Appendix E
Runway Length Justification

Today's aircraft may operate on a wide variety of available field lengths. However, the suitability of those runway lengths is often determined by several factors including:

- Elevation above mean sea level
- Temperature
- Wind velocity
- Airplane operating weights
- Takeoff and landing flap settings
- Runway surface condition (wet or dry)
- Effective runway gradient
- V_1 Engine Out Procedures
- Operational Use (private, charter, fractional ownership, etc.)
- Presence of obstructions within the vicinity of the approach and departure path, and
- Locally imposed noise abatement restrictions and/or other prohibitions

Runway length requirements were evaluated in **Chapter 4**, *Demand Capacity and Facility Requirements*, for CRG based upon historic, current and forecast fleet mix using **FAA Advisory Circular 150/5325-4B**, *Runway Length Requirements for Airport Design*. Additional support data was obtained using the FAA Central Region's Runway Length Adjustment Spreadsheets and FAA Regional Guidance Letter, RGL 01-2, *Runway Length and Strength Requirements for Business Jet Aircraft*, Airports Division, Southern Region, August 2001. This resulted in a runway length requirement of approximately **5,640 feet at a 60% load factor**. Further, based upon FAA approved forecast operations, survey data from existing operators, and letters from existing and interested tenants (provided in **Appendix F** of this report), it was determined that a runway length of 5,600 feet would accommodate approximately 100 percent of business jet aircraft less than 60,000 pounds at a 60 percent load factor[1].

E.1 Runway Length Requirements for Airport Design (AC 150/5325-4B)

In determining recommended runway lengths, the FAA uses a five step procedure based upon a selected list of critical aircraft. The five steps include:

1. Identify the list of critical design airplanes that will make regular use of the proposed runway for an established period of at least five years.

[1] Table 3-2, 100 Percent of Fleet at 60 or 90 Percent Useful Load, FAA AC 150/5325-4B

2. Identify airplanes or family of airplanes that will require the longest runway lengths at maximum certified takeoff weight (MTOW).
3. Using *Table 1-1* of **AC 150/5325-4B** and the airplanes identified in Step #2, determine the method that will be used for establishing the recommended runway length based upon useful load and service needs of critical design aircraft or family of aircraft.
4. Select the recommended runway length from among the various runway lengths generated in Step 3 using the process identified in Chapter 2, 3 or 4 of **AC 150/5325-4B**, as applicable.
5. Apply any necessary adjustment (i.e. pavement gradient, pavement condition (wet or dry), etc.)

The following narrative provides an analysis of the runway length requirements at Craig Municipal Airport (CRG) using the FAA's five step procedures and rationale for determining airport runway lengths.

E.1.1 Step 1 - Identification of Critical Design Airplane(s)

The AC provides the definition of critical design airplanes as the "listing of airplanes (or a single airplane) that would result in the longest recommended runway length" (Chapter 1, pg. 2, paragraph 102.b.2). Therefore, to complete Step 1, a list of aircraft requiring the longest runway length that will operate at CRG over the next five years should be created. For the purpose of this analysis, two important assumptions were made:

1. Models of airplanes operations at CRG in 2006/2007 will continue to operate at CRG over the next five years, and
2. Many of the more demanding airplane models currently operating at CRG incur operational penalties to do so. For example, some may operate at CRG only during cool temperatures in order to increase airplane takeoff performance, while still other may carry less than desirable fuel, passengers, payload, etc in order to effectively operate on the shorter runway.

To determine a list of demanding airplanes currently operating at CRG, operational flight data for the most recent full calendar year of operations (2006) was analyzed. This data was compiled from 2006 GCR & Associates, Inc. database[2], FAA 5010 data, CRG ATCT database, FAA Air Traffic Activity Database System (ATADS) data[3], and tenant surveys. The data included all aircraft operating to and from CRG under instrument flight rules (IFR) during calendar year 2006. The data contains specific information related to aircraft's call sign, manufacturer/model/type, engine type, departure/destination airport, and departure/arrival time. In general, data of this type includes very few records of aircraft operating under visual flight rules (VFR), as those aircraft typically do not file flight plans

[2] Source GCR and Associates, Inc. Private Turbine Aircraft Operations 2006, based upon FAA ATCT Data.
[3] FAA ATADS is an official source of historical air traffic operations for center, airport, instrument and approach counts. Daily, monthly and annual counts are available either by facility, state, region, or nationally.

with air traffic control. However, it is reasonable to assume that most itinerant operations performed by the more demanding turbojet aircraft at CRG are done so operating under IFR conditions.

The 2006 data was analyzed first by totaling airplane operational counts for each aircraft type, and the more demanding airplanes were identified for further analysis. At CRG, the more demanding aircraft were categorized as turbine-powered general aviation and limited air taxi based upon historical data. In 2006, CRG was home to 12 turbojet aircraft, which accounted for approximately 1,662 of the total 4,920 jet operations at CRG. Information provided in **Tables E-1**, *Based Aircraft Turbojet Operations*, and **E-2**, *2006 Based and Transient Jet Fleet Mix*, were obtained from CRG ATCT data, FAA GCR database[4], 2006 and CRG tenants.

Table E-1
Based Aircraft Turbojet Operations
2006

Aircraft	ARC	Based Aircraft	Operations
Cessna 501	B-I	1	76
Cessna 525 (CJ1)	B-I	1	110
MU-300	B-I	3	109
Cessna 525A (CJ2)	B-II	1	2
Cessna 550	B-II	1	97
Cessna 560	B-II	3	830
Cessna 560 XL	B-II	2	438
	Total Turbojet	**12**	**1,662**

Sources: FAA GCR Database, 2006, CRG ATCT, 2006 & 2007, and The LPA Group Incorporated 2007

Also according to airport management, in 2007, PSS World Medical and CAC, both current tenants, have added a Learjet 45 and 35, respectively, to their based aircraft fleets.

Table E-2
2006 Based and Transient Fleet Mix

		ARC A-I[1]		ARC B-I		ARC B-II		ARC C-I		ARC C-II	
	Total Jet Operations	Ops	%[2]	Ops	%[2]	Ops	%[2]	Ops	%[2]	Ops	%[2]
Based	1,662	0	0.00%	295	17.75%	1,367	82.25%	0	0	0	0.00%
Transient	3,258	0	0.00%	905	27.78%	1,346	41.31%	907	27.84%	100	3.06%
TOTAL	**4,920**	**0**	**0.00%**	**1,200**	**24.39%**	**2,713**	**55.14%**	**907**	**18.44%**	**100**	**2.03%**

Notes:
[1]Designates operations associated with experimental jets and very light jets
[2]Percent of operations to total Jet operations
Sources: FAA GCR 2006 Data, FAA ATADS, CRG ATCT Database, Tenant Surveys, The LPA Group, Inc. 2007

In addition, based upon letters from interested operators and existing tenant surveys at CRG, operators want to expand their existing fleet to accommodate the needs of their operators and

[4] Source GCR and Associates, Inc. Private Turbine Aircraft Operations 2006, based upon FAA ATCT data.

stage length requirements while improving the efficiency of their operations. It has been shown that business operators, on-demand charter operators and aircraft fractional owners prefer to use smaller, less congested airports closer to their destinations rather than busy commercial airports. As a result, of the top 50 airports in the United States for itinerant GA traffic, approximately 13 are located within the state of Florida. This is primarily due to the number of flight schools as well as business operators within the state.

Further, in reviewing forecast growth in the use of turbine aircraft for business, fractional ownership, limited air taxi and personal use nationwide, it is logical to assume that an increase in the number of turbine powered aircraft operating to and from CRG will continue to increase over the twenty-year planning period.

As a result of demand, estimates of jet aircraft operations over the twenty year planning period were developed. Based upon the *FAA Aerospace Forecast, 2007-2017*, turbine aircraft use is expected to increase by at least 2.8 percent per year. It is also anticipated that operations associated with newer, quieter and more sophisticated corporate jet aircraft less than 60,000 will increase as a result of continued growth in local business activity and the ease of access to the downtown central business district and beaches. These aircraft are expected to replace older noisier aircraft over time.

Applying the FAA average annual growth rate to CRG resulted in conservative jet aircraft demand of 16,594 operations (7 percent of total aircraft operations) of which approximately four (4) percent of total jet aircraft operations (627 operations) would be attributed to ARC C-II aircraft by the year 2026 as shown in **Table E-3**.

Table E-3
Forecast Turbojet Fleet Mix

		ARC A-I		ARC B-I		ARC B-II		ARC C-I		ARC C-II	
Year	**Total Turbojet Operations**	**Ops[1]**	**%[2]**	**Ops**	**%[2]**	**Ops**	**%[2]**	**Ops**	**%[2]**	**ARC C-II Ops**	**%[2]**
2006	4,920	0	0.00%	1,200	24.39%	2,713	55.14%	907	18.44%	100	2.03%
2007	5,614	0	0.00%	1,358	24.19%	3,080	54.87%	1,043	18.57%	133	2.37%
2011	8,679	92	1.06%	2,018	23.25%	4,670	53.81%	1,697	19.55%	202	2.33%
2016	13,086	192	1.47%	2,895	22.12%	6,871	52.51%	2,776	21.21%	352	2.69%
2021	15,143	307	2.03%	3,188	21.05%	7,759	51.24%	3,406	22.49%	483	3.19%
2026	16,594	465	2.80%	3,319	20%	8,297	50.00%	3,886	23.42%	627	3.78%

Notes: [1]Designates light sport, experimental and very light jet aircraft
[2]Percent of operations to total Jet operations
Sources: FAA Aerospace Forecasts (2006-2017; 2007-2020), Honeywell Business Jet Forecast 2007-2017, NBAA Factbook, 2004, FAA ATC Database, 2006, FAA GCR INC. Operational Data, 2007, FAA ATADS, CRG FAR Part 150 Study, 2006, Tenant Surveys, Fuel Flowage Data, and The LPA Group, Inc. 2007.

Based upon existing and forecast demand, a list of critical design airplanes that currently and will continue to make regular use of the proposed runway was determined as shown in **Table E-4.**

Table E-4
Critical Design Airplanes

Critical Design Aircraft	ARC	2006 Operations[1]	2011 Operations[2]	2026 Operations[2]
VLJs	A-I	0	92	465
Subtotal A-I Aircraft		**0**	**92**	**465**
Cessna 501	B-I	281	473	0
Dassault Falcon 10	B-I	107	181	697
MU300	B-I	404	679	1,311
Cessna 525 (CJ1)	B-I	407	685	1,311
Subtotal B-I Aircraft		**1,200**	**2,018**	**3,319**
Cessna 525A (CJ2)	B-II	239	411	730
Cessna 525B (CJ3)	B-II	44	76	135
Cessna 550	B-II	287	494	878
Cessna 560 XL	B-II	608	1,046	1858
Cessna 560*	B-II	1469	2,529	4493
Dassault Falcon 2000EX	B-II	10	17	30
Falcon 50	B-II	48	83	150
Falcon 50EX	B-II	8	14	24
Subtotal B-II Aircraft		**2,713**	**4,670**	**8,297**
Beechjet 400A	C-I	213	399	1,010
Israel Westwind	C-I	70	130	103
Learjet 31/31A	C-I	181	339	539
Learjet 35	C-I	121	227	804
Learjet 45	C-I	322	602	1,430
Subtotal C-I Aircraft		**907**	**1,697**	**3,886**
Cessna 650	C-II	10	20	64
Cessna 680	C-II	13	25	77
Cessna 750 (Citation X)	C-II	21	43	133
Challenger (Series 600)	C-II	19	38	118
Falcon 900EX	C-II	38	76	235
Subtotal C-II Aircraft		**100**	**202**	**627**
Total Turbojet		**4,920**	**8,679**	**16,594**

Notes:
[1] Based upon historic information obtained from FAA, 2006 GCR Operations Database, CRG ATCT, and tenant information.
[2] 2011 and 2020 forecast operations based upon approved fleet mix forecast from Chapter 3 and 2005 Craig Airport FAR Part 150 Comparative Noise Study.
Source: The LPA Group Incorporated, 2007

E.1.2 Step 2: Aircraft Requiring the Longest Runway Length at MTOW

Step 2 of **FAA AC 150/5325-4B** states: "Identify the airplanes that will require the longest runway length at MTOW. This will be used to determine the method for establishing the recommended runway length" (Chapter 1, Pg. 2, Paragraph 102.b.2).

In accordance with FAA guidance, MTOW data was obtained and listed for each critical design airplane identified in Step 1. For these aircraft, MTOW, 2006 operations, and 2011 and 2026 projected operations are presented in **Table E-5**.

Table E-5
MTOW of Critical Design Airplanes Operations at Craig Municipal Airport

Critical Design Airplane	MTOW (lbs)[1]	2006 Actual Operations[2]	2011 Projected Operations[3]	2026 Projected Operations[3]
VLJs	5,995	0	92	465
Cessna 501	10,600	281	473	0
Dassault Falcon 10	18,740	107	181	697
MU300	14,630	404	679	1,311
Cessna 525 (CJ1)	10,400	407	685	1,311
Cessna 525A (CJ2)	12,500	239	411	730
Cessna 525B (CJ3)	13,870	44	76	135
Cessna 550	14,800	287	494	878
Cessna 560 XL	19,200	608	1,046	1858
Cessna 560	16,830	1469	2,529	4493
Dassault Falcon 2000EX	35,800	10	17	30
Falcon 50	37,480	48	83	150
Falcon 50EX	40,780	8	14	24
Beechjet 400A	16,100	213	399	1,010
Israel Westwind	23,500	70	130	103
Learjet 31/31A	16,500	181	339	539
Learjet 35	18,300	121	227	804
Learjet 45	20,200	322	602	1,430
Cessna 650 (Citation VI)	23,000	10	20	64
Cessna 680 (Sovereign)	30,300	13	25	77
Cessna 750 (Citation X)	36,100	21	43	133
Challenger (Series 600)	48,200	19	38	118
Falcon 900EX	48,300	38	76	235
Total Operations		**4,920**	**8,679**	**16,594**

Notes:
[1]Data obtained from manufacturer's websites.
[2] Based upon historic information obtained from FAA, 2006 GCR Operations Database, CRG ATCT, and tenant information.
[3]2011 and 2026 forecast operations based upon approved fleet mix forecast from Chapter 3 and 2005 Craig Airport FAR Part 150 Comparative Noise Study.
[4]Older Cessna 501 aircraft anticipated to be replaced by newer and quieter B-I model aircraft

Source: The LPA Group Incorporated, 2007

FAA's guidance in Step 2 provides further instruction. Once MTOW of the critical aircraft has been determined, the AC states "when the MTOW of listed airplanes in 60,000 lbs. or less, the recommended runway length is determined according to a family grouping of airplanes having similar performance characteristics and operating weights" (Chapter 1, pg. 2, paragraph 102.b.2). Therefore for the purpose of this analysis, the runway length analysis should be created using a "family grouping of airplanes".

E.1.3 Step 3: Method Needed for Recommended Runway Length Analysis

Step 3 of **FAA AC 150/5325-4B** (Chapter 1, Pg 2, Paragraph 102.b.3) states: "Use Table 1.1 (found in **AC 150/5325-4B**) and the airplanes identified in Step 2 (**Table E-5**) to determine the method that will be used for establishing the recommended runway length".

For reference, Table 3 reflects the information contained in Table 1.1 of the AC (Chapter 1, Pg. 3). All of the critical design airplanes previously presented in **Tables E-4 and E-5**, with the exception of the VLJ and Cessna 501, have a MTOW greater than 12,500 lbs but less than 60,000 lbs. Since 4,920 operations were associated with these aircraft in 2006, the category of "aircraft over 12,500 but less than 60,000 lbs" was selected from Table 1.1 (as replicated in **Table E-6**) in order to continue this analysis.

Table E-6
Airplane Weight Categorization for Runway Length Requirements

Airplane Weight Category Maximum Certificated Takeoff Weight (MTOW)			**Design Approach**	**Location of Design Guidelines (in AC 150/5325-4B)**
12,500 pounds or less	Approach Speed less than 20 knots		Family Grouping of Small Airplanes	Chapter 2; Paragraph 203
	Approach Speeds of at least 30 knots but less than 50 knots		Family Grouping of Small Airplanes	Chapter 2; Paragraph 204
	Approach Speeds of 50 knots or more	With Less than 10 Passengers	Family Grouping of Small Airplanes	Chapter 2; Paragraph 205; Figure 2-1
		With More than 10 Passengers	Family Grouping of Small Airplanes	Chapter 2; Paragraph 205; Figure 2-2
Over 12,500 pounds but less than 60,000 pounds **(Selected Category)**			Family Grouping of Large Airplanes	Chapter 3; Figure 3-1 or 3-2[a] and Tables 3-1 or 3-2
60,000 pounds or more or Regional Jets			Individual Large Airplane	Chapter 4; Airplane Manufacturer Websites (Appendix 1)

Source: FAA AC 150/5325-4B.
Notes:
a) When the design airplane's airport planning manual (APM) shows a longer runway length than what is shown in Figure 3-2 (AC 150/5325-4B), use the airplane manufacturer's APM. However, users of an APM are to adhere to the design guidelines found in Chapter 4 (AC 150/5325-4B).

Runway length calculations were based upon useful load. The term useful load refers to the difference between maximum allowable structural gross weight and the operating empty weight. The useful load is typically defined by usable fuel, passengers and cargo. According to **FAA AC 150/5325-4B**, the recommended runway length must be able to accommodate the critical aircraft or family of critical aircraft at a 60 percent or higher useful load.

Figures 3-1 and 3-2 in the FAA AC provide charts that can be utilized to determine the recommended runway length. Figure 3-1 is a chart to determine runway lengths for "75% of fleet at 60 or 90% useful load," and Figure 3-2 is a chart to determine runway lengths for "100% of the fleet at 60 or 90% useful load". Table 3-1 provides a list of aircraft that constitute 75 percent of the fleet, and Table 3-2 provides a list of aircraft that make up the remaining fleet (100% of fleet). As stated in paragraph 303.a.2 of the AC, "Tables 3-1 and 3-2 should be utilized to determine which Figure (3-1 or 3-2) should be used".

Based on FAA Tables 3-1 and 3-2, CRG's critical design airplanes found in the 75% and 100% categories are shown in **Table E-7**. Table 3-1 applies to aircraft with balanced takeoff field length requirements at ISA of 5,000 feet or less. Table 3-2 applies to aircraft requiring a takeoff balanced field length at ISA of 5,000 feet or greater. Seventeen airplanes fall into the 75% category and five airplanes fall into the 100% category. At this time, very light jets have not been categorized. Chapter 3 of the FAA AC states that if "airplanes under evaluation are listed in Table 3-2, then figure 3-2 should be used to determine the runway length". Therefore, since five aircraft are included in the 100% fleet mix category (Table 3-2) then Figure 3-2 of the FAA AC was utilized to determine required runway length.

Table E-7 Fleet Category of Critical Design Airplanes at Craig Municipal Airport	
Critical Design Airplanes	**Fleet Category[1]**
VLJs (Eclipse 500)	NA
Cessna 501	75%
Dassault Falcon 10	75%
MU300	75%
Cessna 525 (CJ1)	75%
Cessna 525A (CJ2)	75%
Cessna 525B (CJ3)	75%
Cessna 550	75%
Cessna 560 XL	75%
Cessna 560	75%
Dassault Falcon 2000EX	100%
Falcon 50	75%
Falcon 50EX	75%
Beechjet 400A	75%
Israel Westwind	75%
Learjet 31/31A	75%
Learjet 35	75%
Learjet 45	75%
Cessna 650 (Citation VI)	100%
Cessna 680 (Sovereign)	75%
Cessna 750 (Citation X)	100%
Challenger (Series 600)	100%
Falcon 900EX	100%
Critical Design Airplanes in 100% Category: 5	

Notes: [1]Fleet Category corresponds to aircraft groupings contained in Tables 3-1 and 3-2 of FAA AC 150-5325-4B. VLJs, at this time, have not been assigned a category.
Source: The LPA Group Incorporated, 2007

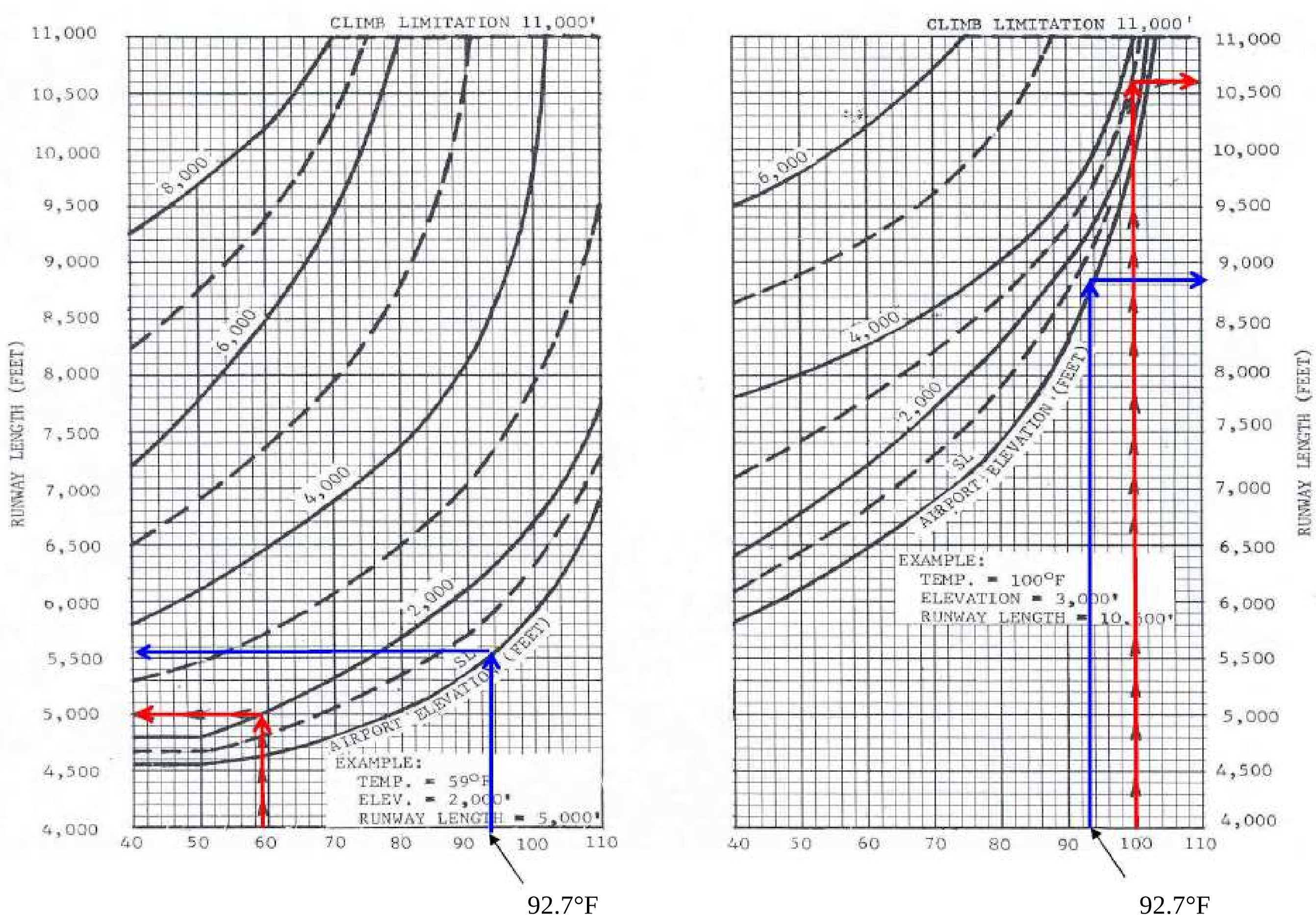
E.1.4 Step 4: Select the Recommended Runway Length

In Step 3, it was concluded that Figure 3-2 (Chapter 3, pg 13) in **FAA AC 150/5325-4B** would be utilized to calculate runway length requirements at CRG. Figure 3-2 provides two separate runway length curves which vary by 60% or 90% of the airplane useful load factor. For the purposes of this analysis both 60% and 90% useful load was evaluated. **Figure E-1** below depicts the runway length chart found in Figure 3-2 for 100% of the fleet operating at 60% or 90% useful load. Given the airport elevation of 41 feet[5], interpolation was used to arrive at a proposed runway length. Utilizing a mean maximum temperature for CRG of 92.7° F[6] and airport elevation of 41 feet above mean sea level, the corresponding unadjusted

[5] Airport elevation obtained from previous approved Airport Layout Plan Set, FAA 5010 Database and verified by 2007 airport survey.
[6] National Climatic Data Center, Official Temperature Records, Craig Municipal Airport (Station 72206), Jacksonville FL Station (August 2006).

runway length associated with the CRG equates to 5,540 feet for aircraft operating at 60% useful load, and 8,840 feet for aircraft operating at 90% useful load as shown in **Figure E-4**. Adjustments for runway gradient, runway condition and aircraft use (i.e. fractional ownership and air taxi) shall be considered in Step 5.

Figure E-1
100 Percent of Fleet at 60 or 90 Percent Useful Load



100% of Fleet at 60 Percent Useful Load **100% of Fleet at 90 Percent Useful Load**

Sources: FAA Advisory Circular 150/5325-4B, Figure 3-2, NCDC Official Weather Data, Runway Inner Approach Survey, and The LPA Group Incorporated, 2007

E.1.5 Step 5: Runway Length Adjustment

The runway takeoff length determined in Step 4 does not include an adjustment for runway gradient. According to Paragraph 304 of the AC (pg. 10), the runway takeoff length should be increased at a rate of 10 feet for each foot of elevation difference between the high and low points of the runway centerline. At CRG, the difference in elevation in the runway high and low points of Runway 14-32 is 10 feet (42 feet - 32 feet)[7]. Therefore, 100 feet should be added to the runway length calculated in Step 4. **This results in a total recommended length of 5,640 feet (5540 + 100 feet) for aircraft operating at 60 percent useful load on dry pavement and 8,940 feet (8,840 + 100 feet) for aircraft operating at 90 percent useful load.**

The AC further states by regulation, the runway landing length for turbojet-powered airplanes obtained from the "60 percent useful load" curves are increased by 15 percent or up to 5,500 feet, whichever is less, to accommodate wet pavement conditions. Since the recommended runway length at CRG exceeds 5,500 feet, an additional adjustment for wet and slippery conditions is technically not required.

E.2 Runway Takeoff Length Supporting Data

In support of **FAA AC 150/5325-4B**, the FAA Central Region, Airport Planning Division, developed two spreadsheets, *Takeoff Runway Length Adjustment (***Figure E-2***)* and *Landing Runway Length Adjustment (***Figure E-4***)*, to provide a methodology for estimating the runway lengths based upon specific aircraft and airport operating requirements. FAA Headquarters is looking into developing similar spreadsheets as part of an updated to **AC 150/5325-4B**.

The aircraft types analyzed as shown in **Table E-4** were based upon a review of existing business jets currently operating at CRG. Runway performance length factors were used for the development of the recommended runway length in support of **AC 150/5325-4B** findings. **Figure E-2**, *FAA Takeoff Length Adjustment Spreadsheet*, provides a more detailed description of the mathematical formulas used to adjust runway length for non-standard local conditions. This is not a substitute for calculations required by airplane operating rules and does not include insurance requirements for specific aircraft or operations.

Applying the aircraft's specific takeoff balanced field length requirement (L) and the following airport specific adjustments for CRG provides an adjusted runway takeoff length.

- Elevation (E) = 41 feet
- Mean Maximum Temperature of Hottest Month = 92.7° Fahrenheit, and
- Effective Gradient Adjustment (difference in Runway 14-32 high and low points) = 10 feet[7]

Figure E-2, *Takeoff Runway Length Adjustment*, demonstrates the mathematical methodology used for determining the adjusted runway takeoff length for the Dassault Falcon 900EX.

[7] Survey data obtained from LD Bradley, November 2007

Figure E-2
Takeoff Runway Length Adjustment
Sample Aircraft: Falcon 900EX

TABLE A-1
TAKEOFF RUNWAY LENGTH ADJUSTMENT
(given takeoff length at sea level, Mean Max Temperature, Elevation & difference in Hi / Lo pts)

Altitude Correction	E = Elevation
(7% per 1,000' above sea level)	L = Takeoff length @ sea level
	L1 = Length corrected for altitude
	L1 = (.07 * E / 1000) * L + L
Temperature Correction	
(0.5% per degree above stnd temp in hottest month)	
(Stnd Temp adjusted to Sea Level)	T1 = Adjusted Stnd Temp
	T = Mean Max High Temperature
	L2 = Length corrected for altitude & temperature
	T1 = 59 - (3.566 * E / 1000)
	L2 = (.005*(T - T1)) * L1 + L1
Effective Gradient Correction (takeoff only)	
(10' for each 1' difference between Hi / Lo P	G = Difference between Hi / Lo point in feet
	L3 = RW length corrected for alititude, temperature & gradient
	L3 = G * 10 + L2

Takeoff Runway Length at Sea Level and 59 Degrees Fahrenheit			
	1. Enter the takeoff runway length at sea level in feet	L =	5215
Altitude			
	2. Enter Airport Altitude in feet above sea level	E =	41
		L1 =	5230
Temperature			
	3. Enter Mean Max Daily Temp in degrees F	T =	92.7
		T1=	58.85
		L2 =	6115
Gradient Adjustment			
	4. Enter Maximum Difference in RW Elevation in feet		10
Takeoff Runway Length Adjusted for Temp, Elevation & Gradient		L3 =	6215

Source: Federal Aviation Administration Central Region, Airport Planning Division, 2005

The runway length requirements were based upon the maximum allowable gross takeoff weight shown in **Table E-5** at maximum payload and range for the aircraft listed. The origin and destination markets for business jet aircraft at CRG include Denver, New York City, Miami, Washington, Dallas, Chicago, and limited trips to the West Coast, including Seattle and Los Angeles. As a result, an average stage length of between 1,200 - 1,500 nautical miles (NM) was used to determine the runway length requirements. **Figure E-3** demonstrates the 1,500 NM coverage (within circle) for aircraft originating at CRG.

Figure E-3
1500 Nautical Mile Aircraft Stage Length From
Craig Municipal Airport

Source: Great Circle Distance, http://gc.KLS2.com

CRG's primary runway is Runway 14-32, which has a currently documented usable pavement length of 3,998 feet. Using the methodology outlined in **Figure E-2**, the following adjusted runway takeoff lengths (**Table E-8**) were developed for each of the critical design aircraft denoted in **Table E-4, Critical Design Airplane**. Aircraft runway takeoff balanced field length data[8] at International Standard Atmosphere (ISA) conditions was obtained from manufacturer's websites and aircraft operating handbooks. ISA balanced field takeoff length is based upon 59° Fahrenheit, elevation at sea level, standard flap setting, zero grade change, dry and uncontaminated pavement conditions, and includes aborted takeoff stopping distance.

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[8] The unadjusted recommended runway length is based upon the longest of the following three distances:

- Accelerate-Takeoff Distance: The total distance needed for the aircraft to accelerate to the critical takeoff speed (V_1), takeoff, and climb to an altitude of 35 feet above ground level with one engine-out at V_1.
- Accelerate-Stop Distance: The distance needed for the aircraft to accelerate to V_1, and brake to a full stop under wet pavement conditions.
- All-engine takeoff distance: 115 percent of the distance needed to accelerate to V_1, takeoff, and climb to an altitude of 35 feet above ground with all engines operating normally.

Table E-8
Critical Design Aircraft
Runway Takeoff Length Adjustment

Critical Design Airplane	Runway Dry Pavement Length Required (ft)		Existing and Projected Operations		
	ISA[1]	Adjusted Length at Mean Max. Temp (92.7°F) [2]	2006 Actual Operations[3]	2011 Projected Operations[4]	2026 Projected Operations[4]
VLJs (Eclipse 500)	2,342	2,846	0	92	465
Cessna 501	2,830	3,418	281	473	0
Dassault Falcon 10	4,450	5,318	107	181	697
MU300	4,300	5,142	404	679	1311
Cessna 525 (CJ1)	3,080	3,712	407	685	1311
Cessna 525A (CJ2)	3,360	4,040	239	411	730
Cessna 525B (CJ3)	3,180	3,829	44	76	135
Cessna 550	3,600	4,321	287	494	878
Cessna 560 XL	3,590	4,310	608	1046	1858
Cessna 560	3,520	4,228	1,469	2529	4493
Dassault Falcon 2000EX	5,757	6,851	10	17	30
Falcon 50	4,890	5,834	48	83	150
Falcon 50EX	4,890	5,834	8	14	24
Beechjet 400A	4,169	4,989	213	399	1010
Israel Westwind	5,250	6,256	70	130	103
Learjet 31/31A	3,500	4,204	181	339	539
Learjet 35	5,000	5,963	121	227	804
Learjet 45	4,439	5,305	322	602	1430
Cessna 650 (Citation VI)	5,150	6,139	10	20	64
Cessna 680 (Sovereign)	4,000	4,790	13	25	77
Cessna 750 (Citation X)	5,140	6,127	21	43	133
Challenger (Series 600)	5,700	6,784	19	38	118
Falcon 900EX	5,215	6,215	38	76	235
		Total Operations	**4,920**	**8,679**	**16,594**

Notes:
[1] Balanced Field Length requirement based upon International Standard Atmosphere (ISA) conditions. Data obtained from manufacturer's websites.
[2] Lengths calculated by LPA Group using FAA Takeoff Runway Length Adjustment Spreadsheet, Exhibit 1, using NCDC 2006 Temperature Data
[3] Based upon historic information obtained from FAA, 2006 GCR Operations Database, CRG ATCT, and tenant information.
[4] 2011 and 2026 forecast operations based upon approved fleet mix forecast from Chapter 3 and 2005 Craig Airport FAR Part 150 Comparative Noise Study.
Source: The LPA Group Incorporated, 2007

E.3 Runway Landing Length Supporting Data

Landing length is also a critical component of the runway length analysis. Like the takeoff length, landing length must be adjusted based upon the unique characteristics of the airport. Using the *FAA Landing Length Adjustment Spreadsheet*, **Figure E-4**, the landing length for the critical aircraft were adjusted based upon airport elevation (41 ft AMSL), mean maximum hottest temperature (92.7°F), and wet pavement conditions.

Figure E-4
FAA Landing Runway Length Adjustment
Sample Aircraft: Falcon 900EX

LANDING RUNWAY LENGTH ADJUSTMENT
(given landing length in dry conditions at sea level, Mean Max Temperature, Elevation)

Altitude Correction	E = Elevation
(7% per 1,000' above sea level)	L = Landing length @ sea level
	L1 = Length corrected for altitude
	L1 = (.07 * E / 1000) * L + L
Temperature Correction	
(0.5% per degree above stnd temp in hottest month)	
(Stnd Temp adjusted to Sea Level)	T1 = Adjusted Stnd Temp
	T = Mean Max High Temperature
	L2 = Length corrected for altitude & temperature
	T1 = 59 - (3.566 * E / 1000)
	L2 = (.005*(T - T1)) * L1 + L1
Wet Pavement Correction (landing length only)	
(15% increase in length based on dry conditions)	
	L3 = Landing RW length corrected for altitude, temperature & wet cond.
	L3 = 1.15 * L2

Landing Runway Length in Dry Conditions at Sea Level and 59 Degrees Fahrenheit			
	1. Enter the landing runway length at sea level in feet	L =	3520
Altitude			
	2. Enter Airport Altitude in feet above sea level	E =	41
		L1 =	3530
Temperature			
	3. Enter Mean Max Daily Temp in degrees F	T =	92.7
		T1=	58.85
		L2 =	4128
Landing Runway Length Adjusted for Temp, Elev. & Wet Cond.			
		L3 =	4747

Source: Federal Aviation Administration Central Region, Airport Planning Division, 2005

Typically, runway length requirements are less than takeoff weight requirements. However, based upon an FAA Rule published in the Federal Register June 2006, Safety Alert for Operators (SAFO 06012) dated 08/31/06, and confirmed with FAA Headquarters Flight Standards Service and Air Transportation Divisions, a mandatory 20 to 40 percent landing distance safety margin is required for all FAR Part 91K (Fractional Ownership certification)[9], 125 (Corporate/Travel Club Certificate)[10], and 135 (Air Taxi/Commuter and On-demand Certification)[11] turbojet operations. According to Mr. Jerry Ostronic of the FAA Air Transportation Division and FAA Flight Standards, aircraft at a primary airport must be able to land within 60 percent of usable runway pavement. According to FAA, the following general methodology can be used to determine if an airport has adequate runway length to accommodate FAR Part 91K, 125 and 135 operations:

- Multiply Balanced Field Length at ISA by a factor of 1.66 for Dry Pavement Conditions.
- Multiply Balanced Field Length at ISA by a factor of 1.92 for wet and uncontaminated pavement conditions. Note, a higher factor is used for snow, ice or contaminated runway conditions.

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[9] As of November 2003, a fractional ownership certification (FAR Part 91.1001K) was to provide oversight for fractional ownership operations created by individuals and corporations that share ownership of aircraft that are scheduled and maintained by a management company, and furnished trained flight crews. Under FAR Part 91.1001K, any person piloting a fractionally owned aircraft, whether they are a professional pilot or a fractional owner/pilot must meet the following requirements:

- Total Flight Time for all Pilots:
  - PIC = 1500 hours
  - SIC = 500 hours
- For Multi-engine turbine-powered aircraft:
  - PIC = ATP and applicable type rating
  - SIC = Commercial and instrument rating

[10] Refers to an aircraft that carries MORE THAN 19 passengers and/or MORE THAN 6,000 pounds of cargo. However, you CANNOT receive money for each individual flight. In other words, the company/group owns the aircraft and they are not "renting" it out to anyone outside the company/group - the aircraft is for their own private use. Corporations that have their own private aircraft for business purposes, whether flying its employees or customers (without direct compensation); Travel Clubs with members that pay annual dues as well as the additional cost to fly to different locations organized by the travel club; Sky Diving Clubs that own their own aircraft. In other words, any group that "jointly" owns an aircraft that carries more than 19 passengers and/or more than 6,000 pounds of cargo can operate under FAAs Part 125.

[11] Air Taxi Certification (Commuter and On-Demand Operations) applicability: Each certificate holder that was issued an air carrier or operating certificate and operations specifications under the requirements of part 135 of this chapter or under SFAR No. 38–2 of 14 CFR part 121 before January 19, 1996, and that conducts scheduled passenger-carrying operations with:
(i) Nontransport category turbopropeller powered airplanes type certificated after December 31, 1964, that have a passenger seat configuration of 10–19 seats;
(ii) Transport category turbopropeller powered airplanes that have a passenger seat configuration of 20–30 seats; or
(iii) Turbojet engine powered airplanes having a passenger seat configuration of 1–30 seats.
(2) Each person who, after January 19, 1996, applies for or obtains an initial air carrier or operating certificate and operations specifications to conduct scheduled passenger-carrying operations in the kinds of airplanes described in paragraphs (a)(1)(i), (a)(1)(ii), or paragraph (a)(1)(iii) of this section.

Thus, adjusted manufacturer landing length requirements based upon pavement condition, gradient and safety margin are provided in **Table E-7.**

Table E-7
Adjusted Landing Length Requirements

Critical Aircraft	Private Use/Corporate Use less than 20 passengers			Fractional Ownership, Air Taxi and Air Charter Requirements*	
	ISA[1]	Adjusted for CRG (92.7°F and 41 ft AMSL)[2]	Wet Pavement[3]	Dry Pavement[4]	Wet Pavement[5]
VLJs (Eclipse 500)	2,250	2,638	3,034	3,735	4,320
Cessna 501	2,350	2,756	3,169	3,901	4,512
Dassault Falcon 10	3,700	4,339	4,989	6,142	7,104
MU300	3,200	3,752	4,315	5,312	6,144
Cessna 525 (CJ1)	2,750	3,225	3,708	4,565	5,280
Cessna 525A (CJ2)	2,980	3,494	4,018	4,947	5,722
Cessna 525B (CJ3)	2,770	3,248	3,735	4,598	5,318
Cessna 550	3,180	3,729	4,288	5,279	6,106
Cessna 560 XL	3,180	3,729	4,288	5,279	6,106
Cessna 560	2,770	3,248	3,735	4,598	5,318
Dassault Falcon 2000EX	2,631	3,085	3,548	4,368	5,052
Falcon 50	2,920	3,424	3,938	4,847	5,606
Falcon 50EX	2,920	3,424	3,938	4,847	5,606
Beechjet 400A	2,960	3,471	3,991	4,914	5,683
Israel Westwind	2,720	3,189	3,668	4,515	5,222
Learjet 31/31A	2,870	3,365	3,870	4,764	5,510
Learjet 35	2,900	3,401	3,911	4,814	5,568
Learjet 45	2,660	3,119	3,587	4,416	5,107
Cessna 650 (Citation VI)	2,900	3,401	3,911	4,814	5,568
Cessna 680 (Sovereign)	2,650	3,107	3,573	4,399	5,088
Cessna 750 (Citation X)	3,410	3,999	4,598	5,661	6,547
Challenger (Series 600)	3,300	3,870	4,450	5,478	6,336
Falcon 900EX	3,520	4,128	4,747	5,843	6,758
Average	**2,934**	**3,441**	**3,957**	**4,871**	**5,634**

Notes:
[1]Manufacturer landing lengths based upon ISA conditions.
[2]Manufacturer's landing length adjusted for temperature and elevation (See Figure E-5, FAA Runway Landing Length Adjustment.
[3]Adjusted landing length corrected for wet pavement conditions (~15%) as shown in Figure E-5, FAA Runway Landing Length Adjustment)
[4]Dry pavement adjustment under 91, 119, 125 and 135 is manufacturer's ISA landing distance multiplied by 1.66 as provided by FAA Aircraft Certification and Flight Standards divisions.
[5]Wet pavement adjustment under 91, 119, 125, and 135 is manufacturer's ISA landing distance multiplied by 1.92 as provided by FAA Headquarters Air Transportation and Flight Standards divisions.
Sources: Manufacturers data, FAA Headquarters Air Transportation, Flight Standards and Certification divisions and The LPA Group Incorporated, 2007

E.4 Summary

The results of the runway length analyses are summarized as follows:

- Based upon existing and anticipated demand, the aircraft or family of aircraft representing the critical aircraft will remain a C-II.
- By following the steps outlined in **FAA AC 150/5325-4B**, this analysis has provided justification that the minimum (60 percent useful load) recommended suitable runway length for critical design airplanes at CRG is between **5,640 feet** and the maximum suitable runway length (90 percent useful load) is **8,940 feet**.
- Although not addressed within this section, a crosswind runway length of 4,000 feet based upon existing and anticipated aircraft use appears to be appropriate to accommodate demand over the twenty-year planning period.

The results of this analysis confirms the findings of previous planning reports that recommend an extension of at least one runway at CRG to accommodate the existing and forecast fleet mix. Further, the fleet mix assumptions are consistent with previous planning and noise studies.

A runway of 5,600 feet would provide adequate length for the majority of business jets with MTOW less than 60,000 pounds at 60 percent useful load and would provide similar service as that provided by other similarly sized reliever airports.