Chapter 3

Facility Requirements

Proper airport planning requires the translation of forecast aviation demand into the specific types and quantities of facilities that can adequately serve the identified demand. This chapter will analyze the existing capacities of Baraboo-Wisconsin Dells Regional Airport (DLL) facilities. The existing capacities will then be compared to the forecast activity levels prepared in Chapter Two to determine the adequacy of existing facilities, as well as to identify any deficiencies that currently exist or may be expected to materialize in the future. This chapter will present the following elements:

- Demand-Based Planning Horizons
- Airfield Capacity
- Airside Facility Requirements
- Landside Facility Requirements

The objective of this effort is to identify, in general terms, the adequacy of existing airport facilities, outline what new facilities may be needed, and determine when these may be needed to accommodate forecast demands. Having established these facility requirements, alternatives to providing these facilities will be evaluated to determine the most practical, cost-effective, and efficient means for implementation.

The facility requirements for DLL were evaluated using guidance contained in several Federal Aviation Administration (FAA) publications, including the following:

- Advisory Circular (AC) 150/5300-13B, *Airport Design*
- AC 150/5060-5, *Airport Capacity and Delay*
- AC 150/5325-4B, *Runway Length Requirements for Airport Design*
- Federal Aviation Regulation (FAR) Part 77, *Objects Affecting Navigable Airspace*
- FAA Order 5090.5, *Formulation of the National Plan of Integrated Airport Systems (NPIAS) and the Airports Capital Improvement Plan (ACIP)*

DEMAND-BASED PLANNING HORIZONS

An updated set of aviation demand forecasts for DLL has been established and was detailed in Chapter Two. These activity forecasts include annual aircraft operations, based aircraft, aircraft fleet mix, and peaking characteristics. With this information, specific components of the airside and landside system can be evaluated to determine their capacity to accommodate future demand.

Cost-effective, efficient, and orderly development of an airport should rely more on actual demand at an airport rather than on a time-based forecast figure. To develop a master plan that is demand-based rather than time-based, a series of planning horizon milestones has been established that takes into consideration the reasonable range of aviation demand projections. The planning horizons are the short term (1-5 years), the intermediate term-(6-10 years), and the long term (11-20 years).

It is important to consider that the actual activity at the airport may be higher or lower than what the annualized forecast portrays. By planning according to activity milestones, the resultant plan can accommodate unexpected shifts or changes in the area's aviation demand by allowing airport management the flexibility to make decisions and develop facilities based on need generated by actual demand levels. The demand-based schedule provides flexibility in development, as development schedules can be slowed or expedited according to demand at any given time over the planning period. The resultant plan provides airport officials with a financially responsible and needs-based program. **Table 3A** presents the short-, intermediate-, and long-term planning horizon milestones for each aircraft activity level forecasted in Chapter Two.

TABLE 3A | Planning Horizon Activity Levels

		PLANNING HORIZON		
	Base Year (2022)	Short Term (1-5 Years)	Intermediate Term (6-10 Years)	Long Term (11-20 Years)
ANNUAL OPERATIONS				
Itinerant				
Air Carrier	0	0	0	0
Air Taxi	226	311	429	700
General Aviation	11,144	12,489	13,185	14,634
Military	1,000	1,000	1,000	1,000
Local				
General Aviation	7,430	8,090	8,232	8,532
Military	0	0	0	0
Total Annual Operations	**19,800**	**21,890**	**22,846**	**24,866**
BASED AIRCRAFT	**53**	**57**	**62**	**72**

Source: Coffman Associates analysis

AIRFIELD CAPACITY

An airport's airfield capacity is expressed in terms of its annual service volume (ASV) and is a reasonable estimate of the number of operations that can be accommodated in a year before significant delay occurs. ASV accounts for runway use, aircraft mix, and weather conditions. The airport's ASV was analyzed following guidance from FAA AC 150/5060-5, *Airport Capacity and Delay*.

Based on the number of recorded operations by aircraft from January 2000 to December 2022, it is estimated that no more than 30 percent of the total operations at the airport are conducted by aircraft over 12,500 pounds. Therefore, using AC 150/5060-5 and guidelines set for airports with a single primary runway and an intersecting crosswind runway, the airfield's ASV is estimated to be 200,000 annual operations. Through the long-term planning horizon, DLL is forecast to have approximately 24,866 operations, which would be 12.4 percent of the airport's ASV. According to FAA Order 5090.5, planning for capacity improvement projects should begin when operations reach approximately 60 percent of ASV. Since this threshold is not projected to be met over the next 20 years, no projects specifically triggered by a capacity deficiency are planned.

AIRFIELD REQUIREMENTS

The analyses of the operational capacity and the critical design aircraft are used to determine airfield needs. This includes runway configuration, dimensional standards, and pavement strength, as well as navigational aids, lighting, and marking. Runway length requirements will focus on Runway 1-19 since it is the airport's primary runway, while other elements of this chapter will not only address Runway 1-19, but also Runway 14-32 in both turf and paved versions for the future condition.

RUNWAY CONFIGURATION

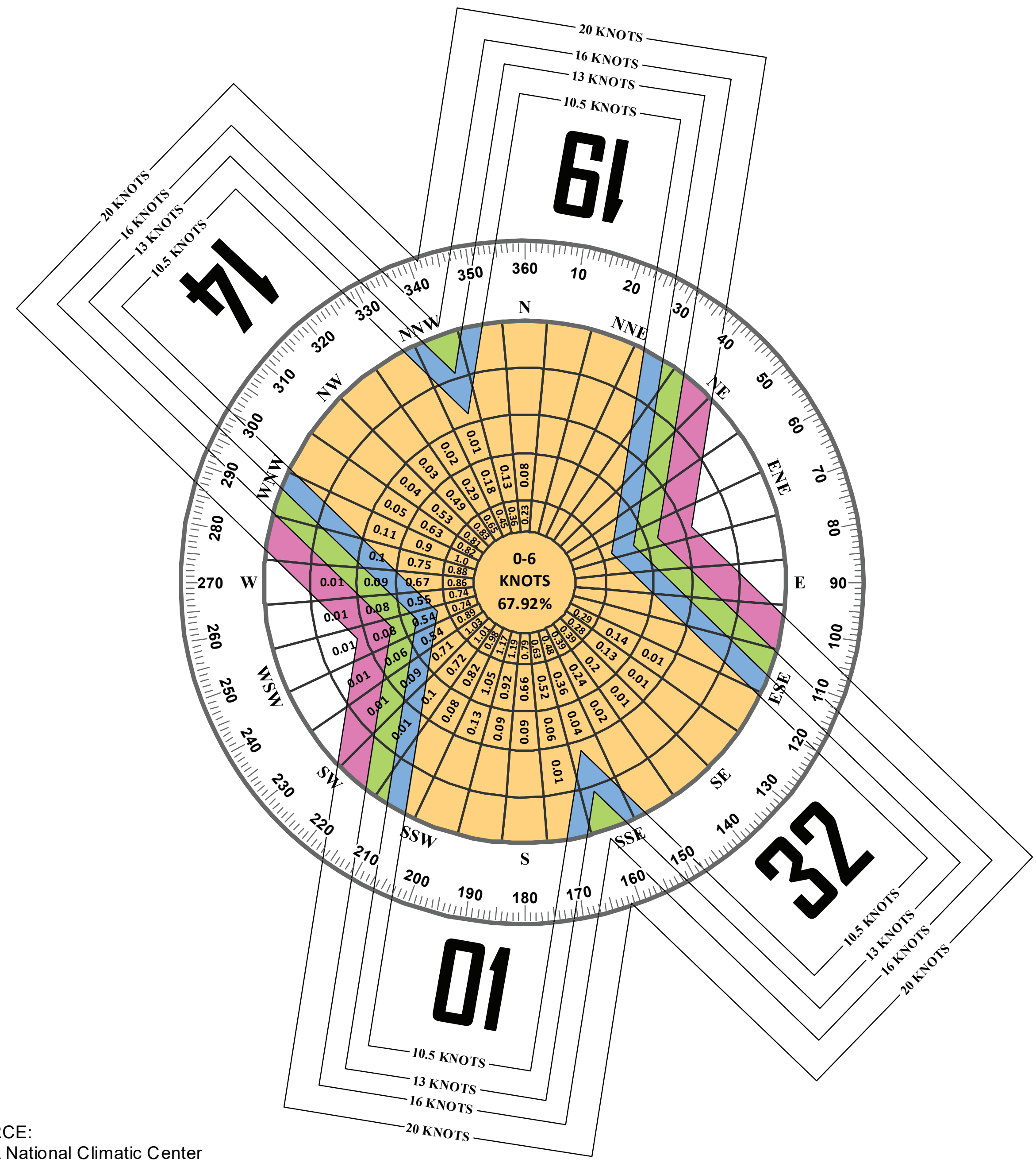
Key considerations in the runway configuration of an airport involve the orientation for wind coverage and the operational capacity of the runway system. FAA AC 150/5300-13B, *Airport Design*, recommends that a crosswind runway be made available when the primary runway orientation provides less than 95 percent wind coverage for any aircraft forecast to use the airport on a regular basis.

The 95 percent wind coverage is computed on the basis of the crosswind component not exceeding 10.5 knots (12 mph) for ARC A-I and B-I; 13 knots (15 mph) for ARC A-II and B-II; 16 knots (18 mph) for ARC A-III, B-III, and C-I through D-II; and 20 knots (23 mph) for ARC C-III through D-IV.

The previous 10 years of wind data were obtained from the on-airport automated weather observing system (AWOS) and have been analyzed to identify wind coverage provided by the existing runway orientations. At DLL, the orientation of the primary runway (Runway 1-19) provides 93.7 percent coverage for the 10.5-knot crosswind component, and greater than 96 percent coverage for the 13-knot component and greater. The current orientation of Runway 1-19 meets the wind coverage for the crosswind component for ARC B-II and C-II, the existing and ultimate runway design codes.

The turf runway, which has been identified as having a design code of A-I, provides 93.3 percent coverage for a 10.5-knot crosswind component, and above 96 percent for all crosswind components 13 knots and higher. The combined crosswind configuration provides greater than 95 percent wind coverage for all crosswind component conditions; thus, the runway configuration is adequate for the wind conditions at DLL and no modification to either runway orientations is needed. Both the visual and instrument flight rules (VFR and IFR) wind roses are shown on **Exhibit 3A**.

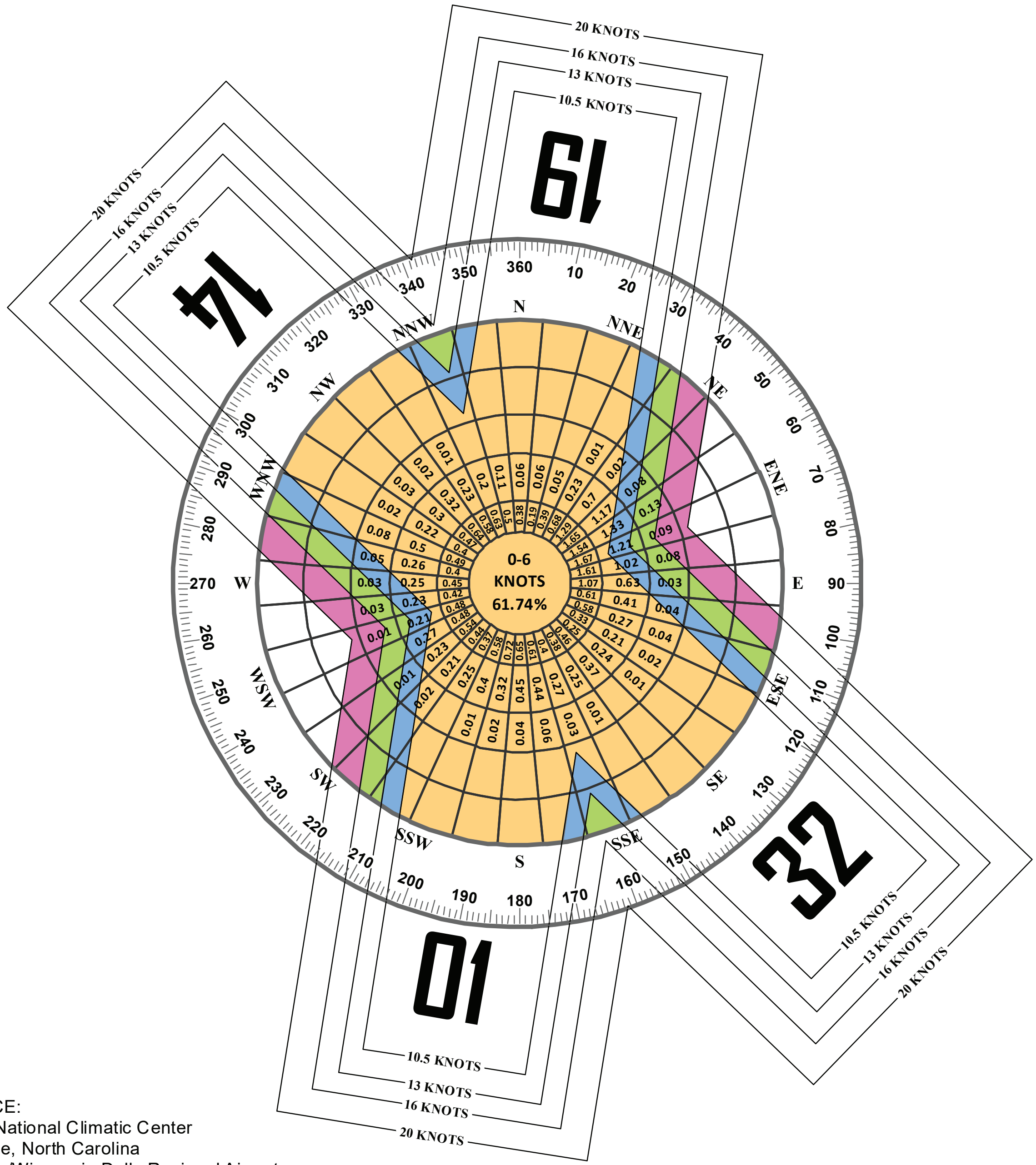
ALL WEATHER WIND COVERAGE				
Runways	10.5 Knots	13 Knots	16 Knots	20 Knots
Runway 1-19	93.72%	96.69%	99.28%	99.87%
Runway 14-32	93.30%	96.52%	99.25%	99.87%
All Runways	97.71%	99.31%	99.86%	99.98%



SOURCE:
NOAA National Climatic Center
Asheville, North Carolina
Baraboo/Wisconsin Dells Regional Airport
Baraboo, WI

OBSERVATIONS:
255,239 All Weather Observations
Jan. 1, 2013 - Dec, 31 2022

IFR WIND COVERAGE				
Runways	10.5 Knots	13 Knots	16 Knots	20 Knots
Runway 1-19	93.93%	97.08%	99.45%	99.93%
Runway 14-32	93.59%	96.72%	99.50%	99.94%
All Runways	97.02%	99.21%	99.89%	100.00%



SOURCE:
NOAA National Climatic Center
Asheville, North Carolina
Baraboo/Wisconsin Dells Regional Airport
Baraboo, WI

OBSERVATIONS:
31,057 IFR Weather Observations
Jan. 1, 2013 - Dec, 31 2022

RUNWAY LENGTH REQUIREMENTS

Aircraft operate on a wide variety of available runway lengths. Many factors govern the suitability of those runway lengths for aircraft, such as elevation, temperature, wind velocity, aircraft operating weight, wing flap settings, runway condition (wet or dry), runway gradient, vicinity airspace obstructions, and any special operating procedures.

FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design*, provides a five-step process for determining runway length needs:

1. Identify the list of critical design airplanes that will make regular use of the proposed runway.
2. Identify the airplanes or airplane group that will require the longest runway length at maximum certificated takeoff weight (MTOW).
3. Determine which of the three methods described in the AC will be used for establishing the runway length.
4. Select the recommended runway length from the appropriate methodology.
5. Apply any necessary adjustments to the obtained runway length.

The three methodologies for determining runway length requirements are based on the MTOW of the critical design aircraft or the airplane group. The airplane group consists of multiple aircraft with similar design characteristics. The three weight classifications are those with a MTOW of 12,500 pounds or less; those airplanes weighing over 12,500 pounds but less than 60,000 pounds; and those weighing 60,000 pounds or more. **Table 3B** shows these classifications and the appropriate methodology to use in runway length determination.

TABLE 3B | Airplane Weight Classification for Runway Length Requirements

Airplane Weight Category (MTOW)	Design Approach	Methodology
12,500 pounds or less		
• *Approach speeds of less than 30 knots*	Family grouping of small airplanes	Chapter 2: para. 203
• *Approach speeds of at least 30 knots but less than 50 knots*	Family grouping of small airplanes	Chapter 2: para. 204
• *Approach speeds of 50 knots or more with less than 10 passengers*	Family grouping of small airplanes	Chapter 2: para. 205, Figure 2-1
• *Approach speeds of 50 knots or more with 10 or more passengers*	Family grouping of small airplanes	Chapter 2: para. 205, Figure 2-1
Over 12,500 pounds but less than 60,000 pounds	Family grouping of large airplanes	Chapter 3: Figures 3-1 or 3-2 and Tables 3-1 or 3-2
60,000 pounds or more or Regional Jets	Individual large airplanes	Chapter 4: Airplane Performance Manuals

Source: FAA AC 150/5325-4B, Runway Length Requirements for Airport Design

Using FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design*, the following presents the five-step process for determining the recommended runway length for Runway 1-19.

Step 1: Identify the critical design airplanes or airplane group.

The first step in determining the recommended runway length for an airport is to identify the critical design aircraft or family grouping of aircraft with similar design characteristics. The critical design aircraft or airplane group accounts for at least 500 annual operations. The FAA's Traffic Flow Management System Counts (TFMSC) database documents those aircraft that fly IFR (with a filed flight plan to or from the airport) and/or those operations captured by FAA radar. Local operations are not captured in the TFMSC. **Table 3C** summarizes the TFMSC data for DLL by weight class. All other operations at the airport are conducted by small piston-powered aircraft weighing less than 12,500 pounds.

TABLE 3C | Jet and Turboprop Operations by Weight Class

	OPERATIONS				
WEIGHT CLASS	**2018**	**2019**	**2020**	**2021**	**2022**
12,500 lbs. or less	160	190	80	190	210
Over 12,500 lbs. but less than 60,000 lbs.	360	764	576	930	970
60,000 lbs. or more	0	4	0	2	4
TOTAL JETS AND TURBOPROPS	**520**	**958**	**656**	**1,122**	**1,184**
Total Jet Operations	348	762	574	910	914
Total Turboprop Operations	172	196	82	212	270

Source: FAA Traffic Flow Management System Counts (TFMSC)

As can be seen in **Table 3C**, there is an average of 720 annual operations by aircraft with a MTOW over 12,500 but less than 60,000 pounds over the last five years. DLL seldom experiences any operations by aircraft with a MTOW greater than 60,000 pounds. Also, over the last five years, the airport has averaged 700 business jet operations with the trend indicating future growth. Therefore, the appropriate runway length methodology is to examine the general runway length tables from Chapter 3 of AC 150/5325-4B, which apply to airports with a significant level of business jet activity.

Step 2: Identify the airplanes or airplane group that require the longest runway length at maximum certificated takeoff weight (MTOW).

Table 3C distinguishes between operations by jets and turboprops. Jet aircraft typically require the longest runway lengths; therefore, the runway length curves in Chapter 3 of AC 150/5325-4B will be utilized. **Exhibit 2H** previously documented the specific business jets and turboprops that operate at the airport.

Step 3: Determine which of the three methods described in the AC will be used for establishing the runway length.

The third step in the runway length recommendation guidance is to select the specific methodology to use. Chapter 3 of the AC groups business jets weighing over 12,500 pounds but less than 60,000 pounds into the following two categories:

- 75 percent of the fleet
- 100 percent of the fleet

The AC states that the airplanes in the 75 percent of the fleet category generally need 5,000 feet or less of runway at mean sea level (MSL) and standard day temperature (59° F), while those in the 100 percent of the fleet category need more than 5,000 feet of runway under the same conditions.

The AC indicates that the airport designer must determine which category to use for runway length determination. According to the AC, if relatively few airplanes under evaluation are in the 100 percent of the fleet category, then this category should be used for runway length determination. It should be noted that, while there is not a specific operational threshold that determines which category may be used to calculate runway length requirements, **only those operations of aircraft or family of aircraft having more than 500 annual operations will justify the specific runway length**.

Table 3D presents the TFMSC operations data at DLL for the 100 percent of the fleet category. For each of the past five years, there has been an average of nearly 90 operations by jet aircraft in 100 percent of the fleet category; therefore, the 100 percent of the fleet category will also be used to determine runway length for DLL.

TABLE 3D | Jet Operations in the 100 Percent of the Fleet Category

	OPERATIONS				
Aircraft Type	**2018**	**2019**	**2020**	**2021**	**2022**
Challenger 600/601/604	0	2	4	2	0
Citation III/IV	2	4	2	6	4
Citation X	2	0	0	2	4
Falcon 900C/900EX	2	2	0	2	8
Falcon 2000/2000EX	8	14	8	20	12
IAI Astra 1125	0	2	0	0	0
Learjet 45XR	8	10	2	0	6
Learjet 60	4	2	4	4	2
Hawker 800/800XP	0	98	100	58	24
Hawker 1000	4	0	0	0	0
TOTAL OPERATIONS	**30**	**134**	**120**	**94**	**60**

Source: FAA Traffic Flow Management System Counts (TFMSC)

There are two runway length curves presented in the AC under both the 75 and 100 percent of the fleet categories:

- 60 percent useful load
- 90 percent useful load

The useful load is the difference between the maximum allowable structural weight and the operating empty weight (OEW). The useful load consists of passengers, cargo, and usable fuel. The determination of which useful load category to use will have a significant impact on the recommended runway length; however, it is inherently difficult to determine because of the variable needs of each aircraft operator. For shorter flights, pilots may take on less fuel; however, pilots may prefer to ferry fuel so that they do not have to refuel frequently. Because of the variability in aircraft weights and haul lengths, the 60 percent useful load category is considered the default, unless there are specific known operations that would suggest using the 90 percent useful load category. Examples of a need to use the 90 percent useful load category include regular air cargo flights, long haul flights (i.e., cross-country), or known fuel-ferrying needs. For this analysis, the default 60 percent useful load category will be used.

Step 4: Select the recommended runway length from the appropriate methodology.

The next step is to examine the 100 percent of the fleet at 60 percent useful load performance chart in Figure 3-2 of the AC (**Figure 3A**). This chart requires the following knowledge:

- The mean maximum daily temperature of the hottest month: July at 82.8°F
- The airport elevation: 979.3 feet above MSL

By locating the appropriate temperature and airport elevation on the performance chart, the recommended runway length – without any adjustments – is approximately 5,400 feet. A formula derived from the AC provides a more specific length requirement of 5,423 feet.

Step 5: Apply any necessary adjustments to the obtained runway length.

The recommended runway length determined in Step #4 is based on zero effective runway gradient and a dry runway surface. Step #5 applies adjustments to the raw runway length for these factors. The adjustments are <u>not cumulative</u>, since the first length adjustment applies to takeoffs and the latter to landings. Any final runway length obtained is rounded to the nearest hundred if above 30 feet; otherwise, the length is rounded down to the nearest hundred. Once the adjustments are made, the higher of the two is the recommended runway length.

With an 0.19 percent effective runway gradient (9.6 feet of elevation difference for Runway 1-19), the runway length obtained from Step #4 is increased at the rate of 10 feet for each foot of elevation difference between the high and low points of the runway centerline. At DLL, this equates to an additional 96 feet of required runway length. This results in a recommended runway length of 5,519 feet for takeoff operations.

For landing operations in wet conditions, the runway length obtained in Step #4 is increased 15 percent up to a maximum 5,500 feet for the 60 percent useful load category and 7,000 feet for the 90 percent useful load category. Since the additional length is calculated to be 6,236 feet, the maximum allowable length for the 60 percent useful load is 5,500 feet.

If there is specific justification to use the 90 percent useful load category, then the recommended runway lengths would be 7,000 for 75 percent of the fleet and 8,200 feet for 100 percent of the fleet. That justification does not exist today. Therefore, **the recommended runway length for DLL, following FAA guidance, is 5,500 feet.**

Table 3E summarizes the data inputs and the final recommended runway length of 5,500 feet.

TABLE 3E | Business Jet Runway Length Requirements

Airport Elevation:	979.3 feet above MSL			
Average High Monthly Temperature:	82.8 degrees F (July)			
Runway Gradient:	0.19% Runway 1-19 (9.6' elevation change)			
Fleet Mix Category	**Raw Runway Length from FAA AC**	**Runway Length with Gradient Adjustment**	**Wet Surface Landing Length for Jets (+15%)[1]**	**Final Runway Length**
75% of fleet at 60% useful load	4,718	4,814	5,425	5,400
100% of fleet at 60% useful load	**5,423**	**5,519**	**5,500**	**5,500**
75% of fleet at 90% useful load	6,317	6,413	7,000	7,000
100% of fleet at 90% useful load	8,055	8,151	7,000	8,200

[1]Max 5,500' for 60% useful load and max 7,000' for 90% useful load in wet conditions
Note: All lengths are in feet
Boldface indicates recommended runway length calculation
Source: FAA AC 150/5325-4B, Runway Length Requirements for Airport Design

Supplemental Runway Length Analysis for Specific Business Jets Operating at DLL

The official runway length methodology previously presented determined that the airport could have a need for a runway length up to 5,500 feet based on existing and projected activity levels by larger, faster C/D-II business jets (those in the 100 percent fleet mix category). In some cases, this generalized methodology may not account for different conditions that may apply to specific aircraft models. The following discussion examines the runway length needs for specific aircraft that can operate at the airport by examining the flight planning manuals of a variety of aircraft.

The flight planning manuals of several business jets and turboprops were analyzed for takeoff and landing length requirements under the local condition of a design temperature of 82.8°(F) at a field elevation of 979.3 feet MSL. **Exhibit 3B** provides detailed runway takeoff and landing length analyses for the most common business jet and turboprop aircraft in the national fleet. This data was obtained from Ultranav software, which computes operational parameters for specific aircraft based on the flight planning manuals for each aircraft, with the exception of the Embraer Legacy 500 (the ultimate critical design aircraft). Runway length calculations for the Legacy 500 were derived from the flight planning guide provided by Embraer. The resulting runway length figures are shaded green or red, based on their relation to the current length of Runway 1-19 (5,010 feet), with red figures exceeding the current runway length.

Takeoff Length Requirements

The runway takeoff length analysis calculates the length needed for a specific aircraft to safely perform a departure from an airport, given the airport's specific conditions (elevation, max temperature, and runway grade). It includes the MTOW allowable and the useful load from 60 percent to 100 percent.

This analysis shows that during the hottest periods of the year, Runway 1-19 can accommodate all but three aircraft evaluated at 60 percent useful load. At 70 percent useful load, five more aircraft become weight-restricted, and progressively fewer turbine aircraft can operate on the available runway as the useful load increases. The average takeoff length needed for all turbine aircraft analyzed at 100 percent useful load is **5,317 feet**.

Aircraft Type	MTOW	Takeoff Length Requirements (ft.) Useful Load 60%	70%	80%	90%	100%
Pilatus PC-12	9,921	2,047	2,211	2,384	2,564	2,753
Citation Mustang	8,645	2,718	2,916	3,156	3,483	3,830
Citation V (Model 560)	15,900	2,749	2,977	3,224	3,488	3,770
Citation CJ3	13,870	2,864	3,006	3,199	3,440	3,674
Citation II (550)	13,300	2,897	3,183	3,489	3,814	4,158
Citation Ultra	16,300	2,972	2,965	3,208	3,463	3,735
Citation (525) CJ1	10,600	3,021	3,416	3,878	4,378	4,815
Citation (525A) CJ2	12,375	3,080	3,320	3,583	3,487	4,118
Citation Encore Plus	16,830	3,105	3,322	3,626	3,967	4,201
Citation 560 XLS	20,200	3,226	3,462	3,714	3,973	4,263
Citation 560 XL	20,000	3,282	3,518	3,783	4,057	4,370
King Air 200 GT	12,500	3,329	3,430	3,535	3,643	3,756
Citation Bravo	14,800	3,460	3,687	3,944	4,264	4,610
Citation Sovereign	30,300	3,501	3,522	3,585	3,802	4,054
Legacy 500	38,360	3,576	3,761	3,987	4,226	4,469
Beechjet 400A	16,300	3,853	4,143	4,447	4,762	5,088
Falcon 900B	46,500	3,880	4,360	4,900	5,510	6,200
Lear 40XR	21,000	4,017	4,271	4,601	4,955	5,306
Gulfstream 350	70,900	4,027	4,386	4,769	5,183	5,631
Falcon 900EX	49,200	4,070	4,580	5,150	5,790	6,380
King Air 1900D	17,120	4,092	4,346	4,629	4,965	5,304
Hawker 4000	39,500	4,122	4,470	4,842	5,227	5,652
Lear 45XR	21,500	4,131	4,434	4,801	5,193	5,600
Falcon 50 EX	41,000	4,162	4,594	5,053	5,541	5,993
Hawker 800XP	28,000	4,179	4,621	5,032	5,522	6,028
Challenger 300	38,850	4,271	4,675	5,091	5,518	5,972
Citation X	35,700	4,310	4,801	5,263	5,731	6,207
Gulfstream 450	74,600	4,325	4,752	5,218	5,726	6,276
Citation III	21,500	4,350	4,746	5,175	5,639	6,136
Gulfstream 550	91,000	4,508	5,133	5,781	6,443	7,188
Citation VII	23,000	4,558	4,866	5,201	5,559	5,953
Falcon 2000	35,800	4,622	5,040	5,500	6,009	6,736
Lear 55	21,500	4,634	5,078	5,617	6,308	7,230
Challenger 604/605	48,200	4,686	5,170	5,713	6,290	6,878
Lear 60	23,500	4,866	5,335	5,898	6,450	7,019
Lear 35A	19,600	5,094	5,707	6,334	6,949	O/L
Gulfstream 200	35,450	5,119	5,746	6,434	7,178	O/L
Hawker 800 (With T/R)	27,400	5,673	6,149	6,692	7,314	8,057
Average Takeoff Length		**3,878**	**4,213**	**4,590**	**4,995**	**5,317**

Green figures are less than the length of Runway 1-19; red figures are greater than the current runway length
MTOW: Maximum Takeoff Weight O/L: Input data is outside the operating limits of the aircraft
Assumptions: 979.3 feet MSL field elevation; 82.8°F ambient temperature; 0.19% runway grade
Sources: Ultranav software; Embraer Legacy 500 Flight Planning guide (August 2016)

Exhibit 3B
RUNWAY LENGTH REQUIREMENTS: TAKEOFF

Aircraft Type	MLW	Landing Length Requirements (ft.) Dry Runway Condition Part 25	80% Rule	60% Rule	Wet Runway Condition Part 25	80% Rule	60% Rule
King Air 200 GT	12,500	1,894	2,368	3,157	N/A		
Pilatus PC-12	9,921	2,318	2,898	3,863	N/A		
Citation II (550)	12,700	2,479	3,099	4,132	5,991	7,489	9,985
Citation Mustang	8,000	2,546	3,183	4,243	3,569	4,461	5,948
Legacy 500	34,524	2,584	3,230	4,307	Unavailable		
Challenger 300	33,750	2,655	3,319	4,425	5,089	6,361	8,482
Hawker 800XP	23,350	2,710	3,388	4,517	4,064	5,080	6,773
Gulfstream 550	75,300	2,828	3,535	4,713	5,061	6,326	8,435
Challenger 604/605	38,000	2,851	3,564	4,752	4,353	5,441	7,255
Lear 40XR	19,200	2,853	3,566	4,755	3,612	4,515	6,020
Lear 45XR	19,200	2,853	3,566	4,755	3,612	4,515	6,020
Citation Sovereign	27,100	2,906	3,633	4,843	3,698	4,623	6,163
Citation (525) CJ1	9,800	2,918	3,648	4,863	3,948	4,935	6,580
Hawker 800 (With T/R)	23,350	2,960	3,700	4,933	6,360	7,950	10,600
Falcon 50 EX	35,715	2,986	3,733	4,977	3,434	4,293	5,723
King Air 1900D	16,765	2,999	3,749	4,998	3,448	4,310	5,747
Citation CJ3	12,750	3,064	3,830	5,107	4,175	5,219	6,958
Citation Encore Plus	15,200	3,083	3,854	5,138	4,693	5,866	7,822
Citation V (Model 560)	15,200	3,106	3,883	5,177	4,599	5,749	7,665
Citation Ultra	15,200	3,123	3,904	5,205	4,639	5,799	7,732
Citation VII	20,000	3,156	3,945	5,260	4,259	5,324	7,098
Falcon 2000	33,000	3,187	3,984	5,312	3,665	4,581	6,108
Citation (525A) CJ2	11,500	3,238	4,048	5,397	6,728	8,410	11,213
Hawker 4000	33,500	3,247	4,059	5,412	3,734	4,668	6,223
Lear 35A	15,300	3,268	4,085	5,447	4,576	5,720	7,627
Gulfstream 350	66,000	3,326	4,158	5,543	3,824	4,780	6,373
Gulfstream 450	66,000	3,326	4,158	5,543	5,647	7,059	9,412
Lear 55	18,000	3,357	4,196	5,595	5,372	6,715	8,953
Citation 560 XL	18,700	3,471	4,339	5,785	5,525	6,906	9,208
Citation 560 XLS	18,700	3,472	4,340	5,787	5,465	6,831	9,108
Gulfstream 200	30,000	3,561	4,451	5,935	4,095	5,119	6,825
Falcon 900B	42,000	3,590	4,488	5,983	4,130	5,163	6,883
Citation Bravo	13,500	3,610	4,513	6,017	5,667	7,084	9,445
Lear 60	19,500	3,633	4,541	6,055	4,850	6,063	8,083
Beechjet 400A	15,700	3,736	4,670	6,227	5,548	6,935	9,247
Falcon 900EX	44,500	3,743	4,679	6,238	4,304	5,380	7,173
Citation X	31,800	3,858	4,823	6,430	5,499	6,874	9,165
Citation III	19,000	4,155	5,194	6,925	6,014	7,518	10,023
Average Landing Length		**3,122**	**3,903**	**5,204**	**4,664**	**5,830**	**7,774**

Green figures are less than the length of Runway 1-19; red figures are greater than the current runway length
MLW: Maximum Landing Weight N/A: Aircraft landing length not adjusted for wet runway conditions
Assumptions: 979.3 feet MSL field elevation; 82.8°F ambient temperature; 0.19% runway grade
Sources: Ultranav software; Embraer Legacy 500 Flight Planning guide (August 2016)

Exhibit 3B
RUNWAY LENGTH REQUIREMENTS: LANDING

Landing Length Requirements

Exhibit 3B also presents the runway lengths required for landing under three operational categories: Title 14 Code of Federal Regulations (CFR) Part 25, CFR Part 135, and CFR Part 91k. Part 25 operations are those conducted by individuals or companies operating their own transport category aircraft. Part 91k includes operations in fractional ownership, which use their own aircraft under direction of pilots specifically assigned to said aircraft. Part 135 applies to all for-hire charter operations, including most fractional ownership operations. Part 91k and Part 135 rules regarding landing operations require operators to land at the destination airport within 60 percent of the effective runway length. An additional rule allows for operators to land within 80 percent of the effective runway length if the operator has an approved destination airport analysis in the operator's program operations manual. The landing length analysis conducted accounts for both these scenarios.

As can be seen on the landing length table on **Exhibit 3B**, the airport is capable of handling nearly all aircraft under Part 25 and the 80 percent rule during dry conditions. However, over half the evaluated aircraft become weight-restricted when operating under the 60 percent rule, including the Citation Excel/XLS, the current critical design aircraft. The average landing length needed for all aircraft analyzed during dry conditions under Part 91/135 rules is **5,204 feet**.

During wet conditions, most of the aircraft analyzed can use the airport under Part 25 conditions but become weight-restricted when conducting for-hire operations. When wet, the airport becomes unusable to aircraft operating under the 60 percent rule, with an average landing length requirement of 7,774 feet. It should be noted that the landing length calculations consider the maximum landing weight; most aircraft will have burned off fuel during flight and will be lighter.

AIRPORT USER SURVEY AND RUNWAY EXTENSION SUPPORT RESPONSES

In conjunction with the preparation of this master plan, surveys were sent to users of the airport in order to better understand facility needs and runway length deficiencies as experienced by aircraft operators. Responses were received from various stakeholders, including corporations with multiple aircraft, small business owners who operate their own aircraft, private pilots, and the FBO.

Many of the parties expressed concern over the existing runway length and provided support for additional runway length based on specific operational constraints of their respective aircraft. Specific examples include:

- Air Wilderness and BTT Citation both operate their Citation XLS/XLS+ jets that are based at DLL and operate approximately 150 and 180 times per year, respectively. The estimated runway length required for takeoff operations is 5,319 feet and 5,369 feet for landing operations under contaminated conditions.

- FSI, Inc. currently operates an Embraer Legacy 500 approximately 120 times per year. The company is evaluating upgrading their aircraft to the Embraer Praetor 600 but has found the existing runway length at DLL restrictive. A runway of at least 6,001 feet would be required for the company to comfortably upgrade to the Praetor 600 and remain based at DLL.

- Kalahari Management operates both a Citation XLS and Legacy 500. The two aircraft operate over 200 times per year between them and can be limited in their operational capabilities due to the current runway length. Furthermore, the company is looking to acquire a long-range, large-cabin aircraft and is considering a Gulfstream 550, Dassault Falcon 7X, or a Bombardier Global 5000. A runway length of 6,000 to 6,200 feet would provide adequate length to accommodate operations by any of these aircraft.

These are a few examples that illustrate an existing demand for a longer runway at DLL. Even with the limited runway length, the total number of operations by these aircraft exceeds 500 annual operations. Extending the runway would allow for an increase in operations, not only by these operators, but by any operator that would use the airport. The letters of support and survey responses can be reviewed in **Appendix B**.

Small Aircraft Runway Length

Most of the operations at DLL are conducted using smaller GA aircraft weighing less than 12,500 pounds, such as the Piper Cherokee, Beechcraft Bonanza, or Cessna Conquest. In the future, Runway 14-32 may be paved to better support operations by this category of aircraft. Following guidance from AC 150/5325-4B, to accommodate 100 percent of these small aircraft, a runway length of 3,900 feet is recommended. For small aircraft with 10 or more passenger seats, 4,200 feet of runway length is recommended. **Table 3F** summarizes the runway length needs for small aircraft.

TABLE 3F | Small Airplane Runway Length Requirements

Airport Elevation	979.3 feet mean sea level (MSL)
Average High Monthly Temp.	82.8 degrees F (July)
Fleet Mix Category	**Runway Length (feet)**
100% of small airplanes	3,900
100% of small airplanes (10+ seats)	4,200

Source: FAA AC 150/5325-4B, Runway Length Requirements for Airport Design

Runway Length Summary

The analysis for determination of the recommended runway length for DLL followed FAA guidance provided in FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design.* To accommodate 100 percent of the general aviation business jet fleet at 60 percent useful load, the runway should be 5,500 feet long. The analysis also indicated that a runway of 8,200 feet could be justified if the 90 percent useful load category were justified. Runway extension planning is restricted to the 60 percent useful load category unless specific documentation can be provided. Therefore, **future planning for DLL will consider a runway length of 5,500 feet for Runway 1-19 and up to 4,200 feet for Runway 14-32**.

Additional analysis was conducted to determine the runway length needs of specific aircraft that may operate at DLL by examining the flight planning manuals for specific aircraft. Under certain operating conditions (e.g., hot days, wet runways, maximum weight), several aircraft will be weight-restricted when operating on the current runway length of 5,010 feet. If activity by any of these specific aircraft can be documented to exceed the 500 operations threshold, then an extension to fully accommodate those aircraft would be justified.

Justification for any runway extension to meet the needs of business jets would require regular use on the order of 500 annual itinerant operations. This is the minimum threshold required to obtain FAA grant funding assistance. The existing length of Runway 1-19 does not fully provide for all jet activity, especially during hot weather conditions, when jet aircraft are carrying full useful loads, or during wet runway conditions. Analysis in the next chapter will examine the potential to extend Runway 1-19 up to 5,500 feet to better serve the needs of larger aircraft during the planning period and beyond. The possibility of paving and expanding Runway 14-32 up to 4,200 feet will also be considered.

RUNWAY WIDTH

Runway width standards are a function of the established runway design code (RDC) and instrument visibility minimums for a given runway. At DLL, Runway 1-19 is served by instrument approach procedures with visibility minimums no less than one mile. The current RDC has been established as B-II and the future RDC established as C-II. Thus, the current surface width of 100 feet is adequate and should be maintained through the planning period in order to accommodate both the current and future design aircraft.

Runway 14-32 is the turf runway at DLL and is 100 feet wide. With no instrument approach procedures and an established RDC of A-I(small), the runway width exceeds design standards and should be maintained. If the surface is paved, an RDC of B-II could be established and require a 75-foot surface width.

PAVEMENT STRENGTH

An important feature of airfield pavement is its ability to withstand repeated use by aircraft of significant weight. At DLL, the pavement for Runway 1-19 should be able to accommodate regular usage by the largest business jet aircraft using and planned to use the airport. The current strength rating on Runway 1-19 is 30,000 pounds single wheel loading (SWL) and 55,000 pounds dual wheel loading (DWL).

The current strength rating is adequate for most business jets, including the identified current and future critical design aircraft, the Cessna Citation Excel and Embraer Legacy 500, respectively. While the airport has experienced operations by aircraft with higher MTOWs, they are infrequent. Pavement strength, like runway length, should be adapted to the aircraft group that uses the runway most often. A review of other commonly used business jet aircraft in the B-II and C-II categories revealed that a 55,000-pound DWL strength is adequate and should be maintained throughout the planning period.

Turf runways, such as Runway 14-32, generally do not have strength ratings. However, if the runway is paved, it should be designed to a strength rating of at least 12,500 pounds SWL to accommodate the “small” aircraft category without excessive wear to the surface. Additional strength can be considered at the time of construction, should the airport pursue that alternative. It should be noted that the FAA minimum pavement design generally conforms to a strength of or exceeding 12,500 pounds, which would be ideal for Runway 14-32 if paved.

TAXIWAYS

The design standards associated with taxiways are determined by both the taxiway design group (TDG) and the airplane design group (ADG) of the critical design aircraft. As determined previously, the applicable ADG for Runway 1-19 is ADG II in both the current and future conditions, while the TDG in the current condition is 1B and advances to 2A in the future condition. **Table 3G** presents the taxiway design standards related to ADG II.

The table also shows those taxiway design standards related to the TDG. The TDG standards are based on the main gear width (MGW) and the cockpit-to-main gear (CMG) distance of the critical design aircraft expected to use the taxiways. Different taxiway/taxilane surfaces can and should be designed to meet the most appropriate TDG design standards.

The ultimate critical TDG for DLL is 2A, which is based on the Beechcraft King Air 200/300/350, a turboprop aircraft commonly used by private businesses and charter operations. Taxiways designed to meet 2A standards are 35 feet wide. All taxiways on the airfield are 40 feet wide with sections that widen at intersections and runway entry points.

TABLE 3G | Taxiway Dimensions and Standards

STANDARDS BASED ON ADG	ADG II
Taxiway Protection	
Taxiway Safety Area (TSA) Width	79
Taxiway Object Free Area (TOFA) Width	124
Taxilane Object Free Area (TLOFA) Width	110
Taxiway Separation	
Taxiway Centerline to:	
Fixed or Movable Object	62
Parallel Taxiway/Taxilane	101.5
Taxilane Centerline to:	
Fixed or Movable Object	55
Parallel Taxilane	94.5
Wingtip Clearance	
Taxiway Wingtip Clearance	22.5
Taxilane Wingtip Clearance	15.5
STANDARDS BASED ON TDG	**TDG 2A**
Taxiway Width Standard	35
Taxiway Edge Safety Margin	7.5
Taxiway Shoulder Width	15

ADG: Airplane Design Group
TDG: Taxiway Design Group
Note: All dimensions are in feet.
Source: FAA AC 150/5300-13B, Airport Design

Taxiways are protected by a Taxiway Safety Area (TSA) and a Taxiway Object Free Area (TOFA). The TSA must be: (1) cleared and graded and have no potentially hazardous ruts, humps, depressions, or other surface variations; (2) drained by grading or storm sewers to prevent water accumulation; (3) capable of supporting firefighting equipment and the occasional passage of aircraft without causing structural damage to the aircraft; and (4) free of objects except for those needed for navigational functions.

TOFA clearing standards prohibit service vehicle roads, parked aircraft, and other objects, except for objects that need to be located in the TOFA for air navigation or aircraft ground maneuvering purposes. The ADG II TSA has a width of 79 feet, and the TOFA has a width of 124 feet, both centered on the taxiway centerline. At DLL, there are no conflicts within either the TSA or TOFA and they should be maintained as such through the planning period.

TAXIWAY DESIGN CONSIDERATIONS

FAA AC 150/5300-13B, *Airport Design*, provides guidance on recommended taxiway and taxilane layouts to enhance safety by avoiding runway incursions. A runway incursion is defined as "any occurrence at an airport involving the incorrect presence of an aircraft, vehicle, or person on the protected area of a surface designated for the landing and takeoff of aircraft."

The taxiway system at DLL generally provides for the efficient movement of aircraft; however, AC 150/5300-13B, *Airport Design*, provides recommendations for taxiway design. The following is a list of the taxiway design guidelines and the basic rationale behind each recommendation:

1. **Taxi Method:** Taxiways are designed for "cockpit over centerline" taxiing with pavement being sufficiently wide to allow a certain amount of wander. On turns, sufficient pavement should be provided to maintain the edge safety margin from the landing gear. When constructing new taxiways, existing intersections should be upgraded to eliminate "judgmental oversteering," which is where the pilot must intentionally steer the cockpit outside the marked centerline in order to ensure the aircraft remains on the taxiway pavement.

2. **Steering Angle:** Taxiways should be designed so that the nose gear steering angle is no more than 50 degrees, the generally accepted value to prevent excessive tire scrubbing.

3. **Three-Node Concept:** To maintain pilot situational awareness, taxiway intersections should provide a pilot with a maximum of three choices of travel. Ideally, these are right and left angle turns and a continuation straight ahead.

4. **Intersection Angles:** Turns should be designed to 90 degrees wherever possible. For acute angle intersections, standard angles of 30, 45, 60, 120, 135, and 150 degrees are preferred.

5. **Runway Incursions:** Taxiways should be designed to reduce the probably of runway incursions.
    - *Increase Pilot Situational Awareness*: A pilot who knows where they are on the airport is less likely to enter a runway improperly. Complexity leads to confusion. Keep taxiway systems simple using the "three-node" concept.
    - *Avoid Wide Expanses of Pavement*: Wide pavements require placement of signs far from a pilot's eye. This is especially critical at runway entrance points. Where a wide expanse of pavement is necessary, avoid direct access to a runway.

- *Limit Runway Crossings*: The taxiway layout can reduce the opportunity for human error. The benefits are twofold, through simple reduction in the likelihood and number of occurrences and through a reduction in air traffic controller workload.
- *Avoid "High Energy" Intersections*: These are intersections in the middle third of runways. By limiting runway crossings to the first and last thirds of the runway, the portion of the runway where a pilot can least maneuver to avoid a collision is kept clear.
- *Increase Visibility*: Right-angle intersections, between both taxiways and runways, provide the best visibility. Acute angle runway exits provide for greater efficiency in runway usage but should not be used as runway entrance or crossing points. A right-angle turn at the end of a parallel taxiway is a clear indication of approaching a runway.
- *Avoid "Dual Purpose" Pavements*: Runways used as taxiways and taxiways used as runways can lead to confusion. A runway should always be clearly identified as a runway and only a runway.
- *Indirect Access*: Do not design taxiways to lead directly from an apron to a runway. Such configurations can lead to confusion when a pilot typically expects to encounter a parallel taxiway.
- *Hot Spots*: Confusing intersections near a runway are more likely to contribute to runway incursions. These intersections must be redesigned when the associated runway is subject to reconstruction or rehabilitation. Other hot spots should be corrected as soon as practicable.

6. **Runway/Taxiway Intersections:**
   - *Right Angle*: Right-angle intersections are the standard for all runway/taxiway intersections, except where there is a need for a high-speed exit. Right-angle taxiways provide the best visual perspective to a pilot approaching an intersection with the runway to observe aircraft in both the left and right directions. They also provide optimal orientation of the runway holding position signs so they are visible to pilots.
   - *Acute Angle*: Acute angles should not be larger than 45 degrees from the runway centerline. A 30-degree taxiway layout should be reserved for high-speed exits. The use of multiple intersecting taxiways with acute angles creates pilot confusion and improper positioning of taxiway signage.
   - *Large Expanses of Pavement*: Taxiways must never coincide with the intersection of two runways. Taxiway configurations with multiple taxiway and runway intersections in a single area create large expanses of pavement, making it difficult to provide proper signage, marking, and lighting.

7. **Taxiway/Runway/Apron Incursion Prevention:** Apron locations that allow direct access into a runway should be avoided. Increase pilot situational awareness by designing taxiways in a manner that forces pilots to deliberately make turns. A taxiway originating from an apron and forming a straight line across a runway at mid-span should be avoided.
   - *Wide Throat Taxiways*: Wide throat taxiway entrances should be avoided. Such large expanses of pavement may cause pilot confusion and make signage, marking, and lighting more difficult.
   - *Direct Access from Apron to Runway*: Avoid taxiway connectors that cross over a parallel taxiway and directly onto a runway. Consider a staggered taxiway layout that forces pilots to make a deliberate decision to turn.
   - *Apron to Parallel Taxiway End*: Avoid direct connection from an apron to a parallel taxiway at the end of a runway.

FAA AC 150/5300-13B, *Airport Design*, states that "existing taxiway geometry should be improved whenever feasible, with emphasis on designated 'hot spots.'" To the extent practicable, the removal of existing pavement may be necessary to correct confusing layouts. DLL does not have any identified "hot spots" and the taxiway system has no geometry deficiencies; however, as development of the airport occurs, it is prudent to keep these design standards in mind to avoid non-standard conditions from occurring.

TAXILANE DESIGN CONSIDERATIONS

Taxilanes are distinguished from taxiways in that they do not provide access directly to or from the runway system. Taxilanes typically provide access to hangar areas. As a result, taxilanes can be designed to varying design standards depending on the type of aircraft using, or expected to use, the taxilane. For example, a taxilane leading to a T-hangar area only needs to be designed to accommodate those aircraft accessing the T-hangar area.

The taxilane separating the T-hangar buildings needs to meet clearance standards for ADG I aircraft, which has a Taxilane Object Free Area (TLOFA) requirement of 79 feet. Currently, the separation between the hangars along the primary T-hangar taxilane is only 63 feet. The remaining taxilanes provide access to larger hangars and have a separation distance of approximately 97 feet, which does not meet the 110-foot standard for an ADG II TLOFA.

In the future, the taxilane centerline for T-hangars should be 39.5 feet from the hangar building, while ADG II taxilanes should have a centerline-to-hangar distance of 55 feet. Typically, the FAA and BOA will not expect airports to demolish and reconstruct existing hangars to meet taxilane design standards, but rather want the ALP to reflect the proper TLOFA when the buildings are at the end of their useful life and when they are to be replaced.

SAFETY AREA DESIGN STANDARDS

The FAA has established several safety surfaces to protect aircraft operational areas and keep them free from obstructions that could affect their safe operation. These include the Runway Safety Area (RSA), Runway Object Free Area (ROFA), Obstacle Free Zone (OFZ), and Runway Protection Zone (RPZ), which are discussed separately. **Table 3H** presents the applicable design standards for the RSA, ROFA, and OFZ for the runways at DLL in their existing and ultimate conditions. It should be noted that if Runway 14-32 remains a turf runway, the existing and ultimate conditions are the same; changes to design standards for Runway 14-32 would only occur if the surface is paved.

Dimensional standards for the various safety areas associated with the runway are a function of the type of aircraft (ARC) expected to use the runway, as well as the approved instrument approach visibility minimums. The entire RSA, ROFA, and OFZ should be under the direct control of the airport to ensure these areas remain free of obstacles and can be readily accessed by maintenance and emergency personnel. **Exhibit 3C** depicts the existing safety areas at DLL; the impacts of changing design standards are explored in the next chapter.

TABLE 3H | Airfield Design Standards

Runway Design Code (RDC)	Runway 1-19 B-II-5000 (Existing)	Runway 1-19 C-II-2400 (Ultimate)	Runway 14-32 A-I(S)-VIS (Existing/Ultimate)	Runway 14-32 B-II(S)-5000 (Ultimate-Paved)
RUNWAY DIMENSIONS				
Runway Width	75	100	60	75
Runway Shoulder Width	10	10	10	10
RUNWAY SAFETY AREA				
Width	150	500	120	150
Length Prior to Threshold	300	600	240	300
Length Beyond Departure End	300	1,000	240	300
RUNWAY OBJECT FREE AREA				
Width	500	800	250	500
Length Prior to Threshold	300	600	240	300
Length Beyond Departure End	300	1,000	240	300
RUNWAY OBSTACLE FREE ZONE				
Width	400	Same	250	Same
Length Beyond Runway End	200	Same	200	Same
SEPARATION STANDARDS – RUNWAY CENTERLINE TO:				
Holding Position Markings	200	250	125	Same
Parallel Taxiway	240	400	150	240

(S): Small aircraft less than 12,500 pounds
Note: All dimensions are in feet

Source: FAA AC 150/5300-13B, Airport Design

Runway Safety Area (RSA)

The RSA is defined in FAA AC 150/5300-13B, *Airport Design*, as a "surface surrounding the runway prepared for or suitable for reducing the risk of damage to airplanes in the event of undershoot, overshoot, or excursion from the runway." The RSA is centered on the runway and dimensioned in accordance with the approach speed of the critical design aircraft using the runway. The FAA requires the RSA to be cleared and graded, drained by grading or storm sewers, capable of accommodating the design aircraft – as well as fire and rescue vehicles – and free of obstacles not fixed by navigational purposes (such as runway edge lights or approach lights).

The FAA has placed a higher significance on maintaining adequate RSA at all airports. Under Order 5200.8, effective October 1, 1999, the FAA established the *Runway Safety Area Program*. The Order states, "the objective of the Runway Safety Area Program is that all RSAs at federally-obligated airports…shall conform to the standards contained in Advisory Circular 150/5300-13B, *Airport Design*, to the extent practicable." Each Regional Airports Division of the FAA is obligated to collect and maintain data on the RSA for each runway at DLL and perform airport inspections.

For ARC B-II design that have greater than ¾-mile instrument approaches, the FAA calls for the RSA to be 150 feet wide and extend 300 feet beyond the runway ends. Analysis in the previous chapter indicated that Runway 1-19 should be planned to accommodate aircraft in ARC C-II and a lower than ¾-mile instrument approach in the future. The RSA for such a condition is 500 feet wide and extends 1,000 feet beyond each runway end. It should be noted that while only 600 feet of RSA is needed prior to the landing threshold on each runway end under ARC C-II standards, the 1,000-foot requirement beyond the runway end is collocated with the 600-foot prior distance and is often the limiting condition.

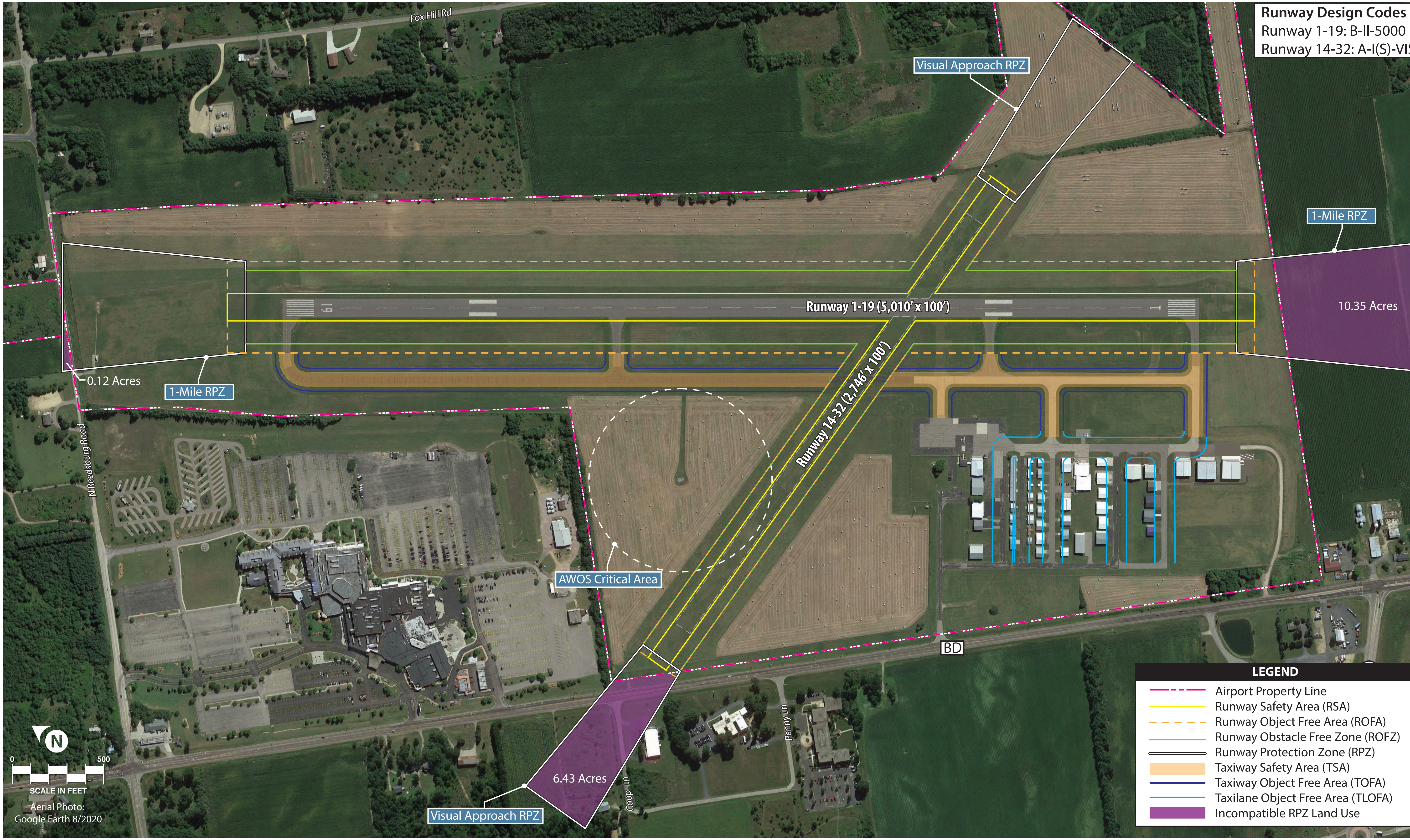


Exhibit 3C
EXISTING SAFETY AREAS

This page intentionally left blank

The RSAs at DLL meet the current design standards. When the airport transitions to C-II, the RSA (and ROFA) design standards for Runway 1-19 become more stringent, getting wider and extending further beyond the runway ends. When paired with the possibility of a runway extension, several conflicts may arise, including land outside the current airport property and the localizer antenna at the north end of Runway 1-19. Additional conflicts would be presented if Runway 14-32 becomes paved and transitions from an A-I(small) to a B-II(small) category, with County Highway BD posing the most immediate threat. Consideration will be given on how to best mitigate these future RSA conflicts in the alternatives analysis.

Runway Object Free Area (ROFA)

The ROFA is a "two-dimensional ground area, surrounding runways, taxiways, and taxilanes, which is clear of objects except for objects whose location is fixed by function (i.e., airfield lighting)." The ROFA does not have to be graded and level as the RSA does; instead, the primary requirement of the ROFA is that no object in the ROFA penetrates the lateral elevation of the RSA. The ROFA is centered on the runway, extending out in accordance with the critical aircraft design category using the runway.

ARC B-II standards for Runway 1-19 require a 500-foot wide ROFA that extends 300 feet beyond the ends of the runway. There are no conflicts currently within the Runway 1-19 ROFA. However, just as with the RSA, the ultimate C-II condition will present possible conflicts, as the standards increase to an 800-foot wide ROFA that extends 1,000 feet beyond the end of the runway.

The ROFA for Runway 14-32 is smaller, with dimensions of 250 feet wide and 240 feet beyond the runway ends. At the current location of the turf runway, approximately 37.4 square yards (sy) of the Runway 14-32 ROFA is outside airport property adjacent to County Highway BD. This may be mitigated by shifting the turf runway or by acquiring the property in question. While a mitigation technique of displacing a runway threshold is an option for paved runways, it is difficult to accomplish on a turf runway. Should the runway become paved and the RDC be improved to B-II(small), the ROFA will increase in size, with additional mitigation techniques required to keep the ROFA under airport control. These considerations will be explored further in the next chapter.

Obstacle Free Zones (OFZ)

The OFZ is an imaginary surface which precludes object penetration, including taxiing and parked aircraft. The only allowance for OFZ obstructions is navigational aids mounted on frangible bases which are fixed in their location by function, such as airfield lighting or signage. The OFZ is established to ensure the safety of aircraft operations. If the OFZ is obstructed, the airport's approaches could be removed or approach minimums could be increased.

For all runways serving aircraft over 12,500 pounds, such as Runway 1-19, the OFZ is 400 feet wide, centered on the runway, and extends 200 feet beyond the runway ends. This standard applies to Runway 1-19 at DLL in both the existing and ultimate conditions. Currently, there are no OFZ obstructions at the airport. Future planning should maintain the OFZ for the appropriate runway design standards and adjust for changes in length that may be planned.

The OFZ for Runway 14-32 also extends 200 feet beyond the runway end but is only 250 feet wide. There are no obstructions within the OFZ, but conflicts may arise should the runway become paved and transition to a more restrictive B-II(small) design standard.

Runway Protection Zones (RPZ)

An RPZ is a trapezoidal area centered on the extended runway centerline, typically beginning 200 feet from the end of the runway. The RPZ has been established to provide an area clear of obstructions and incompatible land uses in order to enhance the safety and protection of people and property on the ground. Airport ownership and/or control of the RPZ and implementation of compatible land use principles is the optimal method of ensuring the public's safety in these areas. The RPZ dimensions are based upon the established RDC of the runway. **Table 3J** details the applicable RPZ dimensions for the runways at DLL.

TABLE 3J | Runway Protection Zone Design Standards

	Runway 1-19		Runway 14-32	
Runway Design Code (RDC)	**B-II-5000 (Existing)**	**C-II-2400 (Ultimate)**	**A-I(S)-VIS (Existing/Ultimate)**	**B-II(S)-5000 (Ultimate - Paved)**
APPROACH RUNWAY PROTECTION ZONES				
Approach Visibility Minimum	1-mile	½-mile	Visual Only	1-mile
Length (ft)	1,000	2,500	1,000	Same
Inner Width (ft)	500	1,000	250	Same
Outer Width (ft)	700	1,750	450	Same
DEPARTURE RUNWAY PROTECTION ZONES				
Length (ft)	1,000	1,700	1,000	Same
Inner Width (ft)	500	500	250	Same
Outer Width (ft)	700	1,010	450	Same

Source: FAA AC 150/5300-13B, Airport Design

While the RPZ is intended to be clear of incompatible objects or land uses, some uses are permitted with conditions and other land uses are prohibited. According to AC 150/5300-13B, the following land uses are permissible within the RPZ:

- Farming that meets the minimum buffer requirements.
- Irrigation channels, as long as they do not attract birds.
- Airport service roads, as long as they are not public roads and are directly controlled by the airport operator.
- Underground facilities, as long as they meet other design criteria, such as RSA requirements, as applicable.
- Unstaffed navigational aids (NAVAIDs) and facilities, such as required for airport facilities that are fixed-by-function in regard to the RPZ.
- Aboveground fuel tanks associated with backup generators for unstaffed NAVAIDS.

In September 2022, the FAA published AC 150/5190-4B, *Airport Land Use Compatibility Planning*, which states that airport owner control over RPZs is preferred. Airport owner control over RPZs may be achieved through:

- Ownership of the RPZ property in fee simple;
- Possessing sufficient interest in the RPZ property through easements, deed restrictions, etc.;
- Possessing sufficient land use control authority to regulate land use in the jurisdiction containing the RPZ;
- Possessing and exercising the power of eminent domain over the property; or
- Possessing and exercising permitting authority over proponents of development within the RPZ (e.g., where the sponsor is a State).

AC 150/5190-4B further states that "control is preferably exercised through acquisition of sufficient property interest and includes clearing RPZ areas (and keeping them clear) of objects and activities that would impact the safety of people and property on the ground." The FAA does recognize that land ownership, environmental, geographical, and other considerations can complicate land use compatibility within RPZs. Regardless, airport sponsors are to comply with FAA Grant Assurances, including but not limited to Grant Assurance 21, *Compatible Land Use*, which states that airports are expected to take appropriate measures to "protect against, remove, or mitigate land uses that introduce incompatible development within RPZs." For proposed projects that would shift an RPZ into an area with existing incompatible land uses, such as a runway extension or construction of a new runway, the sponsor is expected to have or secure sufficient control of the RPZ, ideally through fee simple ownership.

Where existing incompatible land uses are present, the FAA expects sponsors to "seek all possible opportunities to eliminate, reduce, or mitigate existing incompatible land uses" through acquisition, land exchanges, right-of-first refusal to purchase, agreement with property owners on land uses, easements, or other such measures. These efforts should be revisited during master plan or ALP updates, and periodically thereafter, and documented to demonstrate compliance with FAA grant assurances. If new or proposed incompatible land uses impact an RPZ, the FAA expects the airport to take the above actions to control the property within the RPZ, along with adopting a strong public stance opposing the incompatible land uses.

For new incompatible land uses that result from a sponsor-proposed action (i.e., an airfield project such as a runway extension, a change in the critical aircraft that increases the RPZ dimension, or lower minimums that increase the RPZ dimension), the airport sponsor is expected to conduct an alternatives evaluation. The intent of the alternatives evaluation is to "proactively identify a full range of alternatives and prepare a sufficient evaluation to be able to draw a conclusion about what is 'appropriate and reasonable.'" For incompatible development off-airport, the sponsor should coordinate with the Airports District Office (ADO) as soon as they are aware of the development, with the alternatives evaluation conducted within 30 days of becoming aware of the development within the RPZ. The following items are typically necessary in an alternatives evaluation:

- Sponsor's statement of the purpose and need of the proposed action (airport project, land use change, or development)
- Identification of any other interested parties and proponents

- Identification of any federal, state, and local transportation agencies involved
- Analysis of sponsor control of the land within the RPZ
- Summary of all alternatives considered, including:
    - Alternatives that preclude introducing the incompatible land use within the RPZ (e.g., zoning action, purchase, and design alternatives such as implementation of declared distances, displaced thresholds, runway shift or shortening, raising minimums)
    - Alternatives that minimize the impact of the land use in the RPZ (e.g., rerouting a new roadway through less of the RPZ, etc.)
    - Alternatives that mitigate risk to people and property on the ground (e.g., tunnelling, depressing and/or protecting a roadway through the RPZ, implementing operational measures to mitigate any risks, etc.)
- Narrative discussion and exhibits or figures depicting the alternative
- Rough order of magnitude cost estimates associated with each alternative, regardless of potential funding sources
- A practicability assessment based on the feasibility of the alternative in terms of cost, constructability, operational impacts, and other factors.

Once the alternatives evaluation has been submitted to the ADO, the FAA will determine whether or not the sponsor has made an adequate effort to pursue and give full consideration to appropriate and reasonable alternatives. **The FAA will not approve or disapprove the airport sponsor's preferred alternative; rather, the FAA will only evaluate whether an acceptable level of alternatives analysis has been completed before the sponsor makes the decision to allow or not allow the proposed land use within the RPZ.**

In summary, the RPZ guidance published in September 2022 places the responsibility of protecting the RPZ on the airport sponsor. The airport sponsor is expected to take action to control the land uses within the RPZs or to demonstrate that appropriate actions have been taken. It is ultimately up to the airport sponsor to permit existing – and to prevent new – incompatible land uses within an RPZ, with the understanding that the sponsor has grant assurance obligations, and the FAA retains the authority to review and approve or disapprove portions of the ALP that would adversely impact the safety of people and property within the RPZ.

Each runway end has both an approach and a departure RPZ. The departure RPZ is contained within the approach RPZ unless declared distances have been applied to the runway. For a particular runway end, the more stringent RPZ requirements (usually associated with the approach RPZ) will govern the property interests and clearing requirements that the airport sponsor should pursue. For planning purposes, the approach RPZ was used to create the most restrictive condition.

As depicted on **Exhibit 3C**, the existing RPZs extend for a total of approximately 16.9 acres beyond airport property, some of which is over incompatible land uses, such as public roads and residential areas. In the future condition, as some of the RPZs become larger based on lower visibility minimums, additional incompatible land uses could be introduced. The impact and possible mitigation strategies of these larger RPZs will be explored in the next chapter.

Table 3K documents the amount of existing incompatible land use within the RPZs. The Runway 19 RPZ extends over Reedsburg Road, while the Runway 14 RPZ extends over both Coop Lane and County Highway BD. The FAA generally recommends considering road rerouting or other mitigation techniques, such as displaced thresholds and declared distances, when addressing roadways. Furthermore, the Runway 14 RPZ may overlap both a commercial and residential structure. These will also be addressed throughout the alternatives section.

TABLE 3K | Runway Protection Zones Summary

RPZ	Total Acres	Airport-Owned Acres	Uncontrolled Acres	Notes/Incompatibilities
Runway 1	13.77	3.42	10.35	RPZ extends beyond airport property over farmland; however, this is an acceptable land use allowance within the RPZ.
Runway 19	13.77	13.65	0.12	RPZ extends beyond airport property over Reedsburg Road and farmland. While the farmland is an acceptable land use, the roadway is not and would have to be evaluated.
Runway 14	8.03	1.60	6.43	RPZ extends beyond airport property over County Highway BD and Coop Ln and may overlap portions of a residential and commercial structure. Evaluations would be necessary.
Runway 32	8.03	8.03	0.0	RPZ contained entirely within airport property.

Source: Coffman Associates analysis

If, in the future, the runways were equipped with lower instrument visibility minimums, then the level of incompatible land use within the larger RPZ would increase. To lower the visibility minimums, the airport will have to develop a plan of action to mitigate the newly introduced incompatible land uses and work in consultation with BOA to determine if the additional incompatible land is acceptable.

Improved visibility minimums are a vital benefit to general aviation airports with existing and increasing amounts of business and corporate jet operations. Lower visibility minimums extend the usefulness of the airport to times of poor visibility conditions. This means that any executive flying to the Baraboo-Wisconsin Dells area can be reassured that they will be able to complete their business in the community, even in poor visibility conditions.

RUNWAY/TAXIWAY SEPARATION

The design standard for the required separation between a runway and a parallel taxiway is a function of the critical design aircraft and the instrument approach visibility minimum. The separation standard for RDC B-II-5000 is 240 feet from the runway centerline to the parallel taxiway centerline. For RDC C-II-2400, the separation standard is 400 feet. The parallel taxiway is located 400 feet from Runway 1-19 (centerline to centerline). Therefore, the airfield currently meets runway/taxiway separation design standards for the ultimate condition.

Aircraft using turf runways typically taxi along the grassy areas adjacent to or inside the designated runway area and turn around when they reach the runway end in order to takeoff. While it is not uncommon for aircraft to do this on smaller paved runways, it is recommended (and a BOA standard) that an airport of DLL's size have full-length parallel taxiways serving runways. Therefore, if Runway 14-32 is paved in the future, a parallel taxiway would be recommended with a centerline-to-centerline distance of 240 feet.

BUILDING RESTRICTION LINE (BRL)

The BRL identifies suitable building locations on the airport. The BRL encompasses the RPZs, the ROFA, navigational aid critical areas, areas required for terminal instrument procedures, and other areas necessary for meeting airport line-of-sight criteria.

Two primary factors contribute to the determination of the BRL: type of runway ("utility" or "other-than-utility") and the capability of the instrument approaches. Runway 1-19 is an "other-than-utility" runway since it serves aircraft weighing over 12,500 pounds. The BRL is the transitional surface clearance requirements as outlined in CFR Part 77. These requirements stipulate that no object can be located in the primary surface, defined as being 500 feet wide for "other-than-utility" runways with visibility minimums greater than ¾-mile. From the primary surface, the transitional surface extends outward at a slope of one vertical foot to every seven horizontal feet. A change in visibility minimums to ¾-mile and below would result in the primary surface increasing from 500 to 1,000 feet wide.

A common BRL identifies the 35-foot clearance line for the transitional surface. Currently, the 35-foot BRL is 495 feet from the runway centerline. The future 35-foot BRL will be positioned 745 feet from the runway centerline. The BRL only indicates where structures should be below the designated height at that point. Buildings can be in front of the BRL if they remain lower than the transitional surface.

Runway 14-32 is considered a "utility" runway in that it serves aircraft weighing less than 12,500 pounds. This is expected to remain the same throughout the planning horizon, whether or not it is paved. However, the primary surface for the runway does change depending on the approach: if visual-only approaches are maintained, the primary surface is 250 feet wide, and the 35-foot BRL would be located 370 feet from the runway centerline. This distance is increased by 125 feet to 495 feet if a non-precision instrument approach is established on Runway 14-32.

HOLDING POSITION SEPARATION

Holding position markings are placed on taxiways leading to runways. When instructed, pilots should stop short of the holding position marking line. At non-towered airports like DLL, it is common practice for pilots to stop short of the markings before moving onto the active runway. For Runway 1-19, holding position marking lines are situated 195 feet from the runway centerline, which falls short of ARC B-II-5000 design standard of 200 feet and the ultimate C-II-2400 design standard of 250 feet. Therefore, the holding position marking should be relocated to 250 feet from the runway in the ultimate condition.

As previously discussed, turf runways do not have taxiways; therefore, no holding position markings are used. However, should Runway 14-32 be paved and a parallel taxiway provided, hold position markings should be located 125 feet from the runway centerline to meet B-II(small) runway standards with 1-mile instrument approach procedures. The holding position markings currently located on the parallel taxiway prior to crossing the grass strip exceed the B-II(small) standards.

INSTRUMENT APPROACH CAPABILITY

Instrument approaches are categorized as either precision or non-precision. Precision instrument approach aids provide an exact course alignment and vertical descent path for aircraft on final approach to a runway, while non-precision instrument approach aids provide only course alignment information. In the past, most existing precision instrument approaches in the U.S. have been the instrument landing system (ILS); however, with advances in global positioning system (GPS) technology, it can now be used to provide both vertical and lateral navigation for pilots under certain conditions.

DLL currently has instrument approach capability to Runways 1 and 19, including a localizer approach (LOC) and area navigation (RNAV) GPS approaches, as well as a very high frequency omni-directional range (VOR) "circling" approach that aids pilots in locating the airport, then transitions to a visual approach-to-land procedure. Each instrument approach procedure provides for a 1-mile visibility minimum. Consideration will be given to reducing the approach visibility minimums for one or more procedures to ½-mile, as well as establishing RNAV/GPS approaches to Runway 14-32 in the event the runway is paved. This will permit additional operational capacity of the airport during inclement weather or poor visibility conditions.

VISUAL APPROACH AIDS

In most instances, the landing phase of any flight must be conducted in visual conditions. To provide pilots with visual guidance information during landings to the runway, electronic visual approach aids are commonly provided at airports. Currently, Runways 1 and 19 are both served by a two-box precision approach path indicator (PAPI-2) system. There are no visual approach aids provided on Runway 14-32. PAPI-4s are recommended for runways that are used by jet aircraft; therefore, consideration should be given to upgrading the PAPI-2s on Runways 1 and 19 to PAPI-4s.

Runway end identifier lights (REILs) are flashing lights located at the runway threshold end that facilitate rapid identification of the runway end at night and during poor visibility conditions. REILs provide pilots with the ability to identify the runway thresholds and distinguish the runway end lighting from other lighting on the airport and in the approach areas. The FAA states that REILs should be considered for all runway ends where a more sophisticated approach lighting system is not planned. Currently, both ends of Runway 1-19 are equipped with REILs.

Neither end of the runway has an approach lighting system (ALS). These systems provide a visual lighted grid and alignment lead in lights for pilots at nighttime. For visibility minimums lower than ¾-mile, a medium intensity approach lighting system with runway alignment indicator lights (MALSR) is required on the lead-in to the landing end of the runway. A MALSR will be considered for both ends of Runway 1-19 to support the lowest possible instrument approach visibility minimums.

Should Runway 14-32 transition to a paved surface and begin accommodating higher operational activity levels, it is recommended to consider some version of a PAPI and REILs on one end of the runway, if not both.

AIRFIELD LIGHTING, MARKING, AND SIGNAGE

The location of the airport at night is universally indicated by a rotating beacon. For civil airports, a rotating beacon projects two beams of light, one white and one green, 180 degrees apart. The existing beacon at DLL, located on a standalone pole adjacent to the terminal parking area, should be maintained throughout the planning period.

Runway and Taxiway Lighting

Runway lighting provides the pilot with positive identification of the runway and its alignment. Runway 1-19 is equipped with medium-intensity runway lighting (MIRL) and should be maintained through the planning period. If Runway 14-32 transitions to a paved surface, it would be recommended to install MIRL to serve the runway. Medium-intensity taxiway lighting (MITL) is provided on all taxiways. This system is vital for safe and efficient ground movements and should be maintained in the future.

As part of its rehabilitation project in 2018, Runway 1-19 edge lighting was upgraded to light emitting diode (LED) pavement edge lighting technology. LEDs have many advantages, including lower energy consumption, longer lifespan, increased durability, reduced size, greater reliability, and faster switching. While a larger initial investment is required upfront, the energy savings and reduced maintenance costs will outweigh any additional costs overall. Consideration should be given to using LED technology if Runway 14-32 is paved and equipped with MIRL.

Pavement Markings

Runway markings are typically designed for the type of instrument approach available on the runway. FAA AC 150/5340-1M, *Standards for Airport Markings*, provides guidance necessary to design airport markings. Runway 1-19 has non-precision markings, which are adequate for a runway served by instrument approach procedures providing visibility minimums down to ¾-mile. The existing runway markings are sufficient for the existing instrument approaches but will need to be improved if a lower approach minimum is established. If Runway 14-32 becomes a paved surface with instrument approach procedures with minimums no less than ¾-mile, it will also need to be equipped with non-precision markings. If Runway 14-32 remains without instrument approaches, only a runway designation and aiming point markings would be recommended.

Airfield Signs

Airfield identification signs assist pilots in identifying their location on the airfield and directing them to their desired location. Lighted signs are installed on the runway and taxiway system on the airfield. The signage system includes runway and taxiway designations, as well as holding position signs located prior to entering the runway. All signs should be maintained throughout the planning period, and consideration should be given to gradually replacing all lighted signs with LED technology.

Additional consideration may be given to installing distance remaining signage. These lighted signs alert pilots to how much runway length remains in 1,000-foot increments.

WEATHER AND COMMUNICATION INFORMATION

DLL has a lighted wind cone on the west side of the runway adjacent to the terminal ramp. Wind cones provide information to pilots regarding wind speed and direction. The cone was previously surrounded by a segmented circle, which consists of a system of visual indicators designed to provide traffic pattern information to pilots. Alternatives presented in the following chapter will explore installing a new segmented circle around the wind cone. Supplemental wind cones may be necessary and are recommended if the primary wind cone is not visible to pilots on approach and takeoff at each runway end. Additional evaluation may be necessary as the airport expands and additional facilities are installed.

The airport is equipped with an AWOS, which is surrounded by a security fence and provides weather observations 24 hours per day. The system updates weather observations every minute, reporting significant weather changes as they occur. This information is transmitted on radio frequency 118.325 MHz. Additionally, pilots can call a published telephone number (608-356-1071) and receive the information via an automated voice recording. This system should be maintained throughout the planning period.

An FAA-defined critical area surrounds the AWOS with a radius of 500 feet and is depicted on **Exhibit 3C**. Objects and buildings within this area are permissible if they do not obstruct the operation of the AWOS sensors. The airport should monitor any development within the AWOS critical area to ensure the weather equipment remains unobstructed.

AIRFIELD FACILITY REQUIREMENTS SUMMARY

A summary of the airside facilities previously discussed at DLL is presented on **Exhibit 3D**.

LANDSIDE FACILITY REQUIREMENTS

Landside facilities are those necessary for the handling of aircraft and passengers while on the ground. These facilities provide the essential interface between the air and ground transportation modes. The capacity of the various components of each element was examined in relation to projected demand in order to identify future landside facility needs. At DLL, this includes components for general aviation needs, such as:

- General Aviation Terminal Facilities
- Vehicle Parking
- Aircraft Hangars
- Aircraft Parking Aprons
- Airport Support Facilities

GENERAL AVIATION TERMINAL FACILITIES

General aviation (GA) terminal facilities have several functions. Space may be provided for a pilots' lounge, flight planning, concessions, management offices, storage, restrooms, and various other needs.

This space is not necessarily limited to a single, separate terminal building, but can include space offered by fixed base operators (FBOs) for these functions and services. Currently, the terminal building consists of office space for the FBO, as well as passenger spaces, including a holdroom/lounge, vending machines, flight planning space, and restrooms. The terminal building is approximately 1,320 square feet (sf) in size.

The methodology used in estimating GA terminal facility needs is based on the number of airport users expected to utilize GA facilities during the design hour. Space requirements for terminal facilities are based on providing 120 sf per design hour itinerant passenger. A multiplier of 1.1 increasing to 2.0 is also applied to terminal facility needs to better determine the number of passengers associated with each itinerant aircraft operation. This multiplier indicates an expected increase in business and recreational operations throughout the planning period. These operations often support larger turboprop and jet aircraft, which accommodate an increasing passenger load factor.

Table 3L outlines the space requirements for GA terminal services at DLL through the planning period. As shown in the table, the existing terminal building is adequate in size to meet future demand.

TABLE 3L | General Aviation Service Facilities

	Existing	Short Term	Inter. Term	Long Term
Design Hour Operations	12	14	14	15
Design Hour Itinerant Operations	7	9	9	10
Multiplier	1.1	1.1	1.5	2.0
Total Design Hour Itinerant Passengers	8	10	14	20
GA Terminal Building Services (sf)	1,000	1,200	1,700	2,500
FBO GA Services (sf)	320	320	400	600
Total GA Terminal/FBO Services (sf)	**1,320**	**1,520**	**2,100**	**3,100**

Source: Coffman Associates analysis

Vehicle Parking

General aviation vehicular parking demands have also been determined for DLL. Space determinations for itinerant passengers were based on an evaluation of existing airport use, as well as standards set forth to help calculate projected terminal facility needs.

The parking requirements of based aircraft owners should also be considered. Although some owners prefer to park their vehicles in their hangars, safety can be compromised when automobile and aircraft movements are mixed. For this reason, separate parking requirements, which consider one half of the based aircraft at the airport, were applied to GA automobile parking space requirements. Using this methodology, parking requirements for GA activity call for approximately 48 spaces in the short term, increasing to approximately 74 spaces in the long term. The GA based parking space estimate is the recommendation and is not reflective of what is currently available. **Table 3M** presents the vehicle parking needs of the airport through the planning period. Future consideration will be given in the master plan to providing vehicle parking to support additional development potential.

	Available	Short-Term	Long-Term
RUNWAYS			
	**RUNWAY 1-19**		
	RDC B-II-5000	Maintain	RDC C-II-2400
	5,010' x 100'	Maintain	5,500' x 100'
	30,000 lbs. SWL | 55,000 lbs. DWL	Maintain	Maintain
	Standard RSA, ROFA, ROFZ	Maintain	Mitigate new obstructions with upgrading to RDC C-II-2400 standards
	RPZs partially owned, extends over private property, public roads	Mitigate RPZ incompatibilities	Mitigate new RPZ incompatibilities with upgrading to RDC C-II-2400 standards
	RUNWAY 14-32		
	RDC A-I(small)-VIS	Maintain	RDC B-II(small)-5000
	2,746' x 100'	Maintain	4,200 x 75'
	Turf Surface	Maintain	Paved Surface with 12,500 lbs. SWL
	Standard RSA; Partially owned ROFA; Standard ROFZ	Mitigate ROFA issue	Mitigate new conficts with upgrading to RDC B-II(small)-5000 standards
	Runway 14 RPZ partially owned, extends over private property, public roads	Mitigate RPZ incompatibilities	Mitigate new RPZ incompatibilities with upgrading to RDC B-II(small)-5000 standards
TAXIWAYS			
	TDG 1B	Maintain	TDG 2A
	40' Taxiway Width	Maintain	Maintain
	400' Runway Separation	Maintain	Maintain
	Full-length Parallel Taxiway	Maintain	Construct parallel taxiway for paved Runway 14-32
NAVIGATIONAL AND APPROACH AIDS			
	RNAV (GPS) - Runways 1 (1-mile), 19 (1-mile)	Maintain	Reduce RNAV (GPS) Visibility Minimums to ½-mile Consider adding RNAV (GPS) approaches to Runway 14-32 if paved
	LOC - Runway 1 (1-mile)	Maintain	Maintain
	VOR - A (1-mile)	Maintain	Maintain
	AWOS	Maintain	Maintain
	Lighted Windcone	Add Segmented Circle to Windcone	Consider Supplemental Windcones near runway ends
	PAPI-2 - Runways 1, 19	Maintain	Replacement with PAPI-4 - Runways 1, 19 Consider adding PAPI-2 to Runways 14, 32 if paved
	REILs - Runways 1, 19	Maintain	Maintain; Consider adding REILs to Runways 14, 32 if paved
LIGHTING, MARKING, AND SIGNAGE			
	Rotating Beacon	Maintain	Maintain
	Non-Precision Markings - Runways 1, 19	Maintain	Consider Precision Markings - Runways 1, 19 Consider Non-Precision Markings to Runways 14, 32 if paved
	MIRL - Runway 1-19	Maintain	Install MIRL on Runway 14-32 if paved
	MITL	Maintain	Consider gradual replacement with LED technology Install MITL on new parallel taxiway to Runway 14-32 if paved
	Runway Holding Position Markings - 195' from runway centerline	Consider relocating Holding Position Markings to 200' from Runway 1-19 centerline	Relocate Runway 1-19 Holding Position Markings to 250' from center-line; Install Holding Position Markings 125' from Runway 14-32 center-line if paved
	Lighted airfield location signage	Maintain	Consider runway distance remaining signage

KEY

AWOS - Automated Weather Observation System
DWL - Double Wheel Loading
MIRL - Medium Intensity Runway Lighting
MITL - Medium Intensity Taxiway Lighting
PAPI - Precision Approach Path Indicator
RDC - Runway Design Code
REIL - Runway End Identification Lights
RSA - Runway Safety Area
RPZ - Runway Protection Zone
ROFA - Runway Object Free Area
SWL - Single Wheel Loading
TDG - Taxiway Design Group

Exhibit 3D
AIRSIDE REQUIREMENTS SUMMARY

This page intentionally left blank

TABLE 3M | General Aviation Vehicle Parking Facilities

	Existing	Short Term	Inter. Term	Long Term
Design Hour Itinerant Passengers	8	10	14	20
VEHICLE PARKING SPACES				
GA Itinerant Spaces (Terminal)	35	19	26	38
GA Based Spaces (Near/In Hangars)	12	29	31	36
Total Parking Spaces	**47**	**48**	**57**	**74**

Source: Coffman Associates analysis

AIRCRAFT HANGARS

Utilization of hangar space varies as a function of local climate, security, and owner preferences. The trend in GA aircraft, whether single- or multi-engine, is toward more sophisticated (and, consequently, more expensive) aircraft; therefore, many aircraft owners prefer enclosed hangar space to outside tiedowns.

The demand for aircraft storage hangars is dependent on the number and type of aircraft expected to be based at DLL in the future. For planning purposes, it is necessary to estimate hangar requirements based on forecasted operational activity. However, hangar construction should be based on actual demand trends and financial investment conditions.

It is important to note that the types of hangars detailed in this section are categorized based on the proposed size and layout of the facility and do not necessarily correspond with the locally designated hangar facility categories. For example, certain categories, such as T-hangars and linear box hangars, may be grouped into the same category. Other hangar types, such as condominium box hangars, aircraft storage hangars, FBO, and specialized aviation service operator (SASO) hangars, all typically correspond to conventional style hangars detailed in this section.

There are a variety of aircraft storage options typically available at an airport, including T-hangars, linear box hangars, executive/box hangars, and conventional hangars. T-hangars are intended to accommodate one small single-engine piston aircraft or, in some cases, one multi-engine piston aircraft. T-hangars are so named because they are in the shape of a "T," providing a space for the aircraft tail and wings, but no space for turning the aircraft within the hangar. The aircraft can be parked in only one position: backed ("pushed back") into the hangar. T-hangars are commonly "nested" with several individual storage units to maximize hangar space. In these cases, taxilane access is needed on both sides of the nested T-hangar facility. T-hangars are popular with aircraft owners with tighter budgets as they tend to be the least expensive enclosed hangar space to build and lease. There are currently 12 T-hangar units at DLL, totaling 12,140 sf of aircraft storage capacity.

Conventional hangars are large, clear span hangars typically located facing the main aircraft apron at airports. These hangars provide bulk aircraft storage and are often used by airport businesses, such as FBOs and/or SASOs (e.g., an aircraft maintenance business). Conventional hangars generally range in size from 4,000 sf to more than 20,000 sf. Often, a portion of a conventional hangar is used for non-aircraft storage needs, such as maintenance or office space. Box hangars are smaller versions of conventional hangars and are treated as a sub-section of conventional hangars. They may be owned by the airport or by private companies with land leases at the airport who operate their business from the hangar. The conventional hangars at DLL encompass approximately 140,895 sf. The airport has a mix of privately- and sponsor-owned hangars; while included in the total hangar space calculation, private hangars are generally not available for transient aircraft parking/storage.

Planning for future aircraft storage needs is based on typical owner preference and industry standard sizes for hangar space. For determining future aircraft storage needs, a planning standard of 1,400 sf per T-hangar and 3,000 sf per conventional hangar space is used. It should be noted that any projected estimate of required hangar space is an ideal and does not take into consideration the actual function of the hangar. For example, a large 10,000-sf hangar could house four or more aircraft, or the owner may house only one aircraft.

While the trend is toward aircraft owners preferring enclosed aircraft storage space, a small ratio of the total single-engine piston fleet projected to be based at DLL is expected to use outside tiedown areas. Providing a mix of aircraft storage options is preferred when planning hangars to meet the varied needs of aircraft owners. **Table 3N** provides a summary of the aircraft hangar facilities required through the long-term planning horizon.

TABLE 3N | Aircraft Hangar Facilities

	Existing	Short Term	Inter. Term	Long Term
Based Aircraft	53	57	62	72
AIRCRAFT TO BE HANGARED				
T-Hangar Positions	34	36	38	40
Box/Conventional Hangar Positions	16	18	21	28
Total Positions	**50**	**54**	**59**	**68**
HANGAR AREA REQUIREMENTS (sf)				
T-Hangar Area	12,140	50,400	53,200	56,000
Box/Conventional Hangar Area	140,895	54,000	63,000	84,000
Total Hangar Area	**153,035**	**104,400**	**116,200**	**140,000**

Source: Coffman Associates analysis

Due to the projected increase in based aircraft, annual GA operations, and hangar storage needs, facility planning will consider additional hangars at the airport. It is expected that the aircraft storage hangar requirements will continue to be met through a combination of hangar types. The analysis shows that there is a need for over 40,000 sf of new T-hangar storage capacity through 2042. Although the analysis shows a surplus of box- and conventional-type hangar space, this does not consider whether a large hangar is not optimizing the parking space within. This could include instances of a maintenance facility or other SASO that uses some of the hangar area for purposes other than storing aircraft.

It should be noted that hangar requirements are general in nature and based on the aviation demand forecasts. The actual need for hangar space will further depend on the actual usage within hangars. For example, some hangars may be used entirely for non-aircraft storage, as previously mentioned; however, from a planning standpoint, they have an aircraft storage capacity. Therefore, the needs of an individual used may differ from the calculated space necessary.

AIRCRAFT PARKING APRONS

FAA AC 150/5300-13B, *Airport Design*, suggests a methodology by which transient apron requirements can be determined from knowledge of busy-day operations. At DLL, the number of itinerant spaces required was determined to be approximately 15 percent of the busy-day itinerant operations for GA operations. A planning criterion of 800 sy per aircraft was applied to determine future transient apron requirements for turbine aircraft; a planning criterion of 500 sy per piston-powered aircraft is used since they are generally not as large as turbine aircraft. For local apron needs, the 500 sy criterion was applied since most local operations are conducted by piston aircraft. Apron parking requirements are presented in **Table 3P** and are separated into local and transient needs, as well as the total apron needs.

TABLE 3P | Aircraft Parking Apron Facilities

	Existing	Short Term	Inter. Term	Long Term
Local Apron Area	[redacted]	6,500	6,500	7,000
Itinerant Apron Area	[redacted]	5,100	5,100	5,600
Total Apron Area (sy)	**10,800**	**11,600**	**11,600**	**12,600**

Source: Coffman Associates analysis

Currently, the existing GA and terminal aircraft parking apron encompasses approximately 10,800 sy of space at the airport, which includes space adjacent to the self-serve fuel pump; this area would not be used for aircraft parking. Available apron space is not sufficient to meet long-term needs of GA activity at DLL. Alternatives presented in the next chapter will explore additional apron areas at the airport.

SUPPORT FACILITIES

Various facilities that do not logically fall within classifications of airside or landside facilities have also been identified. These other areas provide certain functions related to the overall operation of the airport.

Fuel Storage

Baraboo Flight Center is the only FBO at the airport and is the airport's fuel service provider. There are two underground storage tanks, one 15,000-gallon Jet A and one 12,000-gallon AvGas/100LL, both installed in 2022. These tanks are connected to a set of self-serve pumps located on the east side of the ramp. Pilots can also have fuel delivered by fuel trucks; however, for the purposes of this study, only static fuel storage capacity will be considered.

Records of fuel sales were provided by FBO management. Based on the fuel sales receipts from 2022, the airport pumped 220,000 gallons of Jet A and 20,000 gallons of AvGas. Operational data is extrapolated from the annual estimate of operations for the airport, with an estimated six percent of all operations being conducted by turbine aircraft. The remaining 94 percent of operations are conducted by piston-powered aircraft. Dividing the total fuel flowage by the total number of operations provides a ratio of fuel flowage per operation. Last year, the airport pumped approximately 190.97 gallons of Jet A per turbine operation and 1.07 gallons of AvGas per piston operation. It is anticipated that the ratio of aircraft operations will shift toward higher turbine counts through the planning period.

Fuel storage forecasts were produced using the calculated ratios above with the projected number of annual operations for each planning horizon. The forecasted fuel storage requirements are summarized in **Table 3R**. Maintaining a 14-day fuel supply would allow the airport to limit the impact of a disruption to fuel delivery. Currently, the airport has enough AvGas fuel storage to meet the 14-day supply criteria in the long term, while additional deliveries or tanks may be necessary to satisfy Jet A demand in the long term.

TABLE 3Q | Fuel Storage Requirements

	Current Capacity	Baseline[1]	Short Term	Inter. Term	Long Term
Jet A					
Daily Usage	**15,000**	603	687	837	1,171
14-Day Supply		8,442	9,618	11,718	16,394
Annual Usage		220,000	250,744	305,361	427,391
AvGas					
Daily Usage	**12,000**	55	60	62	66
14-Day Supply		770	840	868	924
Annual Usage		20,000	22,017	22,734	24,212

[1] Baseline data derived from CY2022 fuel sales.
Note: All values are in gallons.
Sources: FBO fuel flowage records, Coffman Associates analysis

PERIMETER FENCING

The entire airfield is equipped with a perimeter fence. Secured access gates provide vehicular access to the apron, hangar facilities, and various locations around the airfield. The secured gates are accessible only to airport tenants and employees. The AWOS is surrounded by an additional fence boundary to mitigate human and wildlife interference. Consideration should be given to upgrading the perimeter security fence to include barbed wire tops to increase the difficulty of accessing the airfield.

LANDSIDE FACILITY REQUIREMENTS SUMMARY

A summary of the required landside facilities for DLL previously discussed is presented on **Exhibit 3E**.

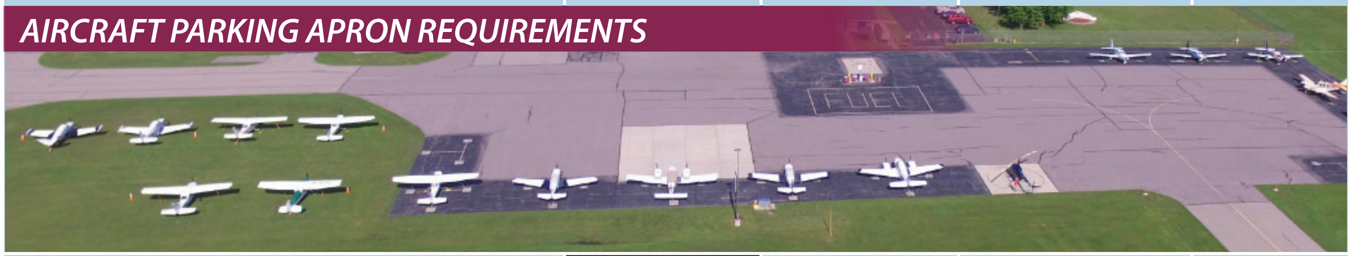
SUMMARY

The intent of this chapter has been to outline the facilities required to meet potential aviation demands projected for DLL through the planning horizon. To provide a more flexible master plan, the yearly forecasts from Chapter Two have been converted to planning horizon levels. The short term roughly corresponds to a five-year period, the intermediate term is approximately six to 10 years, and the long term is 11-20 years. By using planning horizons, airport management can focus on demand indicators for initiating projects and grant requests rather than on specific dates in the future.

AIRCRAFT STORAGE HANGAR REQUIREMENTS

	Existing	Short Term	Intermediate Term	Long Term
Aircrat to be Hangared	50	54	59	68
T-Hangar Positions (#)	12	36	38	40
T-Hangar Area (sf)	12,140	50,000	53,000	56,000
Box/Conventional Hangar Area (sf)	140,895	54,000	63,000	84,000
Total Hangar Positions (sf)	**153,035**	**104,000**	**116,000**	**140,000**

AIRCRAFT PARKING APRON REQUIREMENTS

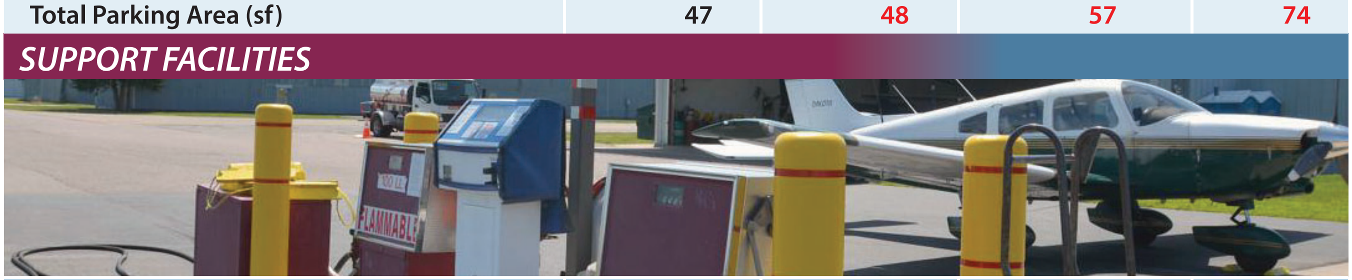


	Existing	Short Term	Intermediate Term	Long Term
Local Apron Area (sy)	[redacted]	6,500	6,500	7,000
Transient Apron Area (sy)		5,100	5,100	5,600
Total Apron Area (sy)	**10,800**	**11,600**	**11,600**	**12,600**

GENERAL AVIATION TERMINAL FACILITIES AND PARKING

	Existing	Short Term	Intermediate Term	Long Term
Building Space (sf)*	1,320	1,520	2,100	3,100
Itinerant Parking Spaces (Terminal)	35	19	26	38
Based Parking Spaces (Near/In Hangars)	12	29	31	36
Total Parking Area (sf)	**47**	**48**	**57**	**74**

SUPPORT FACILITIES



	Existing	Short Term	Intermediate Term	Long Term
14-Day Fuel Storage, Jet A	15,000	9,618	11,719	16,394
14-Day Fuel Storage, AvGas	12,000	840	868	924

*Includes FBO offices and Passenger spaces

Red numbers indicate a deficiency in meeting demand.

Exhibit 3E
LANDSIDE FACILITIES SUMMARY

Runway 1-19 is currently designed to meet FAA design standards associated with RDC B-II-5000. This category includes most small- and medium-sized business jets, such as the Cessna Citation Excel, as well as most turboprop aircraft, including the Beechcraft King Air 300. Ultimately, the runway is planned to meet RDC C-II-2400 design standards to accommodate more frequent operations by larger business jets, such as the Embraer Legacy 500.

The existing paved runway has been adequately serving a wide range of aircraft fleet mix, including business jets. However, to accommodate larger and faster jets flying longer stage lengths, additional runway length is needed. Therefore, runway extension alternatives will be considered in the next chapter. The analysis in the next chapter will also address improvements to lighting and instrument approach capabilities at the airport.

Runway 14-32 is currently designed to RDC A-I(small) design standards with visual-only approach procedures. The turf runway is designed to accommodate small, single-engine piston aircraft only, such as the Cessna 172 or Piper Cub. Through the planning horizon, the airport may choose to keep Runway 14-32 as it currently exists or pave the surface and design the runway to meet RDC B-II(small) standards with a one-mile instrument approach procedure. This is explored in greater detail in the next chapter.

On the landside, planning calculations show a need for expanding aircraft storage hangar capacity as more sophisticated aircraft (i.e., business jets, turboprops, and helicopters) base at the airport. Hangar space will largely depend on the needs of individual aircraft owners and developers and may not precisely follow the forecast. For example, if demand indicates a desire for additional T-hangars, then they should be the first priority. The availability of additional hangar space is a significant factor as to whether the airport will experience and can accommodate the forecasted growth in based aircraft.

The next chapter will examine potential improvements to airport facilities. Several development alternatives will be presented that meet the needs outlined in this chapter. On the landside, several facility layouts that meet the forecast demands over the next 20 years will be presented. On the airside, several options for extending the runway and meeting more restrictive safety area design standards will be presented.