

CHAPTER 4. DEMAND CAPACITY ANALYSIS AND FACILITY REQUIREMENTS

4-1 Design Standards

F.A.A. Advisory Circular 150/5300-13 entitled, *Airport Design*, sets forth recommended runway and taxiway design standards for all reference code airports. The design standards for the current and future airport facilities are set forth in Table 4-1. Included on this table are the existing conditions, the proposed Runway 15-33 extension, and the proposed parallel light aircraft runway. Also included are the existing conditions and the dimensions that will be in effect if the recommended expansion of the airport occurs. It will be noted that the existing and future facilities meet all F.A.A. criteria except for the width of the taxiways.

TABLE 4-1 - AIRPORT DESIGN STANDARDS - AIRPORT REFERENCE CODE C III AIRPORT

Item	Runway 15R-33L				Runway 15L-33R	
	Existing (15-33)		Future (15R-33L)		Future	
	Lincoln Regional Airport	F.A.A. Standard	Lincoln Regional Airport	F.A.A. Standard	Lincoln Regional Airport	F.A.A. Standard
Approach Category and Design Group	C III	C III	C III	C III	B I	B I
Runway Width (foot)	100	100	100	100	75	60
Percentage Effective Gradient	0.0017	2% Max.	0.0017	2% Max.	0.0014	2% Max.
Runway Blast Pad Length (foot)	N/A	200	200	200	100	100
Runway Blast Pad Width (foot)	N/A	140	140	140	80	80
Runway Safety Area Width (foot)	500	500	500	500	120	120
Runway Safety Area - Distance Beyond Runway End (foot)	1,000	1,000	1,000	1,000	240	240
Runway Object Free Area Width (foot)	800	800	800	800	400	400
Runway Object Free Area - Distance Beyond Runway End (foot)	1,000	1,000	1,000	1,000	240	240
Runway Obstacle Free Zone Width (foot)	400	400	400	400	250	250
Runway Obstacle Free Zone - Distance Beyond Runway End (foot)	200	200	200	200	200	200
Runway Centerline to Taxiway Centerline Distance (foot)	900	400	400-900	400	200	225
Runway Centerline to Fixed or Moveable Object (foot)	1,088	500	1,088 East Side 500 West Side	500	200	200
Taxiway Width (foot)	40	50	50	50	50	25
Taxiway Safety Area Width (foot)	118	118	118	118	49	49
Taxiway Object Free Area Width (foot)	186	186	186	186	89	89
Taxiway Centerline to Fixed or Moveable Object (foot)	121	93	121	93	44.5	44.5

4-2 Airfield Capacity

F.A.A. Advisory Circular 150/5060-5, *Airport Capacity and Delay*, contains guidelines for determining airfield capacity and delays. The Annual Service Volume (ASV) is a reasonable estimate of the maximum annual capacity of the airfield facilities. The existing Lincoln Regional Airport with a single runway has an ASV of approximately 230,000 annual operations. In 2005 the total annual operations were 74,406, which is 32 percent of the ASV. By 2030 the forecast annual operations are 138,000, which is 60 percent of the ASV. It is expected that the annual demand-to-ASV ratio would increase to 80 percent in 2035 to 2040. F.A.A. recommends that when the annual demand-ASV ratio approaches 60 percent, planning should be underway for increasing the capacity of the facility and that by the time it reaches 80 percent the work should be accomplished to increase the capacity and thus decrease delays.

The capacity increase at this airport would be obtained by the construction of a parallel runway. The planning for this parallel runway should be started before 2030 with construction completed in the 2035 range. It is recommended that the parallel runway be constructed as a general aviation runway serving small aircraft so as to relieve the main runway for the larger aircraft operations. The parallel runway is recommended to be located between Taxiway A and existing Runway 15-33 with a runway centerline spacing of 700 feet to allow simultaneous VFR operations. The original 1976 Master Plan provided the necessary spacing between Runway 15-33 and Taxiway A to allow the construction of this runway. With 700-foot spacing between runways, simultaneous IFR operations on both runways are not allowed at this time. The IFR capacity is less than the VFR capacity because of spacing requirements. During IFR weather conditions, many aircraft are grounded and the capacity of the single runway will accommodate the anticipated IFR traffic. It is recommended that the runway be constructed between Taxiway F and Taxiway J, which would allow the development of a 3,350-foot long runway. The short runway should be an ARC B I category and be 75 feet wide by 3,350 feet long. No additional land will need to be acquired for the construction and operation of the proposed new parallel runway.

4-3 Runway Length

F.A.A. Advisory Circular 5325-4B, *Runway Length Requirements for Airport Design*, provides generalized plans for runway length requirements. For the Lincoln Regional Airport – with an airport elevation of 118 feet MSL, average maximum average temperature of hottest month of 97 degrees, 0 wind, and 0 runway gradient – the runway length requirement for large airplanes of 60,000 pounds or less is 7,300 feet for 75 percent of the fleet at 90 percent useful load and 9,200 feet for 100 percent of the fleet at 90 percent useful load. The design aircraft for future use at this airport are the business jets such as Citation X, Hawker Horizon, Gulfstream V and Global Express. Mead & Hunt calculated aircraft specific runway length requirements for these aircraft on the hottest days. The results of this analysis have been included in Table No. 4-2.

Table 3-4

TABLE 4-2 – RUNWAY LENGTH REQUIREMENTS

Runway Length Requirements			
Aircraft	Type	Max Take-Off Weight (pounds)	Required Runway Length (ft) ^{1/}
Citation X	Jet	35,700	6,863
Hawker Horizon	Jet	36,000	6,310
Gulfstream V	Jet	90,900	7,344
Global Express	Jet	95,250	6,995

Notes: Runway length requirements are based on the following assumptions:

- Airport elevation of 118 feet MSL
- Average maximum temperature of hot day = 97°
- Zero wind
- Zero runway gradient

^{1/} Required runway lengths are based on 100% of maximum take-off weight.

Sources: Aviation Week & Space Technology, Aerospace Source Book, 2003

Boeing Commercial Airplane Group Airport Planning Manuals—B737-600/ -700/ -800/ -900

Citation X Planning and Performance Manual

Source: Mead & Hunt, Inc., Lincoln Regional Airport Master Plan, October 2004, Table 3-4.

It will be noted that all of these aircraft required runway lengths in excess of 6,000 feet, and only the Gulfstream V required runway lengths greater than 7,000 feet. If the existing runway at Lincoln Regional Airport is extended to 7,000 feet it would adequately serve all of the expected fleet at all conditions except for the very hottest day with full load. On the hottest day the G-V would be required to offload somewhat or wait until the temperature cooled before taking off. It is, therefore, recommended that provisions be made for extending Runway 15-33 by 1,000 feet to a total length of 7,001 feet.

The 3,350-foot length of the proposed parallel runway will accommodate more than 95 percent of the fleet of the small airplanes having less than 10 passenger seats at the maximum temperature of 97 degrees F., which will adequately serve as a reliever runway for the small aircraft at this airport.

4-4 Pavement Strength

A Pavement Evaluation Study/Pavement Management Plan has been prepared by Reinard W. Brandley for the Lincoln Regional Airport. This study is under separate cover. The analysis shows that with existing and forecast traffic the remaining pavement life of all pavements, except the tee hangar taxilanes, is 16 to 20 years so far as subgrade failure is concerned. This analysis includes the forecast use of the G-V and Global Express type aircraft. The pavements at the airport are fairly old and have weathered significantly, and there are numerous cracks developing in the pavement due to weathering and thermal stresses. Rehabilitation of the surface pavement will be required within 6 to 10 years and the required maintenance will increase annually before

that time. After 18 to 20 years it will be necessary to provide a strengthening overlay or reconstruction of the pavements.

The existing pavements are rated to support single gear aircraft with a gross weight of 30,000 pounds or dual gear aircraft with a gross weight of 50,000 pounds. The Pavement Evaluation Study has shown that occasional use of these pavements by the heavier aircraft of the G-V and Global Express types weighing up to 90,000 pounds can be accommodated on the runway, taxiway, and that section of apron designed for the heavier aircraft without causing serious problems other than a slight decrease in the remaining life of the pavements.

It is recommended that the existing cracks on the airport pavements be sealed as early as possible. A Federally-funded project is underway in the summer of 2007 to seal the pavement cracks in the runway, taxiway and the apron. It is further recommended that this crack sealing and minor repairs of the pavement be continued as required until such time as the cost of maintenance makes further maintenance impractical. At that time it is recommended that the pavements be recycled and a thin overlay be placed. It is expected that this will occur within 6 to 10 years (2013 to 2017). In 18 to 20 years it is expected that it will be necessary to strengthen the pavements, and this will require a reconstruction of the sections.

4-5 Taxiway System

The existing taxiways adequately serve the existing runway and aprons at the Lincoln Regional Airport. When the runway is extended to 7,000 feet, it will be necessary to extend the parallel taxiway an equal distance and construct a new cross taxiway. A new aircraft holding apron will also be required on the new cross taxiway. The parallel taxiway – extended Taxiway A – required to serve the new runway extension can be located 400 feet centerline to centerline east of the runway extension without interference with the operation of the proposed new parallel runway. This taxiway location will eliminate the need to acquire additional land east of the proposed runway extension. The existing taxiway system will also serve the future parallel runway. In fact, when the original taxiway and runway system was constructed, it was anticipated that the parallel runway would be installed at the location recommended in this report, and the grades on the taxiway were set to accommodate this future runway.

The existing taxiways are 40 feet wide. For ARC C III classification F.A.A. recommends 50-foot wide taxiways. It is recommended that the critical taxiways serving the existing and proposed lengthened Runway 15-33 be widened to a width of 50 feet. It would be appropriate to include this widening at the same time as the rehabilitation of the pavement on the taxiways in the 6 to 10 year timeframe.

4-6 Airfield Safety Areas

Airfield safety areas are set forth in F.A.A. Advisory Circular 150/5300-13 and FAR Part 77. The Airport Design Manual defines the requirements for Runway Protection Zones (RPZ), Runway Safety Areas (RFA), and Obstacle Free Areas (OFA). FAR Part 77 defines surfaces surrounding the airport above which objects penetrating those surfaces will affect navigable airspace. These surfaces include primary surface, approach surface, transitional surface, horizontal surface, and conical surface. The Lincoln Regional Airport meets all of the design standards for the airfield safety areas as set forth in Advisory Circular 150/5300-13 and, except for a few trees and poles, there are no obstructions that penetrate the FAR Part 77 surfaces. These obstructions have been tentatively identified, and the Airport is in the process of identifying the existence and location of any obstructions and taking action to remove or trim the items so as to eliminate all obstructions.

4-7 Navigational Aids (NAVAIDs)

NAVAID requirements for the Lincoln Regional Airport are based on guidance contained in 150/5300-13, *Airport Design*, and F.A.A. Order 7031.2C, *Airway Planning Standards Number One-Terminal Air Navigation Facilities and Air Traffic Control Services*. NAVAIDs provide precision and non-precision guidance to a runway or to an airport. Precision NAVAIDs provide the pilot with both vertical and horizontal course guidance. Non-precision approach provides only horizontal course guidance. These facilities are used for navigation to the airport and for setting up approaches to the runway.

There are three categories of NAVAIDs used by pilots operating to and from Lincoln Regional Airport:

- Terminal Area NAVAIDs - Terminal Area NAVAIDs provide positive control to an aircraft and maintain orderly flow of air traffic within a specified area. Terminal NAVAIDs currently available to Lincoln Regional Airport include the Oakland Air Route Traffic Control Center (ARTCC) and Norcal Approach/Departure Control.
- Electrical Approach NAVAIDs – The electrical approach NAVAIDs assist the pilot in executing an instrument approach to an airport. Lincoln Regional Airport is currently equipped with a Category 1 instrument landing system on Runway 15 with current minimums for this approach at ½ mile visibility and 200 foot ceiling. The Airport also has a non-precision VOR GPS approach to Runway 15 and a GPS approach to Runway 33. It is recommended that the Airport acquire GPS with F.A.A.'s Wide Area Augmentation System (WAAS) to provide better navigation accuracy and lower minimums.

With instrument approaches to the runway it is important that the Airport protect the approach surfaces to each runway end to accommodate the type of approach that is available with the current and future NAVAIDs. The

approach surface for Runway 15 extends at a slope of 50:1, which meets F.A.A. requirements. Runway 33 is currently a non-precision runway and has an approach surface that extends at a slope of 34:1, which also meets F.A.A. requirements. These approach surfaces should be maintained clear and the Airport should maintain control of the area under these surfaces, either by ownership of the land or avigation easements on the property. When the main runway is extended 1,000 feet to the north, the 50:1 approach surface will also be extended, and it will be necessary that the City obtain additional land or easements to provide protection for the RPZ to this runway.

- Visual NAVAIDs – Visual NAVAIDs available at the Lincoln Regional Airport include:
 - ◆ Visual approach slope indicator (VASI) – Runway 15 and Runway 33
 - ◆ Medium intensity approach lighting system and runway alignment indicator lights (MALSR) – Runway 15
 - ◆ Wind cones and segmented circle and rotating beacon

These visual NAVAIDs meet all F.A.A. requirements. The VASI units are being phased out, and the existing VASIs are being removed and replaced with 4-box PAPI units in a contract that will be completed in the summer of 2007.

4-8 Air Traffic Control Tower

An Air Traffic Control Tower's primary purpose is to ensure a safe airport environment by providing sufficient separation between aircraft landing and departing. As aircraft operations increase and the mix of aircraft types varies, the need for a control tower increases. Provision should be made in the Airport Layout Plan for the installation of an Air Traffic Control Tower.

4-9 General Aviation Facility Requirements

Based aircraft are either stored in hangars or tied down in the aircraft parking apron. Transient aircraft are generally tied down on the apron, but some aircraft owners staying overnight request hangar facilities. With the increased cost and sophistication of the general aviation aircraft, most pilots will store their aircraft in hangars if available rather than tie them down on the aircraft parking apron. Of the 231 aircraft currently based at Lincoln Regional Airport, 171 to 182 are stored in hangars and the rest are tied down on the apron. There is a waiting list for new hangar storage, some of which are pilots who currently store their aircraft off site and others are pilots who have aircraft tied down on the apron. If hangars are available, it is estimated that 80 to 85 percent of the fleet will be stored in hangars and the remaining on the aircraft tie down apron.

Hangar storage facilities constructed should include tee hangars for light twin engine and single engine aircraft, box hangars for larger aircraft, and corporate hangars for the larger business jets.

In their 2004 Master Plan Mead & Hunt prepared as Table 3-6 the general aviation facility requirements table for this airport. This table is included in this report as Table 4-3. The data included in this table appears reasonable for use in evaluating the requirements for general aviation facilities, and it is recommended that planning include development of hangar and apron space to accommodate the forecast requirements.

It will be noted that there is a significant need for both tee hangars and conventional hangars and that the existing aircraft parking apron is significantly larger than will be needed. Portions of the existing aircraft parking apron could be used for the development of future hangars.

TABLE 4-3 – GENERAL AVIATION FACILITY REQUIREMENTS

Table 3-6
General Aviation Facility Requirements

Facility	Existing Capacity	Requirements				
		2002/2003	2008	2013	2023	2033
Based Aircraft	198	218 1/	229	258	318	400
T-Hangars						
Aircraft Stored	142	142	152	166	203	252
Square Feet	183,700	184,600	197,600	215,150	263,250	326,950
Conventional Hangars						
Aircraft Stored	29-40	26	27	35	52	77
Square Feet	126,200	51,000	57,700	74,900	112,500	168,000
Aircraft Parking Apron						
Based Aircraft (Spaces)	230	50	50	57	64	72
Based Aircraft (Square Yards)	93,000	15,000	15,000	17,100	19,200	21,600
Transient Aircraft (Spaces)	10	24	30	43	65	86
Transient Aircraft (Square Yards)	3,600	8,491	10,878	15,480	23,373	30,800
Total Apron Square Yards	107,600	23,491	25,878	32,580	42,573	52,400
Auto Parking (Public)						
Spaces	36	54	67	79	103	135
Square Yards	1,600	2,400	2,970	3,510	4,570	5,990

Source: Mead & Hunt, Inc., 2003

Source: Mead & Hunt, Inc., Lincoln Regional Airport Master Plan, October 2004, Table 3-6.

The Airport Layout Plan provides for construction of new hangars on the east side and west side of the airport. Some of the hangars are shown to be constructed on a portion of the surplus tie down apron and others in undeveloped areas.

A summary showing a comparison of required facilities and proposed facilities on the east side of the airport for the year 2033 is presented in Table 4-4. It will be noted that there is adequate space on the east side of the airport to accommodate most of the forecast growth except for the corporate hangars. Experience at other airports indicates that there is a significant demand at an airport such as Lincoln Regional Airport for corporate hangars in the 100 foot by 100 foot hangar size if space and infrastructure are available. The Airport Layout Plan recommends reserving area on the west side of the runway for additional facility development. Space is provided for corporate hangars, tee hangars, box hangars, an FBO, a jet center, and a tie down apron. It would be advisable to concentrate the business jet activity using corporate hangars in one area away from the smaller general aviation fleet.

The development of the west side of the airport will be driven by need.

**TABLE 4-4 – GENERAL AVIATION FACILITY REQUIREMENTS AND AVAILABILITY COMPARISON
EAST SIDE AIRPORT DEVELOPMENT FOR 2033**

Facility	Requirements in 2033	Planned Facilities in 2033
Based Aircraft	400	400
Tie Down Spaces – Transient Aircraft	86	67
Based Aircraft	72	72
Total Aircraft	158	139
Hangars - Tee Hangars	252	327
Conventional Hangars	77	70
Corporate Hangars	Varies	1
Total Hangars	329	397
Automobile Parking Spaces	135	124

4-10 FBO and Administration Facilities

There are currently four FBOs located at Lincoln Regional Airport providing various aviation services. As the airport grows, there will be need for one or more full-service FBOs on the airport. There are several industrial parks developed in the Lincoln area which are served by the Lincoln Regional Airport. Business jets and larger turboprop aircraft serve these businesses. Additionally, Lincoln Regional Airport serves the industrial and corporate businesses of Placer County, Roseville, and Rocklin given that Lincoln Regional Airport is the largest air facility and has the largest jet capacity in Placer County and for its service area. With the increase of the business jet operations serving commercial/industrial facilities of the region and possible introduction of shuttle airline service or air taxi service, there will be need for the development of an arrival/departure building and of a jet center at the airport. The arrival/departure building should include administration facilities, pilots' lounge, weather information terminals, concession areas, rest rooms, etc. Consideration should be given to

including a restaurant in this facility. The jet center could consist of a large hangar adjoining the arrival/departure building, which could be used for short-term aircraft storage, aircraft maintenance, catering, and servicing facilities and/or a full service FBO.

4-11 Helicopter Facilities

The existing helicopter facilities include a helicopter landing pad and three helicopter parking spots adjacent to the helipad. This facility is located between Taxiway A and the apron. Future development of aircraft storage areas may dictate that these helicopter facilities be moved to the west side of the airport. Planning for a replacement helipad should include potential parking areas for five to six helicopters.

4-12 Fuel Storage

The Airport's fuel service facility is located on the aircraft apron near the Airport Administration Building. Jet-A and 100 Low Lead fuel are stored in 12,000-gallon underground tanks. The City of Lincoln operates the fueling service at the airport using refueler trucks and self-fueling stations. This fueling facility is located in a prime development area. The City of Lincoln plans to relocate this existing facility in the near term. When the west side area develops, consideration should be given to including fueling facilities.

4-13 Airport Maintenance

Airport maintenance is currently provided by the City of Lincoln, Lincoln Regional Airport. There are currently no facilities on the airport to store maintenance vehicles and/or equipment. The City of Lincoln plans to create a formalized airport maintenance and operations building and yard area.

4-14 Utilities

Existing utilities, including water, sewer, electrical, and communication, exist on Airport Boulevard and portions of Flightline Drive. As the west side of the airport develops, it will be necessary to extend the utilities to service the new facilities. In order to plan an orderly development of the airport, a Utility Master Plan should be prepared that shows the location and size of all required utilities, both on the east side and on the west side of the airport.

4-15 Security

Security at all airports, including general aviation airports, has become a high priority item. The Lincoln Regional Airport has a chain link and barbed wire fence around the perimeter of the improved airfield area with controlled entry on the east side of the airport. As the west side of the airport develops, sections of the fence in this area will need to be relocated and controlled access provided in this area. Future requirements may also include perimeter monitoring of the airport property.