CHAPTER 4 - REQUIREMENTS

AIRPORT MASTER PLAN UPDATE

Dickinson, ND

PREPARED FOR:
DICKINSON THEODORE ROOSEVELT REGIONAL AIRPORT
DICKINSON, ND

April 2015

Project # 1513301

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Chapter 4 – Requirements and Concepts

Airport Design

Airport design is largely determined by the physical and operating properties of the most demanding aircraft that will use the Airport. Examples of the requirements aircraft will put on the airport include:

- heavy operating weights stressing paved surfaces
- aerodynamic performance requiring certain runway lengths
- high operating speeds requiring large critical areas
- wide wingspans requiring large taxiway clearances for aircraft passage

The socioeconomic demands that have been impacting the region in recent years have also significantly changed the demands on the Dickinson Theodore Roosevelt Regional Airport (DIK). These demands, evidenced by dramatic fleet and operations changes taking place at Dickinson, are almost unprecedented in the perspective of airports. Traditionally, and as observed in previous master plans from Dickinson, minor modifications to the airfield design have been justified and implemented over the preceding 70 years.

The level of activity the airport is currently experiencing and forecast to experience over the next 20 years provides justification to implement wide-scale changes to the airport's airfield design and landside facilities.

The requirements and concepts that will be discussed in this chapter are based upon the forecast developed for this master plan, and consistent with current Federal Aviation Administration (FAA) design standards for implementation of these concepts.

Airport Reference Code and Design Aircraft

FAA Advisory Circular (AC) 150/5300-13A, Airport Design, establishes the criteria and standards for designing airports. This Advisory Circular relates airport design criteria to the approach speed and wingspan of aircraft through a coding system. This coding system is recognized in general as the Airport Reference Code (ARC) which signifies the highest Runway Design Code (RDC) for a given airport. A detailed explanation of ARC and RDC is found on pages 1-6 of **Appendix A – Airport Design**.

Design Aircraft Analysis

For Dickinson, the forecast has been completed providing the best insight possible into what is expected to occur over the planning period. Dickinson will grow to 82,000 enplanements in the next five years and 170,000 enplanements in the planning period. It is known and exhibited by activity in the past three years that regional jets and business jets have intensely used Dickinson Theodore Roosevelt Regional Airport. In 2013, United Airlines and Delta Airlines began serving Dickinson with twice daily regional jet service and both increased to three times daily in 2014.

Determination of Design Aircraft

For Dickinson, the design aircraft has been determined based upon the following information as related to major airline passenger service:

- Current airline aircraft in use at Dickinson
  - CRJ200 and EMB145 used by United and Delta to Denver and Minneapolis
- Major airline hubs currently served directly from other airports in North Dakota, and the routes most likely to be added to Dickinson
  - Chicago O'Hare (ORD)
  - Houston Intercontinental (IAH)
  - Salt Lake City (SLC)
- Major airline aircraft most likely to operate to these airline hubs based on comparable North Dakota markets
  - Existing Regional Jets – 50 passengers
  - Larger Regional Jets – up to 100 passengers
  - Narrow Body Aircraft – over 100 passengers

In addition to major airline service, there is one niche market airline which has contacted airport management to express interest in serving Dickinson once the runway can accommodate them. This carrier is Allegiant which currently serves Minot, Bismarck, Grand Forks and Fargo in North Dakota. Of the 87 markets Allegiant is in, 22 have less than 170,000 enplanements (forecast activity for Dickinson in planning period) and 9 have less than 82,000 (forecast activity for Dickinson in next 5 years). Dickinson is clearly within Allegiant's market strategy and growth plan, making it important to consider Allegiant's aircraft in identifying the design aircraft group.

Based on this existing and forecast airline market activity, the most demanding airline aircraft and destinations for Dickinson are:

  - United Service to ORD with CRJ200
  - Delta to SLC with CRJ200
  - Allegiant to LAS with MD83

This information is important in this level of detail because it is the primary element used to determine runway length. Runway length will be addressed shortly, but first it is also important to step back briefly and address what the design group means in a broader sense.

What does the Design Group mean for the airport?

The design aircraft for an airport drives three major elements of the airport. The Airport Reference Code (ARC), the pavement strength and the primary runway length. For Dickinson, the design aircraft needs have been grouped into four groupings with different ARC, weight and length requirements. It is necessary from these four groupings to settle on one ARC, one pavement strength and one primary runway length that will best serve all four groupings. The four groupings and their associated attributes are listed in **Table 1 – Key Design Aircraft Groupings for Dickinson**.

TABLE 1 – KEY DESIGN AIRCRAFT GROUPINGS FOR DICKINSON

Design Aircraft Groupings	ARC	Weight	Length
General Aviation Business Jets	C/D-II	60,000	8,900’
Airline Regional Jets	C/D-II	53,000	7,700’
Airline Large Regional Jets	C-III	100,000	7,600'
Airline Narrow Body Aircraft	C/D-III	162,000	7,700’
Recommended Design Aircraft Group	**D-III**	**162,000**	**7,700’**

Of these four groupings there are C and D aircraft approach category (AAC) and II and III airplane design group (ADG). A complete explanation of AAC, ADG and ARC is provided in **Appendix A – Airport Design**. The most demanding of these would be the D AAC and the III ADG thus resulting in an ARC of D-III.

The specific aircraft that currently demands an AAC of “D” currently is the Bombardier CRJ200 used by Delta to Minneapolis. In addition, several business jets frequenting Dickinson are also AAC “D” such as the Lear 35 and 60 and Cessna Citations. As such, there are more than 500 annual operations of AAC “D” aircraft currently operating at Dickinson.

The aircraft that would demand an ADG “III” are large regional jets such as the Embraer 175 used by Delta and United, and the narrow body aircraft such as the Boeing 717 and MD-83, and Airbus A320 used by United, Delta and Allegiant. These narrow body aircraft are currently serving 35 markets across the county with less than 170,000 enplanements. The details of these markets are listed in **Table 11 – Small Airports with Narrow Body Service** in **Appendix A**. While these aircraft are not currently operating at Dickinson, it is likely that an ADG “III” aircraft will have significant operations at Dickinson in the next five years.

One prime example of fleet changes is Delta airlines. In 2013, they leased more than 80 Boeing 717s (formerly operated by AirTran), and is placing them in many markets to replace regional jets. These 110 passenger 121,000 pound aircraft are currently being used in Minneapolis hub by Delta, and it is foreseeable with the level of activity at Dickinson that the B-717s could be used by Delta into Dickinson within the planning period.

As noted above, there is no single aircraft that dictates this requirement of the D-III ARC. There are many changes that will take place in the airline industry in the near future and through the planning period resulting in the potential of many different types of aircraft serving Dickinson. Each of these aircraft groupings in **Table 1** are expected to serve Dickinson in the near future and in the planning period. All of these aircraft can be accommodated if the airport is designed based on the D-III ARC.

Table 1 also provides a simplified listing[1] of aircraft weight. The conclusion shown in **Table 1** is that it is highly likely an aircraft in each group of aircraft will be serving Dickinson in the planning period, so it would be short-sighted to build the runway with only the strength for regional jets and see it then deteriorate prematurely when narrow body aircraft begin using the airport. The narrow body aircraft could be the Allegiants MD83s, A319s, or A320s, Delta's 717s or other aircraft with 100 to 200 seats.

This exact scenario is taking place now as Dickinson's primary runway was built for turboprop aircraft and now regional jets have resulted in a pavement that has a useful life of no more than a year with the aircraft currently using it. For details regarding the current pavement condition refer to **Appendix C – Airport Pavement Structural Evaluation**.

As to the runway length conclusion in **Table 1**, the length of **7,700 feet** was determined to be sufficient to meet the demands of the CRJ200 and MD83 aircraft to specific destinations most probable to be served from Dickinson. The destinations were listed on the previous page as Chicago O'Hare, Salt Lake City and Las Vegas. An extensive analysis of each aircraft type and the runway length required for each potential destination is summarized later in this chapter on pages 10-13 in the section "Increase in Runway Design Standards" and is provided in detail in **Appendix A – Airfield Design**.

IMPACT OF AIRPORT DESIGN CHANGE AT DICKINSON

In FAA Advisory Circular, 150/5300-13A, the following items are identified as required changes for an airport changing from B-II to D-III design standards.

- Change in crosswind component
- Increase in runway separation standards
- Increase in RPZ dimensions
- Increase in runway design standards
- Increase in surface gradient standards
- Increase in taxiway design standards

In addition, if this recommended action to extend, relocate, or otherwise move any runway end is pursued, an Environmental Assessment (EA) of the impacts of this action will need to be completed. It is anticipated the EA will take a minimum of two years to complete before construction of a runway extension or relocation can be started. In addition, an aeronautical survey will need to be completed to assist the FAA in redeveloping instrument approaches for the airport. The instrument approach procedure development also takes as long as two years and should be initiated with enough lead time to make the approach available when construction is completed.

[1] Additional Details regarding pavement strengths are provided on pages 13-14 of this Chapter and in **Appendix D – Pavement Design**

Change in Crosswind Component

FAA design standards establish minimum runway wind coverage of 95 percent for specified levels of maximum crosswind components. The maximum allowable crosswind components increase with aircraft weight and approach speed, and are associated with the designated RDC. Listed below are the maximum crosswind components for each possible RDC.

- 10.5 knots for RDCs A-I and B-I
- 13 knots for RDCs A-II and B-II
- 16 knots for RDCs A-III, B-III, and C-I through D-III
- 20 knots for RDCs A-IV through D-VI

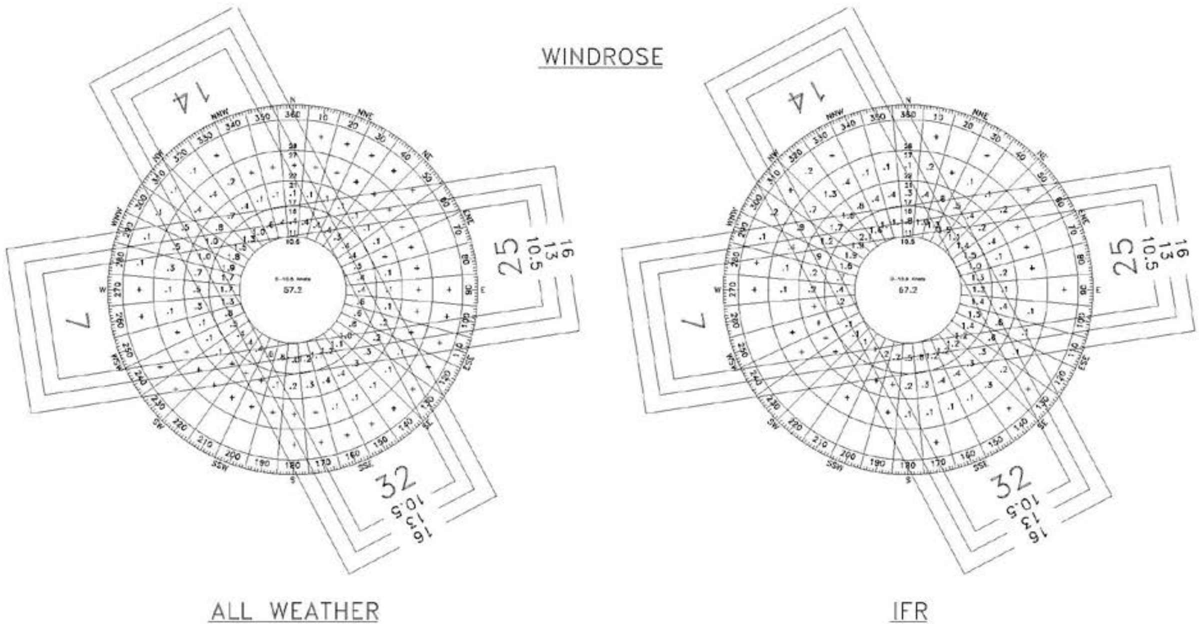
The existing RDC for Runway 14-32 is B-II. Runway 14-32 was analyzed to see if a crosswind runway would be needed for the D-III aircraft forecasted to use the Dickinson Theodore Roosevelt Regional Airport.

Figure 1 illustrates the windroses and wind data tables for Dickinson Regional Airport. A windrose charts the percentages of observations of winds occurring at set levels that coincide with compass directions. By placing a rectangle over the windrose that is aligned with the runway and is the width of the allowable crosswind component, the wind coverage for a runway can be computed by summing the percentages that fall within the rectangle, to determine the percentage of time that a runway will provide wind coverage at a given speed.

The figure illustrates two types of windroses: “All Weather” and “IFR.” The all-weather windrose, as the phrase implies, encompasses all weather conditions. The IFR windrose encompasses only wind occurring during periods of visibility of less than 3 miles and/or cloud ceiling heights less than 1,000 feet above ground. Those weather conditions are associated with flight under instrument flight rules (IFR). The IFR windrose determines which runway orientation should serve instrument approaches.

Wind coverage at 16 knots (RDC C-III) is 97.10 percent for Runway 14-32, using the all-weather windrose. This information shows that Runway 14-32 provides the minimum recommended 95 percent wind coverage for C-III aircraft. Therefore no crosswind runways would be necessary to support C-III aircraft. However, at 10.5 and 13.0 knots, Runway 14-32 does not provide the recommended 95 percent wind coverage, and therefore the 7-25 crosswind runway is needed for A/B-I and B-II aircraft.

FIGURE 1 – CURRENT WIND DATA - DICKINSON



	All Weather Windrose Data			IFR Weather Windrose Data		
Runway	**10.5 Knots**	**13.0 Knots**	**16.0 Knots**	**10.5 Knots**	**13.0 Knots**	**16.0 Knots**
Runway 14 - 32	84.27%	91.43%	97.10%	79.52%	88.70%	96.15%
Runway 7 - 25	78.21%	86.59%	94.27%	66.56%	77.85%	88.88%
Combined	96.19%	98.86%	99.76%	92.58%	97.14%	99.34%

Source: National Climatic Data Center

All Weather - 83,919 Observations IFR – 6,257 Observations

Dickinson Theodore Roosevelt Regional Airport - Station Number 72764

2000 To 2009

+ = Less than 0.05%

Alternative Orientation

Analysis of an alternative orientation was completed to determine if realignment of the primary runway would provide improved wind coverage at the airport that would be sufficient to eliminate the need for a crosswind runway at the airport.

TABLE 2 – ALTERNATE OREINTATION WIND COVERAGE

All Weather Windrose Data			
Runway	**10.5 Knots**	**13.0 Knots**	**16.0 Knots**
Runway 13 - 31	86.00%	92.77%	97.73%
Runway 7 - 25	78.21%	86.59%	94.27%
Combined	96.37%	98.97%	99.76%
IFR Weather Windrose Data			
Runway	**10.5 Knots**	**13.0 Knots**	**16.0 Knots**
Runway 13 - 31	81.23%	89.50%	96.14%
Runway 7 - 25	66.56%	77.85%	88.88%
Combined	92.83%	96.99%	99.03%

Source: National Climatic Data Center
IFR Weather - 6,257 Observations
Dickinson Theodore Roosevelt Regional Airport
Station Number 72764
2000 To 2009

Runway 14-32 was shifted to an orientation of 13-31, which was identified as the best potential alignment based upon historical wind data from the airport. **Table 2** shows the results of this analysis.

There was some increase in the percentage of coverage on the all-weather windrose; however, there was not enough to provide the 95% coverage at 10.5 Knots (for RDC A/B-I) or 13.0 Knots (for RDC B-II) on an orientation of 13-31, to eliminate the crosswind runway. Therefore, it was determined that the existing orientation of Runway 14-32 and Runway 7-25 should remain as the preferred alignment throughout the planning period.

Conclusion to Crosswind Coverage

Runway 14-32 provides the required 95 percent wind coverage at 16 knots for D-III aircraft; however, it does not provide adequate wind coverage for A/B-II aircraft at 13 knots. Therefore Runway 7-25 should be designed to meet A/B-II criteria to provide the required 95 percent wind coverage for the combination of the two runways.

Increase in Runway and Taxiway Separation Standards

Standards are established by the FAA for the separation of important areas on an airport used for movement and relocation of aircraft. These standards increase in size with the increase of aircraft size, approach speed, and visibility minimums to ensure safety. The items which have separation standards include:

- Parallel Runway Centerline
- Holdline
- Taxiway/Taxilane/Centerline
- Aircraft Parking Area
- Helicopter Touchdown Pad

Dickinson Theodore Roosevelt Regional Airport does not have a Parallel Runway or a Helicopter Touchdown so these standards were not considered.

TABLE 3 – RUNWAY & TAXIWAY SEPARATION STANDARDS

Standard Distance from Runway Centerline	Existing	Future	Ultimate
Hold Position Lines	250’	250’	250’
Taxiway/Taxilane Centerline	400’	400’	400’
Aircraft Parking Area	750’	500'	500'

The existing hold position lines for aircraft are 250 feet away from Runway 14-32’s centerline. This is the distance required for category D aircraft; therefore, no improvements would need to be made.

The partial parallel taxiway centerline for Runway 14-32 is 400 feet from the runway centerline. This distance is what is required for category D aircraft with visibility less than ¾ - statue mile; therefore, no increase in this dimension would need to be made.

The final runway separation standard is the minimum distance from the runway centerline to parked aircraft. Currently the aircraft parking area is behind the Building Restriction Line (BRL), which is 750 feet from the runway centerline. The standard requires a minimum of 500 feet from the runway centerline for D-III aircraft; therefore, the existing layout of the field is sufficient for both current and future needs.

Increase in Runway Protection Zone (RPZ) Standards

The runway protection zone (RPZ) is an area off the runway end designed to enhance the protection of people and property on the ground. Upgrading Runway 14-32 to a D-III runway will increase the size of the needed RPZ for existing approaches to Runway 14.

Currently, Runway 14 has a standard instrument approach procedure with visibility minimums not lower than 1 mile. The existing airport property meets the required RPZ needs for C-II aircraft with 3/4 mile or greater visibility minimums, which has dimensions of 1,000 feet (inner width) by 1,750 feet (outer width) by 1,700 feet (length), 48.97 acres – partially by easement. It is probable that in the future, a GPS Precision Instrument Approach would be developed for Runway 14 at its new threshold with visibility minimums lower than ¾ mile. Before this could occur, an RPZ sized to the highest standards for an RPZ, which is 1,000 feet (inner width) by 1,750 feet (outer width) by 2,500 feet long (78.92 acres) would need to be established.

The RPZ for Runway 32 is already at the highest standards, which is required of a precision approach with ½ mile visibility, which is 1,000 feet (inner width) by 1,750 feet (outer width) by 2,500 feet in length (78.92 acres). It is further recommended by the FAA that the RPZ, which functions to protect people and property on the ground, be owned in fee by the airport and that no incompatible objects or activities are allowed. Incompatible land use does include public roads which currently exist in the RPZ: therefore, changes in the position of the RPZ or land uses inside RPZ would need to be made to accommodate this recommendation by the FAA.

TABLE 4 – RUNWAY PROTECTION ZONE DIMENSIONS (INNER WIDTH, OUTER WIDTH, LENGTH)

Runway End	Existing	Future	Ultimate
14	1000' x 1510' x 1700' Partially by Easements With Incompatible uses	1000' x 1750' x 2500' Owned in Fee with Compatible Uses	1000' x 1750' x 2500' Owned in Fee with Compatible Uses
32	1000' x 1750' x 2500' Partially by Easements With Incompatible Uses	1000' x 1750' x 2500' Owned in Fee with Compatible Uses	1000' x 1750' x 2500' Owned in Fee with Compatible Uses
7	500' x 700' x 1000' Partially by Easements	500' x 700' x 1000' Partially by Easements	500' x 700' x 1000' Partially by Easements
25	500' x 700' x 1000' Partially by Easements With Incompatible Uses	500' x 700' x 1000' Partially by Easements With Incompatible Uses	500' x 700' x 1000' Partially by Easements With Incompatible Uses

Increase in Runway Design Standards

Analyzing the runway design standards is a critical part of determining which type of aircraft a runway can support. The standards are dependent on the designated RDC, approach visibility minimums and aerodynamic performance of the critical design aircraft. The following are included in the runway design standards:

- Runway Length
- Runway Width
- Runway Strength
- Runway Shoulder Width
- Runway Blast Pad Width/Length
- Runway Safety Area
- Runway Object Free Area

TABLE 5 – RUNWAY DESIGN STANDARDS

	Existing	Future	Ultimate
Runway 14-32			
Runway Design Code	B-II	D-III	D-III
Design Aircraft	Embraer 120	EMB-175/MD 83	EMB-175/MD 83
Dimensions	6,400' x 100'	7,700' x 150'	8,900' x 150'
Visibility Minimums	Non-Precision/Precision	Precision/Precision	Precision/Precision
Pavement Strength	30,000 SW, 37,500 DW	162,000 DW	162,000 DW
Shoulders	None	25' wide	25' wide
Blast Pad	None	200'w x 200'l	200'w x 200'l
Runway Safety Area	8,400' x 500'	9,700' x 500'	10,900' x 500'
Runway Object Free Area	7,600' x 800'	9,700' x 800'	10,900' x 800'
Runway 7-25			
Runway Design Code	B-II	B-II	B-II
Design Aircraft	B200	B200	B200
Dimensions	4,700' x 75'	4,700' x 75'	4,700' x 75'
Visibility Minimums	Visual/Non-Precision	Non-Precision/Non-Precision	Non-Precision/Non-Precision
Pavement Strength	16,000 SW, 20,000 DW	16,000 SW, 20,000 DW	16,000 SW, 20,000 DW
Shoulders	None	10' wide	10' wide
Blast Pad	None	95'w x 150'l	95'w x 150'l
Runway Safety Area	5,300' x 150'	5,300' x 150'	5,300' x 150'
Runway Object Free Area	5,300' x 500'	5,300' x 500'	5,300' x 500'

SW – Single Wheel; DW – Dual Wheel

Runway Length – Primary Runway

As mentioned earlier in this chapter, the runway length is one of the major elements, and likely the most significant, that results from the selection of a design aircraft group. As simplified in **Table 1 – Key Design Aircraft Groups for Dickinson**, the primary runway length for Dickinson is recommended to be **7,700 feet**. While a runway length of 8,900 feet is indicated in Table 1 for General Aviation Business Jet aircraft, this length is not recommended at this time. The rationale behind the runway length recommendation is summarized in the following information with additional details provided in **Appendix A – Airport Design**.

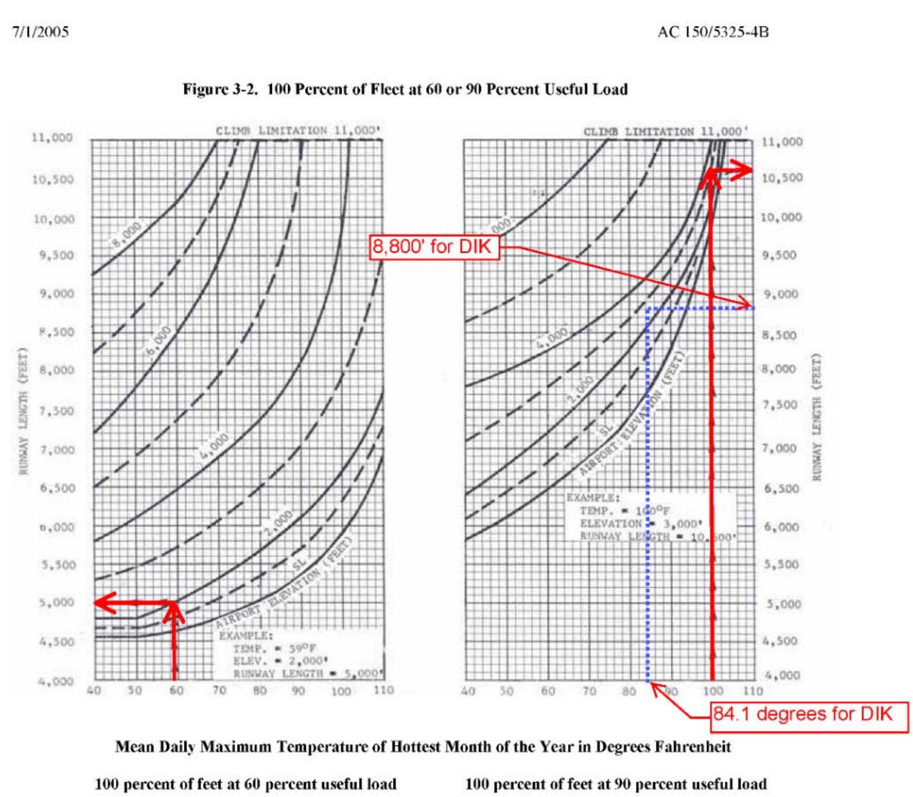
The current 6,400 feet length of Runway 14-32 is not sufficient for the existing and forecast demands for the airport. Both the general aviation and airline aircraft have changed at Dickinson and airline aircraft are forecast to continue to change. Therefore, both the general aviation and passenger airline aircraft requirements were examined.

General Aviation Business Jet Aircraft

Based on the FAA design standards, in AC 150/5325-4B, Runway Length Requirements for Airport Design, to serve current general aviation aircraft operating at Dickinson, the airport should be designed for aircraft more than 12,500 pounds and up to 60,000 pounds. AC 150/5325-4B divides this into two groups for runway length determination. The first group represents 75% of the fleet and the second group represents 100% of the fleet in this weight range, the difference being the top 25% most demanding aircraft in this fleet size. For Dickinson, there were 288 and 269 operations in 2012 and 2013 respectively by aircraft in the top 25%, and therefore a runway length utilizing the 100% fleet chart from the AC was utilized. The chart in **Figure 2** is the 100% fleet with a 90% useful load.

Using the 100% fleet length table, the runway length for Runway 14-32 would need to be 8,800 feet for the current general aviation needs, plus a runway gradient adjustment of 100 feet resulting in a required runway length of 8,900 feet. However, since there are not 500 annual operations of these aircraft as of yet, this length will not be used as the recommended length of the runway. **This length of 8,900 feet is important to note and is recommended as the ultimate future of the airport.**

FIGURE 2 – 100% FLEET AT 90% USEFUL LOAD



<u>Passenger Airline Aircraft</u>

As noted earlier, United and Delta Airlines currently serve Dickinson to Minneapolis and Denver with CRJ-200 and EMB145 aircraft. The CRJ-200 and MD-83 aircraft were determined to be likely aircraft in the critical design aircraft groupings at Dickinson. The most probable new routes within the next five years would be to Chicago, Salt Lake City and Las Vegas based upon comparable airport analysis. As indicated in the **Table 6 - Design Aircraft Analysis**, the runway length for Runway 14-32, for these aircraft and routes requires lengths of 7,500 and 7,700 feet.

Airline service to other locations was also examined and most of these routes, with potential aircraft, can fully operate on a 7,700 foot runway. These destinations could be served by regional aircraft and narrow body aircraft depending how the airline market at Dickinson evolves and how airlines choose to serve them.

Analysis was completed with all the possible fleet that airlines could use to serve Dickinson's needs over the planning period. As seen in **Table 6**, there are certain destinations, highlighted in red, including DFW International, Phoenix/Mesa Gateway, Atlanta, Washington Dulles, New York JFK, and Orlando Sanford that would require runways longer than 7,700 feet for some of their fleet to operate. The applicable fleet that requires the longer runway to these destinations includes CRJ200, CRJ900, B-717 and MD83. However, there are other aircraft in the airline's fleets that could operate off a 7,700 foot runway. This information is detailed further in **Appendix A – Airfield Design**.

Future Runway Length Conclusion

The four groupings listed in **Table 1** will all be operating at Dickinson through the planning period with enough frequency each to justify a given runway length. The critical decision at this time is to recognize that these groupings of aircraft must all be considered. The runway length that allows Dickinson Theodore Roosevelt Regional Airport to be a fully functional long-term transportation asset is a length that allows it to meet the interests of the region it serves. Based on these four groupings, a consensus determination was formed as to the appropriate length. The recommended length of **7,700 feet** long will allow all groups, with the exception of some business jets, to fully utilize the airport.

TABLE 6 – DESIGN AIRCRAFT ANALYSIS

DESIGN AIRCRAFT ANALYSIS

Adjusted for Runway Gradient: Maximum Difference between Runway Centerline Elevations 5' = 50' Takeoff Length Extension

AIRLINES	HUBS		Aircraft / ARC / Engines / Maximum Gross Takeoff Weight (LBS)									
			CRJ200	E145	CRJ700	CRJ900	E175	B717	MD83	MD90	A320	B737-800
	Current Service in ND*	Engine	CF34-3B1	AE 3007-A1E	CF34-8CG	CF34-8C5	CF34-8E5	BR715-A1-30	JT8D-219	V2500-D5	CFM56	CFM56-7B
		Maximum Takeoff Weight (lbs)	53,000	53,131	75,000	80,500	82,673	121,000	160,000	156,000	171,961	174,200
		Runway Design Code (RDC)	D-II	C-II	C-II	C-III	C-III	C-III	D-III	C-III	C-III	C-III
		Taxiway Design Group (TDG)	3	3	3	3	3	3	4	4	3	3
		Distance (NM)	Runway Length (FT) @ ISA +15C									
Delta	MSP	420	7,300		5,100	6,100	4,900	6,600		6,000		
United	DEN	425	7,300	6,000	5,100	6,100	4,900					
Delta	SLC	540	7,500		5,200	6,200	5,000	6,700				
United	ORD	700	7,700	6,300	5,500	6,400	5,100					
American	ORD	700		6,300								
Alaska	SEA	800			5,600							
Allegiant	LAS	850							7,700		6,100	
American	DFW	875	7,800	6,600			5,300					
Allegiant	IWA	905							8,000		6,100	
United	IAH	1,070		6,900	6,400	7,300					5,700	6,400
Delta	ATL	1,150	8,300		6,500	7,600		7,600		7,000	5,700	6,500
United	IAD	1,200	8,400		6,500	8,500	6,800				5,900	6,600
Delta	JFK	1,310			6,600	8,600	6,900	8,100		7,300	6,100	6,700
Allegiant	SFB	1,500							8,900		6,800	
Alaska	ANC	1,825										7,200

* Non Stop Service to Cities in North Dakota include MSP, DEN, SLC, ORD, LAS, DFW, IWA, IAH, ATL, SFB, LAX, and PIE

FAA A/C 150/5325 - 4B Runway Length: 75% of Fleet (up to 60,000lb MTOW) at 90% Useful Load, Length =	7,300
FAA A/C 150/5325 - 4B Runway Length: 100% of Fleet (up to 60,000lb MTOW) at 90% Useful Load, Length =	8,900

- Mean daily high temperature of 84 degrees F
- Runway difference in center line elevations 5 feet
- Elevation 2,590 MSL

Ultimate Runway Length

Although current activity forecasts do not predict the demand for longer stage length markets developing in the next five years, proper planning dictates that the proposed airport design include the possibility. Inclusion of the ultimate runway length of 8,900 feet in the planning effort ensures a primary objective:

> An approved ALP showing the 8,900 foot ultimate runway length will constitute a "plan on file" with the FAA, thereby identifying the necessary airspace for the potential runway extension.

It's important to note that the **ultimate runway length of 8,900 feet** represents a planning length to accomplish the above objectives and is not predicated on a specific aircraft being flown to specific destinations. While an air carrier may intend to use a specific aircraft that would require a runway length of 8,900 feet or more, the air carriers examined in this study also have other aircraft that would be able to provide the planned service using the proposed 7,700 foot runway.

Runway Length – Crosswind Runway

Runway 7-25 is needed by B-II and smaller aircraft using the airport, because the primary Runway 14-32 does not provide 95 percent coverage at 13.0 knots crosswind component and below. Runway 7-25 provides the necessary wind coverage to meet FAA standards for aircraft of this size.

Runway 7-25 is 4,700 feet long and is designed for RDC B-II. This length is adequate to meet the FAA design standards for aircraft of this size, and no extension is required.

Runway Width

Primary Runway 14-32 is 100 feet wide and Runway 7-25 is 75 feet wide. The required width is dependent on the designated RDC and approach visibility minimums.

Runway 14-32 has approach visibility minimum of ½ mile and it is anticipated to be utilized by ARC D-III aircraft in the future. According to FAA AC150/ 5300-13A design standards, a runway width of 150 feet is needed for these approach minimums and design aircraft. The current width of 100 feet is appropriate for C-II aircraft but is not sufficient for ARC D-III aircraft which requires the runway to be 150 feet wide.

The Runway 7-25 has an approach visibility minimum of 1 mile. According to FAA AC150/5300-13A design standards a minimum width of 75 feet is needed. **The current width of Runway 7-25, which is 4,700 feet long, is sufficient for future aviation needs.**

Runway Strength

The current published weight bearing capacity for the runways at Dickinson are listed in **Table 7**.

TABLE 7 – CURRENT WEIGHT BEARING CAPACITY OF RUNWAYS

Aircraft Landing Gear Configuration	Runway 14-32 Gross Landing Weight	Runway 7-25 Gross Landing Weight
Single Wheel	30,000 pounds	16,000 pounds
Dual Wheel	37,500 pounds	20,000 pounds
Dual Tandem	N/A	N/A
Pavement Classification Number	12 F/W/D/T	6 F/W/D/T

PCN: Determined through analysis by Applied Pavement Technology, March 28, 2013 for NDAC

The smallest 50 passenger turbojet aircraft used daily by United and Delta airlines have a dual wheel configuration and are in excess of the published limit of 37,500 pounds. The Embraer EMB-145XR has a maximum gross takeoff weight (MTOW) of 53,131 pounds and the Bombardier CRJ-200 has a MTOW of 53,000 pounds. The Pavement Classification Number (PCN), as detailed in Chapter 2, for Runway 14-32 is 12 based upon a D category subgrade (Ultra Low Strength) with the current aircraft. For this same D category subgrade, the Embraer 145 and CRJ200 each have an Aircraft Classification Number (ACN) requirement of 17. In comparison the Embraer 120, previously serving Dickinson, has ACN of 8. As noted in Chapter 2 and in **Appendix C**, the existing strength of Runway 14-32 needs to be addressed as soon as possible considering the current airline activity.

The new runway strength must, at a minimum, accommodate regional aircraft up to 100,000 pounds MTOW. Pavement designs were developed for both Regional Aircraft and for Narrow Body Aircraft (MTOW between 100,000 and 200,000 pounds). The details for these pavement designs are discussed further in Chapter 5 and included in **Appendix D – Pavement Design**. The pavement designs for narrow body aircraft utilizing the FAA FAARField Pavement Design Program are based on 312 annual departures, or 12% of airline operations, with minimal future growth rate.

Based upon the forecast activity, and as shown in **Table 1,** the four key aircraft design groupings are establishing the justification of the pavement strength. All four groupings of these aircraft, not a single unique one, but the groupings as a whole, will be in Dickinson in the near future and within the planning period. Since all of these aircraft groupings will operate at Dickinson, an optimum strength for a **162,000 pound** aircraft is recommended. This strength will be achieved with a design to handle daily regional jets and narrow body aircraft.

Runway Shoulder and Blast Pad

Dickinson Theodore Roosevelt Regional Airport currently does not have runway shoulders or a blast pad. These typically are installed at airports that have turf surrounding the airport that is susceptible to soil erosion. In the future, if erosion of the soil surrounding the runway begins to occur, it is recommended that these elements be installed on the runway. For a D-III runway, the Runway Shoulders should be 25 feet wide, and the blast pad should be 200 feet wide and 200 feet long.

Runway Safety Area and Object Free Area

Similarly to other airport design standards, the size of the Runway Safety Area (RSA) and Object Free Area (OFA) is dependent on the type and size of aircraft using a runway.

The RSA is a "defined surface surrounding a runway prepared or suitable for reducing the risk of damage to airplanes in the event of an undershoot, overshoot, or other excursion from the runway." The runway safety area should be cleared, graded, and have no potentially hazardous ruts, humps, depressions and or surface variations. To meet standards for an RDC of D-III, the RSA would need to be expanded to extend 1000 feet beyond each runway end, and widened to 500 feet, centered on the runway centerline.

The OFA is “an area on the ground, centered on a runway, taxiway, or taxilane centerline, provided to enhance the safety of aircraft operations by having the area free of objects, except for objects that need to be located in the OFA for air navigation or aircraft ground maneuvering purposes.” To meet the standards and to protect D-III aircraft, the OFA must be 800 feet wide and extend 1000 feet beyond the ends of the runway.

Access roads currently exist inside the OFA and RSA, and the area would need significant grading in order for Runway 14-32 to meet D-III OFA and RSA design standards. If a new runway were to be constructed, all design standards in regards to RSA and OFA would be incorporated into the design of that runway.

Increase in Runway Gradient Standards

The runway gradient standards are important to ensure that the vertical curves along the runway are spaced as to allow the aircraft to have a smooth takeoff and landing, and not too steep as to degrade takeoff or landing performance. The FAA AC 150/5300-13A paragraph 313 specifies the maximum longitudinal grade, maximum allowable grade, length of vertical curves as well as the distance between vertical curves.

For an AAC C or D runway, the maximum longitudinal grade along the centerline for the first and last quarter of the runway is 0.8 percent. The middle half of the runway is recommended to be no greater than 1.5 percent. At Dickinson the difference in runway elevation from end to end is approximately 5 feet, which results in an overall surface gradient of approximately 0.068 percent.

Other Airside Facility Requirements

Taxiways

In Advisory Circular 150/5300-13A, first released in 2011, a new item was added called the Taxiway Design Group (TDG). These groups, from 1 to 7, are based on the width of the aircraft main gear and the distance from the main gear to the cockpit. The TDG for each critical aircraft is included in **Table 6** in addition to each aircraft's Runway Design Code. The TDG is applicable for the area of the airport that each aircraft will be using. For instance, if the design aircraft has a TDG of 3, this requires a 50 foot wide taxiway. This does not mean all taxiways must be 50 feet wide, but it does mean that a taxiway system used by the critical aircraft to access the primary runway needs to be 50 feet wide. A portion of Taxiway B is 40 feet wide and the remaining taxiways are all 35 feet wide, and the existing intersections fillets were designed to handle smaller aircraft, and designed with previous FAA design standards. In order to accommodate existing and future TDG 3 and potential TDG 4 aircraft, it will be necessary to have a 50 foot wide taxiway parallel for and connecting to Runway 14-32 and the airline terminal, and intersection fillets design to meet the current standards.

Taxiway Strength

The strength of a taxiway's pavement must be strong enough to support the weight of the design aircraft it serves, which is usually equal to the runway it serves. In the future, it is anticipated that the strength of the taxiways on the airport will need to be increased to the same weight bearing capacity of the runways as the strength of the runways are increased.

Navigational Aids and Instrument Approaches

The current navigational aids and established instrument approaches at the airport are anticipated to be adequate through the planning period with the exception of the Instrument Landing System (ILS) Glide Slope array on Runway 32.

The ILS Glide Slope antenna array is an "end fire" system that the FAA Tech Ops division has indicated will likely be replaced in the near future. This type of glide slope is highly susceptible to interference from snow build-up on the ground and over the years has experienced several outages which have caused multiple aircraft delays and cancelled flights.

The FAA would be responsible for replacement of this system which is usually done through a reimbursable agreement. Close coordination with the FAA should be initiated to ensure that replacement of this system would coincide with a major runway construction project to coordinate the timing of the work and mitigate outages that would be experienced otherwise.

Landside Facilities

Commercial Service Terminal Requirements

The current commercial service terminal at Dickinson is approximately 9,500 square feet. An expansion in the spring of 2012 was constructed to comfortably handle the 30 passenger Embraer EMB-120, operated by Great Lakes Airlines, and has the ability to seat 50 passengers with additional seating. With the addition of United and Delta Airlines 50 seat regional jet service, the airport has added a portable building on the apron to provide additional seating to accommodate the existing demand. Through the planning period, 50 to 90 seat regional jet aircraft and 166 seat narrow body aircraft are anticipated to operate at Dickinson. A "peak hour" of 143 passengers is predicted by the forecast to occur during the peak year.

Peak hour is the maximum number of passengers that a terminal is likely to have using it on the busiest day of the busiest month of the year.

Another simple analysis is to project that 2 hubs are likely to be served from Dickinson (MSP & DEN), and it is likely that these hubs will have departure and arrival times that are similar in time of day.

If there are two 70 seat aircraft (or a 70 and 90 seat aircraft) departing at approximately the same time, the peak hour will range between 140 and 180 passengers.

For purposes of determining the requirement for a terminal facility, the Transportation Research Board, Aviation Cooperative Research Program (ACRP) Report #25 was utilized to determine an estimated square footage for the key function areas of the terminal. The peak hour enplanement determined in Chapter 3 was used as the basis for running these key function area calculations. The peak hour demand is indicated in **Table 8 – Air Service Peak Activity**.

TABLE 8 – AIR SERVICE PEAK ACTIVITY

	2013	2014	2018	2023	2028	2033
Peak Hour Enplanements	25	46	68	111	138	143
Peak Hour Departures	1	1	2	2	2	2

The peak hour enplanements will range from 46 to 143 during the planning period. While on an average, these enplanements will be encountered, the airline schedules are anticipated to have two regular scenarios that would exceed this number. These are 1) departing morning flights to three different destinations with two 76 seat and one 50 seat aircraft totaling 202 enplanements, and 2) departing midday to two different destinations with one 156 seat and one 50 seat aircraft totaling 206 passengers. For this reason it is recommended that 150 peak hour passengers be used for the future demand and 200 passengers for the ultimate demand.

To determine a size of the terminal, a program from ACRP Report #25 was used, and was based upon 150 and 200 passenger peak hour numbers. This program was designed by several terminal designers as a method to determine the function spaces of a terminal, based upon actual or projected peak hour passenger demands. This program helps determine the size of the key areas in a terminal.

Key Function Areas Include:

- Ticketing, Airline Ticket Offices
- Ticketing Kiosks
- Baggage Screening
- Passenger Screening
- Baggage Make up
- Hold Room plus circulation
- Baggage Claim

There are several areas of a terminal which were not included in the ACRP 25 program. These areas are estimated to have similar floor space requirements for both 150 and 200 passenger hour demands.

Support Areas include:

- Lobby/Entrance
- Restaurant/concessions
- Rental Car offices
- Restrooms
- Storage/Mechanical
- Airport Administration

TABLE 9 – TERMINAL SPACE REQUIREMENTS BASED ON PEAK HOUR

	150 Passenger Peak Hour	200 Passenger Peak Hour
Key Function Areas:	**36,222 s.f.**	**50,308 s.f.**
Support Areas:	**13,600 s.f.**	**13,600 s.f.**
Total Space:	**49,822 s.f.**	**63,908 s.f.**

Terminal design can impact space requirements from terminal to terminal and airport to airport; however, the program from ACRP 25 provides an estimate of the space requirements to conduct the essential functions of a terminal building at various forecasted demand levels.

Terminal Parking

The addition of jet airline service at Dickinson Theodore Roosevelt Regional Airport has created an increased need for private automobile parking. With this in mind, parking facility requirements are made up of three primary components: parking needs of arriving and departing passengers; parking needs of airport employees and tenants; and parking needs of car rental agencies.

Airline Passenger Parking

Airline passengers include arriving and departing passengers along with "meeters and greeters" of these passengers. A suggested methodology for developing parking facility requirements is contained in FAA Advisory Circular 150/5360-13, Planning and Design Guidelines for Airport Terminal Facilities. This method indicates that the number of parking spaces available per million originating passenger varies between airports of differing size. These ranges may vary from less than 1,000 to as high as 3,300 parking spaces per million originations. Using this ratio, there are between 100 and 330 parking spaces per 100,000 enplanements needed for the future. Using the midpoint or average, roughly 220 parking spaces per 100,000 enplanements could be used for planning purposes. With a passenger estimate of 136,989 by 2023 and 176,164 by 2033, this translates into a need for 299 (by 2023) and 387 (by 2033) auto parking spaces for airline passengers (rounded to 300 and 390). The Advisory Circular suggests the provision of 15 percent additional parking spaces so that patrons can more easily find a parking place. Applying this to Dickinson, there will be a total of 345 (by 2023) and 448 (by 2033); for planning purposes, these have been rounded to 350 and 450 spaces for the terminal parking lot.

Employee Parking

Employees using parking facilities at the terminal building will include both airport staff and terminal tenants. FAA Advisory Circular 150/5360-13 does not indicate a clear method for estimating the number of employee parking, but a suggested level of between 10 and 20 percent of public parking spaces is made in FAA Advisory Circular 150/5360-9, Planning and Design of Airport Terminal Facilities at Non-Hub Locations. Using an average of 15 percent, a total of 52 (by 2023) and 67 (by 2033) spaces (rounded to 55 and 70) will be needed.

Rental Cars

FAA Advisory Circular 150/5360-13, Planning and Design Guidelines for Airport Terminal Facilities guidance suggested 1 rental car space for every 750 originating passengers. This would result in almost 182 rental car spaces by 2023 and 234 rental car spaces for year 2033. This level appears to be somewhat excessive for Dickinson. Many will be rented during the week. Thus, this requirement was reduced to 160 spaces (for 2023) and 200 spaces (for 2033) to cover the planning period. It should be noted that these are on-airport spaces and can be supplemented with other rental car agency parking spaces off the airport or away from the airline terminal parking area.

In summary, based upon Advisory Circular 150/5360-13, the primary parking component needs at Dickinson Theodore Roosevelt Regional Airport are summarized in **Table 10**.

TABLE 10 – AUTOMOBILE PARKING SPACE REQUIREMENTS

	2023 (Future)	2033 (Ultimate)
Airline Passengers	**350**	**450**
Employees	**55**	**70**
Rental Cars	**160**	**200**
Total Parking Spaces	**565**	**720**

Another simple metric used for planning parking in a terminal complex is 4.5 spaces per 1,000 annual enplanements. This includes passenger parking, rental car and employee parking.

For this metric, the requirement is 136(000) x 4.5 = **612** and 176(000) x 4.5 = **792**

This calculation validated the estimates using AC 150/5360-13 and the parking spaces computed from AC 150/5360-13 were used for the remainder of the parking assessment. To determine an estimated space required for terminal complex parking, an allocation of 45 s.y. per parking space for parking, drive ways, and sidewalks can be used.

TABLE 11 – SPACE REQUIREMENTS FOR PARKING STALLS

	Parking Lot Space Required
Future (year 2023)	565 x 45 s.y. = 25,425 s.y.
Ultimate (year 2032)	720 x 45 s.y. = 32,400 s.y.

To determine the total space that should be designated for the terminal parking, including roads, drive lanes, revenue control devices, rental car parking, etc., analysis of the existing configuration was made. The current parking lot, including the access road, drive lanes, paved and unpaved parking covers approximately 6.5 acres, and has approximately 380 paved and unpaved parking spaces. Of these, 200 spaces are paved. This translates to 82 square yards per parking space.

The total space required for the terminal area complex would be as follows:

TABLE 12 – PARKING COMPLEX FOOTPRINT

Guideline	Parking Complex Footprint
Future (year 2023)	720 x 82 s.y. = 46,330 s.y.
Ultimate (year 2032)	720 x 82 s.y. = 59,040 s.y.

For the terminal parking lot, it is recommended that a minimum of 59,040 square yards be allocated and limit pedestrian walking to no more than 1,000 feet from the furthest parking stall to the front of the terminal building.

Total Landside Acreage for Terminal Area

The terminal area will require sufficient acreage for the terminal building, setbacks, road network, car rental service area, and all types of parking. Including all of these items, the airport currently uses 8.0 acres of a 17.6 acre area. The future acreage needed will be 21.3 acres. The ultimate acreage need within the planning period will be 24.2 acres.

TABLE 13 – TOTAL LANDSIDE ACREAGE FOR TERMINAL AREA

Area	Future	Ultimate
Entry Road (500 l.f.)	1.7 acres	1.7 acres
Circulation Road (3,000 l.f.)	5.5 acres	5.5 acres
Parking	9.5 acres	12.1 acres
Terminal	1.1 acres	1.4 acres
Rental Car Quick Turn	0.4 acres	0.4 acres
Set Back & Buffer	3.1 acres	3.1 acres
Total	21.3 acres	24.2 acres

For comparison purposes, commercial service airports with similar levels of enplanements were analyzed from aerial photos. The terminal areas for these airports were measured including all landside elements. This included the terminal building, parking, rental car areas, entrance roads and circulation roads, green space reserved for terminal area development and visual corridors from any major roadways. The area did not include the terminal apron or other airside components in the terminal area. The results of this analysis is included **Table 14**.

TABLE 14 – TERMINAL AREA SIZES FOR SMALL AIRPORTS

ID	City	State	Airport	CY 2013 Enplanements	Terminal Area (Acres)	Expansion Capability
JAC	Jackson	WY	Jackson Hole	294,752	29	none
GRB	Green Bay	WI	Austin Straubel International	293,703	42	none
RAP	Rapid City	SD	Rapid City Regional	256,052	34	
ATW	Appleton	WI	Outagamie County Regional	246,211	41	
BIS	Bismarck	ND	Bismarck Municipal	238,929	42	none
MOT	Minot	ND	Minot International	220,789	29	
BMI	Bloomington-Normal	IL	Central IL Regional	211,957	58	
GJT	Grand Junction	CO	Grand Junction Regional	211,091	56	none
GPI	Kalispell	MT	Glacier Park International	199,701	25	
GTF	Great Falls	MT	Great Falls International	182,390	29	
DLH	Duluth	MN	Duluth International	155,496	38	
GFK	Grand Forks	ND	Grand Forks International	148,665	16	none
IDA	Idaho Falls	ID	Idaho Falls Regional	147,073	40	
BFL	Bakersfield	CA	Meadows Field	143,175	25	
LNK	Lincoln	NE	Lincoln	138,787	34	
UNV	State College	PA	University Park	131,753	11	none
ELM	Elmira	NY	Elmira/Corning Regional	129,749	18	none
AZO	Kalamazoo	MI	Kalamazoo/Battle Creek International	129,211	20	none
CWA	Mosinee	WI	Central Wisconsin	123,797	21	
EWN	New Bern	NC	Coastal Carolina Regional	121,479	24	
MBS	Saginaw	MI	MBS International	120,689	35	
STS	Santa Rosa	CA	Charles M. Schulz - Sonoma County	112,779	10	none
RST	Rochester	MN	Rochester International	109,870	28	
LRD	Laredo	TX	Laredo International	109,773	21	
ERI	Erie	PA	Erie International/Tom Ridge Field	109,520	16	none
RFD	Rockford	IL	Chicago/Rockford International	109,384	19	none
ITH	Ithaca	NY	Ithaca Tompkins Regional	103,501	14	none
CPR	Casper	WY	Casper/Natrona County International	98,622	44	
HLN	Helena	MT	Helena Regional	97,310	17	
ISN	Williston	ND	Sloulin Field International	96,086	10	none
CLL	College Station	TX	Easterwood Field	87,409	19	
TYR	Tyler	TX	Tyler Pounds Regional	85,789	38	
ABI	Abilene	TX	Abilene Regional	82,758	14	none
FSM	Fort Smith	AR	Fort Smith Regional	82,742	29	
MHK	Manhattan	KS	Manhattan Regional	65,683	20	
GRI	Grand Island	NE	Central Nebraska Regional	57,165	11	
SGU	St. George	UT	St George Municipal	54,574	28	
GCC	Gillette	WY	Gillette-Campbell County	29,130	11	
ABR	Aberdeen	SD	Aberdeen Regional	25,567	25	

Terminal Apron

Sizing of a terminal apron is based upon the estimated number of gates that will be required for the terminal to service the aircraft forecast to be at the terminal at any given time. This is usually a function of the number of aircraft that will remain overnight at the airport to handle early morning departures.

At Dickinson, the forecast is projecting that there will be 3 parking spots required for the terminal. If passenger boarding bridges are installed in the future, each bridge can service two separate parking positions. Therefore, two passenger boarding bridges should be anticipated which will be able to service up to four parking positions.

Apron size is based upon the wingspan of the aircraft anticipated to be parked on the apron, in a typical linear terminal configuration. For 70 or 90 passenger aircraft, wingspans are typically between 79-117 feet.

In addition, adequate maneuvering space for aircraft and ground service equipment must be provided.

For width planning purposes, 3 parking positions at 117 feet wide each, plus adequate space between each aircraft and the edge of the apron, would require a width of 500 feet.

For depth planning purposes, 70 to 90 passenger regional jets are 90 to 110 feet long, a depth of three times this length would provide adequate space for pushing aircraft back from the terminal.

In summary, initial stage of terminal apron to handle forecast traffic should be 500 feet wide by 300 feet deep (this is 16,666 s.y.). By comparison, the current terminal apron is 250 feet wide by 200 feet deep, or 5,555 s.y.

General Aviation Apron

The size requirements of the general aviation apron are driven by the forecast number of transient aircraft parking needs on a peak day during a peak month during the year. Additionally, based aircraft stored on tie downs, self-service fueling apron requirements, taxilanes and additional local requirements must be factored into the determination of apron size.

The FAA provides guidance for developing space requirements for general aviation aprons in AC 150/5300-13A, Appendix 5. Based upon using this guidance, and the FAA Apron Calculator developed by the Central Region Airports office, the following space requirements were developed.

TABLE 15 – CURRENT AND FUTURE GA APRON REQUIREMENTS

	Square Yards Recommended		
	Current	Future	Ultimate
General Aviation Aircraft Parking	9,500	16,500	21,500
Taxilanes/Hangar Access (associated with apron)	8,700	12,300	13,600
Fueling Access (comingled with hangar access)	2,500	2,500	
Fueling Apron			2,500
Total	**20,700**	**31,300**	**37,600**

The current general aviation apron is approximately 9,500 s.y., which is below the 16,500 s.y. recommended to satisfy current demand. This shortfall in space is noticeable as aircraft parking demands exceed available parking regularly.

It is recommended that expansion of the general aviation apron should occur in the near term to accommodate the current demands. An immediate expansion of approximately 7,000 s.y. (an increase of 73% in apron size) is recommended.

Hangar Requirements

Hangar space requirements for Dickinson Theodore Roosevelt Regional Airport were based upon industry standards and experience with aircraft owner preferences in North Dakota. Year 2033 hangar space requirements were calculated based on the following general assumptions:

Percent of Aircraft Type	Type of Storage
100% of Jet Aircraft	Conventional Hangar
50% of Multi Engine Aircraft	Conventional Hangar
50% of Multi Engine Aircraft	T-Hangar
75% of Single Engine Aircraft	T-Hangar
25% of Single Engine Aircraft	Apron Tie-Down

Hangar space requirements were determined from an average "footprint" of each class of aircraft, and assume 5,000 square feet per based jet aircraft and 3,600 square feet per multi engine aircraft, while T-hangar units for single engine aircraft were assumed to average 1,200 square feet. Applying these standards to the forecast of based aircraft at Dickinson yielded the following hangar needs for the year 2033:

Conventional Hangar Space:	34,400 square feet
T-Hangar Units:	30 Units

Air Cargo

Air Cargo demand at Dickinson is similar to many other communities of its size across the country. Dickinson, like other communities less than 100,000 people, are typically net receivers of express air cargo and are served by small single and twin engine aircraft similar in size to business or corporate aircraft.

UPS and FedEx are the primary express cargo carriers in the United States. While air cargo transportation has been around for almost 100 years, only in the past 30 years has the express or overnight distribution system been fully developed. Both of these carriers have established complex networks of cargo distribution with key hubs and focus cities which allow them to maximize customer service demands and maximize revenue. There have been few significant expansions or changes to the national air cargo system in the past 10 years and the network is considered to be mature.

Currently, the demands of air cargo for Dickinson are adequately accommodated within the existing facilities. It is anticipated that this will continue through the planning period.

The unknown variable that could dramatically change the demand for air cargo facilities at Dickinson would be if a local company were to begin producing a product that requires express overnight service, i.e. computers, cell phones, on-line retail distributors. While local economic activity is increasing, and it has been anecdotally noted that cargo activity is increasing (no cargo tonnage records are kept by the airport) the petroleum-based industry is not a major producer of goods that can be shipped by air cargo, but require express cargo to keep production equipment operational.

The requirements of air cargo will need to be observed and it is recommended that airport administration maintain regular communication with regional managers of both FedEx and UPS to ensure that adequate aircraft parking, servicing and sorting facilities are provided on the airport.

Bulk Fuel Storage

Currently, the bulk fuel storage at the airport is owned and operated by the FBO, Western Edge Aviation.

The demands for bulk fuel storage are based upon the amount of fuel sold on the airport and availability of aviation fuels in the area.

To ensure that adequate fuel is available on the airport, a general recommendation is to have a minimum of 5 days of fuel available on the airport. However, this is only a recommendation and the ultimate decision rests with the operator of the FBO at Dickinson. Bulk fuel storage facilities are an expense to acquire and maintain and the operator needs to ensure that a profit can be made and service can be provided on a regular basis.

It is advantageous to have enough storage to maintain fueling operations and to be able to handle a minimum of 10,000 gallon transport loads to be able to maximize transportation costs for shipping of fuel in the future.

On a related matter, MDU Resources is constructing a diesel fuel refinery near Dickinson. It may be worth discussing the potential of this refinery ability to produce jet fuel for use at Dickinson and surrounding airports. This would reduce the transportation costs of jet fuel.

Conclusion

The requirements for space allocation are defined in large part by the FAA design criteria and forecasted demand levels. A table which summarizes all of the required changes on the airport identified in this chapter is included as **Table 16 – Design Requirements Matrix**.

The alternatives discussed in the following chapter are laid out using all of the current FAA design criteria. Requirements are based on preferred airfield design practices to maximize utility of the airport for the future while taking into consideration construction impacts on operations.

The growth that the Dickinson airport has recently experienced and the growth forecasted to occur is significant and implementation of any of these alternatives will be costly. It is important to ensure that facilities be able to safely and efficiently handle the demands of this airport and community.

Table 16 – Design Requirements Matrix

Dickinson Theodore Roosevelt Regional Airport

= Change Required

Design Element	Existing	Future Requirement	Ultimate Development
Airport Reference Code	B-II	D-III	D-III
Primary Runway 14/32	6,400' x 100'	7,700' x 150'	8, 900' x 150'
Runway Design Code	B-II	D-III	D-III
Critical Aircraft	EMB-120	CRJ-200/CRJ-900/ MD-83/A320	CRJ-200/CRJ-900/ MD-83/A320
Visibility Minimums	Non-Precision/Precision	Precision/Precision	Precision/Precision
Parallel Taxiway TDG & Width	none	TDG 4, 50’	TDG 4, 50’
Pavement Strength	30,000 SW, 37,500 DW	162,000 DW	162,000 DW
Shoulders/Blast Pad	None	25’ wide Shoulders 200’w x 200’l Blast Pad	25’ wide Shoulders 200’w x 200’l Blast Pad
Runway Safety Area	8,400’ x 500’	9,700’ x 500’	10,900’ x 500’
Runway Object Free Area	7,600’ x 800’	9,700’ x 800’	10,900’ x 800’
Runway 14 Runway Protection Zone	1000’ x 1510’ x 1700’ Partially by Easements With Incompatible uses	1000’ x 1750’ x 2500’ Owned in Fee with Compatible Uses	1000’ x 1750’ x 2500’ Owned in Fee with Compatible Uses
Runway 32 Runway Protection Zone	1000’ x 1750’ x 2500’ Partially by Easements With Incompatible Uses	1000’ x 1750’ x 2500’ Owned in Fee with Compatible Uses	1000’ x 1750’ x 2500’ Owned in Fee with Compatible Uses
Crosswind Runway 7/25	4,700' x 75'	4,700' x 75'	4,700' x 75'
Runway Design Code	B-II	B-II	B-II
Critical Aircraft	B200	B200	B200
Visibility Minimums	Visual/Non-Precision	Non-Precision/Non-Precision	Non-Precision/Non-Precision
Parallel Taxiway TDG & Width	none	TDG 2, 35’	TDG 2, 35’
Pavement Strength	16,000 SW, 20,000 DW	16,000 SW, 20,000 DW	16,000 SW, 20,000 DW
Shoulders/Blast Pad	none	10’ wide Shoulders 95’w x 175’l Blast Pad	10’ wide Shoulders 95’w x 175’l Blast Pad
Runway Safety Area	5,300’ x 150’	5,300’ x 150’	5,300’ x 150’
Runway Object Free Area	5,300’ x 500’	5,300’ x 500’	5,300’ x 500’
Runway 7 Runway Protection Zone	500’ x 700’ x 1000’ Partially by Easements	500’ x 700’ x 1000’ Partially by Easements	500’ x 700’ x 1000’ Partially by Easements
Runway 25 Runway Protection Zone	500’ x 700’ x 1000’ Partially by Easements With Incompatible Uses	500’ x 700’ x 1000’ Partially by Easements With Incompatible Uses	500’ x 700’ x 1000’ Partially by Easements With Incompatible Uses

Terminal Landside Facilities

Dickinson Theodore Roosevelt Regional Airport

[highlighted] = Change Required

Design Element	Existing	Future Requirement	Ultimate Development
Terminal Building Size	9700 s.f.	49,822 s.f.	63,908 s.f.
Terminal Parking Stalls	~ 250	565	720
Parking Area Required Space (82 s.y. per stall based on existing layout)	20,500 s.y	46,330 s.y.	59,040 s.y.
Total Acres Required	17.6	21.3	24.2
Terminal Apron			
Use	2 - Group II aircraft	3 - Group III aircraft	4 - Group III Aircraft
Dimensions	250'w x 200'd	500' w x 300' d	650' w x 300' d
Space	5,555 s.y.	16,666 s.y.	21,666 s.y.
G.A. Requirements			
General Aviation Apron	20,700 s.y.	29,900 s.y.	37,600 s.y.
Conventional Hangar Space S.F. needed	51,050	84,778	TBD
T-Hangar Units	5 units	35 units	TBD