide margin, noting that only 23% of based aircraft parked on an open apron leaving a surplus of about 26,600 square yards of space. Therefore, the recommendation is to convert unused apron space into hangar space.

[12] FAA Engineering Brief 89, Taxiway Nomenclature Convention, FAA Memorandum dated March 29, 2012

- **Hangars.** As noted in the previous bullet, 77% of based aircraft are stored in hangars, and demand continues to exceed capacity. The analysis indicates that the Airport needs about 24 additional hangar spaces today and that demand will require 57 total new hangar spaces by 2041. Therefore, the recommendation is to convert unused apron space into hangars and to expand the existing hangar footprint to meet the long-term demand.

- **Administration Building.** As noted, the administration building was constructed in the late 1950s. As a result, the building does not meet the current Americans with Disabilities Act (ADA) requirements. In addition, it must be equipped with a fire sprinkler system per Massachusetts state law. Two options are currently under consideration in the Airport's Capital Improvement Plan (CIP). The preferred solution is to replace the building under a MassDOT program or to upgrade the ADA and fire suppression system as soon as possible.

Figure 16. Future Administration Building Architects Rendering

Source: Fennick McCredie Architecture

- **Perimeter Road.** The only access between the north and south ramp areas is either via public roads or across both runways. The FAA's Runway Safety Action Team (RSAT) noted the latter as a significant issue that must be addressed in this study. Consequently, the recommendation is to find a solution that reduces the number of runway crossings to those essential to airport safety and maintenance.

Alternatives

To satisfy the facility requirements identified in the study, a range of alternative concepts, site configurations, and development options were created for the Airport. Concepts deemed most reasonable to support the long-term operational sustainability of the Airport were carried forward and were considered and approved by the airport commission.

Regardless of the timeframe or activity level, the central principles guiding these airport improvement recommendations aim to provide an elevated level of safety and customer service and to promote economic wellbeing. These principles were used to accommodate the evolving business model of the airport and tenants. For functional areas – such as the airfield – the relevant recommendations are primarily driven by FAA design standards and existing infrastructure: the width of taxiways, taxiway design and safety concerns, and the separation standards between runways and taxiways. In contrast, improvements related to the hangar and terminal areas are more variable. This is due to the range of existing and forecasted space deficiencies, private financing, and implementation challenges, and their influence on surrounding airport facilities.

Each alternative was evaluated based on eight criteria, which included:

1. **Advantages.** Are there aspects of the alternative that help promote a safe, more efficient, and economically developed airport?

2. **Disadvantages.** What are the negative aspects of the alternative, if any, and how does it fail to meet the needs of the Airport?

3. **Technically Feasible.** Is the alternative possible given current conditions, design standards, location, cost, etc?

4. **Meets FAA Design Standards.** Does the alternative meet current standards for construction, location, layout, etc?

5. **Environmental Rating.** On a scale of 0 to 5, an environmental rating was applied to each alternative to determine whether the option would have no impact on the environment, would it benefit the environment, have no effect, had some adverse or harmful effects, or would it have a significant impact.

6. **NEPA Review.** What level of review is required under the National Environmental Protection Act (NEPA). Can it be Categorically Excluded (CATEX), is an Environmental Assessment required, or does it rise to the level of an Environmental Impact Statement?

7. **Estimated Cost:** A planning level cost estimate was provided for each applicable alternative.

8. **Recommended:** The final criteria were whether the consultant recommended the alternative.

Fifteen total alternatives were evaluated for the two runways, taxiways, navigation aids, runway protection zones, aprons and hangars, and a perimeter road. And each alternative included a "do nothing" option and

one or more additional choices depending on the infrastructure and reasonable options that passed a commonsense approach. The Table 4 matrix lists each along with the options and alternatives, the environmental impact rating, the NEPA requirements, the estimated cost, the consultant's recommendation, and which option LMAC adopted.

Table 4. Alternatives Summary Matrix

INFRASTRUCTURE	OPTIONS & ALTERNATIVES		ENV. INDEX	NEPA	COST	STANTEC REC	LMAC ACCEPTS
Runway 5-23 – Narrow to 75'	1	Do nothing	0			No	
	2	Narrow to 75-ft	1	CATEX	$7.5 million	Yes	X
Runway 14-32 – Narrow to 75'	1	Do nothing	0			No	
	2	Narrow to 75-ft	1	CATEX	$7.0 million	Yes	X
Runway 32 Displaced Threshold	1	Do nothing	0			No	
	2	Remove	4	CATEX	$2.5 million	Yes	X
Taxiway A – Realign	1	Do nothing	0			No	
	2	Realign	3	CATEX	$7.3 million	Yes	X
Taxiway D – Close & Remove	1	Do nothing	0			No	
	2	Close/Remove	2	CATEX	$495,000	Yes	X
Taxiway E2 – Construct	1	Do nothing	0			Yes	X
	2	Construct	3	CATEX	$990,000	No	
Taxiway F – Extend to "C"	1	Do nothing	0			No	
	2	Close/Remove	2	CATEX	$218,371	No	
	3	Extend	3	CATEX	$7.1 million	Yes	X
Taxiway F2 (C2) – Construct	1	Do nothing	0			No	
	2	Construct	3	CATEX	$990,000	Yes	X
Runway Protection Zones	1	Do Nothing	0			No	
	2	Acquire Easements	4	EA	TBD	No	
	3	Purchase Property	4	EA	TBD	Yes	X
Approach Lights	1	Do nothing	0			No	
	2A	RWY 5 MALS	4	EA	$1.2 million	Yes	
	2B	RWY 5 MALSR	4	EA	$1.3 million	No	
	2C	RWY 5 MALSR	4	EA	$1.7 million	No	
	3A	RWY 23 MALS	4	EA	$700,000	No	
	3B	RWY 23 MALSR	4	EA	$900,000	No	
	3C	RWY 23 MALSR	4	EA	$1.12 million	Yes	X

Table 4. Alternatives Summary Matrix

INFRASTRUCTURE	OPTIONS & ALTERNATIVES		ENV. INDEX	NEPA	COST	STANTEC REC	LMAC ACCEPTS
Runway 14 – REIL	1	Do nothing				No	
	2	Install	2	CATEX	$50,000	Yes	
Runway 14 – PAPI	1	Do nothing	0			No	
	2	Install	2	CATEX	$100,000	Yes	X
Apron Imbalance	1	Do nothing	0			No	
	2	Rebalance	0			Yes	X
Hangars – Construct	1	Do nothing	0			No	
	2	Short-Term	3	TBD	$3.2 million	Yes	X
	3	Long-term	3	TBD	TBD	Yes	X
Perimeter Road	1	Do Nothing	0	N/A	N/A	No	
	2	Use Public Roads	0	N/A	N/A	Yes	X
	3	Road round RWY 23 & 32	5	EA	$3.2 million	No	
	4	Tunnel and around RWY 23	5	EA	$16.3 million	No	

Environmental Index
0. Not applicable/no impact
1. Benefits and protects environmental and community resources
2. No effects
3. Some adverse effects that can be reasonably mitigated
4. Harmful effects that could potentially delay or compromise alternative implementation
5. Significant impacts that cannot be reasonably permitted and mitigated

Legend:
N/A – Not applicable
EA – Environmental Assessment
CATEX – Categorically Excluded
ENV – Environment
NEPA – National Environmental Policy Act
REC – Recommended
LMAC – Lawrence Municipal Airport Commission
MALSR – Medium Intensity Approach Lighting System with Sequence Flashers

The preferred alternative, which forms the basis of the Airport Layout Plan was adopted by LMAC on July 22, 2022.

Airport Layout Plan

An Airport Layout Plan (ALP) is a scaled, graphical presentation of the existing and future airport facilities, their location on the airport campus, and proper clearance and dimensional information. The ALP is a significant product of the Master Plan Update, which contains information the FAA uses to program future funding assistance and monitor the Airport's compliance with design standards and grant assurances. It also allows the FAA to anticipate budgetary and procedural needs and to protect the airspace required for facility or aircraft approach procedure improvements. An up-to-date FAA-approved ALP that ensures the safety, utility, and efficiency of the Airport is required for the Airport to receive financial assistance under the terms of the Airport and Airway Improvement Act of 1982 (AIP) and to be able to obtain specific AIP funding.

An ALP, which is a public document that serves as a record of present and future aeronautical requirements, is a blueprint for airport development by which the airport sponsor – in this case, the City of Lawrence – can ensure that growth remains consistent with airport design standards and safety requirements, as well as Airport and community land use plans.

The ALP is a set of plans prepared either as first-time planning documents, formal revisions based on changes to the Airport (such as this ALP), or informal modifications based on minor improvements to the Airport. In addition, minor corrections, often referred to as pen-and-ink revisions (now accomplished electronically), can be made to individual sheets of the ALP drawing set. However, the responsibility for review and approval must still be coordinated with the FAA. These and other requirements are discussed in FAA Order 5100.38, Airport Improvement Program Handbook.

Individual sheets that comprise the airport layout plan set will vary with each planning effort. The ALP preparer (Stantec Consulting Services), airport sponsor (City of Lawrence), FAA and MassDOT determined early in the process which sheets are necessary during the project scoping activities. For this project, 12 separate sheets were prepared and included in the airport layout plan drawing set, described below.[13]

- **Sheet 1 – Cover Sheet.** The Cover Sheet serves as an introduction to the ALP set. It includes the name of the Airport, location map, an index of drawings, and other pertinent data.
- **Sheet 2 – Airport Data Sheet.** The Airport Data Sheet contains detailed information regarding the existing and future facilities at the Airport
- **Sheet 3 – Airport Facilities Drawing.** The Facilities Layout Plan is a graphic representation, to scale, of the existing airport facilities in their current configuration. This drawing shows all existing airport facilities, locations, pertinent dimensions, clearance information, and the runway and taxiway infrastructure.

[13] Included with the ALP set was a copy of the airport's property map (Exhibit A). While no changes were made to this important document, it is typically included as part of the project.

- **Sheet 4 – Airport Layout Plan.** The Airport Layout Plan Drawing is a graphic representation, to scale, of the existing airport facilities in their current configuration. Like the Airport Facilities Drawing, this drawing shows all existing airport facilities, their location, pertinent dimensions, clearance information, and the runway and taxiway infrastructure. However, future planned development is also displayed on the Airport Layout Plan Drawing. This sheet is included at the end of this document.

- **Sheet 5 – Terminal Plan (South).** This Plan shows the existing and proposed apron and hangar development on the west, south, east, and terminal ramps. In addition, the South Plan offers the current and planned apron and hangar development south of Runway 5-23 and west of Runway 14-32, which includes the location of the existing and planned administration building.

- **Sheet 6 – Terminal Plan (North).** This Plan shows the existing and proposed apron and hangar development on the north ramp, east of Runway 14-32, which includes an expansion of the airport hangar infrastructure northwest of the existing apron area.

- **Sheet 7 – Inner Approach Surface Plan and Profile – Runway 5.** The inner portion of the approach surface drawing is a required and critical drawing that depicts the trapezoidal RPZs and the approach profiles of each runway. This and the subsequent two sheets include obstructions obtained from an earlier obstruction analysis study. The Runway 5 drawing depicts the current Part 77 50:1 approach slope for the precision instrument approach. Also shown are the 20:1 Approach Surface #5 and the 40:1 Departure Surface.[14]

- **Sheet 8 – Inner Approach Surface Plan and Profile – Runway 23.** This inner portion of the approach surface drawing provides information for Runway 23. It depicts the 34:1 non-precision Part 77 Approach Slope, the 20:1 Approach Surface #5, and the 40:1 Departure Surface.

- **Sheet 9 – Inner Approach Surface Plan and Profile – Runways 14 and 32.** This inner portion of the approach surface drawing provides information for Runway 14. It includes the FAR Part 77 20:1 Approach Surface, the 20:1 Approach Surface #2, and the 40:1 Departure Surface.

- **Sheet 10 – Airport Land Use Plan.** The Airport Land Use Plan drawing depicts the current and future land use in the vicinity of the Airport. The Plan identifies North Andover zoning designations for land off-airport. In addition to land use descriptions, a desktop noise analysis was prepared to provide aircraft noise contours for forecast conditions in 2041 at LWM. This analysis was designed as a planning-level effort using software analysis only; no noise monitoring equipment was used.[15]

[14] As defined in AC 5300-13B, Airport Design.

[15] The noise analysis was prepared using the FAA Aviation Environmental Design Tool (AEDT).

- **Sheet 11 – Part 77 Airspace Plan.** The airport Airspace Plan is a plan view of all FAR Part 77 surfaces based on runway length, which has not changed.[16] The Plan uses a USGS base map and includes 50-ft contours on all slopes. It shows the penetrations to all Part 77 surfaces.

- **Sheet 12 – Airport Development Plan.** The Airport Development Plan highlights the infrastructure projects planned for the next 20 years.

- **Sheet 13 – Airport Property Map (Exhibit A).** The Airport Property Map presents the airport property line and a history of airport land purchases and acquisitions. Bearings and approximate distances from cardinal points define the airport property line. No changes were made to this Plan. It was included for reference purposes.

[16] Title 14, Code of Federal Regulations, Part 77, Safe, Efficient Use, and Preservation of The Navigable Airspace

Financial and Implementation Plan

The Financial Feasibility and Implementation Plan develop a financially feasible phased approach to implement the recommendations described in the Master Plan. The process identified the level of financial commitment and the specific funding strategies required to implement the recommendations over the next 20 years. Funding is estimated at a rough order of magnitude (ROM). This element of the master plan process:

- Examined potential funding strategies
- Provided a phased implementation and funding plan for the five-year, ten-year, and 20-year planning horizons
- Summarized the updated 20-year Capital Improvement Program (CIP)
- Delivered descriptions, justifications, and the point at which demand will trigger the need for development projects

Implementation Process

Several steps were necessary before completing a capital improvement project at LWM. In some cases, preparing for a facility improvement may start as early as five years before the actual need for the facility. This lead-in time may be necessary for coordination with the FAA and MassDOT regarding funding, environmental entitlement, and other regulatory compliance requirements, as well as time to complete site or facility design and construction.

Financial Overview

LWM operates under a "landlord-style" management structure whereby the Airport Commission leases land to tenants under established development requirements and minimum operating standards. Tenants develop hangars and other facilities according to their business models and contractual lease conditions. Each development is reviewed and approved by LMAC according to development guidelines and staff recommendations to ensure land is developed responsibly and not haphazardly, which could hinder the success of airport growth and safe operations. The Airport collects revenues from tenants through land rent and charges from a particular tenant and user activities. This revenue is then used to finance airport operations and capital improvements without needing local tax dollars. Assisted by a growing and prospering local and regional economy, this airport management model has proven successful for LWM for many years.

Funding Outlook

Typically, airports cannot satisfy capital development funding needs strictly from internal funding sources. Capital projects are generally funded from federal, state, local, and private sources, combined with airport funds and debt issuance. Project funding eligibility criteria vary depending upon the requirements established by each funding source, making it critical to examine each project element to determine its eligibility. Another important consideration is the availability of funds from each funding source.

Fortunately, sources that may be available to provide capital for preferred development projects are available at the federal and state levels.

- **State Funding.** The Commonwealth of Massachusetts funds airports in two ways: The MassDOT matching grant program and the Airport Safety and Maintenance Program (ASMP).

  MassDOT Aeronautics provides a 5% matching grant to any airport that receives a federal AIP grant and obtains its funding for airport development and planning projects from a General Appropriations account and State Transportation Bond Issuance, both of which are approved by the State Legislature. Appropriated funds are derived from aircraft registration fees, the aviation gas tax, and fees for air transportation charged to other state agencies.

  Under the ASMP, MassDOT Aeronautics can reimburse an airport sponsor for up to 100% of the total project cost.

- **Federal Funding.** Federal funding is available to airports through the FAA Airport Improvement Program (AIP), dependent upon the airport category. The role the Airport fills within the National Plan of Integrated Airport Systems (NPIAS), and the priority of the improvement as determined within the national priority ranking system are two determining factors in funding availability.

  Through congressional authorizations, LWM receives $150,000 of AIP non-primary entitlement money per fiscal year. General aviation airports expect to receive 90% of eligible costs from the FAA AIP for projects listed in their CIP and identified on an FAA-approved ALP. This means that the expected remaining 10% of total project costs must be matched at the state and local level. For example, when LWM matches 5% of AIP eligible project costs, MassDOT matches the remaining 5%.

  Additionally, discretionary grants are offered through the AIP depending on the availability of funds and the FAA's assessment of need and priority ranking. Historically, LWM has secured discretionary funding to support airfield safety improvements partly because of its importance as a reliever airport to Boston-Logan International Airport (BOS), one of the busiest airports in the US. But also, because the airport has a long record of maintaining the facility at the highest standards, something that the FAA and MassDOT notice.

  The AIP has been providing federal airport development and planning grants since the Airport and Airway Improvement Act of 1982 (PL 97-248). AIP funding is usually spent on projects that support aircraft operations, such as runways, taxiways, aprons, noise abatement, land purchase, and safety or emergency equipment. The funds obligated for the AIP are drawn from the Airport and Airway Trust Fund, which is supported by various user fees and fuel taxes.

Capital Improvement Plan

Based on the facility requirements and recommended development plan presented previously, a CIP was developed that lists projects proposed by this Master Plan Update. The CIP represents the proposed projects developed in the Update, combined with several existing and ongoing projects, and is shown by phase in Table 5.

Table 5. Capital Improvement Program

FEDERAL FISCAL YEAR	PROJECT	ESTIMATED FUNDING SHARE			
		PROJECT COST	FAA	MASSDOT	AIRPORT
SHORT-TERM (2022-2026)					
2022	Extend Taxiway C	$9,940,000	$8,946,000	$497,000	$497,000
2022	Environmental Assessment	$83,000	$74,700	$4,150	$4,150
2023	Administration Building	$6,500,000		$6,175,000	$325,000
2023	Avigation Easements	$1,500,000	$1,350,000	$75,000	$75,000
2024	Obstruction Removal	$750,000	$675,000	$37,500	$37,500
2024	ADA Improvements & Fire Suppression[17]	$1,000,000		$950,000	$50,000
2025	Wildlife Fence (NEPA & Permitting)	$175,000	$157,500	$8,750	$8,750
2026	Wildlife Fence (Construction)	$1,500,000	$1,350,000	$75,000	$75,000
	SHORT-TERM TOTALS	**$21,448,000**	**$12,553,200**	**$7,822,400**	**$1,072,400**
INTERMEDIATE -TERM (2027-2031)					
2027	Land Use Planning	$175,000	$157,500	$8,750	$8,750
2028	Purchase Loader & Blower	$400,000	$360,000	$20,000	$20,000
2029	Reconstruct Runway 14-32	$15,000,000	$13,500,000	$750,000	$750,000
2029	Install PAPI & REIL Runway 14	$200,000	$180,000	$10,000	$10,000
2030	Environmental Assessment for Land & Easement Acquisition	$50,000	$45,000	$2,500	$2,500
2031	Land Acquisition and Property Removal (Lot 32.3)	$3,600,000	$3,240,000	$180,000	$180,000
2031	Development Easement Acquisition (Lots 5.29-5.33, 5.37)	$350,000	$315,000	$17,500	$17,500
		$19,775,000	**$17,797,500**	**$988,750**	**$988,750**
LONG-TERM PROJECTS (2032-2041)					
2032	Taxiway A (Phase I)	$6,000,000	$5,400,000	$300,000	$300,000
2033	Environmental Assessment for Balance of Long-Term Projects	$150,000	$135,000	$7,500	$7,500
2038	Land Acquisition and Property Removal (Lot 32.1 & 32.2)	$4,200,000	$3,780,000	$210,000	$210,000
2039	Taxiway A (Phase II)	$2,500,000	$2,250,000	$125,000	$125,000
2040	MALSR Runway 23	$1,500,000	$1,350,000	$75,000	$75,000
	LONG-TERM TOTALS	**$14,350,000**	**$12,915,000**	**$717,500**	**$717,500**
	CIP TOTALS	**$55,573,000**	**$43,265,700**	**$9,528,650**	**$2,778,650**
	FUNDING SHARE		**77.9%**	**17.1%**	**5.0%**

As listed in Table 5, over the 20-year planning period, the airport is slated to spend approximately $2.8 million, including expenditures for land acquisition and property removal in the two RPZs. Although the amount listed is highly speculative because it is based on 2022 valuations set by the Town of North Andover. The general thought is that the RPZ effort will probably cost more than $50 million and will take many decades to accomplish. A more realistic cost estimate for the airport during the 20-year planning

[17] This project will be cancelled if the Administration Building slated for 2023 is constructed.

period is about $2.6 million based on 2022 dollars, so inflation must be considered when looking beyond the next few years.

In the short-term, between now and 2026, the airport's share is estimated at $1,072,400, of which the airport has planned. The medium-term cost estimates suggest that the airport's share will be just shy of $1 million.

The FAA's estimated share in the short-term is about $12.6 million and the MassDOT share is between $1.65 and $6.87 million depending on the final disposition of the planned new administration building. The lesser amount is based on no building funding and just the ADA and fire suppression upgrades. And the larger amount assumes building funding, which means the upgrades will no longer be required.

In total, the estimated project costs over the next 20 years, less the RPZ property acquisitions will be about $51 million.

Runway Protection Zones

The master plan study addressed the condition of the Airport's RPZs. As noted, the Runways 5 and 32 RPZs are mostly off Airport and not under the Airport's control through an easement, fee simple, or zoning. The study recommended the purchase of all developed properties within fee simple and a development easement on all undeveloped properties. Concurrently, the airport should petition the town of North Andover to implement strict zoning to prevent further conflicting uses.

As shown in Figures 17 and 18, forty-four properties in the Runway 5 and Runway 32 RPZs should be under the control of the LMAC to protect the people and properties. The unprogrammed projects include the property acquisition recommendations in the Runway 5 and 32 RPZs. The purchase of these properties in fee simple or through development easements and then the eventual removal of the buildings is the only reliable method of eliminating the impact of having people and property living and working in the RPZ. Therefore, acquisition of the properties is recommended when each becomes available for sale. Purchasing a development easement over undeveloped properties should proceed as soon as possible.

Figure 17. Runway 5 RPZ Acquisition Plan

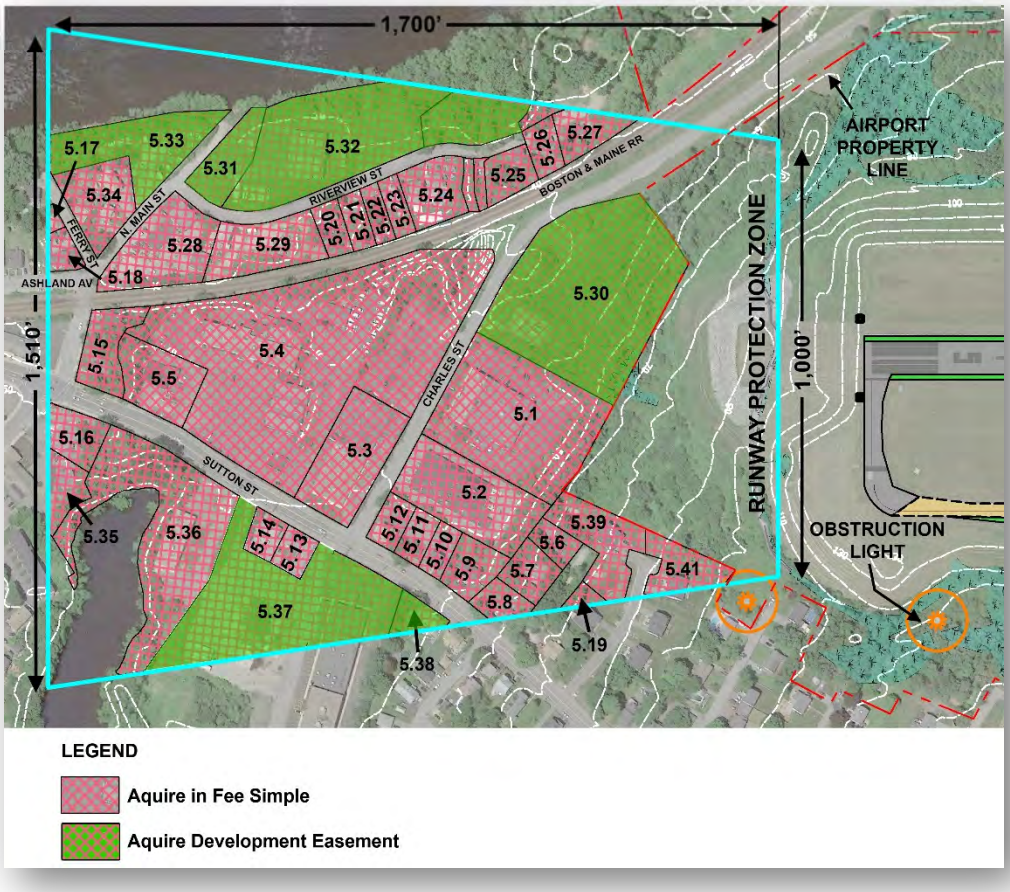
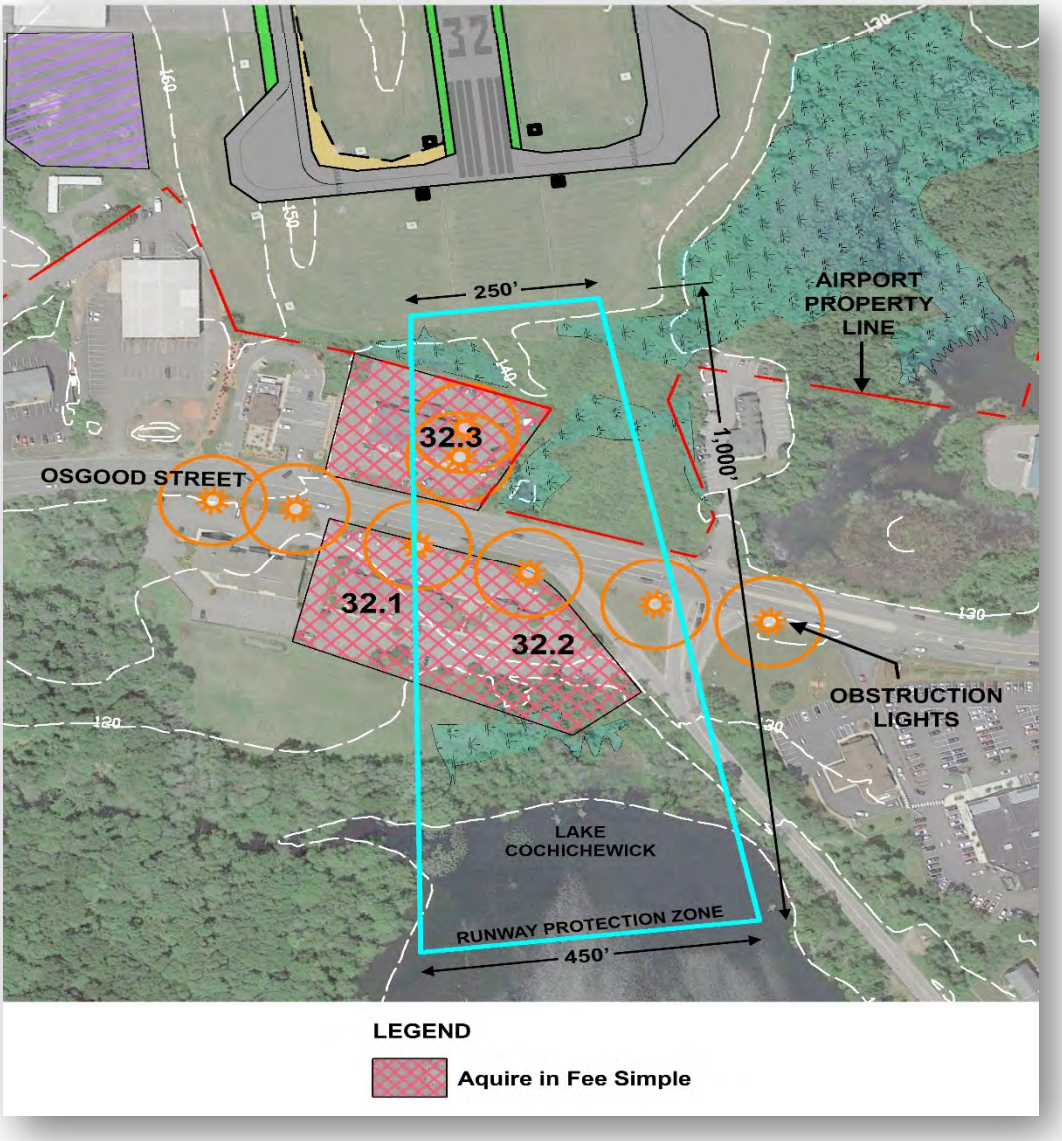


Figure 18. Runway 32 RPZ Acquisition Plan



It is recognized that this will be a very long-term process because of the number of properties impacted, with an estimated cost of over $50 million. For fee simple acquisition properties, the LMAC should consider sending each property owner a letter and notice of intent to purchase when the owner decides to sell the property and the reasons for this proposal. In addition, development easements should be coordinated directly with the property owners.

The timing of acquiring a development easement should be discussed internally between airport management and LMAC and then included in the Airport's capital improvement program after coordination with the Airport's consultant, MassDOT, and the FAA.

Figure 1. Airport Layout Plan