Chapter 4: Facility Requirements

Introduction

This chapter of the Airport Master Plan analyzes the existing and anticipated future facility needs at the Rapid City Regional Airport (RAP). This chapter is divided into sections that assess the needs of primary airport elements including airside facilities, passenger terminal complex, air cargo facilities, general aviation facilities, landside elements and support facilities.

Airside requirements are those necessary for the operation of aircraft. Landside requirements are those necessary to support airport, aircraft and passenger operations. Proposed requirements are based on a review of existing conditions, capacity levels, activity demand forecasts and airport design standards using FAA guidance and industry standards. Existing facility deficiencies are identified along with potential future facility needs. The level of review completed is sufficient to identify major airport elements that should be addressed in this comprehensive airport plan.

Rapid City Regional Airport is a growing airport facility as a result of a continued strong demand as a result of regional tourism, health care, retail and financial sector growth and a strong Federal government presence. Since the last Master Plan, the airport has constructed various improvements including expanding passenger security screening and updating the terminal, relocating aircraft rescue and fire fighting, constructing a consolidated rental car quick turn around facility, straightening Taxiway A to correct a modification to FAA standards and expanding apron areas.

Discussions with airport management, coupled with forecasts depicting growth in all areas of aviation led to areas of emphasis in this chapter. These include identifying future commercial airline driven needs and assuring that existing users such as cargo, USFS, general aviation hangars, SDARNG, and support facilities have sufficient room to expand. Overall, airport facility development will be identified to adequately accommodate existing and expected activity levels in this Master Plan.

Potential solutions to address the facility needs through the planning period are discussed in this chapter. Specific alternatives that implement the recommendations are evaluated in **Chapter 5: Alternatives**.

Planning Activity Levels

There are various airport activity measures used to determine facility requirements including passenger enplanements, peak hour and airport operations. Airport activity can be sensitive to industry changes, national and local economic conditions. This results in difficulty in identifying a specific calendar year for the airport to each demand levels associated recommended improvements. For this Master Plan, Planning Activity Levels (PALs) are used to identify demand thresholds for recommended facility improvements. If an activity level is approaching a PAL then the airport should prepare to implement the improvements. Alternatively, activity levels that are not approaching a PAL can allow improvements to be deferred. The forecasts developed in the last chapter are now correlated with each PAL 1, 2 3 and 4 which were 2018, 2023, 2028, and 2033 respectively.

The following Table identifies the PAL metrics for the Rapid City Regional Airport.

Table 4-1 - Planning Activity Levels (PALs)

Planning Activity Levels					
Metric	**Base**	**PAL 1**	**PAL 2**	**PAL 3**	**PAL 4**
Passengers					
Annual Enplanements	256,191	275,634	296,254	318,133	341,298
Peak Month (12.22%)	31,255	33,627	36,143	38,812	41,638
Design Day	1,031	1,110	1,193	1,281	1,374
Design Hour Departing (19.5%)	201	216	233	250	268
Design Hour Arriving (19.5%)	201	216	233	250	268
Design Hour Total Seats (14.3%)	295	317	341	366	393
Passenger Airline Operations					
Total Operations	14,016	13,700	14,079	14,491	14,623
Peak Month	1,713	1,674	1,720	1,771	1,787
Design Day	59.6	58.3	59.9	61.6	62.2
Design Hour	5.4	5.2	5.4	5.5	5.6
Total Operations					
Total Operations	41,358	43,280	46,610	50,396	54,753
Peak Month	4,214	4,410	4,750	5,135	5,579
Design Day	208	218	235	251	276
Design Hour	21	22	23	25	28

Source: KLJ Analysis

Airside Facilities

Airfield Design Standards

Guidance on airport design standards is found in FAA Advisory Circular 150/5300-13A, *Airport Design*. Change 1 to the Advisory Circular was issued February 26, 2014 and is incorporated into this chapter. Airport design standards provide basic guidelines for a safe, efficient, and economic airport system. Careful selection of basic aircraft characteristics for which the airport will be designed is important. Airport designs based only on existing aircraft can severely limit the ability to expand the airport to meet future requirements for larger, more demanding aircraft. Airport designs that are based on large aircraft unlikely to operate at the airport are not economical.

Design Aircraft

Aircraft characteristics relate directly to the design components on an airport. Planning a new airport or improvements to an existing airport requires the selection of one or more "design aircraft." FAA design standards for an airport are determined by a coding system that relates the physical and operational characteristics of an aircraft to the design and safety separation distances of the airfield facility. The design aircraft is the most demanding aircraft operating or forecast to operate at the airport on a regular basis, which is typically considered 500 annual operations. The design aircraft may be a single aircraft, or a grouping of aircraft. It is not the usual practice to base the airport design on an aircraft that uses the airport infrequently, thus some elements may be designed for a less demanding aircraft. The FAA typically only provides funding for the airport to be designed to existing and forecasted critical aircraft that are expected to exceed 500 annual operations.

Other Design Considerations

Other airport design principles are important to consider for a safe and efficient airport design:

- Runway/Taxiway Configuration – The configuration of runways and taxiways affects the airport's capacity/delay, risk of incursions with other aircraft on the runway and overall operational safety. Airports with simultaneous operations on crossing runways can cause delay. Location of and type of taxiways connecting with runways correlates to minimizing runway occupancy time. The design of taxiway infrastructure should promote safety by minimizing confusing or complex geometry to reduce risk of an aircraft inadvertently entering the runway environment.
- Approach and Departure Airspace & Land Use – Runways have imaginary surfaces that extend upward and outward from the runway end to protect normal flight operations. Runways also have land use standards beyond the runway end to protect the flying public as well as persons and property on the ground from potential operational hazards. Runways must meet grading and clearance standards considering natural and man-made obstacles that may obstruct these airspace surfaces. Surrounding land use should be compatible with airport operations. Airports should develop comprehensive land use controls to prevent new hazards outside the airport property line. Obstructions can limit the utility of a runway.
- Meteorological Conditions – An airport's runways should be designed so that aircraft land and takeoff into the prevailing wind. As wind conditions change, the addition of an additional runway may be needed to mitigate the effects of significant crosswind conditions that occur more than five percent of the year. Airports that experience lower cloud ceiling and/or visibility should also consider implementing an instrument procedures and related navigational aids to runways to maximize airport utility.
- Controller Line of Sight – The local Airport Traffic Control Tower (ATCT) relies on a clear line of sight from the controller cab to the airport's movement areas which includes the runways, taxiways, aprons and arrival/departure corridors. Structures on an airport need to consider this design standard, and in some cases require the completion of a shadow study to demonstrate no adverse impact.
- Navigation Aids & Critical Areas – Visual navigational aids (NAVAIDs) to a runway or the airfield require necessary clear areas for these NAVAIDs to be effective for pilots. Instrument NAVAIDs on an airport require sufficient clear areas for the NAVAID to

properly function without interference to provide guidance to pilots. These NAVAID protection areas restrict development.

- Airfield Line of Sight – Runways need to meet grading standards so that objects and aircraft can be seen along the entire runway. A clear line of sight is also required for intersecting runways within the Runway Visibility Zone to allow pilots to maintain visual contact with other objects and/or aircraft that may pose a hazard.
- Interface with Landside – The airfield configuration should be designed to provide for the safe and efficient operation of aircraft as they transition from the airfield to landside facilities such as hangars and terminals.
- Environmental Factors – Airport development must consider potential impacts in and around the airport environs through the National Environmental Policy Act (NEPA). Additionally, development should also reduce the risk of potential wildlife hazards such as deer and birds that may cause hazards to flight operations.

Design Aircraft

The design aircraft types must be identified to determine the appropriate airport design standards to incorporate into airport planning. The design aircraft is the most demanding aircraft to operate at the airport at least 500 annual operations.

Operational Analysis

Existing airport operations at Rapid City in FFY 2013 were analyzed considering potential changes to the design aircraft from the aviation forecasts developed in **Chapter 3** from local and national aviation trends. **Table 2 and 3** summarize the existing Rapid City air cargo and passenger airline operations conducted by the most demanding or “critical” aircraft types based on FAA design standards.

Table 4-2 - Critical Air Cargo Operations

Critical Air Cargo Operations				
Aircraft Type	**AAC**	**ADG**	**TDG**	**2013 Operations**
Air Cargo				
ATR-42/72	B	III	2	517
Beechcraft 99	B	I	1A	126
Beechcraft 1900	B	II	2	479
Cessna 310	A	I	1A	576
Swearingen Metro III	B	II	2	702

Source: Flight Aware, KLJ Analysis
NOTE: Operations counted are on an instrument flight plan. Shaded cells represent design aircraft.

Table 4-3 – Critical Passenger Airline Operations

Critical Passenger Airline Operations				
Aircraft Type	**AAC**	**ADG**	**TDG**	**2013 Operations**
Passenger Airlines				
Airbus A319	C	III	3	268
Airbus A320	C	III	3	96
Boeing 717	C	III	3	na
Boeing 737-700	C	III	3	12
Boeing 737-800	D	III	3	23
Boeing 757-200	C	IV	4	8
Bombardier CRJ-200	D	II	2	4,555
Bombardier CRJ-700	C	II	2	8
Bombardier CRJ-900	C	II	2	26
Bombardier Q400	C	III	3	2,205
Embraer ERJ-135	C	II	2	105
Embraer ERJ-145	C	II	2	1,585
Embraer ERJ-145X	C	II	2	1,169
Embraer E170	C	III	2	130
Boeing (Douglas) MD-83	D	III	4	486
Boeing (Douglas) MD-88	D	III	4	201
Boeing (Douglas) MD-90	C	III	4	66

Source: FlightAware, KLJ Analysis
NOTE: Operations counted are on an instrument flight plan. Shaded cells represent design aircraft.

The most demanding aircraft for the overall airport is a Category D, Group III aircraft. The Category D aircraft that are each most heavily used at Rapid City are each scheduled by the airlines to be phased out. These are the Bombardier CRJ-200 operated by Delta, and the Boeing (Douglas) MD-83, operated by Allegiant Airlines. Since these two specific Category D aircraft are scheduled to be phased out it is recommended to work with a Category C design which there are multiple examples in the chart above. These aircraft operate on Runway 14/32.

The following Table depicts the critical general aviation aircraft operations.

Table 4-4 - Critical General Aviation Aircraft Operations

Critical General Aviation Aircraft Operations				
Aircraft Type	AAC	ADG	TDG	2013 Operations
General Aviation				
Aero Commander 690	B	I	-	169
Beechcraft King Air 90/100	B	II	1A	1,572
Beechcraft King Air 200/300	B	II	2	595
Beechcraft King Air 350	B	II	-	57
Cessna Conquest II	B	II	-	118
Cessna Citation I (501)	B	I	-	89
Cessna Citation Mustang (510)	B	I	2	55
Cessna CitationJet CJ1 (525)	B	II	2	490
Cessna Citation II (550)	B	II	2	279
Cessna Citation V (560)	B	II	2	393
Cessna Citation Excel (560XL)	B	II	2	205
Cessna Citation X (750)	C	II	1B	90
Eclipse 500	A	I	-	297
Hawker 400	B	I	-	224
Hawker 800	C	II	-	113
Learjet 31/35	C	I	-	51
Learjet 40/45	C	I	-	100
Pilatus PC-12	A	II	-	1,149
Piper Meridian	A	I	-	44
Swearingen Merlin 3	B	I	-	60
TBM 850	A	I	-	59

Source: FlightAware, KLJ Analysis

NOTE: Operations counted are on an instrument flight plan. Shaded cells represent design aircraft.

Small general aviation aircraft utilize Runway 5/23 during crosswind conditions on an occasional basis. It is used when wind conditions are limiting operations on Runway 14/32 for small aircraft.


Pilatus PC-12

The most demanding family of aircraft to use the airport are summarized in **Table 4-5.** This determination is adequate for the current classification of the airport as a C-III, TDG-4 facility.

Table 4-5 - Design Aircraft Operations

Design Aircraft Operations	
Design Component	2013 Operations
AAC-C	6,233
ADG-III	3,908
TDG-4	761

Source: FlightAware, KLJ Analysis

Forecast Trends

The aviation forecasts predict the overall design aircraft should be a C-III and TDG-4 representing a mix of aircraft currently and projected to serve Rapid City including the Airbus A319 operated by Allegiant Airlines, the Bombardier Q400 operated by United and the Boeing 717 operated by Delta. Passenger airline service aircraft are forecast to change in capacity with overall operations remaining steady.

Airbus A-320

As noted previously, new aircraft types are anticipated to be introduced to the airport, however, the aircraft forecast do not change the design aircraft classification throughout the planning period. The MD-83, CRJ 200 and Embraer 145 which currently serve Rapid City are planned to be phased out by the airlines in the short term. The MD-83 is being replaced by Allegiant with A319 and A320 aircraft. The CRJ 200 and Embraer 145 are each 50 passenger regional jets and all airlines serving Rapid City are upsizing their fleet to 70+ passenger aircraft as the smallest in their fleet.

Based on user input, the ATR-42 and Beechcraft 1900 turboprop aircraft are anticipated to operate more from Rapid City for air cargo operations. This aircraft has a TDG-2 classification thus operational surfaces utilized by this aircraft type should meet this standard.

General aviation aircraft of ADG-II classification are anticipated to continue utilizing the airport. These aircraft have a maximum takeoff weight of up to 36,600 pounds. A growing Rapid City business and medical community will likely contribute to increased operations over time. Future general aviation airport facilities should plan to accommodate the design standards for ADG-II airplanes to provide flexibility.

Summary

The design characteristics associated with the runways at Rapid City are summarized in the table below. Additional design aircraft information will be utilized to drive the design standards for taxiways, aprons and parking areas.

Table 4-6 – Airfield Design Aircraft Summary

Airfield Design Aircraft Summary		
Design Characteristics	**Runway 14/32**	**Runway 5/23**
Aircraft Make/Model	A319/Q400/B717	Single Engine Piston
Airplane Approach Category	C	B
Airplane Design Group	III	I (small)
Taxiway Design Group	4	1
Wingspan	117' 5"	49'
Length	124' 0"	30'
Tail Height	38' 7"	20'
Approach Speed	Up to 138 knots	Up to 121 knots
Maximum Takeoff Weight	166,000 pounds	12,500 pounds
Landing Gear Configuration	Dual Wheel	Dual Wheel
Aircraft Classification Number	65/R/C/W/T[1]	15/F/B/X/T[2]
Takeoff Runway Length*	8,550 feet	4,450 feet
Landing Runway Length*	5,800 feet	4,450 feet

Source: Boeing Airport Planning Manuals and General Aviation Aircraft evaluation, KLJ Analysis
**Runway length is for planning purposes only and varies based on operation. Figure shown is based on maximum takeoff or landing weight, wet runway (if applicable) 86.9 degrees F at Rapid City.*

Airfield Capacity

The total capacity of the airfield is the measure of the maximum number of aircraft arrivals and departures capable of being accommodated for a runway and taxiway configuration. Delay occurs when operations exceed the available capacity at an airport. Airports should plan to provide capacity enhancements well in advance to avoid undue operational delays. A master planning-level analysis was completed using the methods outlined in FAA Advisory Circular AC 150/5060-5, *Airport Capacity and Delay*.

Capacity is measured using various metrics:

- Hourly Capacity – The maximum throughput of arrivals and departures an airfield can safely accommodate in a one-hour period.
- Annual Service Volume – The maximum throughput of annual operations and airfield can safely accommodate in one-year with an acceptable level of delay.
- Aircraft Delay – The difference in time between a constrained and an unconstrained aircraft operation, measured in minutes.

Input Factors

Measuring airfield capacity is driven by many factors including aircraft fleet mix, runway use configuration, meteorological flight conditions and runway operational procedures. Each is

[1] The calculations are based on a mixture of aircraft including: MD-83 (500 Annual Departures), CRJ-200 (2,000 Annual Departures), ERJ-145 (2,500 Annual Departures) and A319/A320 (150 Annual Departures)
[2] The calculations are based on a mixture of aircraft including PC-12 (3,500 Annual Departures), Citation VI/VII (24,500 Annual Departures)

calculated to cumulatively determine the hourly capacity and annual service volume for an airport.

Aircraft Fleet Mix

Different types of aircraft operating on an airport impacts airport capacity. In addition to required arrival and departure flow separation requirements between similar aircraft types, aircraft with different speeds create the need additional spacing requirements to maintain minimum separation. Greater spacing is also required for small aircraft to avoid wake turbulence created by larger aircraft. The airport's fleet mix index is established using FAA guidelines. These classifications are provided in **Table 4-7**.

Table 4-7 – Aircraft Capacity and Delay Fleet Mix Classifications

Aircraft Capacity and Delay Fleet Mix Classifications			
Aircraft Classification	**Maximum Takeoff Weight (MTOW)**	**Number of Engines**	**Wake Turbulence**
A	<12,500 lbs.	Single	Small (S)
B		Multi	Small (S)
C	12,500 – 300,000 lbs.	Multi	Large (L)
D	>300,000	Multi	Heavy (H)

Source: FAA AC 150/5060-5, Airport Capacity and Delay

The aircraft fleet mix percentage for capacity calculations is determined by the FAA's formula (C + 3D) using aircraft fleet mix classifications. In reviewing the aviation forecasts for Rapid City, the fleet mix percentage for Instrument Flight Rules (IFR) operations and Visual Flight Rule (VFR) operations are summarized in the table below. In analyzing flight activity from 2012 through 2013, 41.5 percent of the total operations under IFR are estimated to be conducted in Class C aircraft. Operations in Class D aircraft total 0.01 percent.

Table 4-8 – Aircraft Capacity and Delay Fleet Mix Index

Aircraft (Class C & D in Table 4-7) Fleet Mix Percentage		
Metric	**Base**	**PAL 4**
IFR Fleet Mix Percentage	41.56%	41.5%
VFR Fleet Mix Percentage	6.77%	6.7%

Source: FAA AC 150/5060-5, Airport Capacity and Delay, KLJ Analysis

Runway Use

The runway use configuration affects the operational efficiency and capacity of an airfield. An independent runway is one that can be operational and not affect arrivals and/or departures from other runways. A dependent runway is directly affected by the operations of another runway. Operations from another runway must be clear so operations on the other runway can safely occur. This dependent runway configuration increases wait time, reduces capacity and can increase overall delay. This is commonly seen for airfields with crossing runways.

At Rapid City, Runway 14/32 and 5/23 intersect at the north westerly portion of each runways total length. See **Exhibit 4-1 Runway Use Configuration**. Both of these runways can handle VFR and IFR operations, arrivals and departures. The estimated runway end utilization is identified in the table below.

Table 4-9 - Runway Utilization

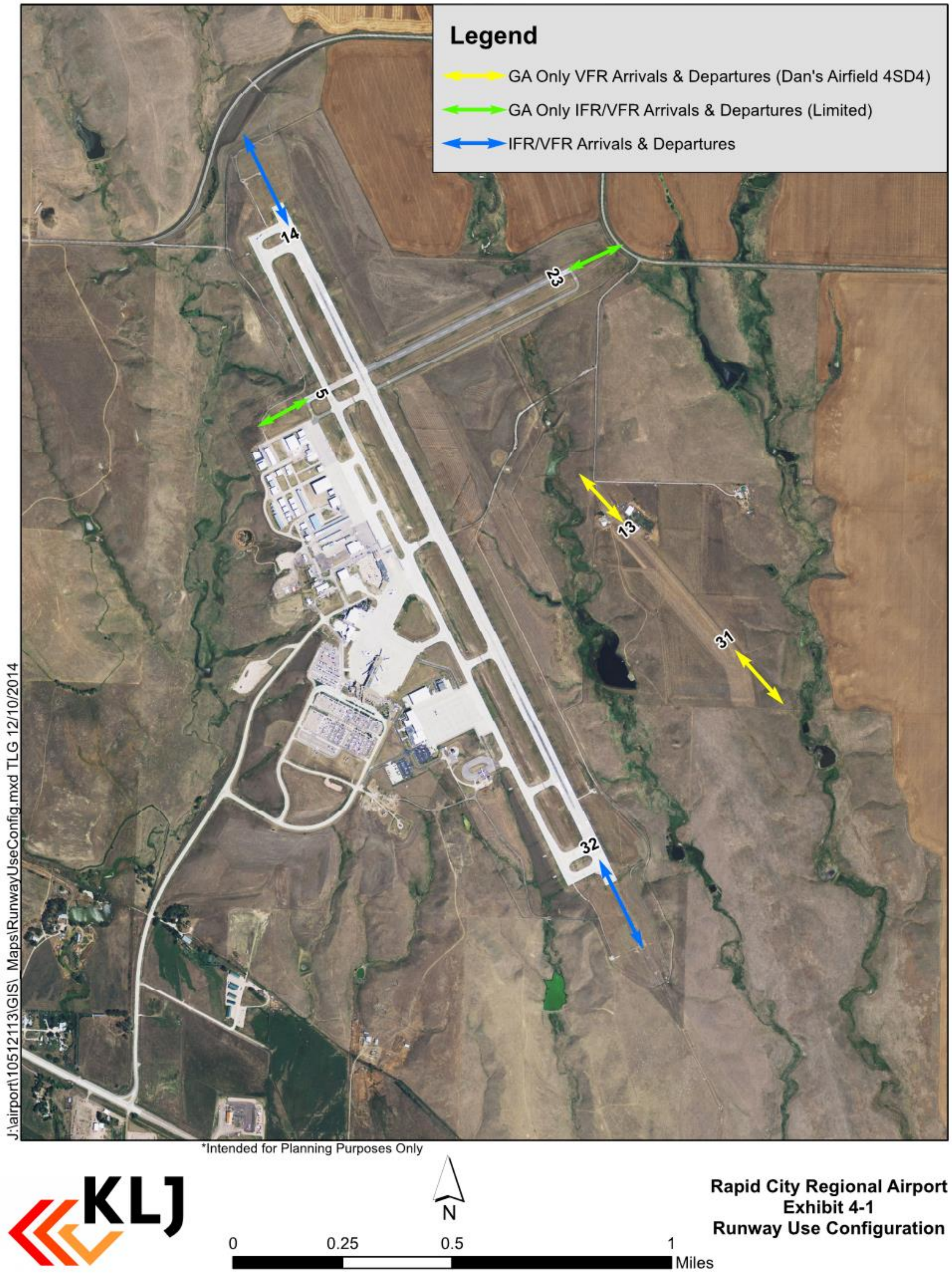
Runway Utilization		
Runway End	**End Utilization**	**Runway Utilization**
14	34.9%	97.0%
32	62.1%	
5	2.0%	3.0%
23	1.0%	

Source: KLJ Analysis (estimate) and ATCT Feedback

Based on weather observations and operational patterns, it is assumed a single runway scenario occurs 95.9 percent of the time during VFR conditions and 93.0 percent of the time during IFR conditions. Runway 5/23 is used periodically during high wind conditions as a general aviation runway.

A unique element with Rapid City is the existence of Dan's Airfield (FAA Identifier 4SD4) which is approximately 2,000 feet east of the airport with a runway 13/31 generally parallel but converging to Rapid City's primary runway. The ATCT staff advised that Dan's Airfield is not used often but when it is used the activity at Dan's Airfield Runway 13/31 and Rapid City's Runway 14/32 are treated as one runway to avoid conflicts.

Exhibit 4-1 – Runway Use Configuration



Source: KLJ Analysis

Other Considerations

Meteorological conditions are a consideration for capacity calculations. An analysis of the weather observations over the past 10 years show VFR conditions are experienced 86.77 percent of the time, IFR conditions within the capability of current approach minimums experienced 10.23 percent, and IFR conditions below current instrument approach minimums occurring 3.00 percent of the time.

The number and location of exit taxiways were considered. Ideally spaced exit taxiways allow aircraft to expediently leave the runway environment upon landing, thus increasing airfield capacity. Each assumes an average of two exit taxiways spaced between 3,500 and 6,500 feet from the landing threshold spaced at least 750 feet apart for VFR operations and one exit taxiway between 5,000 and 7,000 feet for IFR operations. FAA determines the exit factor to range from 0.86 to 0.97, depending on runway configuration and weather conditions.

Touch and go operation are those that land then takeoff on the same runway without exiting the runway. These typically occur with small training aircraft and counts for two operations, thus increasing airfield capacity. There is not an unusually higher percentage of touch-and-go operations at Rapid City as a result of flight training operations, thus a standard 1.00 exit factor was applied for capacity calculations.

A weighting factor is also applied per FAA guidance ranging from 1 to 25 for determining weighted hourly capacity. Arrivals are assumed to be 50 percent of total operations. Additional arrivals causes capacity to decrease due to separation requirements.

Hourly Capacity

Hourly capacity is calculated during IFR and VFR conditions using an FAA recommended equation based on runway configuration, touch-and-go and taxiway exit factors. Weighted hourly capacity is determined based on runway utilization, weather conditions and an FAA weighting factor. The results for the base and PAL 4 scenarios are identified below. Assuming no change to the airfield configuration, the results are similar for the base through PAL 4 due to a minimal change in fleet mix.

Table 4-10 – Hourly Capacity

Hourly Capacity	
Factors	**Base, PAL 1-4 Fleet Mix**
Single Runway Use Scenario	
VFR Hourly Capacity	74
IFR Hourly Capacity	57

Source: FAA AC 150/5060-5, Airport Capacity and Delay, KLJ Analysis

Annual Service Volume

Annual Service Volume (ASV) is an estimate of the total annual aircraft operations on an airfield annually. ASV is calculated based on the weighted hourly capacity multiplied by hourly and daily demand ratios. The ratio of the total operations to an airport's ASV determines if and when an airport should plan for capacity improvements to increase overall capacity. For Rapid City, the IFR Hourly Capacity was the most restrictive resulting in an

Annual Service Volume of 195,000 operations which was therefore used to determine the airport's capacity level.

Table 4-11 – Annual Service Volume (ASV)

Annual Service Volume (ASV)					
Metric	**Base**	**PAL 1**	**PAL 2**	**PAL 3**	**PAL 4**
Annual Operations	41,358	43,280	46,610	50,396	54,753
Average Design Day	208	218	235	254	276
Average Design Hour	21	22	23	25	28
Annual Service Volume	195,000	195,000	195,000	195,000	195,000
Capacity Level	**21.2%**	**22.2%**	**23.9%**	**25.8%**	**28.1%**

Source: FAA AC 150/5060-5, Airport Capacity and Delay, KLJ Analysis

FAA recommends airports take action to implement capacity enhancement projects when an airport has reached 60 percent of its annual capacity. Rapid City Regional Airport is not projected to be near 60% within the planning period.

Aircraft Delay

Aircraft delay exists because of local weather and operational conditions and cannot be entirely eliminated. Delay is measured in minutes per aircraft and hours per year. The FAA's assumptions identified in *Advisory Circular 150/5060-5, Airport Capacity and Delay* are used to identify delay measures and estimated cost. A four-to-six minute delay per aircraft is considered acceptable for normal airport operations. Delay consistently approaching 10 to 15 minutes per aircraft is a trigger for a new capacity-driven runway. Delay at Rapid City Regional Airport on average does not approach these thresholds. Delay is considered acceptable for operations into the planning period.

Summary

The purpose of this review is to provide a master planning-level review of airport capacity for long-range planning. A review of the capacity assumptions is recommended at or before that level as operational patterns may change over time. If the capacity ratio of 60 percent is reached, enhancements should be programmed into the capital improvement plan to enhance capacity, and reduce delay. Example improvements may include additional taxiway turnoffs or high-speed exits.

Meteorological Considerations

Meteorological conditions that affect the facility requirements of an airport include wind coverage and weather condition encountered. Metrological data at Rapid City were reviewed using that past 10 years of data from the Rapid City Regional Airport AWOS facility from April 2004 through March 2014, available from the National Climatic Data Center (NCDC). This provides a comprehensive look into the average weather trends at an airport.

Wind coverage and weather conditions are evaluated based on the two different flight rules, VFR and IFR. Visual Meteorological Conditions (VMC) are encountered when the visibility is 3 nautical miles or greater, and the cloud ceiling height is 1,000 feet or greater. Conditions less than these weather minimums are considered Instrument Meteorological Conditions (IMC) requiring all flights to be operated under IFR.

Wind Coverage

Wind coverage is important to airfield configuration and utilization. Aircraft ideally takeoff and land into headwinds alighted with the runway orientation. Aircraft are also designed and pilots are trained to land aircraft during crosswind conditions but there are limitations. Small, light aircraft are most affected by crosswinds. To mitigate the effect of crosswinds, runways on an airport are aligned so that they meet a minimum of 95 percent wind coverage where crosswind conditions are encountered 5 percent of the time or less. Each aircraft's AAC-ADG combination corresponds to a maximum crosswind wind speed component.

Table 4-12 - Wind Coverage Requirements

Wind Coverage Requirements	
AAC-ADG	**Maximum Crosswind Component**
A-I & B-I	10.5 knots
A-II & B-II	13.0 knots
A-III, B-III, C-I through D-III	16.0 knots
A-IV through D-VI	20.0 knots

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

Wind coverage for the airport is separated into all-weather (VMC and IMC) and IMC alone. All-weather analysis helps determine runway orientation and use. Local weather patterns commonly change in IMC. An IMC review helps determine the runway configuration for establishing instrument approaches.

Table 4-13 - All-Weather Wind Analysis

All-Weather Wind Analysis					
Runway	**AAC-ADG**	**Crosswind Component (Wind Speed)**			
		10.5 knots	**13.0 knots**	**16.0 knots**	**20.0 knots**
Runway 14/32	C-III	95.97%	98.16%	99.40%	99.82%
Runway 5/23	B-I	70.18%	77.24%	-	-
Combined*	-	**98.22%**	**99.47%**	**99.40%**	**99.82%**

**Combined assumes up to maximum design aircraft crosswind component for each runway*
Source: National Climatic Data Center data from Rapid City Regional Airport ASOS (2004-2014)

The design aircraft (able to use the runway with a 16.0 knot crosswind component) is accommodated on Runway 14/32 during all-weather conditions with airfield wind coverage exceeding 95 percent. For small aircraft that have a 10.5 knot crosswind threshold, these airplanes can be accommodated 98.22 percent of the time with the current two-runway configuration.

Table 4-14 - IFR Wind Analysis

IFR Wind Analysis					
Runway	**AAC-ADG**	**Crosswind Component (Wind Speed)**			
		10.5 knots	**13.0 knots**	**16.0 knots**	**20.0 knots**
Runway 14/32	C-III	93.06%	97.00%	99.16%	99.77%
Runway 5/23	B-I	64.33%	71.65%	-	-
Combined*	**-**	**96.58%**	**98.81%**	**99.16%**	**99.77%**

**Combined assumes up to maximum design aircraft crosswind component for each runway*
Source: National Climatic Data Center data from Rapid City Regional Airport ASOS (2003-2012)

The design aircraft is accommodated on Runway 14/32 during IFR with airfield wind coverage exceeding 95 percent. For small aircraft that have a 10.5 knot crosswind threshold, these airplanes can be accommodated 96.58 percent of the time with the current two-runway configuration.

When analyzed by runway end, Runway 32 is the preferred end by wind direction for IMC operations, followed by 05, 14 then 23. The lowest published instrument approach minimums are available on Runway 32 followed by Runway 14. It is recommended to take steps to lower approach minimums to Runway 14 to maximize airfield utilization. It is not recommended to lower the minimums for Runway 05 because it was found that the favorable coverage that Runway 05 has is due to a large portion of winds favoring between 360° and 030° which are counted as acceptable for both Runways 05 and 32.

Table 4-15 - IFR Wind Analysis by Runway End

IFR Wind Analysis by Runway End					
Runway End	**AAC-ADG**	**Crosswind Component (Wind Speed)**			
		10.5 knots	**13.0 knots**	**16.0 knots**	**20.0 knots**
Runway 14	C-III	38.48%	39.18%	39.72%	39.87%
Runway 32	C-III	63.16%	66.40%	68.02%	68.47%
Runway 5	B-I	55.45%	61.95%	68.48%	74.00%
Runway 23	B-I	17.46%	18.27%	19.36%	20.27%

Source: National Climatic Data Center data from Rapid City Regional Airport ASOS (2004-2014)

Weather Conditions

When reduced visibility weather conditions occur, aircraft must operate under IFR and utilize instrument approach procedures to an airfield. These IFR conditions drive the need to accommodate instrument approach procedures with sufficient weather minimums to continue airport operation and increase utilization.

Weather conditions are broken down into occurrence percentages based on instrument approach minimums in the following table.

Table 4-16 – Meteorological Analysis

Meteorological Analysis			
Weather Condition	**Cloud Ceiling Minimum**	**Visibility Minimum**	**Observation Percentage**
Visual Flight Rules (VFR)	3,000 feet	5 miles	79.20%
Marginal Visual Flight Rules (MVFR)	1,000 feet	3 miles	7.57%
Instrument Flight Rules (IFR)	600 feet	1 mile	6.59%
Instrument Flight Rules (IFR) Category I	200 feet	½ mile	3.64%
Instrument Flight Rules IFR Category II	100 feet	¼ mile	0.59%
IFR Category III & Below	0 feet	1/8 mile	2.41%
TOTAL			100.00%

Source: National Climatic Data Center data from Rapid City Regional Airport ASOS (2004-2014)

Average high temperature data for the hottest month was reviewed from climate summaries available from the National Weather Service for Rapid City. The average high temperature in the hottest month from 2004-2013 was 86.9 degrees Fahrenheit.

Runways

Rapid City has two runways, one air carrier runway and one general aviation runway. Runway 14/32 is the longest runway at 8,701 feet long and 150 feet wide. This runway is currently designed to accommodate precision approaches with lowest precision instrument approach minimums on the airfield of ½ mile (2400 RVR). Runway 5/23 is a secondary runway used by general aviation aircraft which are 12,500 pounds and under. This runway is 3,601 feet long by 75 feet wide with non-precision instrument approaches with visibility minimums as low as 1 mile.

Runway Design Code

The existing design aircraft identifies the RDC for Runway 14/32 as C/III/2400 (½ mile). The RDC for Runway 5/23 is A/I/5000 accommodating small aircraft exclusively. These are recommended to remain through the future as C/III/2400 and A/I/5000 respectively.

Design Standards

One primary purpose of this master plan is to review and achieve compliance with all FAA safety and design standards. The design standards vary based on the RDC and RRC as established by the design aircraft. In addition to the runway pavement width, some of the safety standards include:

- Runway Safety Area (RSA) – A defined graded surface surrounding the runway prepared or suitable for reducing the risk of damage to aircraft in the event of an undershoot, overshoot or excursion from the runway. The RSA must be free of objects, except those required to be located in the RSA to serve their function. The RSA should also be capable to supporting airport equipment and the occasional passage of aircraft.
- Runway Object Free Area (ROFA) – An area centered on the ground on a runway provided to enhance the safety of aircraft operations by remaining clear of objects, except for objects that need to be located in the OFA for air navigation or aircraft ground maneuvering purposes.

- Runway Obstacle Free Zone (ROFZ) – The OFZ is the three-dimensional volume of airspace along the runway and extended runway centerline that is required to be clear of taxiing or parked aircraft as well as other obstacles that do not need to be within the OFZ to function. The purpose of the OFZ is for protection of aircraft landing or taking off from the runway and for missed approaches.

Other design standards include runway shoulder width to prevent soil erosion or debris ingestion for jet engines, blast pad to prevent soil erosion from jet blast, and required separation distances from objects and other infrastructure for safety. Critical areas associated with navigational aids as well as airspace requirements are described further in this chapter.

Runway Protection Zone

The Runway Protection Zone (RPZ) is a trapezoidal land use area at ground level prior to the threshold or beyond the runway end to enhance the safety and protection of people and property on the ground. The land within the RPZ should be under airport control and cleared of incompatible land uses. FAA issued an interim policy on activities within an RPZ on September 27, 2012. Currently there is a public road, Long View Road, within the approach RPZ to Runway 14 and the RPZ to Runway 23.

New development discouraged within the RPZ includes new roads, structures and places of public assembly. New development within an RPZ or new RPZ size/location of an RPZ is subject to FAA review on a case-by-case basis to reduce risk to people on the ground. Mitigation tactics for new or existing land uses may include removal/relocation of the object or modifying usable runway length (declared distances) to relocate the RPZ outside of the land use. Tables identifying the runway design standards follow.

Table 4-17 - Runway 14/32 FAA Design Standard Matrix

Runway 14/32 FAA Design Standard Matrix			
Design Standard	Actual	Runway Design Code (RDC)	
		C/III/2400 (Future)	C/III/2400 (Ultimate)
Approach Reference Code	C/III/2400	C/III/2400	C/III/2400
Departure Reference Code	C-III	C-III	C-III
Runway Width	150 feet	150 feet	150 feet
Shoulder Width	0 feet	25 feet	25 feet
Blast Pad Width	200' – RW 14 150' – RW 32	200 feet	200 feet
Blast Pad Length	200 feet	200 feet	200 feet
Line of Sight Requirements	No Objects	No Objects	No Objects
RSA Width	500 feet	500 feet	500 feet
RSA Length Past Departure End	1,000 feet	1,000 feet	1,000 feet
RSA Length Prior to Threshold	600 feet	600 feet	600 feet
ROFA Width	800 feet	800 feet	800 feet
ROFA Length Past Departure End	1,000 feet	1,000 feet	1,000 feet
ROFA Length Prior to Threshold	600 feet	600 feet	600 feet
ROFZ Length Past Runway	200 feet	200 feet	200 feet
ROFZ Width	400 feet	400 feet	400 feet
Inner Approach OFZ	N/A	50:1 Slope	50:1 Slope
Inner Transitional OFZ	N/A	Varies	Varies
Precision ROFZ Length	200' RW 32	200 feet	200 feet
Precision ROFZ Width	800' RW 32	800 feet	800 feet
Approach RPZ Start from Runway	200 feet	200 feet	200 feet
Approach RPZ Length	1,700' RW 14 2,500' RW 32	2,500 feet	2,500 feet
Approach RPZ Inner Width	500' RW 14 1,000' RW 32	1,000 feet	1,000 feet
Approach RPZ Outer Width	1,010' RW 14 1,750' RW 32	1,750 feet	1,750 feet
Departure RPZ Start from Runway	200 feet	200 feet	200 feet
Departure RPZ Length	1,700 feet	1,700 feet	1,700 feet
Departure RPZ Inner Width	500 feet	500 feet	500 feet
Departure RPZ Outer Width	1,010 feet	1,010 feet	1,010 feet
Runway Centerline to Parallel Taxiway Centerline	450 feet	400 feet	400 feet
Runway Centerline to Edge of Aircraft Parking	570 feet	500 feet	500 feet
Runway Centerline to Hold Line	250 feet	250 feet	250 feet

Note: RED indicates a deficiency to existing design standards
Source: FAA AC 150/5300-13A Airport Design, KLJ Analysis

Table 4-18 - Runway 5/23 FAA Design Standard Matrix

Runway 5/23 FAA Design Standard Matrix		
Design Standard	**Actual**	**Runway Design Code (RDC)** **B/I/5000 - Small Aircraft (Existing & Future)**
Approach Reference Code	B-I Small	B-I Small
Departure Reference Code	B-I	B-I
Runway Width	75 feet	60 feet
Shoulder Width	0 feet*	0 feet*
Blast Pad Width	0 feet*	0 feet*
Blast Pad Length	0 feet*	0 feet*
Line of Sight Requirements	No Objects	No Objects
RSA Width	150 feet	120 feet
RSA Length Past Departure End	300 feet	240 feet
RSA Length Prior to Threshold	300 feet	240 feet
ROFA Width	500 feet	250 feet
ROFA Length Past Departure End	300 feet	240 feet
ROFA Length Prior to Threshold	300 feet	240 feet
ROFZ Length Past Runway	200 feet	200 feet
ROFZ Width	250 feet	250 feet
Inner Approach OFZ	N/A	N/A
Inner Transitional OFZ	N/A	N/A
Precision ROFZ Length	N/A	N/A
Precision ROFZ Width	N/A	N/A
Approach RPZ Start from Runway	200 feet	200 feet
Approach RPZ Length	1,000 feet	1,000 feet
Approach RPZ Inner Width	250 feet	250 feet
Approach RPZ Outer Width	450 feet	450 feet
Departure RPZ Start from Runway	200 feet	200 feet
Departure RPZ Length	1,000 feet	1,000 feet
Departure RPZ Inner Width	250 feet	250 feet
Departure RPZ Outer Width	450 feet	450 feet
Runway Centerline to Parallel Taxiway Centerline	250 feet	150 feet
Runway Centerline to Edge of Aircraft Parking	300 feet	125 feet
Runway Centerline to Hold Line	125 feet	125 feet

Note: RED indicates a deficiency to existing design standards
**Not required for aircraft operations type and RDC*
Source: FAA AC 150/5300-13A Airport Design, KLJ Analysis

Recommendations

Runway improvement recommendations are as follows:

- **Construct 25 foot paved shoulders for Runway 14/32.**
- **Expand the Blast Pad width for Runway 32.**
- **Expand the Runway Protection Zone for Runway 14.**
- **While this was not identified in this section, it was determined in the site visit that there is a hill area which is currently obstructing the view of aircraft on Runway 23 from being seen by the Airport Traffic Control Tower. This hill should be removed.**

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Legend

- Existing Airport Property
- Object Free Area
- Object Free Zone
- Precision Object Free Zone
- Runway Protection Zone
- Runway Safety Area
- Runway Visibility Zone

Existing Runway Design Code:
Runway 14/32: C/III/2400
Runway 5/23: A/I/5000 Small Aircraft

Runway Design Standard Deficiencies

1. No Runway Shoulder (14/32)
2. Substandard Blast Pad
3. Road within Future RPZ
4. Objects in Approach Surface for Future Precision Instrument Approach

N

0 1,000 2,000 4,000 Feet

*Intended for Planning Purposes Only

KLJ

Rapid City Regional Airport
Runway Design Standards
Exhibit 4-2

Runway Length

The recommended runway length for an airport facility varies widely based on runway usage (number of operations per year), specific aircraft operational demands (aircraft type, weight/load) and local meteorological conditions (elevation, temperatures). Runway length should be suitable for the forecasted critical design aircraft.

Design Aircraft

A runway length analysis was performed using the manufacturer's Aircraft Planning Manuals and other available performance data. Sufficient runway length is important for the airport to maintain operational capability. It allows an aircraft operator to adequately serve their destinations. Restrictions on runway length may lead to reduced weight on a flight, which then translates into reduced fuel, passenger and/or cargo loads. The design approach identified in FAA Advisory Circular AC 150/5325-4B, *Runway Length Requirements for Airport Design* was used to determine runway length calculations for Rapid City.

It is very important to adequately plan for a future runway configuration as these projects tend to effect the community beyond the property line. Projects of these magnitude require many resources and long lead times for planning, environmental review and funding allocation.

A summary of the runway length requirements for various design aircraft types is outlined in the following Tables.

Table 4-19 - Design Aircraft Runway Length Requirements (Zero Gradient)

DESIGN AIRCRAFT ANALYSIS Zero Runway Gradient Adjustment														
			Aircraft and Engines											
			CRJ200	CRJ700	CRJ900	Q400	E145	E175	MD83	A319	A320	B717	B737-800	B757-200
		Engine	CF34-3B1	CF34-8C5B1	CF34-8C5	PW 150A	AE 3007-A1E	CF34-8E5	JT8D-219	CFM56-5B5/3	CFM56	BR715-A1-30	CFM56-7	PW 2037
		Maximum Takeoff Weight (lbs)	53,000	72,250	80,500	64,500	53,131	82,673	160,000	166,449	171,961	121,000	174,200	255,000
		Runway Design Code (RDC)	D-II	C-II	C-III	C-III	C-II	C-III	D-III	C-III	C-III	C-III	D-III	C-IV
		Taxiway Design Group (TDG)	3	3	3	3	3	3	4	3	3	3	3	4
Airlines/Hubs		Distance (NM)	Runway Length (FT)											
United	DEN	260	6,900			5,700	5,700	5,000						
Delta	MSP	425	6,900	5,700	6,600					7,200		6,300	6,200	5,500
Delta	SLC	440	6,900	5,700	6,600							6,500		
American	ORD	675	7,000		7,400		6,300	5,200						
United	ORD	675	7,000				6,300	5,200						
American	DFW	725	7,200		7,500		6,400	5,300						
Allegiant	LAS	730							7,500	7,200	7,000			
Allegiant	IWA	760							7,500	7,200	7,000			
Alaska	SEA	830											6,800	
United	IAH	920					6,800	5,500						
Delta	ATL	1,070		6,600	7,700							7,300		
Allegiant	SFB	1,390							8,800	7,200	7,000			

FAA A/C 150/5325 - 4B Runway Length: 75% of Fleet (up to 60,000lb MTOW) at 90% Useful Load, Length = **8,050**

FAA A/C 150/5325 - 4B Runway Length: 100% of Fleet (up to 60,000lb MTOW) at 90% Useful Load, Length = **9,150**

- Runway lengths calculated based on specific aircraft manufacturer's manuals for ISA +15C temperatures
- Mean daily high temperature of 87 degrees F
- Runway difference in center line elevations N/A *Runway Gradient Adjustment* *0* *feet*
- Elevation 3,204 MSL

Table 4-20 - Design Aircraft Runway Length Requirements (49 Feet Gradient)

DESIGN AIRCRAFT ANALYSIS Adjusted for Runway Gradient: Maximum Difference between Runway Centerline Elevations 49' = 500' Takeoff Length Extension														
			Aircraft and Engines											
			CRJ200	CRJ700	CRJ900	Q400	E145	E175	MD83	A319	A320	B717	B737-800	B757-200
		Engine	CF34-3B1	CF34-8C5B1	CF34-8C5	PW 150A	AE 3007-A1E	CF34-8E5	JT8D-219	CFM56-5B5/3	CFM56	BR715-A1-30	CFM56-7	PW 2037
		Maximum Takeoff Weight (lbs)	53,000	72,250	80,500	64,500	53,131	82,673	160,000	166,449	171,961	121,000	174,200	255,000
		Runway Design Code (RDC)	D-II	C-II	C-III	C-III	C-II	C-III	D-III	C-III	C-III	C-III	D-III	C-IV
		Taxiway Design Group (TDG)	3	3	3	3	3	3	4	3	3	3	3	4
Airlines/Hubs		Distance (NM)	Runway Length (FT)											
United	DEN	260	7,400			6,200	6,200	5,500						
Delta	MSP	425	7,400	6,200	7,100					7,700		6,800	6,700	6,000
Delta	SLC	440	7,400	6,200	7,100									
American	ORD	675	7,500		7,900		6,800	5,700						
United	ORD	675	7,500				6,800	5,700						
American	DFW	725	7,700		8,000		6,900	5,800						
Allegiant	LAS	730							8,000	7,700	7,500			
Allegiant	IWA	760							8,000	7,700	7,500			
Alaska	SEA	830											7,300	
United	IAH	920					7,300	6,000						
Delta	ATL	1,070		7,100	8,200							7,800		
Allegiant	SFB	1,390							9,300	7,700	7,500			

FAA A/C 150/5325 - 4B Runway Length: 75% of Fleet (up to 60,000lb MTOW) at 90% Useful Load, Length = **8,550**

FAA A/C 150/5325 - 4B Runway Length: 100% of Fleet (up to 60,000lb MTOW) at 90% Useful Load, Length = **9,650**

- Runway lengths calculated based on specific aircraft manufacturer's manuals for ISA +15C temperatures
- Mean daily high temperature of 87 degrees F
- Runway difference in center line elevations 49 feet *Runway Gradient Adjustment 500 feet*
- Elevation 3,204 MSL

Not all aircraft are operated at maximum takeoff weight at Rapid City. During hot summer days, a few operators are weight limited by the existing 8,701 foot runway length. Takeoff weight is restricted for CRJ200's and MD-83s when the temperature reaches 85 degrees Fahrenheit. For the CRJ200's this is for destinations in Denver, Dallas/Fort Worth and Minneapolis and the MD-83 this is for Allegiant to Las Vegas and Mesa. New aircraft types are expected to have more efficient engines and improved takeoff performance. While the existing length is sufficient for current and forecasted operations there are trigger points which could require a longer runway. These trigger points, which will require 500 annual operations of this activity are identified below:

- International/Further Domestic Destinations – in order to fly non-stop to most international destinations or further domestic destinations a longer runway would be required. The furthest scheduled destination for Rapid City is Atlanta at 1,070 nautical miles. The amount of runway length required will be dependent upon the aircraft type.
- Continuation of MD-83, CRJ200 or similar aircraft to further distances – the MD-83 and CRJ200 are aircraft that require a longer runway than other aircraft serving Rapid City. If aircraft like these serve Rapid City to further destinations, then a longer runway will be required so that the aircraft can operate fully loaded. For example the MD-83 from Rapid City to Orlando Sanford at 1,390 nautical miles, would require 9,300 feet in runway length.

Aircraft Less Than 60,000 Pounds

A runway length analysis for other aircraft was performed using the FAA's methodology found in FAA Advisory Circular AC 150/5325-4B, *Runway Length Requirements for Airport Design*. These aircraft include business jets and other general aviation aircraft for identifying the recommended runway length for secondary runways accommodating aircraft less than 60,000 pounds. The FAA recommended runway length calculations for Rapid City are summarized in the following table:

Table 4-21 - FAA Runway Length Requirements

FAA Runway Length Requirements	
Airport and Runway Data	
Airport Elevation	3,204 feet
Mean Daily Maximum Temperature of Hottest Month	86.9°F
Maximum Difference in Runway Centerline Elevation	49 feet
Runway Condition	Wet and Slippery Runways
Aircraft Classification	**Recommended Runway Length**
Large airplanes less than 60,000 lbs. but greater than 12,500 lbs.	
100 percent of fleet at 90 percent useful load	9,650 feet
100 percent of fleet at 60 percent useful load	7,500 feet
75 percent of fleet at 90 percent useful load	8,550 feet
75 percent of fleet at 60 percent useful load	6,200 feet
Small airplanes 12,500 lbs. or less	
10 or more passenger seats	5,200 feet
Less than 10 passenger seats at 100 percent of fleet	5,200 feet
Less than 10 passenger seats at 95 percent of fleet	4,450 feet

Note: Runway length requirements estimated based on charts for airport planning purposes only.
Source: FAA AC 150/5325-4B, Runway Length Requirements for Airport Design

The existing length of 8,701 feet is sufficient for Runway 14/32 to handle the vast majority of departures from Rapid City. The runway is sufficient for operations in aircraft greater than 60,000 pounds, and most aircraft less than 60,000 pounds at 100 percent of fleet aircraft with 90 percent useful load. Local wind conditions allow this runway to accommodate business jet aircraft over 96 percent. Common mid-sized business jets that operate at Rapid City include the Cessna Citation 560/750 and Hawker 800 aircraft. High load factors are common for aircraft that require passengers and cargo to be transported to destinations located thousands of miles away. These operations are common at an airport such as Rapid City.

The design aircraft for Runway 5/23 is a Single Engine Piston aircraft. While the ideal runway length is 4,650 feet, the runway is not recommended to be lengthened due to the high construction costs associated with a 1,000 foot extension coupled with the low frequency of use.

Pavement Strength

Airfield pavements should be adequately maintained, rehabilitated and reconstructed to meet the operational needs of the airport. Typical airport pavements have a 20-year design life. The published pavement strength is based on the construction materials, thickness, aircraft weight, gear configuration and operational frequency for the pavement to perform over its useful life. Larger aircraft could exceed the pavement strength but not on a regular basis.

The new FAA standard for measuring the reporting pavement strength is defined in Advisory Circular 150/5335-5B, *Standard Method of Reporting Airport Pavement Strength*. The Aircraft Classification Number – Pavement Classification Number (ACN-PCN) method is defined within this guidance. The PCN value must equal or exceed the ACN value assigned for the design aircraft. Public-use primary airports must report PCN figures by August 2014 to be eligible for federal funding. An ACN-PCN analysis for Runway 14/32 and Runway 5/23 for Rapid City was completed in 2010.

The pavement strength for Runway 14/32 should be sufficient to accommodate regular use by the design aircraft. The design aircraft for pavement strength calculations is the MD-83 with an Aircraft Classification Number (ACN) of 53 and the A320 with an ACN of 51. The calculated Pavement Classification Number (PCN) of the runway is 65, thus no increases to pavement strength are necessary through the planning period. Runway 5/23 should be maintained to accommodate small aircraft of 12,500 pounds or less maximum takeoff weight.

Table 4-22 – Pavement Strength Requirements

Pavement Strength Requirements				
Runway	Existing		Future Need	
	Capacity	PCN	Capacity	PCN
Runway 14/32	140,000 lbs. - SW 190,000 lbs. - DW 300,000 lbs. - DT	65/R/C/W/T[3]	140,000 lbs. - SW 190,000 lbs. – DW 300,000 lbs. - DT	65/R/C/W/T
Runway 5/23	12,500 lbs. – SW	15/F/C/X/T[4]	12,500 lbs. - SW	15/F/C/X/T

SW = Single Wheel, DW = Dual Wheel, DT = Dual Tandem landing gear configuration
Source: RAP Airport Master Record (FAA Form 5010-1), KLJ Analysis

Instrument Procedures

Instrument approach procedures to a runway end are used by landing aircraft to navigate to the airport during low visibility weather when cloud ceiling is 1,000 feet of less and/or visibility is 3 miles or less. Establishing approaches with the lowest possible weather minimums allow the airport to maximize its operational capability. Each approach type requires differing infrastructure and navigational aids. Approaches with lower visibility minimums typically have additional infrastructure and navigational aids requirements. Types of approach procedures include non-precision approach (NPA), approach with vertical guidance (APV) and precision approach (PA).

As of May 2014, Rapid City has a Category I Instrument Landing System (ILS) established for Runway 32 with a 200-foot cloud ceiling minimum. The runways 14, 5 and 23 have non-precision RNAV (GPS) approach (APV) with the lowest design visibility minimums of 1 mile.

The existing approach procedures are considered adequate for the current facility. The goal for an airport is to enhance its approach procedures to increase its operational capability. At Rapid City, these include upgrading Runway 14 to accommodate a Category I ILS.

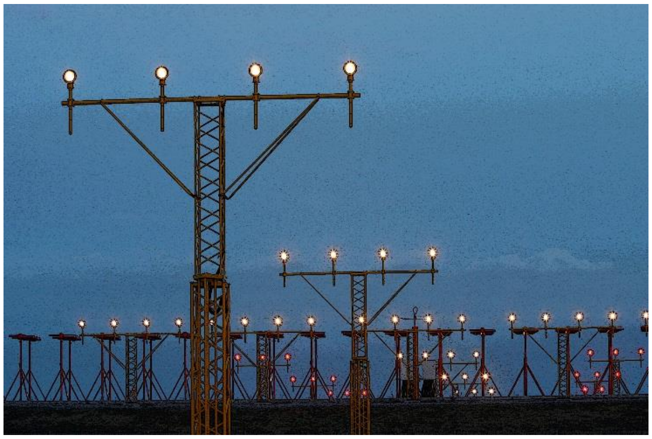
[3] The calculations are based on a mixture of aircraft including: MD-83 (500 Annual Departures), CRJ-200 (2,000 Annual Departures), ERJ-145 (2,500 Annual Departures) and A319/A320 (150 Annual Departures)

[4] The calculations are based on a mixture of aircraft including PC-12 (3,500 Annual Departures), Citation VI/VII (24,500 Annual Departures)

Upgraded Runway 14 Approach

As of May 2014, Runway 14 is served by an approach procedure with vertical guidance (LPV). The weather minimums are 300 foot cloud ceiling and 1 mile visibility for Runway 14. An approach with visibility minimums of no lower than ½ mile will trigger the following requirements:

- The FAA airport design approach surface is widened to 800 feet inner width expanding upward and outward at a 34:1 slope.
- The 14 CFR Part 77 Primary Surface expands from 250 feet to 500 feet wide centered on runway centerline. New development that penetrates this or its related 7:1 transitional surface is discouraged.
- The 14 CFR Part 77 Approach Surface is widened and the slope is lowered to 50:1.
- Approach Runway Protection Zone (RPZ) expands to 2,500 feet long, 1,000 feet wide inner width and 1,750 feet for the outer width.
- Typically requires a Category I Instrument Landing System which includes two ground based electronic aids, a localizer antenna and a glide slope antenna. However an RNAV (GPS) approach can be achieved now without the typical ILS ground based electronic equipment.
- An approach lighting system is required to achieve ½ mile visibility minimums. An example is a Medium Intensity Approach Lighting System with Runway Alignment Indicator Lights (MALSR) which extends 2,400 feet from the runway end.
- A 200-foot long by 800-foot wide Precision Obstacle Free Zone (OFZ) is required at the runway end.
- Typical lowest cloud ceiling is 200 feet depending on obstructions.
- Precision approach runway markings.



Recommendations

Instrument procedure recommendations include the following:

- **Maintain or remove any obstructions from existing approaches to maintain or improvement current minimums.**
- **Remove hillside near the approach to Runway 14 that penetrates into the protective surfaces and place material in areas to allow for hangar development.**
- **Relocate Long View Road to be outside of the expanded RPZ.**
- **Plan to install a MALSR system for Runway 14 to lower the existing RNAV (GPS) minimums.**
- **Plan to upgrade Runway 14 to a Category I ILS approach.**

Airspace Protection

Airspace is an important resource around airports that is very essential for safe flight operations. There are established standards to identify airspace obstructions around airports. FAA grant assurances (obligations) require the airport sponsor to take appropriate action to assure that airspace is adequately cleared to protect instrument and visual flight operations by removing, lowering, relocating, marking or lighting, or otherwise mitigating existing airport hazards and preventing the establishment or creating of future airport hazards. Sufficiently clear airspace near the approach and departure ends and along extended centerline are vitally important for safe airport operations.

An obstruction analysis is currently underway to identify obstructions to Part 77 and other airspace surfaces. The results of this analysis will be identified in the Airport Layout Plan drawing set.

Area Airspace

The airspace classification including and within 5 nautical miles of Rapid City is Class D controlled airspace. The Airport Traffic Control Tower (ATCT) safely and efficiently handles all operations within this airspace. Ellsworth Air Force Base, 5 miles north of Rapid City Regional Airport is also in Class D airspace and operates 24 hours a day Monday through Friday providing approach/departure control for Rapid City Regional Airport. On weekends the approach/departure control is provided by Denver ARTCC.

Part 77 Civil Airport Imaginary Surfaces

Title 14 CFR (Code of Federal Regulations) Part 77 *Safe, Efficient Use, and Preservation of the Navigable Airspace* is used to determine whether man-made or natural objects penetrate these “imaginary” three-dimensional airspace surfaces and become obstructions. Federal Aviation Regulation (FAR) Part 77 surfaces are the protective surfaces most often used to provide height restriction zoning protection around an airport. Sufficiently clear airspace is necessary for the safe and efficient use of aircraft arriving and departing an airport. Part 77 airspace standards are defined by the most demanding approach to a runway. These airspace surfaces include the primary, approach, transitional, horizontal and conical surfaces each with different standards. The slope of an airspace surface is defined as the horizontal distance traveled for every one vertical foot (i.e. 50:1).

Of note is the primary surfaces which should be kept clear of non-essential objects above the runway centerline elevation. The approach surface extends upward and outward from the runway on a slope defined as the horizontal distance traveled for every one vertical foot (i.e. 50:1). The transitional surface is a 7:1 slope and extends to the side of the primary and approach surfaces. The following **Table 4-23** indicate the future approach airspace surfaces for Rapid City:

Table 4-23 - Future Part 77 Approach Airspace Requirements

Future Part 77 Approach Airspace Requirements						
Runway End	Approach Standards	Part 77 Code	Inner Width*	Outer Width	Length	Slope
14	Precision	PIR	1,000’	16,000’	50,000’	50:1/40:1
32	Precision	PIR	1,000’	16,000’	50,000’	50:1/40:1
5	Non-Precision Utility	A	500’	2,000’	5,000’	20:1
23	Non-Precision Utility	A	500’	2,000’	5,000’	20:1

**Inner width is also the Primary Surface width driven by the most demanding approach to a runway.*
Blue indicates change from existing conditions.
Source: 14 CFR Part 77, KLJ Analysis

New development should be kept below the Part 77 surface elevation. Airspace surfaces must clear public roads by 15 feet, interstate highways by 17 feet, railroads by 23 feet, and private roads by 10 feet or the height of the most critical vehicle.

For existing obstructions that cannot easily be removed, an aeronautical study should be completed to determine the aeronautical effect and identify potential mitigation strategies (i.e. lighting, marking). There are various existing Part 77 obstructions located around Rapid City that will be identified on the Airport Layout Plan for evaluation.

Runway Approach/Departures Surfaces

FAA identifies sloping approach surfaces that must be cleared at an absolute minimum for safety for landing aircraft. These surfaces are identified in Table 3-2 of FAA Advisory Circular 150/5300-13A, *Airport Design*. All objects must clear the surface for the applicable runway operational design standard to meet minimum aviation safety standards for a given runway landing threshold location. Approach airspace penetrations require mitigation which may include the removal of the object or the runway landing threshold to be shifted or displaced down the runway.

The departure surface applies to instrument departures. It begins at the end of the takeoff distance available and extends upward and outward at a 40:1 slope. Penetrations to the departure surface may simply require the obstacle to be published, or require mitigation including increasing the minimum aircraft climb rate or runway length operational restrictions.

When usable landing or takeoff distances do not match the runway length, then a special application of declared distances should be used to meet operational safety requirements. Declared distances can be used to mitigate approach/departure obstructions, land use incompatibilities, or incompatible airport design areas.

Per FAA Table 3-2, the following approach/departure surface standards apply:

Table 4-24 - Approach/Departure Surface Requirements

Approach/Departure Surface Requirements			
Runway End(s)	Table 3-2 Row	Description	Slope
Existing			
32	7	Instrument approaches having visibility minimums < ¾ statute mile	34:1
14	5	Approaches supporting instrument night operations in greater than Category B aircraft	20:1
5, 23	4	Approaches supporting instrument night operations in Category A and B aircraft only	20:1
All	9	Departure runway ends for all instrument operations	40:1
Future			
14, 32	7	Instrument approaches having visibility minimums < ¾ statute mile	34:1
5, 23	4	Approaches supporting instrument night operations in Category A and B aircraft only	20:1
All	9	Departure runway ends for all instrument operations	40:1

Note: Most critical row(s) shown. Only changes from existing shown in future.
Source: FAA Advisory Circular 150/5300-13A, KLJ Analysis

Critical obstructions to the existing approaches exist along the Runway 32 departure end. Several objects including the airport perimeter fence and ground penetrate the 34:1 approach surface. Improvements to the Runway 14 approach is expected to correct departure issues with Runway 32.

Terminal Instrument Procedures (TERPS)

The FAA has established standards to develop instrument procedures in the United States. FAA Order 8260.3B, *U.S. Standards for Terminal Instrument Procedures (TERPS)* and related orders outlines these complex standards to develop departure, climb, en-route, approach, missed approach and holding standards for aircraft operating along a published route with different navigational equipment. Some critical obstruction clearance standards are integrated into the approach/departure surfaces identified in Airport Design including many final approach segments and the 40:1 sloped departure surface. Other important obstacle clearance surfaces within the inner airport environment identified in TERPS include the precision obstacle clearance surfaces and the missed approach surfaces. Some TERPS surfaces may even be more restrictive that Part 77 standards. Penetrations to TERPS surfaces results in higher weather minimums or operations restrictions.

Other Design Surfaces

Other airport design airspace surfaces considered protect navigational aids and identify airport data to populate FAA databases.

Inner-Approach/Transitional Obstacle Free Zones

If an approach lighting system is installed, a clear inner-approach and inner-transitional Obstacle Free Zone (OFZ) is necessary. The inner-approach OFZ is a 50:1 sloped surface begins 200 feet from the runway threshold and extends 200 feet beyond the last approach light. The inner-transitional OFZ airspace surface is along the sides of the ROFZ. No objects not necessary for airport operations, including aircraft tails can penetrate this surface. There are no objects that penetrate this surface at Rapid City.

Precision Obstacle Free Zone (POFZ)

If a precision instrument approach is established there exists a POFZ which begins at the runway threshold as a flat surface 800 feet wide centered on the runway centerline and extending 200 feet to connect to the inner-approach OFZ. As with the OFZ, no objects not necessary for airport operations including aircraft or vehicles on the ground can penetrate this surface. This surface is currently clear of all objects where it applies at Runway 32 and the requirements will apply to Runway 14 when a precision approach is established.

Airport Surveillance Radar (ASR)

The Dakota Air Traffic Control Facility, located at Ellsworth AFB, has a Digital Airport Surveillance Radar (DASR) which provides primary radar coverage for terminal airspace in the vicinity of the airport. The DASR site at Rapid City is located along Radar Hill Road, 2.5 miles northwest of the airport and is maintained by the U.S. Air Force.

Visual Aids

Visual aids at an airport require clear line of sight to provide sufficient guidance for pilots. These include approach lighting systems and visual guidance slope indicators. For a Precision Approach Path Indicator (PAPI) system, this surface begins 300 feet in front of the VGSI system and extends upward and outward at an angle 1 degree less than the lowest on-course aiming angle. For a standard 3 degree glide path this equates to a 31.29:1 sloped surface. The specific airspace standards for this and for approach lighting systems are defined in FAA Order 6850.2B.

FAA Aeronautical Surveys

The FAA has implemented Aeronautical Survey requirements per Advisory Circular 150/5300-18B *General Guidance and Specifications for Submission of Aeronautical Surveys to NGS: Field Data Collection and Geographic Information System (GIS) Standards*. FAA airport survey requirements require obstruction data to be collected using assembled aerial imagery for the airport. This data is used in aeronautical publications and to develop instrument approach procedures.

An updated aeronautical survey is being conducted with this planning effort. Imagery was acquired in 2014. As of FY 2013, all projects at this airport must now comply with Airports GIS standards. When runway ends change or an enhanced instrument approach is proposed then a new obstruction analysis is necessary. Obstructions that have been removed can be deleted from the database by coordinating with FAA Flight Procedures Office.

Navigational Aids

Airfield NAVAIDs are any ground or satellite based electronic or visual device to assist pilots with airport operations. They provide for the safe and efficient operations of aircraft on an airport or within the vicinity of an airport. The type of NAVAIDS required are determined by FAA guidance based on an airport's location, activity and usage type.

Area Navigation

The FAA is updating the nation's air transportation infrastructure through the Next Generation Air Transportation System (NextGen) program. New procedures and technology are to be implemented to improve the efficiency and safety of the national air transportation system. For area navigation, satellite-based NAVAIDs will primarily be used for air navigation with ground-based NAVAIDs used for secondary purposes. Other initiatives include implementing a new surveillance technology for tracking aircraft known as Automatic Dependent Surveillance-Broadcast (ADS-B) to improve position accuracy reporting and supplement ground radar data for air traffic control.

Rapid City should plan for the use of satellite-based area navigation. Satellite based RNAV approaches have been created for all four runway approaches. These approaches do not rely on ground-based NAVAIDs such as the existing Very-high Frequency Omni-directional Range (VOR) which are planned for decommissioning by the FAA in the long term future. It is also anticipated that the existing Airport Surveillance Radar will be replaced by ADS-B.

Runway Approach

Other NAVAIDs are developed specifically to provide "approach" navigation guidance, which assists aircraft in landing at a specific airport or runway. These NAVAIDs are electronic or visual in type. FAA Order 6750.16D, *Siting Criteria for Instrument Landing Systems* and FAA Order 6850.2B, *Visual Guidance Lighting Systems* defines the standards for these lighting systems.

Instrument Landing System (ILS)

An ILS is a ground-based system that provides precision instrument guidance to aircraft approaching and landing on a runway. ILS approaches enable a safe landing in IMC with low cloud ceiling and/or visibility. Major components of ILS include the localizer antenna for horizontal guidance, glide slope antenna for vertical guidance and an approach lighting system. The localizer and glide slope require critical areas that are sufficiently graded and do not contain certain objects.

There are three categories of ILS systems, each capable of supporting approaches in equipped aircraft with lower weather minimums. Each category also requires an increasing complexity of airport equipment as well as aircraft and flight crew certifications. Currently Runway 32 is equipped with a Category I ILS approach. It is proposed to plan for a Category I ILS in the future for Runway 14. Ultimately, the ground-based localizer and glideslope systems may eventually be replaced by precision GPS systems.

Table 4-25 - Standard ILS Categories

Standard ILS Categories		
ILS Category	**Decision Height (ft.)**	**Runway Visual Range (ft.)**
Category I	200	2,400/1,800
Category II	100	1200
Category IIIa	0-100	700
Category IIIb	0-50	150
Category IIIc	0	0

Source: FAA Aeronautical Information Manual

Visual Guidance Slope Indicator (VGSI)

A VGSI system provides visual descent guidance to aircraft on approach to landing. There are several types of VGSI systems available including a Precision Approach Path Indicator (PAPI) system and a Visual Approach Slope Indicator (VASI). These systems are typically installed on runway ends with instrument approaches and co-located with the glideslope antenna, but are also installed for visual runways. PAPI systems, a newer technology, consist of a single row of two to four lights. The two light system is for non-jet runways and the four light system is for jet-capable runways.

Unlike most airports, Rapid City maintains the PAPIs for all four runways at the airport. This equipment has become outdated and it is proving difficult to obtain parts. **Rapid City should replace the existing PAPI system for all four Runways or work with the FAA for the FAA to install and begin to maintain PAPIs for the airport.** All PAPIs should meet obstacle clearance requirements.

Runway End Identifier Lights (REIL)

REILs consist of high-intensity flashing white strobe lights located on the approach ends of runways to assist the pilot in early identification of the runway threshold. Additionally, these are typically installed on runways that are surrounded by a preponderance of other lights or if the runway lacks contrast with surrounding terrain. These are not installed with an approach lighting system.

The REILs for Runway 14 should be maintained until such time as an approach lighting system is installed for a precision instrument approach to Runway 14.

Approach Lighting System (ALS)

ALSs help pilots transition from instrument flight to visual flight for landing. An ALS is required as part of an ILS. An ALS installed on non-precision approach runways can help provide ¼ mile visibility credit for instrument approach minimums. There are various configurations, lighting types and complexities to these systems. The requirement for an airport runway end is dependent upon the type of precision approach and visibility minimums of the approach.

The type of ALS which should be considered at Rapid City is the Medium-intensity Approach Lighting System with Runway Alignment Indicator Lights (MALSR). The MALSR consists of seven rows of lights, five flashing lights and a row of steady burning green

lights prior to runway threshold. The system is 2,400 feet in total length. This is required for the Category I approach for Runway 32 and will be required for a Category I approach for Runway 14.

Airfield Visual

Visual NAVAIDs provide airport users with visual references within the airport environment. They consist of lighting, signage and pavement markings on an airport. Visual NAVAIDS are necessary airport facility components on the airfield, promoting enhancing situational awareness, operational capability and safety. FAA Advisory Circular 150/5340-30E, *Design and Installation of Airport Visual Aids* defines the standards for these systems.

Airport Beacon

The airport beacon serves as the airport identification light so approaching pilots can identify the airport location during night and IMC. The airport beacon's location at Rapid City is outside of any development areas and adequately serves the airport without known obstruction to its line of sight. If the Airport Traffic Control Tower is relocated in the future, it will be necessary to assure that the airport beacon does not impair the controllers' field of vision. This could require the airport beacon to be relocated.

Runway Lighting

Runway edge lights are placed off the edge of the runway surface to help pilots define the edges and end of the runway during night and low visibility conditions. Runway lights are classified according to the intensity of light they produce including high intensity (HIRL), medium intensity (MIRL) and low intensity (LIRL). The existing HIRL for Runway 14/32 is required for RVR based minimums. Runway 5/23 has MIRL and this system is recommended for continued night operations.

Runway 14/32 has edge lighting that is installed with a modification to FAA standards. The FAA standards require the lighting to be spaced no more than 200 feet apart. There are four locations at Rapid City where the lighting for runway 14/32 is greater than 200 feet apart. These are at the runway 14/32 intersection with taxiways A3, A4, A5 and B. This modification to standards is approved by the FAA and recorded in the Airport Certification Manual.

Taxiway Lighting

Taxiway edge lighting delineates the taxiway and apron edges. The FAA standard taxiway edge lighting system is Medium Intensity Taxiway Lights (MITL). Taxiway edge lights are installed for all taxiways at Rapid City. Other taxiway lights are installed at airports to promote safe operations. These include taxiway centerline lighting, runway guard lights (RGL), runway stop bar and clearance bar. RGL are installed at all taxiway-runway intersections for Runway 14/32 and the intersection of Taxiway A and Runway 5/23 as recommended by FAA.

Airfield Signage

Airfield signage is essential for the safe and efficient operation of aircraft and ground vehicles on the airport movement area. Common signs include mandatory instruction signs, location signs, boundary signs, direction/destination signs, information signs and distance remaining signs. Airports certificated under 14 CFR Part 139 such as Rapid City must have a sign plan developed and implemented to identify taxi routes and holding positions. This plan must be consistent with FAA Advisory Circular 150/5340-18F, *Standards for Airport Sign Systems*. This plan should be updated to meet current standards and operating procedures.

Pavement Markings

Pavement markings help airport users visually identify important features on the airfield. FAA has defined numerous different pavement markings to promote safety and situational awareness as defined by FAA AC 150/5340-1L, *Standards for Airport Markings*.

Runway

Runway pavement markings are white in color. The type and complexity of the markings are determined by the approach threshold category to the runway end. The minimum required runway markings for a standard runway are as follows:

- Visual (landing designator, centerline)
- Non-Precision (landing designator, centerline, threshold, aiming point)
- Precision (landing designator, centerline, threshold, aiming point, touchdown zone, edge)

Additional runway markings for blast pad and runway shoulders are also required. Runway 14/32 should continue to have precision markings maintained. Runway 5/23 now has a non-precision approach, thus non-precision approach markings should be maintained. Please note, since Runway 5/23 is less than 4,200' in length, an aiming point marking is not required.

Taxiway/Taxilane

Taxiway and taxilane markings are important for directional guidance for taxiing aircraft and ground vehicles. Common taxiway and apron markings include taxiway/taxilane centerline, edge and non-movement area boundary. Enhanced taxiway markings are required along taxiway centerlines that lead to runway entrances. Taxiway/taxilane centerline markings should be used throughout to define a safe centerline with object clearance. Taxiway/taxilane edge markings should be used to delineate the taxiway edge from the shoulder, apron or some other contiguous paved surface. The non-movement area boundary should be marked appropriately per ATCT line of sight requirements.

Holding Position

Holding position markings are a visual reference to prevent aircraft and vehicles from entering critical areas such as an active runway environment. These markings consist of yellow bars and dashes on a black background. The required setback is 250 feet from Runway 14/32 centerline, and 125 feet for Runway 5/23.

Meteorological

Aircraft operating to and from an airport require meteorological aids to provide current weather data. Weather information helps pilots make informed decision about flight operations. Airports have various aids installed providing local weather information.

Surface Weather Observation

The existing FAA-owned ASOS located east of Runway 32 is sufficient for the long-term. Weather observing systems are recommended to be kept clear of agricultural operations within 100 feet, clear of objects 15 feet below the sensor height within 500 feet, and clear of objects greater than 10 feet above the sensor within 1,000 feet. Should development be considered on the east side of the airport, the ASOS will need to be relocated.

Wind Cone

Wind cones visually indicate the current wind direction and velocity on an airfield. The primary wind cone and segmented circle is located east of Runway 32, adjacent to the ASOS and is in a central visible location, lighted for night operations. Lighted supplemental wind cones are installed around the airfield near Runway 14/32 and 23 ends to provide local surface wind direction information to pilots. Should development be considered for the east side of the airport, the wind cone will need to be relocated.

Other

Runway Visual Range (RVR) visibility sensor systems provide instant reporting of the visibility at targeted locations on the airfield. The existing Runway 32 system is installed to serve the touchdown zone for this runway end. An RVR will need to be installed to serve the touchdown zone for Runway 14 to allow for the precision instrument approach for Runway 14.

Communications & ATC

The ability for pilots to communicate with other pilots and air traffic control is critical for the safety and efficiency of the overall air transportation system.

Rapid City has an operating airport traffic control tower (ATCT) located south of SDARNG complex. ATCT provides clearances, radar advisories and safety alerts to IFR and VFR flights within the controlled Class D airspace. ATCT operates between 6 a.m. and 10 p.m. daily. Approach Control is provided by Ellsworth AFB and operates 24 hours per day. Airport communication frequencies are sufficient for Class D airport operation.

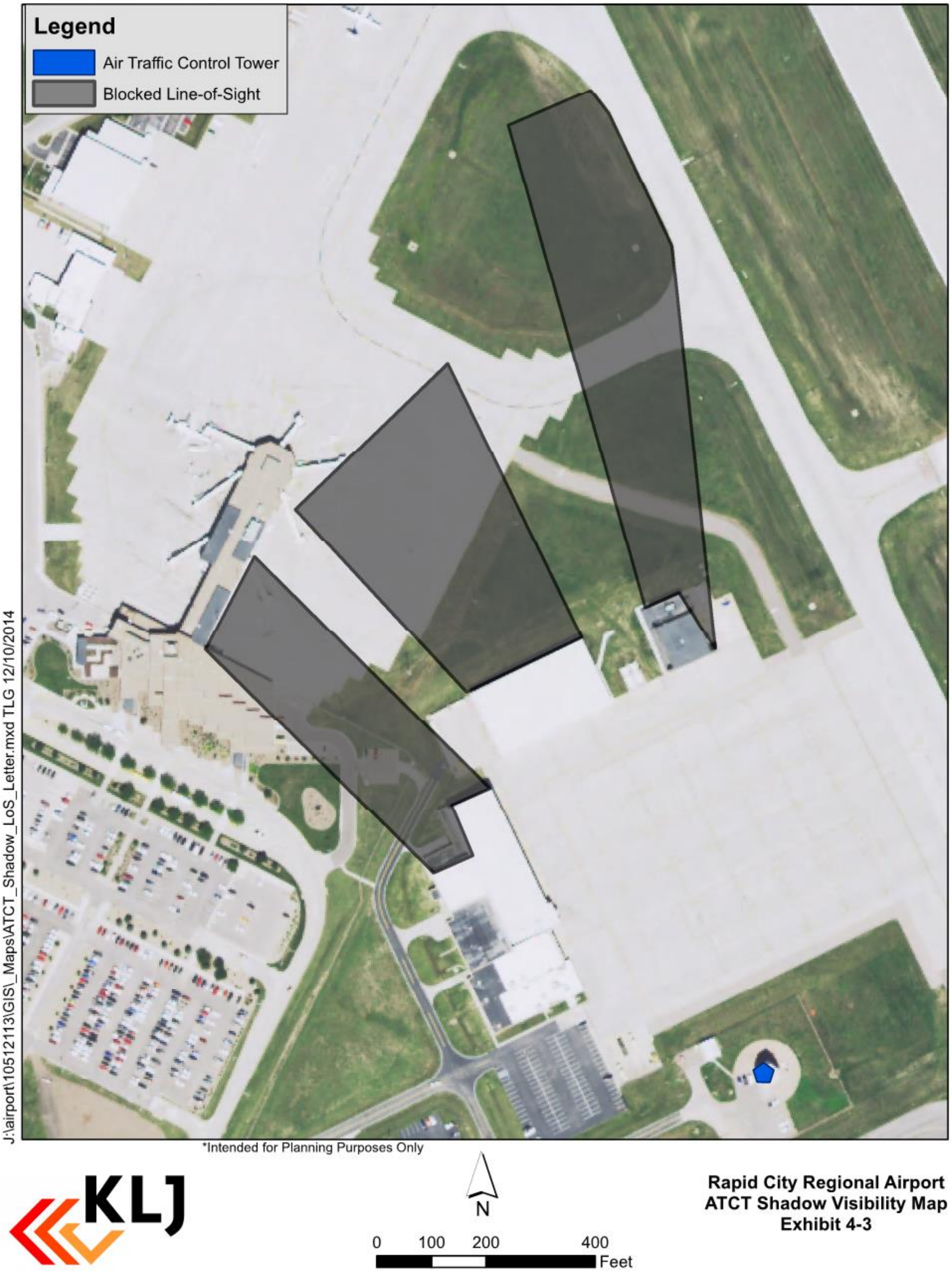
ATCT requires clear line of sight to the airfield. Currently, the tower has limited visibility to Taxiway T2 and the terminal apron as a result SDARNG buildings. A formal analysis of the visibility from the ATCT was not completed but a sight visit resulted in a general assessment showing the building shadows that exist from the tower. These shadows are portrayed in **Exhibit 4-3 ATCT Building Visibility Shadows**. In addition to the building visibility shadows, the ATCT staff advised that aircraft on Taxiway B, when they are near the approach end of Runway 23, are not visible due to terrain.

The tower is 50 years old and within the planning period the structure may need to be replaced on the current site or at another location. The potential addition of public airport access to the east side of the airfield could open new ATCT site options not previously explored. FAA Order 6480.4A, *Airport Traffic Control Tower Siting Process* identifies the criteria used for considering a new tower location:

1. Visual performance
2. TERPS airspace surfaces
3. FAR Part 77 airspace
4. Sunlight/daylight
5. Airport/background lighting
6. Atmospheric Conditions
7. Industrial Municipal Discharge
8. Site Access
9. Interior Physical Barriers
10. Security

The Airport Layout Plan will show the preferred site location based on a preliminary analysis. Additional research and modeling will be required prior to actual site selection. In order to replace the existing ATCT, either on site or at a new location, the airport will need to initiate an ATCT siting study which will be closely coordinated with the FAA.

Exhibit 4-3 ATCT Building Visibility Shadows



Taxiways

Taxiways provide for the safe and efficient movement of aircraft between the runway and other operational areas of the airport. The taxiway system should provide critical links to airside infrastructure, increase capacity and reduce the risk of an incursion with traffic on the runway. The taxiway system should meet the design requirements identified in FAA AC 150/5300-13A, *Airport Design*.

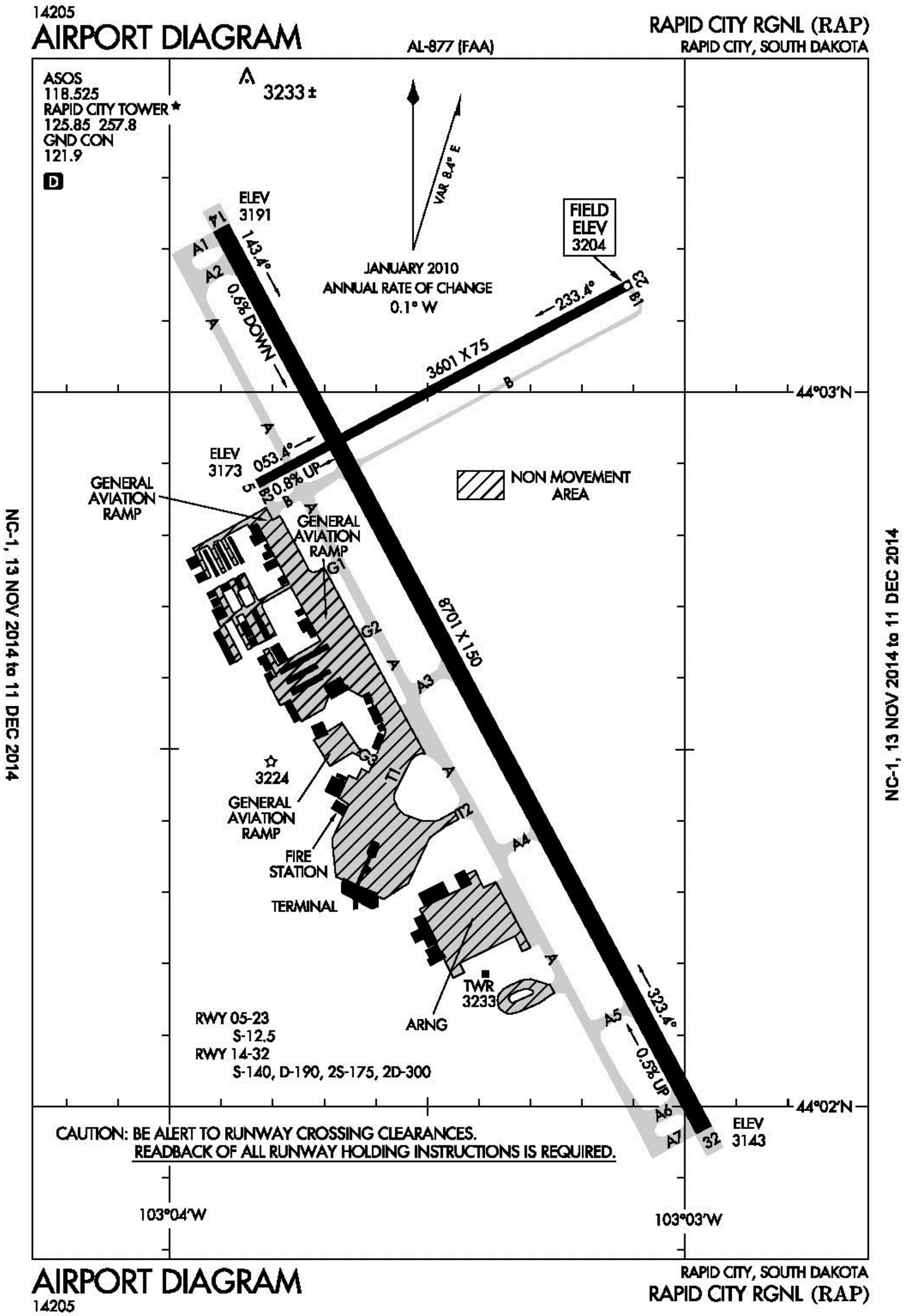
System Design

FAA has placed a renewed emphasis on taxiway design in the updated airport design standards (AC 150/5300-13A). In order to develop efficient systems that meet demands, reduce pilot confusion and enhance safety the following considerations were identified:

- Design taxiways to meet FAA design standards for existing and future users considering expandability of airport facilities.
- Design taxiway intersections so the cockpit is over the centerline with a sufficient taxiway edge safety margin.
- Simplify taxiway intersections to reduce pilot confusion using the three-node concept, where a pilot has no more than three choices at an intersection.
- Eliminate “hot spots” identified by the FAA Runway Safety Action Team where enhanced pilot awareness is encouraged.
- Minimize the number of runway crossings and avoid direct access from the apron to the runway.
- Eliminate aligned taxiways whose centerline coincides with a runway centerline.
- Other considerations include avoiding wide expanses of pavement and avoiding “high energy intersections” near the middle third of a runway.

Rapid City has no identified “hot spots” or other identified design problems with taxiways since Taxiway A was straightened recently to correct an FAA modification to standards.

Exhibit 4-4 – Rapid City Airport Diagram



Source: FAA Terminal Procedures

Design Standards

FAA identifies the design requirements for taxiways. The design standards vary based on the Taxiway Design Group (TDG) and Airplane Design Group (ADG) identified for the design aircraft using a particular taxiway. In addition to taxiway/taxiway pavement width, some of the safety standards include:

- Taxiway/Taxilane Safety Area (TSA) – A defined graded and drained surface alongside the taxiway prepared or suitable for reducing the risk of damage to an aircraft deviating from the taxiway. The surface should be suitable to support equipment during dry conditions
- Taxiway Edge Safety Margin (TESM) – The minimum acceptable distance between the outside of the airplane wheels and the pavement edge.
- Taxiway/Taxilane Object Free Area (TOFA) – An area centered on the centerline to provide enhanced the safety for taxiing aircraft by prohibiting parked aircraft and above ground objects except for those objects that need to be located in the OFA for aircraft ground maneuvering purposes.

Other design standards include taxiway shoulder width to prevent jet blast soil erosion or debris ingestion for jet engines, and required separation distances to other taxiways/taxilanes. A table describing the specific FAA taxiway design standards for various ADG and TDG design aircraft is identified in the following tables.

Table 4-26 - FAA Taxiway Design Standards Matrix (ADG)

FAA Taxiway Design Standards Matrix (ADG)		
Design Standard	Airplane Design Group (ADG)	
	ADG II* (Existing)	ADG III* (Existing & Future)
Taxiway Safety Area	79 feet	118 feet
Taxiway Object Free Area	131 feet	186 feet
Taxilane Object Free Area	115 feet	162 feet
Taxiway Centerline to Parallel Taxiway/Taxilane Centerline	105 feet	152 feet
Taxiway Centerline to Fixed or Movable Object	65.5 feet	93 feet
Taxilane Centerline to Parallel Taxiway/Taxilane Centerline	97 feet	140 feet
Taxilane Centerline to Fixed or Movable Object	57.5 feet	81 feet
Taxiway Wingtip Clearance	26 feet	34 feet
Taxilane Wingtip Clearance	18 feet	27 feet

ADG II applies to general aviation, ADG III applies to some general aviation and existing and future commercial service aircraft.

Source: FAA AC 150/5300-13A Airport Design, KLJ Analysis

Table 4-27 - FAA Taxiway Design Standards Matrix (TDG)

FAA Taxiway Design Standards Matrix (TDG)			
Design Standard	**Taxiway Design Group (TDG)**		
	TDG 2* (Existing)	**TDG 3* (Future)**	**TDG 5* (Existing)**
Taxiway Width	35 feet	50 feet	75 feet
Taxiway Edge Safety Margin	7.5 feet	10 feet	15 feet
Taxiway Shoulder Width	10 feet	20 feet	25 feet
Taxiway Fillet Dimensions	See specific guidance in FAA AC 150/5300-13A		

**TDG 2 applies to existing general aviation, TDG 3 applies to future general aviation, TDG 5 applies to existing commercial service aircraft and overall airfield.*
Source: FAA AC 150/5300-13A Airport Design, KLJ Analysis

The existing airfield system serving Runway 14/32 has taxiways that are at least 75 feet in width sufficient to accommodate existing and future design aircraft. Taxiway A including A1, A2, A6 and A7 and T1 and T2 are designed to TDG 5 standards, A1 and A7 are 100 feet wide and A2 and A6 are 125 feet wide. Taxiways A3, A4, A5 and B (between A and Runway 14/32) are designed to TDG 4 standards for the filets. The remainder of Taxiway B that serves Runway 5/23 is 40 foot wide designed to TDG 2 standards. These taxiway design standards are considered to be sufficient through the planning period.

The only deficiency to the existing design standards is the lack of a taxiway shoulder. A paved taxiway shoulder width of 25 feet is required for taxiways supporting ADG-IV operations and recommended for taxiways supporting ADG-III aircraft.

Bypass Taxiways & Holding Bays

Bypass taxiways and holding bays provide the flexibility to allow runway use when an aircraft is not ready for takeoff and would otherwise block the taxiway. Runway departure delays can be caused by aircraft awaiting departure clearance or completing pre-flight checks. Bypass taxiways provide a secondary access to runways and can separate a mix of small and large aircraft at a runway end. Holding bays provide space for aircraft away from the taxiway environment. Both bypass taxiways and holding bays improve capacity and overall flow.

Rapid City has Taxiways A5 and A6 that can be used as a bypass taxiway within 1,200 feet of Runway 32. There is also Taxiway A2 that can be used as a bypass taxiway within 250 feet of Runway 14. These bypass taxiways should be sufficient to meet the needs at Rapid City through the planning period.

Rapid City does not have holding bays for any of the four runways. FAA recommends holding bays be constructed when peak hour operations reach 30. This is not forecast to occur in the planning period and therefore no holding bays are recommended for Rapid City.

Recommendations

Taxiway recommendations include the following:

- **Construct 25-foot wide paved shoulders for TDG-5 taxiways by PAL 1.**
- **Construct 20-foot wide shoulders for TDG-3 and 4 taxiways by PAL 1.**

Passenger Terminal

The requirements identified for the passenger terminal are identified to accommodate the travelling public with a sufficient level of service based on existing and projected growth. The airport has completed significant upgrades in the terminal building over the past several years including an expanded passenger screening area, expanded concessions in the concourse, expanded rental car area and remodeling throughout.

Currently, the passenger terminal building and concourse consists of approximately 90,000 total usable square feet, including offices, administration, ticketing, baggage, security, concessions, holdrooms/gates, storage and mechanical spaces. Public space open to everyone in non-secure areas is about 29,600 square feet, and sterile areas for passengers that require security clearance is about 24,100 square feet including the security checkpoint. Rapid City has seven gates in the concourse.

This section will identify key issues with the existing passenger terminal building and provide planning-level conceptual planning and space requirements. Landside requirements for passenger loading/unloading and automobile parking are evaluated separately. Requirements identified as based on the following references to FAA, Transportation Security Administration (TSA), International Air Transport Association (IATA), and industry standards:

- FAA Advisory Circular AC 150/5360-13A, *Planning and Design Guidelines for Airport Terminal Facilities* (2012)
- Airports Cooperative Research Program (ACRP), Report 25: *Airport Passenger Terminal Planning and Design Guidebook* (2010)

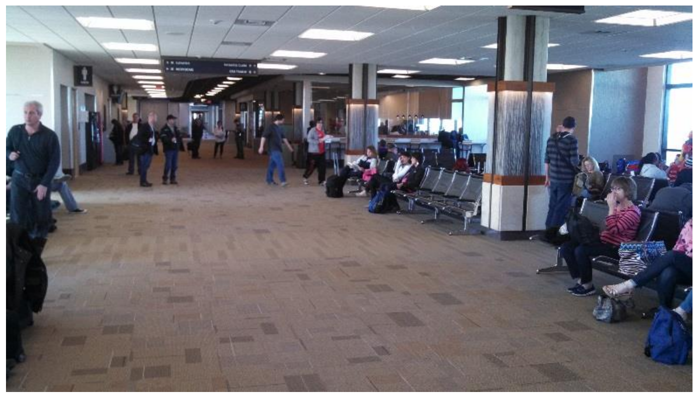
The first step is to identify the terminal space needs for Rapid City to provide a terminal building that meets passenger demands and exceeds expectations. Once the space needs are identified, future terminal building configuration alternatives will be developed in the next chapter. The airport will need to know how future expansion will be accommodated. Broad recommendations will be made in this study; details on a specific interior layout and engineering and architectural review would be identified in a separate terminal master planning study.

Terminal Design

Overall Considerations

Terminals are designed to handle passenger volume and functions to interface between aircraft and ground transportation. Terminals must accommodate changes in the airline industry and passenger preferences. Factors that influence terminal design include:

- Total Passenger Volume – The annual number of passenger enplanements affects the total size and recommended configuration of a terminal building.
- Passenger Peaking Characteristics – Arriving or departing flights concentrated into a small timeframe require adequate space and throughput for surges in passenger ticketing, security, gates, baggage claim and concessions.
- Passenger Preferences – Business travelers typically are more experienced with airports, demand shorter wait times and efficiency. Leisure passengers require more time, attract meters/greeters and typically have more baggage to process. Airline fees also drive passenger preferences to check or carry-on baggage.



- Airline Station Characteristics – A spoke airport such as Rapid City has destinations as airline hubs. Spoke airports accommodate origin & destination (O&D) passengers rather than using the airport to connect to another flight. Aircraft tend to remain overnight for the first flight out to a hub airport. All passengers have a requirement for check-in, security, baggage, ground transportation and parking.
- Aircraft Mix – The size and frequency of the aircraft activity affects the number and size of the gates, passenger waiting holdroom and the terminal apron configuration.
- International Service – Airports with international service require aircraft to have longer gate occupancy times and additional space for Federal Inspection Services (FIS)
- Industry Trends – Industry changes are affecting terminal design. Examples include reduced airline flight frequency, higher load factors, aircraft types, use of check-in kiosks, TSA pre-check program and airline fees affecting baggage.

Level of Service

Terminal improvements are evaluated in their ability to serve passengers and provide a comfortable experience through the airport. A Level Of Service (LOS) concept uses a set of standards to measure the quality of the passenger experience. LOS standards are used to evaluate the efficiency of passenger flow, space requirements and wait time. Each LOS has a defined space planning standard to determine facility requirements.

Table 4-28 - Level of Service (LOS) Standards

Level of Service (LOS) Standards		
LOS		Service Level
A	Excellent	Conditions of free flow; no delays; direct routes; excellent level of comfort
B	High	Condition of stable flow; high level of comfort
C	Good	Condition of stable flow; provides acceptable throughput; related systems in balance
D	Adequate	Condition of unstable flow; delays for passengers; condition acceptable for short periods of time
E	Unacceptable	Condition of unstable flow; subsystems not in balance; represents limiting capacity in the system
F	System Breakdown	Unacceptable congestion and delays

Source: ACRP Report 25: Airport Passenger Terminal Planning and Design

The assumption for this master plan is to obtain LOS C which peak wait times are 10 minutes or below. Delays and space requirements are typically considered acceptable. LOS C is considered reasonable balance between ideal size and economic considerations.

Rapid City Considerations

There are specific space-planning considerations at Rapid City that need to be evaluated in this study. One consideration is determining the ideal terminal layout. The number of gates and the size of the design aircraft is critical in planning a future layout.

Demand Factors

The primary function of a terminal is to provide adequate space to serve passengers. An evaluation of the passenger and gate demand is first completed to provide overall terminal space planning metrics at Rapid City.

Passenger Activity Levels

The following planning activity levels (PAL) numbers are to be used for terminal building planning. These figures provide an estimate of the number of passengers to arrive, depart and generally flow through the terminal building. The figures are based on a percentage of total enplaned passengers distributed based on the existing airline schedule. No surge factor is provided for irregular operations.

Table 4-29 - Terminal Passenger Activity Levels

Terminal Passenger Activity Levels					
Metric	Base	PAL 1	PAL 2	PAL 3	PAL 4
Terminal Passengers					
Annual Enplanements	256,191	275,634	296,254	318,133	341,298
Design Hour Departing	201	216	233	250	268
Design Hour Arriving	201	216	233	250	268
Design Hour Total Seats	295	317	341	366	393

Source: KLJ Analysis

Design Hour & Fleet Mix

The aircraft fleet mix in the terminal area is determined using the total number of forecast departures as shown during the design hour. The design hour is the early morning block of flights where four flights depart Rapid City. Aircraft types are grouped in Airplane Design Group (ADG) and class. The design aircraft for Rapid City will remain a narrowbody aircraft accommodating 110 to 177 passengers. The airlines serving Rapid City will be increasing the sizes of the smallest aircraft in the market which will increase enplanements but leave operations relatively flat. The aviation forecasts project the average number of seats per aircraft will increase. As a result, the total number of flights is projected to increase 4 percent while the total number of passengers will increase nearly 33 percent through PAL 4.

Table 4-30 - Design Hour Departures

Design Hour Departures						
Design Aircraft	**Seats**	**Base**	**PAL 1**	**PAL 2**	**PAL 3**	**PAL 4**
Regional Aircraft (ADG II)	40-60	3.82	3.63	3.47	3.40	3.38
Regional Aircraft (ADG III)	61-99	0.36	0.41	0.46	0.66	0.63
Narrowbody Aircraft (ADG III)	100-120	0.00	0.11	0.29	0.28	0.27
Narrowbody Aircraft (ADG III)	121-150	1.18	1.05	1.04	1.02	1.19
Narrowbody Aircraft (ADG III)	151+	0.04	0.00	0.15	0.14	0.14
Design Hour Departures	**-**	**5.4**	**5.2**	**5.4**	**5.5**	**5.6**

Source: KLJ Analysis

Gate Requirements

Gates are necessary for aircraft to adequately serve arriving and departing aircraft. The minimum number of gates at an airport is a function of the peak hour activity. Additional contingency metrics are also used to determine the required gates. At Rapid City the peak gate utilization period is the early morning departure block which exceeds the demand of the late evening arrival period. One contingency gate is added to accommodate unscheduled charter flights or long-term delayed flights.

Table 4-31 - Gate Requirements

Gate Space Requirements					
Design Aircraft	**Base**	**PAL 1**	**PAL 2**	**PAL 3**	**PAL 4**
Design Hour Departures	5.4	5.2	5.4	5.5	5.6
Contingency Gate	1.0	1.0	1.0	1.0	1.0
Total Gates	6.4	6.2	6.4	6.5	6.6
Total Required Gates	**6**	**6**	**6**	**7**	**7**

Source: KLJ Analysis

The total required gates is then split up into aircraft types using the fleet mix determinations to determine the total and equivalent number of gates for space planning. There are seven gates at Rapid City able to accommodate regional and narrowbody aircraft simultaneously with a passenger boarding bridge (PBB). The existing gates are designed to meet the size of the design aircraft. Two parking stands with PBB access are available at gates 5 and 7 for overnight parking. The contingency gates should accommodate the occasional use of a narrowbody aircraft for nonscheduled operations.

Table 4-32 - Gate Space Requirements

Gate Space Requirements					
Design Aircraft	**Existing /Base**	**PAL 1**	**PAL 2**	**PAL 3**	**PAL 4**
Medium Regional Aircraft (ADG-II)	0	4	3	3	3
Large Regional Aircraft (ADG-III)	4	0	1	1	1
Narrowbody Aircraft (ADG-III)	3	1	1	2	2
Total Number of Gates	**7**	**5**	**5**	**6**	**6**
Narrowbody Equivalent Gate (NBEG)	7.0	3.8	4.1	5.1	5.1
Equivalent Aircraft (EQA)	5.0	2.6	2.7	3.7	3.7

Source: KLJ Analysis

Rapid City will not require any additional gates during the planning period. The increased amount of Large Regional and Narrowbody Aircraft may require aircraft parking to be reconfigured but is feasible within the current gate positions and terminal structure.

Building Areas

Individual functional areas of the terminal building have been evaluated to determine planning-level space needs to accommodate current and future demand. Space requirements will be a major consideration when evaluating terminal building alternatives.

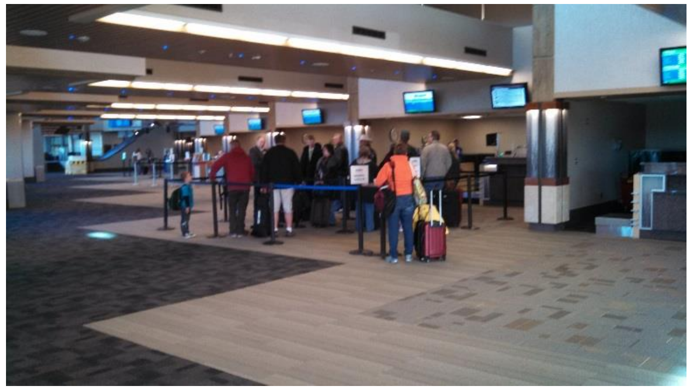
Airline Space

There is currently 11,030 square feet of area behind the ticketing counters dedicated for airline offices and baggage make up. There are a total of six airline areas within this space. Average space per office is 558 square feet. A common industry planning factor is 900 square feet per office. The amount of space required is a function of the total number of airlines serving the airport rather than the total volume of passengers. There are four airlines serving Rapid City presently and two different companies currently provide ticketing and ground handling services for these four airlines. DGS serves Delta and United and World Wide serves both American and Allegiant. If a new airline enters into the Rapid City market then existing office space is available. There is sufficient space to accommodate up to six airlines at Rapid City.

Other airline space considerations include airline ramp offices and support facilities on the airside portion of the airport. These are used for airline ground servicing functions. There is currently 6,439 square feet of office and garage space provided on the concourse lower level used among the two service providers for four airlines at Rapid City. Using a planning space metric of 1,300 square feet per office and 2,500 square feet for ramp services, there is a need for 11,400 square feet of space. The airlines are able to adequately function with the existing space as some services are contracted to other providers. Additionally, lower level of the concourse has approximately 13,200 square feet of space available for expansion to meet any future space needs. The total airline ramp space needs are forecast to be fully met into the future.

Baggage Service Offices (BSO) provide handling and storage for late or unclaimed bags. There is not currently a BSO facility at Rapid City. Baggage is stored in a secure area and retrieved from the airline ticket counters. While the amount of space is sufficient to meet current demands the lack of a physical location in the bag claim area makes it confusing for passengers who are needing assistance with late bags. Recommendations on how to address this issue will be made in the Alternatives Chapter.

Ticketing & Check-In



The passenger check-in process continues to change as new technologies and processes are implemented. These changes have reduced the space needed in the ticketing lobby space and staffed ticket counter positions. Waiting times are also reduced. Traditionally, all passengers checked in at the ticket counter to both receive boarding passes and check baggage. Now, remote self-service equipment allows individuals to obtain boarding passes online or at the airport without the need to use staffed ticket counters. Checked baggage is accommodated by a dedicated airline bag-drop representative at the counter. The use of self-service equipment continues to grow. Potential future trends include self-tagging stations and remote off-airport bag-drop facilities which would reduce the need for staffed positions at the airport.

The passenger check-in assumptions are important to evaluate space and facility needs. For planning purposes the following assumptions are made:

- Passengers Checking Baggage: Average is 50 percent with 70 percent for leisure flights
- Checked Baggage Location: 100 percent within the terminal, 0 percent curbside, 0 percent remote location
- Passenger Check-In Location: 30 percent remote, 30 percent in-terminal kiosk, 40 percent in-terminal counter

The ticketing lobby at Rapid City currently consists of 6,127 square feet for ticket counters and queuing with a total of 22 available check-in positions provided at the airport with 66 linear feet of counter space. The airlines lease 8 staffed counters and provide two positions per counter for a total of 16 positions. Each 440 square foot ticket counter area also currently houses at least one of five Transportation Security Administration (TSA) pieces of equipment and associated staff to conduct checked baggage screening. The screening equipment and the logistics of TSA's working in this area are discussed later.

Many airlines also provide self-service kiosks near their ticket counter area mostly within the ticket counter queue. There are several check-in kiosks located in the corridor, owned by Delta Air Lines, United Airlines and American Airlines. There are no curbside check-in facilities provided. The ticketing lobby has a 24 foot queue depth which is more than the FAA's minimum recommendation of 15 feet.

Table 4-33 - Ticketing Requirements

Ticketing Requirements						
Metric	***Existing***	**Base**	**PAL 1**	**PAL 2**	**PAL 3**	**PAL 4**
Staffed Ticketing Positions	*16*	9	12	12	13	14
Staffed Bag Drops	-	2	3	3	3	3
Number of Dedicated Kiosks	*6*	4	5	6	6	7
Total Staffed Positions	*16*	11	14	15	16	18
Total Equivalent Positions	-	13	16	17	19	20
Total Queue Area (SF)	*3,475*	1,717	2,148	2,309	2,479	2,660

RED indicates a deficiency to existing facilities
Source: KLJ Analysis

The total number of airport provided ticketing positions meets the needs through PAL 4. Each individual airline is responsible for leasing space to allow customers adequate space and check-in options. Additional positions may be provided for frequent fliers and/or first class customers. Most airlines at Rapid City require customers to proceed to a check-in position where an agent and a kiosk are available. It is recommended additional self-service kiosks be installed in the ticketing areas with staffed bag drops. Kiosks reduce passenger waiting time and require minimal space.

A simple review shows there is sufficient total queuing space for passengers. There will be individual peak periods that may exceed leased space in front of each airline counter and queue area. The space is available from the airport but is it the responsibility of each airline to lease the space for passenger exclusive use.

Curbside check-in is provided to enhance the LOS and reduce congestion within the ticketing lobby. Rapid City does not offer curbside check-in. There is adequate space and a high LOS within the existing ticketing lobby. Curbside check-in would require a 30-foot wide curb, check-in podiums and with either a baggage conveyor or baggage cart.

Baggage Screening & Make-up

Baggage screening facilities are located within each individual airline ticket counter area. This equipment is operated by the TSA to screen checked bags for explosives. Bags are fed through one of three Explosive Detection System (EDS) machines or screened with one of four Explosive Trace Detection (ETD) stations. The Delta, United and Allegiant counters each have EDS machines. The American and vacant counters have the four ETD stations. Since the equipment is positioned separately there is limited ability to handle peaks from individual flights or redirect baggage when equipment is out of service. Once bags are cleared they are sent by baggage belt to the airlines bag make-up area to be carted to the aircraft. The screening equipment occupies a portion of the six 440 square foot ticket counter areas.

This arrangement of baggage screening is not recommended for the long term as it requires extra equipment and personnel and is unable to efficiently handle any surges. An in-line baggage screening arrangement is recommended as soon as practicable. The amount of space that will be required for this in-line baggage screening should be 3,380 square feet since this is the amount of space projected to be needed as early as PAL 2, see **Table 4-34**. This will free up 1,155 square feet of space in the ticketing area that is currently used for baggage screening.

Baggage make-up facilities are located directly behind the airline offices. After the bags are screened behind the ticket counters by TSA staff, they are placed on bag belts which send them to the back of the airline office areas. Behind the airline office areas there is a small area for bag make-up exclusive to each airline connected to a driving corridor for baggage carts and tugs. This driving corridor is also used for the storage of ground support equipment. The area totals 8,699 square feet and includes the 3,323 square feet corridor for equipment maneuvering and 2,232 square feet in two empty airline areas physically separated and unavailable for general use. This results in an average of 786 square feet of space for each of the four airline positions for conveyors and loading baggage carts for a total effective space of 6,558 square feet including the maneuvering corridor. The current configuration is depicted in **Exhibit 4-5 Existing Baggage Handling Layout**.

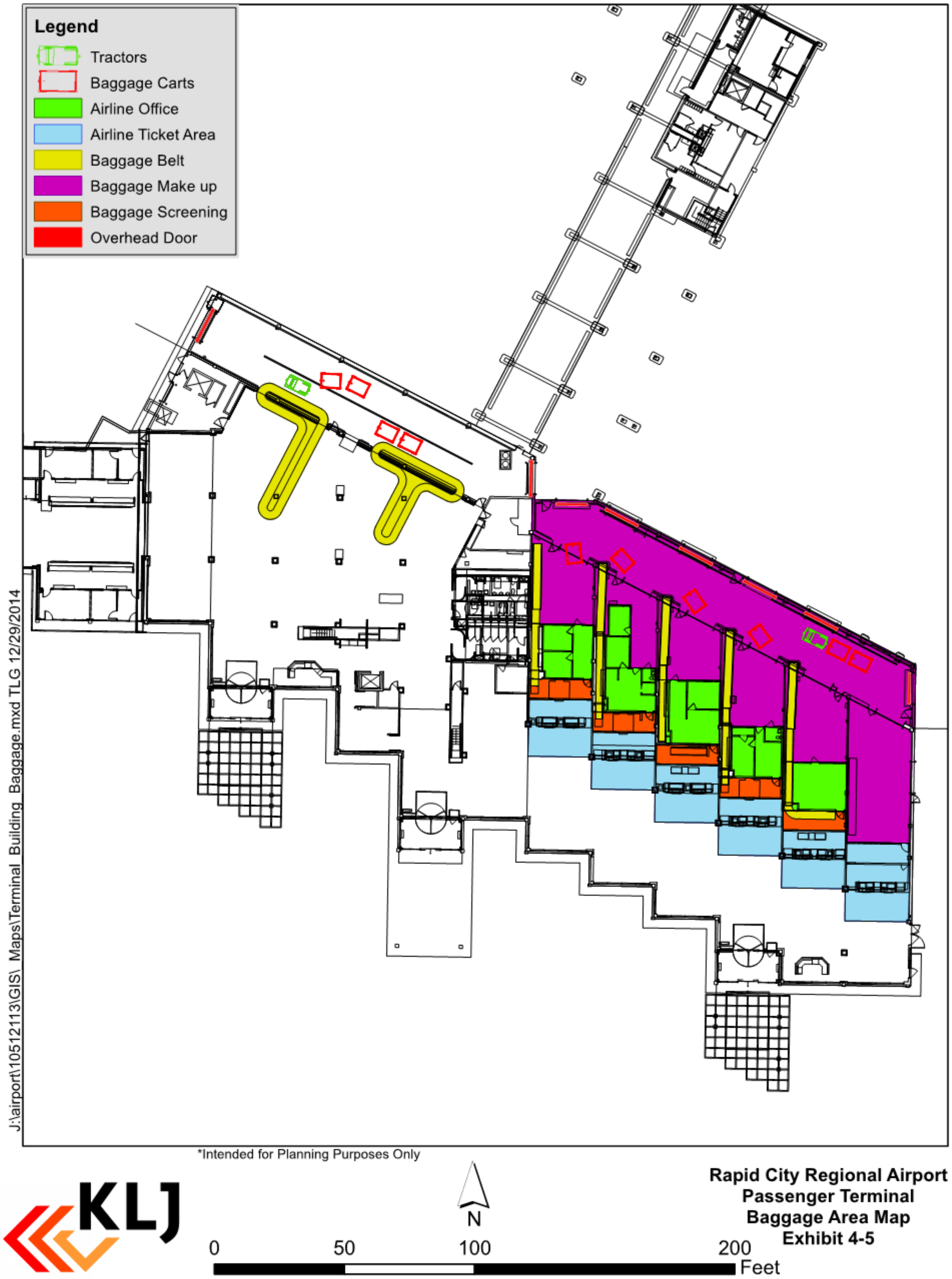
Table 4-34 - Baggage Screening & Make-Up Requirements

Baggage Screening & Make-Up Requirements						
Metric	***Existing***	**Base**	**PAL 1**	**PAL 2**	**PAL 3**	**PAL 4**
Baggage Screening Area	*1,155**	2,580	2,580	3,380	3,380	3,380
Baggage Make-Up Area	*6,476***	5,700	5,900	5,900	8,100	8,100

** Baggage Screening is collocated with 2,652 square feet of airline ticket counter area and is not a separate space. ** Baggage Make-Up includes 4 airline positions and maneuvering corridor. 2,232 square feet of space is separated in two additional airline positions and not configurable for use with the existing four occupied positions.*
RED indicates a deficiency to existing facilities
Source: KLJ Analysis

Based on the volume of bags for Rapid City it is recognized that the airport currently needs 5,700 square feet of space for baggage make-up and 8,100 square feet by PAL 4. It is recommended that at the same time that the in-line baggage screening is created, that the airport also address the disjointed layout for baggage make-up. Recommendations on how to address this issue will be made in Chapter 5 Alternatives.

Exhibit 4-5 – Existing Baggage Handling Layout



Security Checkpoint

The Security Screening Checkpoint (SSCP) area is used by TSA to screen passengers and property prior to entering the sterile area of the terminal concourse. Rapid City has upgraded the facility to meet the current and future demands. There are currently 3 lines for checking passengers. One is configured for TSA PreCheck and the other two are for all other passengers. There are currently three x-ray machines for property search, two walk-through metal detectors, and one Advanced Image Technology (AIT) scanner, all staged in a wide corridor. There is a large queue area in front of the screening equipment. The total security and queue area is about 5,030 square feet in size. There is another 254 square feet of TSA screening and office space. The calculated maximum current wait time in queue is 4.9 minutes according to calculations using metrics from ACRP's terminal planning spreadsheet.

SSCP space requirements are driven by equipment and queuing space from the number of passengers and estimated throughput rate. Actual throughput rates of 175 passengers per hour per lane are common nationally. To achieve a maximum 10 minute queue wait time, all three security lanes are needed by PAL 2.

Table 4-35 – Security Screening Checkpoint Requirements

Security Screening Checkpoint Requirements						
Metric	***Existing***	**Base**	**PAL 1**	**PAL 2**	**PAL 3**	**PAL 4**
Security Screening Lanes	*2*	2	2	3	3	3
Maximum Wait Time (min.)	*4.9*	4.9	11.1	2.3	4.0	5.7
Security Screening Area	*2,400*	1,250	1,250	1,875	1,875	1,875
Total Security Area	*5,666*	3,125	3,125	4,688	4,688	4,688

NOTE: Security Screening Checkpoint was expanded and upgraded in 2013.
Source: KLJ Analysis

Technology and processes will continue to evolve. The TSA PreCheck program will likely increase throughput which in the future may reduce the need for additional queuing areas.

Passenger Holdrooms

Passenger holdrooms are designated areas in the sterile concourse area where passengers wait to board the aircraft at the gate. The size of the holdrooms are directly related to the aircraft size at each gate. The estimated fleet mix is used to determine holdroom sizing for each gate. Each holdroom is sized assuming 80 percent of the total number of passengers are seated and the remaining 20 percent are standing. Additional space requirement for the gate podium and podium queue are also taken into account.

The terminal concourse was expanded in 2013 with additional concessions, restroom and passenger screening space. There is a total of 8,644 square feet of holdroom space for seven gates. Holdroom seating capacity is often shared among several gates or in separate areas of the terminal. Cumulatively, total existing seating capacity is approximately 450 seats which provides seating for 59 percent of the peak hour departing passengers through the planning period.

The evaluation of holdroom requirements is based on the average number of passengers per aircraft per gate. The peak hour departure block requires five gates in the existing configuration with an additional two departures through PAL 4. This assumes a maximum of seven of the seven gates are in use at the same time for RON (Remain Over Night) flights.

The analysis concludes additional holdrooms will not be needed within the planning period.

Table 4-36 - Holdroom Requirements

Holdroom Requirements						
Metric	***Existing***	**Base**	**PAL 1**	**PAL 2**	**PAL 3**	**PAL 4**
Design Aircraft						
50 passengers (1,000 SF)	*0*	4	4	3	3	3
76 passengers (1,400 SF)	*0*	0	0	1	1	1
110 passengers (1,800 SF)	*4*	0	0	0	0	1
138 passengers (2,200 SF)	*2*	1	1	1	1	1
166 passengers (2,600 SF)	*1*	0	0	0	0	0
Total Airline Gates In Use	*7*	5	5	5	5	6
Total Holdroom Area	*8,644*	6,200	6,600	6,600	6,600	8,400

Source: KLJ Analysis

Concourse Size & Circulation

The overall size of the terminal concourse was evaluated for future space planning. The exterior terminal frontage is based on the aircraft fleet mix parked at the gate with sufficient wingtip clearance between aircraft. The current concourse exterior frontage available to aircraft is 860 linear feet (LF) with a total length of 400 LF. The width of the terminal varies based on whether the terminal has gates on one or both sides (single vs. double loaded) and the corridor width. The current Rapid City terminal is double loaded with gates across from each other. The current corridor width is 22.5 feet for a walkway. The suggested minimum width for a double-loaded terminal is 20 feet for a high LOS facility. The concourse width is adequate to meet current standards within the planning period.

Table 4-37 - Concourse Size & Requirements

Concourse Size & Circulation Requirements						
Metric	***Exist.***	**Base**	**PAL 1**	**PAL 2**	**PAL 3**	**PAL 4**
Narrowbody Equivalent Gate (NBEG)	7.0	3.8	3.8	4.1	5.1	5.1
Aircraft Frontage (LF)	*860*	571	584	640	661	652
Concourse Length* (LF)	*390*	255	262	290	301	296
Concourse Circulation Area (SF)	*5,160*	4,600	4,600	5,000	5,000	5,000
Concourse Width (ft.)*	*22.5*	20	22.5	22.5	22.5	22.5

**Assumes double-loaded concourse*
Source: KLJ Analysis

Baggage Claim & Handling

Baggage claim devices are provided for arriving passengers to retrieve their checked bags from the aircraft. Bags are offloaded from the aircraft, placed on baggage carts, transported to a baggage handling area and then offloaded onto the baggage belts in a secure area.

The baggage claim area at Rapid City has two flat-plate baggage claim devices each providing 62 LF of presentation frontage for a total baggage claim frontage space of 124 LF. There is approximately 7,160 square feet of baggage claim area connected directly to entry/exit corridors to the front of the terminal and to the car rental area. A doorway for distributing oversized baggage is located between the two baggage belts which provides limited room for claiming large bags as other passengers are also retrieving bags from the baggage belts. It is assumed 70 percent of passenger check bags.

Additional baggage claim frontage is needed to accommodate overall design hour baggage claim demands starting by PAL 4. The individual largest arriving aircraft will require additional frontage preferably using one claim device. Currently when a single narrowbody aircraft arrives, a single baggage claim device provides only 62 feet of frontage which is less than the industry recommended 90 feet. The second baggage claim device can be used but it would be confusing for passengers and require extra baggage tugs. No change is recommended at this time but the baggage claim devices should be monitored for any congestion issues with narrowbody aircraft.

Table 4-38 - Baggage Claim & Handling Requirements

Baggage Claim & Handling Requirements						
Metric	***Exist.***	**Base**	**PAL 1**	**PAL 2**	**PAL 3**	**PAL 4**
Peak People at Claim	-	57	71	77	83	88
Baggage Claim Frontage	*124*	86	107	115	124	133
Peak Single Aircraft Frontage	*62*	90	90	90	90	90
Total Baggage Claim Area	*7,160*	3,425	4,277	4,613	4,950	5,306
Total Baggage Handling Area	*3,428*	3,400	3,400	3,400	3,400	3,400

Note: RED indicates a deficiency to existing facilities
Source: KLJ Analysis

The baggage handling area is approximately 3,428 square feet in size. The baggage handling area requires a baggage tug drive lane, offloading zone and bypass lane. Multiple flights arriving near the same time will also require additional space to drive around active unloading operations. The existing depth is 23 feet and is adequate for the planning period.

Total percentage of passengers checking bags dramatically changes the baggage claim requirements. Baggage trends should continue to be monitored by the airport with space needs updated. Over the past several years airline fee structures have charged for checked bags reducing demand. The trend is for airlines to charge for carry-on bags as well which may cause the number of checked bags to increase again.

Concessions

Concessions are areas within the airport terminal used for retail space located in the public and sterile portions of the terminal. Airport industry trends demand more concessions in the sterile portion of the terminal as passengers have increased dwell times after the security checkpoint. Additionally liquids, aerosols and gels are heavily restricted through the checkpoint. Currently 70 percent of the concession area is located in the public area with 30 percent in the sterile concourse.

Concessions located in the public area include a 4,686 square foot restaurant which was renovated in 2013 with the remainder of the terminal. A unique outside eating area was added on top of the terminal which adds 4,000 square feet as weather permits. Within the sterile concourse concessions include an 875 square foot news/gift shop and a 1,059 square foot cafe/bar area. Other amenities such as vending machines are included in the terminal.

Rental Car

Near baggage claim in the public area, there are four rental car counters at Rapid City totaling about 3,310 square feet. The size of the offices are sufficient. The queue area is not designated but is a portion of the 22 foot wide corridor separating the facing ticket counters. This corridor is also used for rental car customers exiting the terminal to the parking lot. All four rental car counters and offices are occupied, so there is no space constructed for additional providers.

Table 4-39 - Rental Car Requirements

Rental Car Requirements						
Metric	***Exist.***	**Base**	**PAL 1**	**PAL 2**	**PAL 3**	**PAL 4**
Number of Providers	*4*	4	4	4	5	5
Rental Car Office Area (SF)	*903*	900	900	900	1,125	1,125
Rental Car Counter Area (SF)	*651*	648	648	648	810	810
Rental Car Area (SF)	*3,310*	2,748	2,748	2,748	3,435	3,435

Note: RED indicates a deficiency to existing facilities
Source: KLJ Analysis

The deficiencies identified in the table are based on one additional car rental agency operating from the airport. While the identified car rental area does not have space reserved for expansion there is space in the meeter/greeter arrivals area, adjacent to the rental car area, which can be modified for such use. In addition to the rental car area there is 193 square foot space used by Rapid Shuttle which is in the arrivals area of the terminal.

Airport Administration

The Airport Administration terminal areas include staff operations, offices and conference rooms. This includes 2,631 square feet of space, all on the second level adjacent to the concourse entry. This space should provide sufficient space through the planning period.

Public Spaces

Public spaces include non-revenue generating areas of the terminal building used for restrooms, circulation, as seating and waiting areas. Including sterile and non-secure areas, 3,817 square feet is dedicated to public restrooms. The number of restrooms is based on the design hour passengers in the public area, and on the number of equivalent aircraft within the secure area. Restrooms are located in adequate locations within the sterile and non-secure areas.

Table 4-40 - Restroom Requirements

Restroom Requirements						
Metric	***Exist.***	**Base**	**PAL 1**	**PAL 2**	**PAL 3**	**PAL 4**
Sterile Area						
Male Restrooms	*12*	4	4	4	4	4
Female Restrooms	*10*	3	3	4	4	4
Family Restrooms	*1*	1	1	1	1	1
Total Fixtures	*23*	8	8	9	9	9
Non-Secure Area						
Male Restrooms	*10*	5	5	5	6	6
Female Restrooms	*13*	4	5	5	5	6
Family Restrooms	*1*	1	1	1	1	1
Total Fixtures	*24*	10	11	11	12	13

Source: KLJ Analysis

The meet/greet areas has traditionally been on the second level prior to security or in the baggage claim area. The second level area is 6,546 square feet of space adjacent to the open seating area of 4,686 square foot restaurant area. The restaurant area is open yet unlighted after hours so that overflow meters and greeters can enter this area.

General circulation within the terminal is adequate but includes some narrow areas of movement in the baggage claim area with escalators and stairs. A general minimum corridor width standard of 15 feet is considered minimally acceptable to clear of objects and queuing lines within the terminal, with a 30 foot wide corridor for a double-loaded terminal concourse. The corridor near the rental car counters provides 22 feet of width including queuing and is generally adequate.

The exit from the rental car area to the parking lot however has two automatic doors which are only 3.5 feet wide. A passenger must make a 90 degree turn to enter the vestibule through the first doorway then another 90 degree turn in the vestibule before exiting the second doorway. There is less than 10 feet of distance separating the two doorways. This vestibule exit should be addressed in the short-term.

The lobby on the first floor of terminal is of sufficient size to accommodate current and future passenger circulation.

Circulation efficiency is a product of good wayfinding signage. No deficiencies were noted but as changes do take place in the terminal signage must be adjusted to properly direct the public to terminal building services.

Recommendations

Below is a table summarizing the identified space requirements for the passenger terminal building:

Table 4-41 - Passenger Terminal Building Space Requirements

Passenger Terminal Building Space Requirements						
Metric	***Exist.***	**Base**	**PAL 1**	**PAL 2**	**PAL 3**	**PAL 4**
Demand						
Annual Enplanements	-	256,191	275,634	296,254	318,133	341,298
Building Areas						
Total Required Gates	*7*	6	6	6	7	7
Airline Ticket Office (SF)	*3,350*	4,000	4,000	5,000	5,000	5,000
Airline Ramp/Support (SF)	*6,439*	7,600	7,600	11,400	11,400	11,400
Staffed Equivalent Positions	-	13	16	17	19	20
Dedicated Kiosks	*6*	4	5	6	6	7
Baggage Screening Area (SF)	*1,155*	2,580	2,580	3,380	3,380	3,380
Baggage Makeup Area (SF)	*6,476*	5,700	5,900	5,900	8,100	8,100
Security Screening Lanes	*2*	2	2	3	3	3
Total Security Area (SF)	*5,666*	3,125	3,125	4,688	4,688	4,688
Total Holdroom Area (SF)	*8,644*	6,200	6,600	6,600	6,600	8,400
Aircraft Frontage (LF)	*860*	571	584	640	661	652
Concourse Circulation (SF)	*5,160*	4,600	4,600	5,000	5,000	5,000
Baggage Claim Frontage (LF)	*124*	86	107	115	124	133
Baggage Claim Area (SF)	*7,160*	3,425	4,277	4,613	4,950	5,306
Baggage Handling Area (SF)	*3,428*	3,400	3,400	3,400	3,400	3,400
Rental Car Area (SF)	*3,310*	2,748	2,748	2,748	3,435	3,435
Sterile Area Restrooms	*23*	8	8	9	9	9
Public Area Restroom	*24*	10	11	11	12	13

Note: RED indicates a deficiency to existing facilities
Source: KLJ Analysis

Passenger terminal building facility recommendations include the following:

- **Improve the rental car exit vestibule to allow a wider, more direct corridor for rental car customers.**
- **Provide additional self-service check-in kiosks in the ticketing lobby for added customer convenience.**
- **Install an in-line baggage screening system to increase throughput and allow ticket counter space to be used exclusively by airline personnel.**

- **Restructure baggage make-up area when in-line baggage screening is installed to improve capacity.**
- **Expand concessions in the sterile area as major improvements or expansion of the concourse is made.**
- **Add an additional security screening lane within the existing space as demand may require it within the planning period.**

Apron

Terminal Apron

The primary purpose of the terminal apron is to provide parking for commercial passenger aircraft at the terminal gate and provide circulation space for aircraft and airline support functions. There are 7 passenger boarding bridges and 9 parking positions around the terminal gate.

The primary driver for the size of a terminal apron is the terminal building. The building layout and configuration will drive the size and space needs for the apron. The terminal apron size and configuration is a function of the total number of gates, building configuration, aircraft type, airfield configuration, aircraft maneuvering and FAA design standards including wingtip clearances. As the terminal building concepts are developed, software will be utilized to model gate configuration which will help identify the required terminal apron size. Gates should be designed to provide adequate space for taxi-in and pushback-out operations.

The terminal apron should be sized to accommodate regular use of larger aircraft as identified in the gate space requirements. Known existing considerations to the terminal apron size include deicing operations along Taxiway T-1, narrowed apron depth for Gates 2 and 4 which from the terminal are 210 and 250 feet respectively, and deicing truck parking. The apron near Gate 2, the narrowest position, also accommodates parking for deicing trucks for the airlines. The remainder of the gates range from 300 to 350 feet in apron depth. Currently aircraft parked at Gate 2 must be pushed back to behind Gate 7 before being released to taxi. The west portion of the apron, which is narrowest, is bounded on the landside by a road and parking for rental cars. There are no structures that would impede expansion of this apron.

Remain Overnight Parking (RON)

There is currently no designated RON parking apron at Rapid City. Commercial aircraft typically park overnight at the terminal gates. There are currently 9 aircraft parking stands surrounding the terminal building accommodating aircraft ranging from a CRJ-200 to a Boeing 757. All 9 aircraft can connect to a passenger boarding bridge depending on aircraft size. The March 2014 flight schedule shows there are 5 RON aircraft (1 Bombardier Q400, 1 Embraer ERJ-145 and 3 CRJ-200 aircraft) during weekdays and the July 2014 flight schedule shows 7 RON aircraft (2 Airbus A319, 3 Embraer ERJ-145 and 2 CRJ-200 aircraft).

Deicing Apron

Aircraft deicing is necessary prior to departure in cold weather conditions. Deicing operations are currently accomplished on the existing aircraft apron along taxilane T-1 which can accommodate only one aircraft at a time. An ADG II aircraft can be deiced while an ADG III aircraft taxis on T-1. If an ADG III aircraft is being deiced then T-1 is restricted to no larger than an ADG II aircraft. Since there is just one position this creates delay as aircraft gate pushback and deicing operations can last approximately 15 minutes.

Aircraft deicing pads should be located in reasonable proximity to the departure runway. A location near the terminal apron should be explored or deicing at each airline gate should be explored.

Deicing facilities need to have space for aircraft and wingtip clearance, as well as space for mobile equipment maneuvering, a bypass taxiway, appropriate runoff mitigation to meet environmental requirements, lighting and support facilities. **A consolidated RON apron and deicing facility should also be considered.**

Ground Equipment Storage

Airlines operate their own ground service equipment (GSE), including a variety of aircraft tugs, pushbacks, service vehicles, deicers, ground power units (GPUs), baggage belt-loaders, and other support vehicles. GSE is currently stored outdoors clear of critical areas, under the concourse in open and garaged space and inside the baggage make-up corridor behind the airline offices.

Air Cargo

Rapid City is a destination airport for air cargo flights mostly from Sioux Falls, SD sometimes with an interim stop at Pierre, SD. FedEx, UPS and USPS serve the airport through various feeder airlines which connect to Sioux Falls. Cargo is processed on Apron AP-5 adjacent to Taxiway T-1 for FedEx and USPS and on Apron AP-1 for UPS. Total enplaned and deplaned air cargo is forecasted to grow a total of 48 percent through PAL 4. There is minimal belly cargo carried by the airlines.

The air cargo operations at Rapid City occur in the morning and early evening for FedEx and UPS and occur in the late evening only for USPS to meet delivery schedules. Cargo is loaded and unloaded on the apron areas.

During the Sturgis Motorcycle Rally there is additional cargo demand and UPS has a flight directly from Sioux Falls to Spearfish SD to meet this demand. The reason is not because of lack of space at Rapid City, but to limit ground vehicle travel going to Sturgis SD during the congested time of the rally. Spearfish's Black Hills Airport (SPF) is 17 miles west of Sturgis as compared to Rapid City Regional Airport (RAP) which is 41 miles east of Sturgis.

The Apron AP-5 area will likely be lost for air cargo as the old terminal is removed and a new FBO terminal is constructed adjacent to Apron AP-4 and Apron AP-4 is expanded to connect with Apron AP-6. There is a need to have sufficient apron for FedEx to park through the day and the UPS carriers typically hangar their aircraft during the day to avoid deicing. The apron area for air cargo needs close access to roadways to minimize movement of cargo trucks on the airside and it needs to be conveniently located for services needed for the aircraft such as storage, fueling and deicing.

The apron needs will be based on estimated fleet mix. Current fleet mix includes:

- Zero ADG-I air cargo aircraft unless replacing an ADG-II aircraft
- Two ADG-II air cargo aircraft (1 UPS, 1 USPS)
- One ADG-III FedEx ATR-42 air cargo aircraft

It is estimated cargo aircraft will increase at PAL 4 about 46 percent over the base scenario. Size requirements were calculated for each design aircraft using calculated clearances from other aircraft, objects and an assumed taxilane. An additional 10 percent is added for Ground Support Equipment (GSE).

- Airplane Design Group I – 1,000 square yards per aircraft
- Airplane Design Group II – 2,400 square yards per aircraft
- Airplane Design Group III – 3,300 square yards per aircraft

The apron should be designed to FAA standards so that sufficient space for parking, circulation and ground operations. Expansion concepts will be developed in the following chapter.

Table 4-42 - Air Cargo Apron Requirements

Air Cargo Apron Requirements						
Category	***Existing***	**Base**	**PAL 1**	**PAL 2**	**PAL 3**	**PAL 4**
Cargo Aircraft						
Design Group I	-	-	-	-	-	-
Design Group II	*1**	1*	1*	2*	1*	1*
Design Group III	*1*	1	1	1	2	2
Total	2	2	2	3	3	3
Cargo Apron Space (SY)						
Design Group I	-	-	-	-	-	-
Design Group II	-	2,400	2,400	4,800	2,400	2,400
Design Group III	-	3,300	3,300	3,300	6,600	6,600
Total Space	*0*	5,700	5,700	8,100	9,000	9,000

**USPS aircraft is not added since it operates at a time when the other aircraft have already departed the airport. Red indicates a deficiency to existing facilities.*
Source: KLJ Analysis

Recommendations

The Air Cargo needs are as follows:

- **Establish an area of apron and associated buildings for air cargo with sufficient airside and landside access. The facility should be sized to meet the requirements in PAL 1 (5,700 SY) with expansion capability through PAL 4 (9,000 SY).**
- **Locate the cargo apron area so that there is flexibility to either store aircraft in hangars in the area or conveniently tow aircraft for storage in other hangars.**

General Aviation

General Aviation includes all civil aviation activities except for commercial service. GA covers a much broader portion of the aviation community. GA activities found at Rapid City include corporate travel, medical transport, flight training, personal and business flights as well as recreational flying. These types of aeronautical activates serve the public in a capacity that may be less noticeable to the average citizen. Providing facilities and access for GA users at Rapid City will continue to be vital for the community and region.

Rapid City Regional Airport continues to serve as the primary GA facility for the community handling the vast majority of corporate business traffic. There are 111 based aircraft and over 22,500 annual flight operations classified as GA. Based aircraft is projected to grow 38 percent with operations growing by 55 percent through the planning period. GA facilities are necessary to support these operations on the airfield. On-airport businesses providing aeronautical services known as Fixed-Base Operators (FBOs) and Specialized Aviation Service Operators (SASOs) provide aircraft maintenance, fueling and other pilot and passenger services.

The following Table identifies the PAL metrics for the General Aviation.

Table 4-43 - General Aviation Planning Activity Levels (PALs)

General Aviation Planning Activity Levels					
Metric	**Base**	**PAL 1**	**PAL 2**	**PAL 3**	**PAL 4**
Based Aircraft					
Single Engine	70	75	75	86	91
Multi-Engine	31	34	36	43	47
Jet	8	10	11	13	15
Helicopter	1	1	0	0	0
Other	1	1	1	1	1
Total Based Aircraft	111	121	125	143	154
General Aviation Operations					
Local Operations	7,593	8,604	9,750	10,698	11,941
Itinerant Operations	14,997	16,153	17,878	20,216	23,102
Total Operations	22,590	24,757	27,628	30,914	35,043
General Aviation Peak Transient Operations					
Peak Month Transient Operations	1,079	1,162	1,287	1,455	1,662
Design Day Transient Arrivals	24	26	28	32	37
Transient Aircraft Parked on Apron	19	21	23	26	29

Source: KLJ Analysis

Aircraft Storage

Aircraft storage requirements are driven by the aircraft size, local climate and owner preferences. Aircraft are becoming increasing more complex and expensive. The overall trend is for larger turboprop and corporate business jet aircraft to operate at the Rapid City Regional Airport. The harsh winters in the upper Midwest drive all owners to seek aircraft storage facilities rather than outdoor parking on an aircraft parking apron. Owners prefer to have covered, secure storage for their aircraft with space for other aeronautical facilities including an office or maintenance/storage areas. Nearly all the based aircraft at Rapid City are stored in covered storage facilities.

A facility space model was developed using the based aircraft forecast, estimating a hangar type preference and applying space per aircraft. The Rapid City based aircraft forecasts estimate another 43 based aircraft through the planning period (PAL 4) consisting of 21 single-engine, 16 multi-engine and 7 turbojet aircraft.

Aircraft are currently stored in approximately 259,000 square feet of aircraft storage space. There are three main hangar types identified:

- T-Hangar: Nested small aircraft storage units
- Small Conventional Hangar: Private aircraft storage or Commercial aeronautical use of 8,000 square feet or less
- Large Conventional Hangar: Private aircraft storage or Commercial aeronautical use of more than 8,000 square feet

The following assumptions were made about aircraft storage space requirements:

- T-Hangar: 1,200 square feet per aircraft; 85% single-engine, 15% multi-engine aircraft
- Small Conventional Hangar: 3,000 square feet per aircraft; 15% single-engine, 40% multi-engine, 25% turbojet aircraft
- Large Conventional Hangar: 3,600 square feet per aircraft; 45% multi-engine, 75% jet aircraft
- An additional 20 percent of the building is added for hangar to be used for other aeronautical purposes including maintenance and transient aircraft storage.

Using these assumptions with based aircraft forecasts, a projected need for aircraft storage space is determined. It is important to understand that this projection provides a broad estimate of needed space into the future for facility planning. Actual space needs are demand-driven.

Table 4-44 - Aircraft Storage Requirements

Aircraft Storage Requirements						
Category	***Existing***	**Base**	**PAL 1**	**PAL 2**	**PAL 3**	**PAL 4**
Hangar Space						
T-Hangar	*72,710*	85,350	91,800	92,700	107,520	113,970
Small Conventional	*80,083*	57,000	63,300	66,600	79,980	86,280
Large Conventional	*106,375*	104,610	118,500	125,820	150,900	164,790
Total	*259,168*	246,960	273,600	285,120	338,400	365,040
Capacity/(Deficiency)	-	12,208	(14,432)	(25,952)	(79,232)	(105,872)

Note: RED indicates a deficiency to existing facilities
Source: KLJ Analysis

Of the existing T-Hangar space, 38,060 square feet (27 of the existing units) is scheduled for demolition in the next 4 years. Because of the condition of these existing units many are not currently occupied and single engine aircraft are being stored in larger hangars. The most critical deficiency at PAL 1 therefore will be a need for 57,000 square feet of new T-Hangar space (approximately 45 units).

One important issue with hangar construction in the General Aviation area is the current limited fire flow. While improvements have been made in the water supply and fire flow to the airport, the general aviation area is still limited due to small water lines through the area. Phased replacement of these water lines with higher capacity lines should be completed to allow additional hangar construction without having to increase setbacks or implement additional preventative measures.

All other requirements for hangar space will be demand driven and it is recommended that space be allocated in airfield alternatives so that expansion can occur in each area of need without negatively affecting any other area. This facility requirement analysis shows there is a need for about 51 percent more hangar space at Rapid City through PAL 4.

Aircraft Parking Apron

At airports general aviation aircraft parking is used by both itinerant and based aircraft. At Rapid City Regional Airport nearly all based aircraft are stored in hangars, and most of the aircraft parking area is for itinerant aircraft for a short period of time ranging from a few minutes to a few days. The design day aircraft operations that use GA facilities were evaluated to determine the total apron size requirements at Rapid City during the peak month. Itinerant aircraft in these aircraft operations require apron parking space. The apron size is driven by the number and size of aircraft. The purpose of this analysis is to determine the triggering point for additional GA apron space using the aviation activity demand forecasts.

Assumptions include:

- Transient operations are 70 percent of itinerant operations, conducted by non-local users.
- Peak month (10.28 percent of annual operations) and design day (4.41 percent of monthly operations) are based on the aviation forecasts.
- An operation is an arrival or a departure.
- Apron space will be needed by 80 percent of arriving transient aircraft, with the remaining 20 percent requiring hangars.

Table 4-45 - Transient Apron Aircraft Requirements

Transient Apron Aircraft Requirements						
Category	***Existing***	**Base**	**PAL 1**	**PAL 2**	**PAL 3**	**PAL 4**
Operations						
GA Itinerant	-	14,997	16,153	17,878	20,216	23,102
Apron Aircraft						
Transient Operations	-	10,498	11,307	12,515	14,151	16,171
Peak Month Ops.	-	1,079	1,162	1,287	1,455	1,662
Design Day Ops.	-	48	51	57	64	73
Design Day Arrivals	-	24	26	28	32	37
Apron Aircraft	-	19	21	23	26	29

Source: KLJ Analysis

Itinerant airport operations included 26.6 percent single/multi-engine piston and helicopters, 54.2 percent turboprop and 19.2 percent business jet. The aviation forecasts were utilized to project future fleet mix. Aircraft types were then split by Airplane Design Group (ADG) classification to determine the necessary parking area with required FAA setbacks. Size requirements were calculated for each design aircraft:

- Single/Multi-Engine Piston (ADG-I) – 800 square yards per aircraft
- Turboprop (ADG-II) – 2,000 square yards per aircraft

- Business Jet (ADG-II) – 2,000 square yards per aircraft (98% of business jet operations)
- Business Jet (ADG-III) – 4,100 square yards per aircraft (2% of business jet operations)

Additionally, total space requirements also assume 10 percent of the based aircraft are located on the apron for transient purposes.

Based on this assessment, the existing apron is sufficient to accommodate the project needed through the planning period. Reconstruction of the north general aviation apron will be necessary within the planning period. Any future apron should be designed to FAA standards so there is sufficient space for the design aircraft (ADG II, III) parking and maneuvering.

Table 4-46 – Total Apron Space Requirements

Total Apron Space Requirements						
Category	***Existing***	**Base**	**PAL 1**	**PAL 2**	**PAL 3**	**PAL 4**
Aircraft						
Single/Multi Engine Piston	-	12	13	13	15	16
Turboprop	-	13	15	16	18	21
Turbojet	-	4	5	6	7	8
Total	*31*	30	32	35	40	45
Capacity/(Deficiency)	-	1	(1)	(4)	(9)	(14)
Apron Space (SY)						
Single/Multi Engine Piston	-	9,654	10,299	10,686	12,094	13,145
Turboprop	-	26,832	29,022	31,796	36,612	41,183
Turbojet	-	10,321	11,558	12,957	14,965	17,366
Total Space	*60,331*	46,807	50,880	55,438	63,671	71,693
Capacity/(Deficiency)	-	13,524	9,451	4,893	(3,340)	(11,362)

Note: RED indicates a deficiency to existing facilities
Source: KLJ Analysis

This evaluation combines total apron space. At Rapid City there is one general aviation apron area. The area is designed to meet ADG-II requirements with a pavement strength of 90,000 lbs. As Taxiway A has been straightened the apron has been expanded east to allow the maximum amount of apron close to Taxiway A. In addition, the old Airline Terminal is being removed and the apron will be reconstructed and expanded in this southern area. The northern portion of the apron has not been expanded and reconstructed like the other areas and should be completed as funding allows.

On the general aviation apron a roadway exists approximately 60 to 90 feet from the hangars facing the apron. In the site visits of the airport and in feedback from several tenants many aircraft were seen parked across this roadway. Airport staff indicated this was an ongoing problem. Since the current location of this road is within a prime location for aircraft parking it is recommended the roadway location be reconsidered by the airport to one that is more functional for tenants and aircraft. The roadway should either be much closer to the hangars or well beyond the typical parking area for aircraft but its current location in the middle of this parking area is problematic. The best timing to consider this will be after the old terminal is removed in early 2015 and the apron in the area is reconstructed. It is important to note that the location of a marked road may at times use taxilanes rather than adding roadway markings. This is important to consider and the information is noted again in the section of this chapter regarding roadways.

Recommendations

The General Aviation needs are as follows:

- **In PAL 1 construct 57,000 square feet of new T-Hangar space (approximately 45 units) to meet demand and replace 38,060 square feet (27 units) of existing dilapidated hangars.**
- **Replace smaller water lines in General Aviation area to increase fire flow.**
- **Identify development areas for as much as 40% more hangar space with a variety of sizes. T-hangars and large conventional hangars are those that are expected to be in in the greatest demand. Small conventional hangars less than 6,000 square feet are not expected to have as great a demand. Development must include sufficient airside and landside access suitable for the types of hangars.**
- **Repair and expand the north general aviation apron area to match the alignment of the recently improved portions of the general aviation aprons.**
- **Relocate the roadway across the general aviation apron area to both allow typical aircraft parking and ensure a safe route for vehicles in the non-movement area.**

Landside Facilities

Terminal Curbside

The terminal building at Rapid City is served by one curbside area adjacent to the arrival and departure areas. There are a total of five lanes, two parking and three driving, providing access to the terminal area to pick-up and drop-off passengers:

- Lane 1 – Direct curbside access next to the terminal building providing 520 linear feet of capacity for personal vehicles, taxis and shuttles.
- Lane 2 – Lane used for vehicle circulation. During peak hours Lane 2 can be used as a secondary curbside area for passenger pick-up and drop-offs where double-parking is observed. These are operations are typical even for LOS C standards.
- Lane 3 – Dedicated vehicle through lane for those entering and existing the inner curbside area.
- Lane 4 – Outer curbside access for other vehicles, typically busses. This portion has 440 linear feet of capacity for vehicles.
- Lane 5 - Dedicated vehicle through lane for the outer curbside area vehicles.

Total inner and outer curbside length each is a total of 960 linear feet less pedestrian walkways.

Terminal curbside needs are evaluated using industry planning criteria to determine linear frontage for the curb to meet LOS standards. A planning factor of about 0.40 vehicles per peak hour total passengers based on factors developed from typical vehicle movements. A dwell time of 5 minutes was used for personal vehicles at Rapid City assuming unloading, loading or waiting times. Industry standard vehicle lengths were used to determine curbside length requirements based on demand. The individual peak 15 minute period represents 35 percent of the design hour vehicles which is a conservative estimate.

Table 4-47 - Curbside Requirements

Curbside Requirements						
Category	***Exist.***	**Base**	**PAL 1**	**PAL 2**	**PAL 3**	**PAL 4**
Lane 1 Inner Curbside						
Personal Occupancy Vehicles	*69*	69	86	93	100	107
Taxis/Limousines	*4*	4	6	7	7	8
Shuttles	*3*	3	3	3	4	4
Curbside Length	*520*	172	214	232	249	266
Lane 4 Outer Curbside						
Taxis/Limousines	*4*	4	6	7	7	8
Shuttles	*3*	3	4	5	5	5
Commercial/Other Vehicles	2	2	2	2	2	2
Curbside Length	*440*	160	199	215	231	247

Source: KLJ Analysis

As enplanements increase at the airport, so will the number of vehicles occupying the terminal curbside. The curbside length at Rapid City is projected to be adequate for LOS C standards with no lanes approaching capacity within the planning period. Dwell times for Rapid City are very generous and if curbside congestion begins to occur it is recommended that dwell times be reviewed for different classes of vehicles. As activity increases there will be additional peak periods where double-parking occurs on the inner curbside. These operations are deemed acceptable for LOS C standards but may not meet customer expectations at Rapid City.

Automobile Parking

The automobile parking needs at a commercial service airport directly relates to the number of annual enplaned passengers. Automobile parking types include public, employee and rental car parking.

Existing automobile parking supply is summarized in the table below. The airport reconfigured the main parking lots when the terminal was constructed an expanded portions in parking lot in 2010. This increased parking capacity by about 150 spaces. The number of effective parking spaces was determined. This figure assumes 95 percent of the actual supply of spaces is available to the public due, maintenance or snow removal or for circulating parkers to find an available stall. The effective space count will be used for planning purposes.

Table 4-48 - Automobile Parking Supply

Automobile Parking Supply		
Parking Category	**Actual Spaces**	**Effective Spaces (95%)**
Public Parking		
Gravel Cell Phone Lot	14	14
Short-Term Lot	312	296
Long-Term Lot	709	674
Total Public Parking	1,035	984
Employee Parking		
South Employee Lot	27	27
Total Employee Parking	27	27
Rental Car Parking		
Ready-Return Lot	340	323
Remote Gravel Storage Lot	140	133
Total Rental Car Parking	480	456
Total Parking Spaces	1,542	1,467

Source: KLJ Analysis

Public Parking

Public parking includes cell phone, short-term and long-term parking lots at Rapid City. This analysis combines all public parking needs into a cumulative review. The need for public parking spaces is driven by passenger enplanements in the peak day of the peak month.

Public parking demand is projected using the 2.10 spaces per 1,000 annual enplanements ratio projected through the planning period. The forecasted demand is within the available capacity through the planning period with 123 spaces of capacity through PAL 4.

Table 4-49 - Public Parking Requirements

Public Parking Requirements					
Category	**Base**	**PAL 1**	**PAL 2**	**PAL 3**	**PAL 4**
Enplanements	256,191	275,634	296,254	318,133	341,298
Public Parking Demand (with 20% daytime accumulation)	646	695	747	802	860
Effective Public Parking Supply	984	984	984	984	984
Capacity/(Deficiency)	338	289	237	182	123

Note: RED indicates a deficiency to existing facilities
Source: KLJ Analysis

Rapid City provides a cell phone and waiting lot with 14 total spaces. These spaces should be sufficient through PAL 4.

Employee Parking

Employee parking is comingled with the short term and long term public parking The majority of employee parking needs are therefore considered with the public parking needs. There is also a 27 stall south lot used by some airline and airport personnel. The existing capacity will meet the needs through PAL 4.

Table 4-50 - Employee Parking Requirements

Employee Parking Requirements					
Category	**Base**	**PAL 1**	**PAL 2**	**PAL 3**	**PAL 4**
Employee Parking Demand	10	11	12	13	14
Effective Employee Parking Supply	26	26	26	26	26
Capacity/(Deficiency)	16	15	14	13	12

Note: RED indicates a deficiency to existing facilities
Source: KLJ Analysis

Rental Car Parking & Facilities

Rental car parking needs include ready/return lots for customers near the terminal, and long-term storage lots where the rental car fleet can be stored. Facilities with the parking areas include a quick-turn facility for rental car companies to clean and maintain vehicles. Each of the four car rental concessionaires at Rapid City will have different facility needs. Car rental facility requirements are evaluated cumulatively.

Ready/Return Parking

Ready/return parking needs correlates with the peak number of customer transactions rather than the total number of customers. Increased demand requires rental car staff to transport cars to/from the storage lot more frequently placing additional costs and demands on their operation. This parking lot should be located immediately adjacent to the rental car counters as is the case with the present location at Rapid City. There are currently 323 spaces occupying a total space of 3.4 acres.

Table 4-51 - Rental Car Ready/Return Parking Requirements

Rental Car Ready/Return Parking Requirements					
Category	**Base**	**PAL 1**	**PAL 2**	**PAL 3**	**PAL 4**
Peak Hour Transactions/Demand		221	237	255	273
Effective Ready/Return Supply	*323*	*323*	*323*	*323*	*323*
Capacity/(Deficiency)		102	86	68	50

Note: RED indicates a deficiency to existing facilities
Source: KLJ Analysis

The calculation shows there is sufficient space during the peak period. The observations are however that the ready/return lot does exceed capacity because of insufficient space for rental car storage.

Rental Car Storage

The size of the rental car storage lot is directly tied to the total rental car fleet. Total fleet is directly attributed to the total number of arriving passengers requiring rental cars. Rental car companies were queried to determine their peak parking needs. Car deliveries, or "ramp-up" occurs during the summer and late October through late November. There is not sufficient space using the ready return and storage areas to handle the ramp-up periods. Between all rental car agencies there is an estimated need to store 300 cars that are delivered to Rapid City, in addition to the existing fleet, to prepare for peak rental car activity. Since there is a current surplus of long term public parking through the planning period and the "ramp-up" period is outside of the peak enplanement period, it would be possible to use a distinguishable portion of the public parking lot for rental car storage.

Table 4-52 - Rental Car Storage Parking Requirements

Rental Car Storage Parking Requirements					
Category	**Base**	**PAL 1**	**PAL 2**	**PAL 3**	**PAL 4**
Typical Rental Car Storage Demand		303	326	350	375
Effective Rental Car Storage Supply	*133*	*133*	*133*	*133*	*133*
Capacity/(Deficiency)		(170)	(193)	(217)	(242)

Note: RED indicates a deficiency to existing facilities
Source: KLJ Analysis

A permanent parking solution to add space for ready return and storage should be included in the airport alternatives. These parking expansions could then be added as demand dictates.

Quick Turn Facility (QTF)

A facility to accommodate rental car operations is a maintenance or "quick-turn" facility. These facilities are located within the vicinity of rental car operations and parking. A typical rental car QTF consists of a car wash, maintenance bays, storage and fueling area. The existing rental car QTF was completed in 2014 and is located within the rental car parking area. Total space is approximately 9,800 square feet of total space two car washes, five maintenance bays and a fueling area with underground storage tanks. The airport constructed the QTF and revenues from car rental agencies are used to pay for its operation. The QTF will meet the existing need though PAL 4.

Recommendations

Automobile parking facility recommendations for Rapid City include:

- **Provide additional parking particularly for rental car storage. It is possible in the short term to use some portions of public parking for rental car storage but this area will not be adequate for the long term.**
- **Be cognizant of any additional need for the cell phone waiting lot. It is yet to be determined how well this lot is serving passengers' needs particularly as it is unpaved and not well known.**

Ground Access & Circulation

Passenger Terminal Complex

Access to the passenger terminal complex is provided by Airport Road and Terminal Road from State Highway 44. There is one entrance and exit. All vehicle traffic for the terminal complex is guided to the terminal via Terminal Road. This includes passenger vehicles, busses, taxis, shuttles and rental cars. The rental car area is accessible from general aviation road immediately north of the terminal complex.

As passenger volumes increase so will the traffic count and flow through the terminal complex. The existing ground access and circulation infrastructure is adequate through the planning period.

Roadway System Considerations

Surrounding roadways provide adequate access for customers to and from the airport. Roadway plans can also influence airport development. The only access roadway for Rapid City is State Highway 44. This roadway provides direct connection to the Rapid City central business district which is 11 miles from the airport terminal building. The airport property is within 4 miles of Interstate 90 but is 10 miles by road.

Interstate Access

There is no direct access point from the local interstate system to the airport.

Long View Road around Runway 14 and 23

Currently the Runway Protection Zone (RPZ) for Runways 14 and 23 have public roads traversing through the RPZ. Under recent FAA policy if the runway thresholds were to change or the instrument approaches were to change, these roads would need to be realigned so that they are outside of the RPZ. It is recommended that the instrument approach to Runway 14 be improved. This will require Long View Road to be realigned outside of what will be a larger RPZ for Runway 14.

Public Transportation

There is no public transportation access to Rapid City to serve passengers or airport employees. State Highway 44 is not served by fixed route service on the Rapidride system. The closest bus stop is at the corner of State Highway 44 (Omaha Street) and Centre Street adjacent to Western Dakota Technical Institute approximately 8 miles from the airport terminal. It is recommended the Airport work together with the Rapidride to determine any need for service to the airport.

Support Facilities

Support facilities are necessary to support a safe and efficiently run airport supporting airport operations and the travelling public.

Fueling Facilities

The airport has one Fixed Base Operator and a Specialized Aviation Service Operator that sells fuel. Each operator has their own dedicated fuel farms with Jet-A and 100 low lead (LL) aviation fuel types. The combined privately owned fuel tanks have a 50,000 gallon capacity of Jet-A fuel and 25,000 gallons capacity of 100LL fuel.

The fuel tanks for the FBO, WestJet are located in a fuel farm area west of the general aviation area. The area can be expanded but is currently situated in an area that would be well suited for hangar development. An alternative location for the fuel farm with expansion capability will be considered in the airfield alternatives. The fuel tanks for the SASO, Rapid Fuel are self-fueling tanks on the apron.

Each fuel farm should provide capacity for two-week usage and be sized for a full tanker truck. Overall 100LL airport operations are forecast to increase 35 percent through PAL 4, with Jet-A operations increasing 19 percent. There are plans within the aviation industry for a replacement fuel for 100LL. If it is possible to completely replace this fuel so that existing aircraft can use the new fuel then it may be possible to convert the 100LL tanks to use for the new fuel. If it is not possible for existing aircraft to use the new fuel, then it will be necessary to maintain three types of fuel at the airport for general aviation aircraft.

There will be the need for additional fuel storage as demand occurs. Considerations should also be made to encourage the use of alternative fuels through accommodating additional storage. Additional fuel tanks and facilities will be constructed as demand arises. There is expandable space to meet the needs through PAL 4 at Rapid City.

The SDARNG also maintains JP-8 fuel tanks with 25,000 gallons of capacity. This tank capacity is dedicated to the needs of the National Guard and not otherwise available for the public.

The airport currently has diesel and unleaded fuel for airport maintenance equipment. The total storage capacity is 30,000 gallons of diesel and 30,000 gallons of unleaded. This fuel farm is located with the current WestJet fuel tanks. An alternative location will be considered with the airfield alternatives.

Aircraft Rescue and Fire Fighting (ARFF)

As a certificated FAR Part 139 facility, Rapid City must comply with ARFF equipment, staffing, training and operational requirements. The airport owns and operates the ARFF facility with City of Rapid City Fire Department staff on the north side of the terminal building. This facility, Station 8, was completed in 2011 and its operation meets all FAA requirements.

ARFF requirements are driven by the length of the largest air carrier aircraft that serves the airport with an average of five or more daily departures. Rapid City is currently classified as an ARFF Index B facility. Future anticipated operations would regularly be conducted in a Boeing 717 (124' 0" length) aircraft. The ARFF index is not anticipated to change into the future.

Table 4-53 - ARFF Index Requirements

ARFF Index Requirements		
ARFF Index	**Aircraft Length**	**Representative Aircraft**
A	< 90 feet	Beech 1900D
B	90 feet - < 126 feet	CRJ-900, A-320, ERJ-145
C	126 feet - < 159 feet	B-737-800, B-757, MD-80
D	159 feet - < 200 feet	B-767, A-300
E	> 200 feet	B-747

Source: Title 14 CFR Part 139

The ARFF station must be located so that at least one firefighting vehicle can reach the midpoint of the farthest runway serving air carrier aircraft within three minutes and the remaining firefighting vehicles reaching this same midpoint within four minutes. The current ARFF site meets this requirement. With no major airfield configuration changes anticipated, this location will be sufficient to meet the needs into the future.

Airport Maintenance & Snow Removal

The airport maintenance complex is located at Airport Road and La Croix Court in the General Aviation area. Total facilities consists of 22,400 square feet of offices, maintenance, storage and shop space in four different buildings. Some of the buildings are old and in need of repair. The complex is generally adequate but is located in an area with prime access for general aviation development. Relocation of these facilities to make space for general aviation development should be pursued in PAL 1.

Winter operations require the removal of snow and ice from the airfield to maintain airport operations. Snow removal equipment is stored in the airport maintenance building. Snow needs be cleared from the pavement surfaces, around airfield lights and signs. Piled snow should not create a visible obstruction to pilots. It should be piled in a location that does not impede airport operations and can sufficiently melt and adequate drainage. There are no known snow removal or storage issues at Rapid City. Future facilities should provide adequate clear space for snow removal storage.

Customs and Border Protection (CBP)

The Rapid City community has investigated the prospects of a CBP facility at the airport to accommodate general aviation activity. The purpose would be to handle aircraft coming to Rapid City as a destination from an international location, most likely Canada or Mexico. It would also be for the purpose of handling aircraft coming into the United States who would be more conveniently served on their route by clearing customs at Rapid City as compared to the location they actually used. Both of these types of users would be important to make a CBP facility most cost effective. In regards to the routed flights, the actual flight records of 31,429 international flights from 2008 through 2013 were examined in the region. Of these flights approximately 4% or 200-250 flights per year could benefit from routing through Rapid City as compared to the location they choose to clear customs through. Rapid City could easily entice more of the international flights depending on outreach marketing and whether Rapid City would be more convenient for a fuel stop than other locations. These attributes were not examined.

Since there is interest in the community to establish a CBP facility for general aviation, a location for such a facility will be included in the airfield alternatives analysis. This separate long-term GAF facility would be approximately 3,000 square feet plus vehicle and airside access. The facility can also be established near a cargo area in the event international cargo might be explored in the future.

Table 4-54 - Customs and Border Protection (CBP) Space Requirements

Customs and Border Protection (CBP) Space Requirements	
Area Type	**Square Feet Required**
General Aviation Facility (GAF)	
Passenger Waiting and Processing	2,160
CBP General Office	225
Computer/Communications Room	60
Storage Room	60
Search/Hold Room	80
Interview Room	80
Agricultural Quarantine Inspection (AQI) Laboratory	110
Public Restrooms	112
TOTAL	**2,892**

Source: Airport Technical Design Standards for Passenger Processing Facilities (USCBP, 2006)

Security & Access

Security is an important consideration when operating a safe airport. Transportation Security Administration (TSA) publishes recommended airport design guidelines. The first line of security protection infrastructure is a perimeter fence. Its installation will help prevent unauthorized persons from entering the airfield and also to control wildlife. A minimum 6-foot high fence with added barbed wire is recommended by TSA with upgraded FAA standards recommended to control wildlife. At Rapid City the perimeter fence is sufficient to meet the security and wildlife requirements of the airport and should be maintained to all TSA and FAA standards. All access points are controlled.

The TSA recommends a 300 foot bomb blast separation from public parking to the passenger terminal. If this is not possible, the TSA recommends an analysis be completed to determine if a reduced distance will be acceptable. Rapid City currently has less than a 300 foot separation and a study was completed to determine if this was acceptable. The study determined it would be acceptable for Rapid City and certain specific measures were taken to improve the security of the terminal. These measures are not included as they were determined to be security sensitive information.

FAA generally recommends airports have a full internal access road system that allows authorized vehicles to access various portions of the airfield, minimizing the need to navigate on taxiways, cross runways or leave the boundaries of airport property. A typical perimeter road is 20 to 24 feet wide and located outside of the airfield safety areas. Rapid City uses aprons and taxilanes for traversing the east side of the airport. This is the most heavily traveled area of the airport and keeps vehicle activity off of runways, taxiways and most aircraft movement areas.

A portion of this roadway is on the general aviation apron approximately 60 to 90 feet from the hangars facing the apron. In the site visits of the airport and in feedback from several tenants many aircraft were seen parked across this roadway. Airport staff indicated this was an ongoing problem. Since the current location of this road is within a prime location for aircraft parking it is recommended the roadway location be reconsidered by the airport to one that is more functional for tenants and aircraft. The best timing to consider this will be after the old terminal is removed in early 2015 and the apron in the area is reconstructed. It is important to note that the location of a marked road may at times use taxilanes rather than adding roadway markings.

An unpaved perimeter road exists around all of the airport. This road is used to access navigational aids and the perimeter fence. As opportunity arises, the unpaved portions of the perimeter road should be paved beginning with those roads nearest to aircraft movement areas and those used to access navigational aids.

Airport Utilities

On-airport utilities including power, communications, natural gas, sanitary sewer, water and storm sewer are discussed in this section. Future facility development may require the relocation, replacement and/or upgrading of portions of the airport utility infrastructure.

The utility services for electrical power, communications and natural gas were determined to be sufficient to meet the existing and projected needs of the airport on the west side. If development were to occur on the east side of the airport, there is limited utility service and new utilities of adequate size will need to be added.

The airport maintains its own system for storm sewer purposes. This system is considered to be adequate for the needs of the airport in the planning period.

Water service from the City of Rapid City exists at the airport. The current service is a 12" water main connecting to the airport at Airport Road and RTR road. It also includes a looped water main along Taxiway A which added capacity to provide 1500 gallons per minute of fire flow near the terminal. The water service is planned for improvement with a new water main connection from the north on the west side which will provide additional capacity to meet fire suppression requirements. With the improvements it is estimated that there will be 4000 gallons per minute of fire flow near the terminal. As noted earlier, the fire flow in the General Aviation area will still be limited until smaller water lines are replaced.

The Sanitary Sewer system at the airport uses an existing lagoon system for treatment. The lagoon is located on the west side of the airport and is estimated to be inadequate for the airport within the planning period. A sanitary sewer connection to the City of Rapid City's system is being planned. The current city treatment facility is 2 miles directly southwest of the airport on the south side of State Highway 44. The connection will require a lift station and that lift station will either be directly south of the airport or further east of the airport along State Highway 44. The location has not be determined and no timeline or funding plan has been established for the connection of the airport to the city's sewer treatment plant.

Other

Military Facilities

The military facilities at Rapid City support the South Dakota Army National Guard (SDARNG). SDARNG leases approximately 30 acres of land from the Airport for both aeronautical and non-aeronautical facilities. The scope of this Master Plan related to the military is limited to planning the appropriate location on the Airport for military area requirements, as determined by the military.

Ongoing coordination between the Airport and SDARNG will ensure that facilities remain sufficient for current and future military operations. Space for potential future expansion of these military facilities should be factored into the long-term, on-airport land use planning.

USFS Facilities

The United States Forest Service (USFS) maintains an air tanker base at the airport. There is a long term need to maintain such a facility at the airport. The size and layout of the current air tanker base is not adequate to meet the needs of the USFS and improvements should be made as early as practicable. The current facility sees C-130 aircraft as the largest but these aircraft can only enter one at a time because the loop taxilane is not separated from the perimeter fence and other taxilane enough for two aircraft to be in the loop at one time. As early as the summer of 2015, the USFS expects to have MD-87 aircraft conducting tanker operations. These MD-87 aircraft cannot maneuver through the existing air tanker base. The USFS improvements should be sufficient to handle multiple aircraft as large as the MD-87 and DC-10. These aircraft and others are being configured for use in aerial firefighting.

Since the SDARNG and USFS facilities are funded by the state and federal government the improvements are generally not eligible for funding from the FAA through the Airport Improvement Program. Funding for these improvements to the SDARNG must come from other state or federal funding sources or may come from the airport through long term leases and thus annual payments for the improvements.

Other Aeronautical/Non-Aeronautical Development

Other aeronautical development includes aviation-related businesses. Examples include aircraft maintenance, repair and overhaul (MRO) facilities or other businesses that require direct access to the airfield. Considerations for developing property for these uses include adequate airfield access, parcel size, landside roadway access/parking and utilities. This type of development should be protected if sufficient available land exists.

Airports should primarily be reserved for existing and planned aeronautical uses, however, non-aeronautical uses can enhance the customer experience and provide additional revenue-generation opportunities to the airport. If airport owned land does not have any aeronautical need for the safety, capacity or other airport development needs then it can be considered for a non-aeronautical use. Non-aeronautical development requires a concurrent land use or land release with approval from the FAA.

Examples of non-aeronautical land uses at Rapid City include SDARNG and agricultural production. A few examples of non-aeronautical land uses include retail development, manufacturing/storage facilities, mineral extraction and even cell phone towers (compatible with airspace). Non-aeronautical development can be financially lucrative for the airport but must be approved by FAA.

Additional opportunities for non-aeronautical uses are located outside of access to the airfield including land near the initial passenger terminal access road. Considerations for developing property for non-aeronautical uses parcel size, landside roadway access/parking and utilities.

There are no recommendations for non-aeronautical use in this Master Plan, however the airport should continue to explore and market opportunities in areas not needed for aeronautical use. The preferred development alternative in the next chapter and in the subsequent Airport Layout Plan will identify the land needed for aeronautical use.

Summary

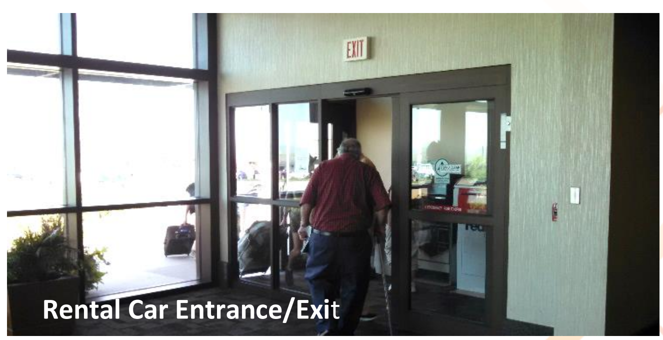
This chapter identifies safety, capacity and development needs for the Rapid City Regional Airport based on forecasted activity levels. These recommendations provide the basis for formulating development alternatives to adequate address recommended improvements. The following summarizes the facility recommendations:

Airside Facilities

- **Maintain Runway 14-32 to accommodate regular use of an Airbus A319, Bombardier Q400 and Boeing B717 aircraft with ARC C-III standards. No runway extension is recommended.**
- **Replace PAPIs on all runways with equipment maintained by the FAA.**
- **Remove hillside near the approach to Runway 14 that penetrates into the protective surfaces and place material in areas to allow for hangar development.**
- **Relocate Long View (Radio Towers) Road to be outside of the expanded RPZ.**
- **Install a MALSR system for Runway 14 to lower the existing RNAV (GPS) minimums.**
- **Upgrade Runway 14 to a Category I ILS approach.**
- **Construct 25-foot wide paved shoulders for TDG-5 taxiways by PAL 1.**
- **Construct 20-foot wide shoulders for TDG-3 and 4 taxiways by PAL 1.**

Passenger Terminal

- **Install an in-line baggage screening system to increase throughput and allow ticket counter space to be used exclusively by airline personnel.**
- **Add an additional security screening lane within the existing space as demand may require within the planning period.**
- **Improve the rental car exit vestibule to allow a wider, more direct corridor for rental car customers.**
- **Provide additional self-service check-in kiosks in the ticketing lobby for added customer convenience.**



Rental Car Entrance/Exit

- Expand concessions in the sterile area as major improvements or expansion of the concourse is made.
- Provide additional parking particularly for rental car storage. It is possible in the short term to use some portions of public parking for rental car storage but this area will not be adequate for the long term.
- Be cognizant of any additional need for the cell phone waiting lot. It is yet to be determined how well this lot is serving passengers' needs particularly as it is unpaved and not well known.

Air Cargo

- Establish an area of apron and associated buildings for air cargo with sufficient airside and landside access. The facility should be sized to meet the requirements in PAL 1 (5,700 SY) with expansion capability through PAL 4 (9,000 SY).
- Locate the cargo apron area so that there is flexibility to either store aircraft in hangars in the area or conveniently tow aircraft for storage in other hangars.

General Aviation

- In PAL 1, construct 57,000 square feet of new T-Hangar space (approximately 45 units) to meet demand and replace 38,060 square feet (27 units) of existing dilapidated hangars.
- Replace smaller water lines in General Aviation area to increase fire flow.
- Identify development areas for as much as 40% more hangar space with a variety of sizes. T-hangars and large conventional hangars are those that are expected to be in in the greatest demand. Small conventional hangars less than 6,000 square feet are not expected to have as great a demand. Development must include sufficient airside and landside access suitable for the types of hangars.
- Place only large conventional hangars directly on the main apron areas. Any existing small conventional hangars positioned directly on the main aprons should be removed in the long term.
- Relocate the roadway across the general aviation apron area to both allow typical aircraft parking and ensure a safe route for vehicles in the non-movement area.

Landside Facilities

- Coordinate with local transportation planning to prioritize a direct road connection from the airport north to Interstate 90.
- Complete scheduled water system improvements with northwest connection to City water.
- Replace smaller water lines in General Aviation area to increase fire flow.
- Connect the airport to the City of Rapid City's sanitary sewer system.

Support Facilities & Other

- **Identify a new location for the Airport's Snow Removal Equipment buildings and initiate this project in PAL 2. This project is necessary in the short term to free up space for general aviation development.**
- **Identify a location for a general aviation CBP area. The area should include the appropriate access for the airside and landside.**
- **Identify a location for a replacement ATCT in order to update the facility and improve visibility of the movement areas from the tower. Work must be directed by the airport and closely coordinated with the FAA.**
- **Identify a location and layout suitable for the USFS for the fire fighting aircraft which are expected to use the airport in the planning period.**
- **Continue to coordinate with the SDARNG to allow this facility to meet its mission.**