APPENDIX D: RUNWAY LENGTH ANALYSIS

Purpose

A runway length analysis was completed to FAA standards identified in FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design* in this airport master plan study for the Sidney-Richland Regional Airport. Due to the technical nature of this analysis, a separate appendix has been prepared to calculate recommended runway lengths for the design aircraft identified in the aviation forecasts.

Aircraft Up to 60,000 Pounds

A runway length analysis was performed using the FAA's current methodology found in FAA AC 150/5325-4B. The design approach identifies a recommended runway length based on a family grouping of design aircraft.

At SDY, the aircraft fleet includes a variety of small and large aircraft, with the existing design aircraft categorization falling within the B-II(Small) category. An example of the differing aircraft fleet includes the Tecnam P2012 operated by Cape Air, the Pilatus PC-12 operated by Sidney Health Center as well as a mix of aircraft ranging from the Beechcraft King Air 200 to the Cessna 182 for both business and recreational use. The complete design aircraft fleet mix is identified in **Chapter 1: Airport Overview and Aviation Activity**. The length of the primary Runway 01/19 will be driven by the length needs of the critical design aircraft fleet mix as well as large aircraft greater than 12,500 pounds but less than 60,000 pounds.

Various other airfield surfaces at SDY are designed for smaller aircraft. This includes large aircraft greater than 12,500 pounds but less than 60,000 pounds, and small general aviation aircraft with approach speeds of 50 knots or greater and maximum certified takeoff weight of 12,500 pounds or less.

Small Airplanes Up to 12,500 Pounds

FAA Design Curves

The FAA design approach identified in Chapter 2 of FAA AC 150/5325-4B for most small aircraft less than 12,500 pounds requires several steps to be performed to determine runway length:

1. **Identify Number of Passenger Seats:** Classify design aircraft as one of two categories; "Less than 10 Passenger Seats" and "10 Passenger Seats or Greater"
2. **Select Percentage of Fleet:** Airplanes classified as "Less than 10 Passenger Seats" are grouped into two percentage categories based on the airport's location and the amount of existing or planned aviation activities. The categories include "95 Percent of Fleet" and "100 Percent of Fleet".
3. **Consider Future Airport Expansion:** Consider runway length requirements during Instrument Meteorological Conditions (IMC) or expansions to accommodate airplanes more than 12,500 pounds.
4. **Determine Airport Data:** Evaluate the airport elevation, mean daily temperature in hottest month and runway condition to adjust runway length.
5. **Calculate Runway Length Based on Curves:** Utilize FAA runway length curves published in AC 150/5325-4B.

Individual Aircraft

Runway length requirements vary depending on individual aircraft size, weight as well as weather, elevation and performance capabilities of the specific aircraft. Generally, smaller general aviation aircraft require less length because they operate with a lower weight and at slower approach speeds. These aircraft are able to stop more easily due to their light weight, as well as accelerate and reach lift at slower speeds, meaning they don't require as much distance to become airborne. Conversely, aircraft in higher AAC and ADG classifications have greater runway length requirements for takeoff and landing. This is in part due to their greater weight, contributing to slow acceleration, meaning additional length is needed to generate faster takeoff speeds to achieve lift. Additionally, longer available distances for stopping are required in order to provide the aircraft time to decelerate on landing. General operating requirements in regards to safety are also a consideration for larger aircraft, particularly in regards to the ability of an aircraft to safely continue or abandon a takeoff in the case of an engine failure, necessitating extra runway length beyond the amount required for a standard operation.

FAA AC 150/5325-4B states airport planners can "determine the recommended runway length from airplane flight manuals for the airplanes to be accommodated by the airport in lieu of the runway length curves depicted in figures 2-1 or 2-2." The results of this method are depicted in **Figure D-2** and **Figure D-3.** In certain instances, it is also recommended to use airplane flight manuals in lieu of FAA Figure 2-1 or 2-2, when applicable. In addition to the runway length calculation tables from the FAA, KLJ utilizes the Airport Cooperative Research Program (ACRP) Small Aircraft Runway Length Analysis Tool (SARLAT), which was released in late 2022. This tool allows multiple general aviation aircraft to be applied to the airport environment to evaluate the runway length needed for said airport. Using based aircraft data and verified flight operations at SDY. SARLAT calculated the takeoff and landing length needed in wet and dry conditions.

The results of the tool can be seen in **Table D-1**. The piston aircraft (Cessna 172 Skyhawk, Cessna 182 Skylane to Cirrus SR22) have an Aircraft Approach Category (AAC) of A and an Aircraft Design Group (ADG) of ADG-I and maximum takeoff weight (MTOW) between 3,100 lbs. and 3,800 lbs. The turboprop aircraft (Beechcraft King Air C90, Piper 46 Malibu and Pilatus PC-12) have an AAC-A/B and ADG-II with MTOW ranging from 4,340 lbs. to 10,450 lbs. The Runway Design Code (RDC) for the Sidney-Richland Regional Airport is A/B-II.

Table D-1 – FAA AC 150/5345-4B Runway Length Requirements (≤ 12,500 lbs.)

Airport and Runway Data		
Longest Runway Length (01/19)	5,705 feet	
Airport Elevation	1985 feet	
Mean Daily Maximum Temperature of Hottest Month	87.8°F	
Aircraft Classification	**Recommended Runway Length (Ft)**	
Small Airplanes 12,500 Pounds or less		
Less than 10 passenger seats at 100 percent of fleet	**4,390 feet**	
Less than 10 passenger seats at 95 percent of fleet	**3,690 feet**	
Aircraft with more than 10 passenger seats	**4,550 feet**	
Small Aircraft Analysis Tool	**Dry**	**Wet**
Beechcraft 55 Baron	3,933	4,523
Cessna 172 Skyhawk	1,928	2,217
Cessna 180 Skywagon	1,611	1,853
Cessna 182 Skylane	1,812	2,084
Cessna 340	4,187	4,815
Cessna 402B	3,776	4,342
Cirrus SR 22	2,506	2,882
Mooney M20J	3,470	3,990
Piper 28B Dakota	1,870	2,151
Pilatus PC12	3,201	3,682
Piper 46 Malibu	3,029	3,483

Figure D-1 SARLAT Runway Length Requirements for aircraft ≤ 12,500 lbs.

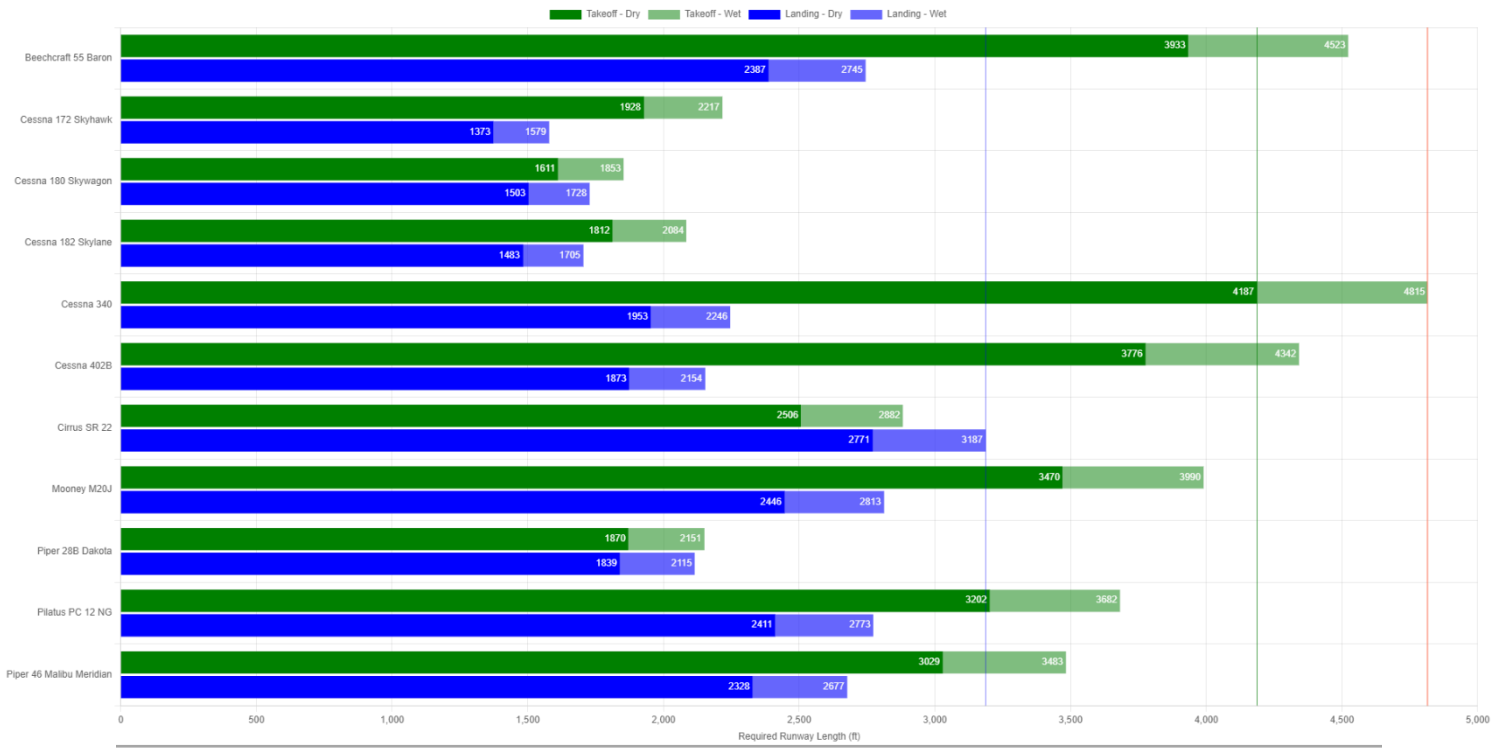
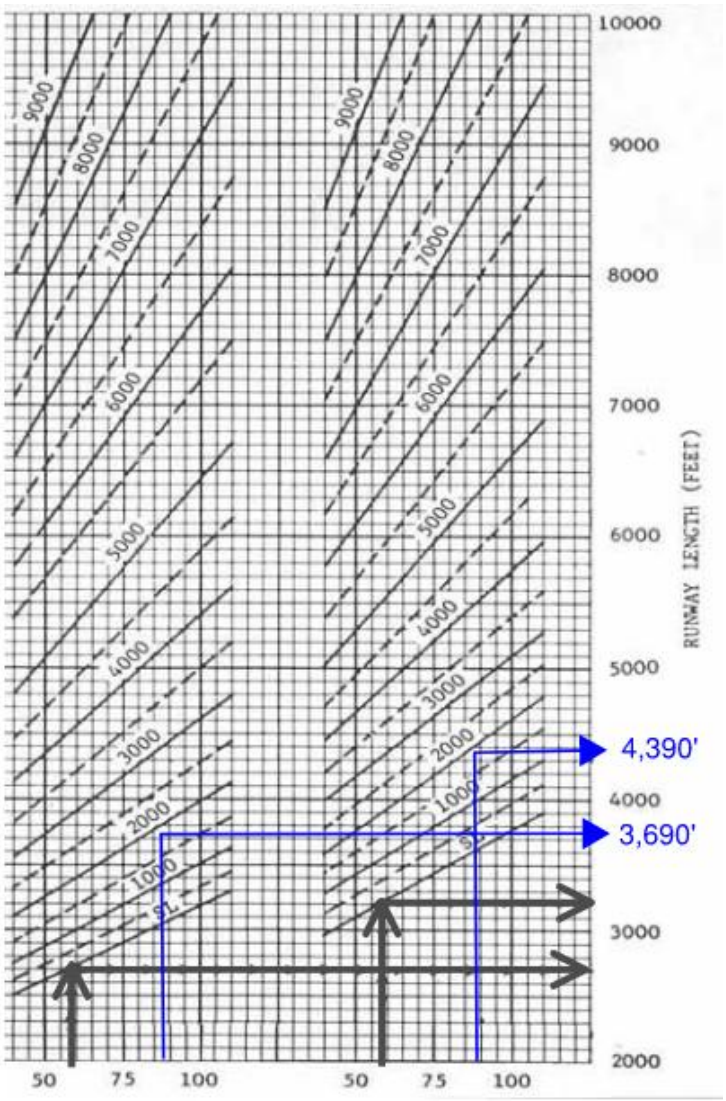


Figure D-2- (FAA Figure 2-1) Small Airplanes with Fewer than 10 Passenger Seats (Excludes Pilot and Co-pilot)

Sidney Richland Regional Airport
Temperature: 87.8°F / 31.0°C - Airport Elevation: 1,985' MSL

Airport Elevation (feet)

95 Percent of Fleet 100 Percent of Fleet

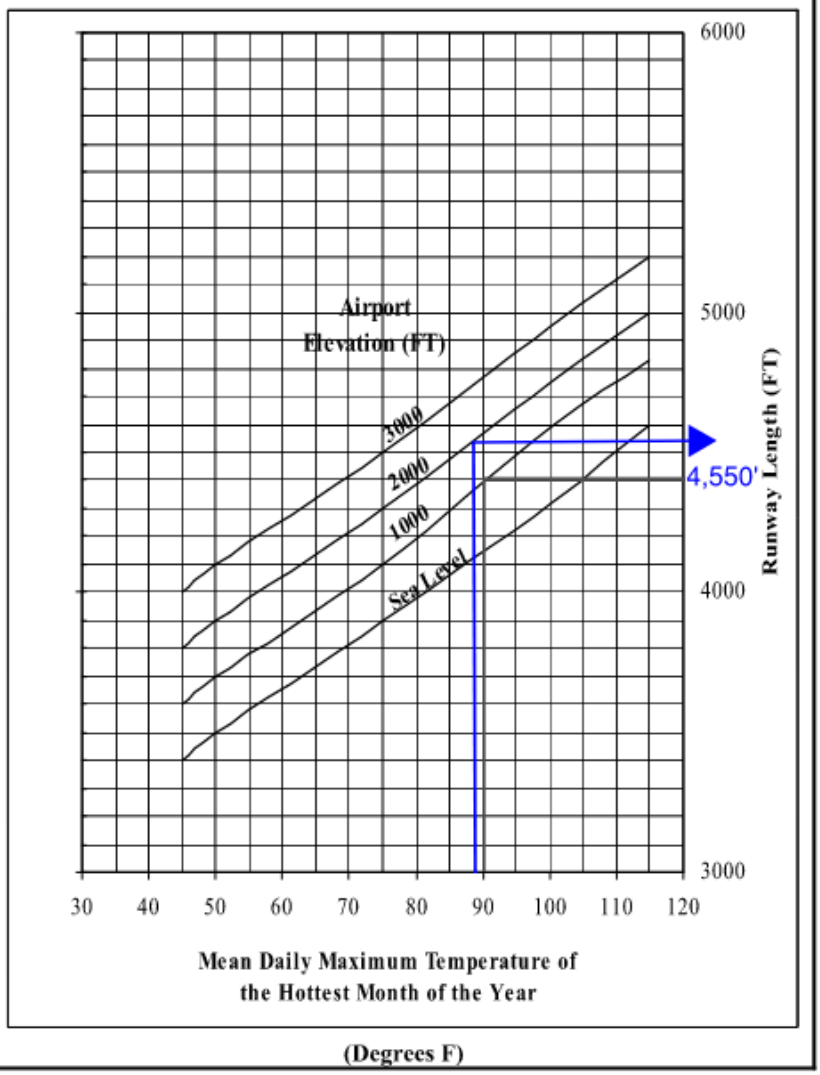


Runway Length at 95 Percent of Fleet: **3,690 feet**
Runway Length at 100 Percent of Fleet: **4,390 feet**

Figure D-3- (FAA Figure 2-2) Small Airplanes Having 10 or More Passenger Seats (Excludes Pilot and Co-pilot)

Sidney Richland Regional Airport
Temperature: 87.8°F / 31.0°C - Airport Elevation: 1,985' MSL

Representative Airplanes	Runway Length Curves
Raytheon B80 Queen Air **Raytheon** E90 King Air **Raytheon** B99 Airliner **Raytheon** A100 King Air (Raytheon formerly Beech Aircraft) **Britten-Norman** Mark III-I Trilander **Mitsubishi** MU-2L **Swearigen** Merlin III-A **Swearigen** Merlin IV-A **Swearigen** Metro II	**Example:** Temperature (mean day max hot month) 90° F (32° C) Airport Elevation (msl) 1,000 feet (328 m) Recommended Runway Length 4,400 feet (1,341 m) **Note:** For airport elevations above 3,000 feet (915 m), use the 100 percent of fleet grouping in figure 2-1.



Recommended Runway Length: **4,550 feet**

Large Airplanes Up to 60,000 Pounds

FAA Design Curves

The FAA design approach identified in Chapter 3 of FAA AC 150/5325-4B for aircraft greater than 12,500 pounds and less than 60,000 pounds requires the following steps to be performed to determine runway length.

1. **Select Percentage of Fleet:** Group the design airplane into one of two percentage categories based on performance. The categories include "75 Percent of Fleet" and "100 Percent of Fleet".
2. **Identify Useful Load Factor:** Determine the useful load factor for the design aircraft based on the difference in maximum gross weight and the basic operating weight. Useful load consists of passengers, cargo, and usable fuel. The categories include "60 percent useful load" and "90 percent useful load".
3. **Determine Airport Data:** Evaluate the airport elevation, mean daily temperature in hottest month and runway condition to adjust runway length.
4. **Calculate Runway Length:** Utilize FAA runway length curves published in AC 150/5325-4B.
5. **Apply Adjustments:** The effective runway gradient affects the aircraft's takeoff length. Wet and slippery runways for turbojet airplanes allow for runway length curves to be increased by 15 percent up to 5,500 feet for "60 percent useful load" and 7,000 feet for "90 percent useful load".

Table D-2 – FAA AC 150/5345-4B Runway Length Requirements (>12,500 but ≤ 60,000 lbs.)

Airport and Runway Data		
Airport Elevation	1958 feet	
Mean Daily Maximum Temperature of Hottest Month	87.8°F	
Maximum Difference in Runway Centerline Elevation	0.036	
Aircraft Classification	**Recommended Runway Length (ft)**	
Large Airplanes more than 12,500 Pounds but less than 60,000 Pounds		
100 percent of fleet at 90 percent useful load	8,490	
100 percent of fleet at 60 percent useful load	6,000	
75 percent of fleet at 90 percent useful load	6,700	
75 percent of fleet at 60 percent useful load	5,000	
Small Aircraft Analysis Tool	**Dry**	**Wet**
Beechcraft King Air 350ER	5,727	6,586
Beechcraft King Air B200GT	3,904	4,490
Beechcraft King Air C90	2,969	3,414
Cessna 208 Caravan	2,265	2,605
Cessna Citation Jet 1	4,571	5,257
Cessna Citation Jet 3	3,757	4,321
Phenom 300	3,989	4,587

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

Figure D-4 SARLAT Runway Length Requirements for Aircraft >12,500 but ≤ 60,000 lbs

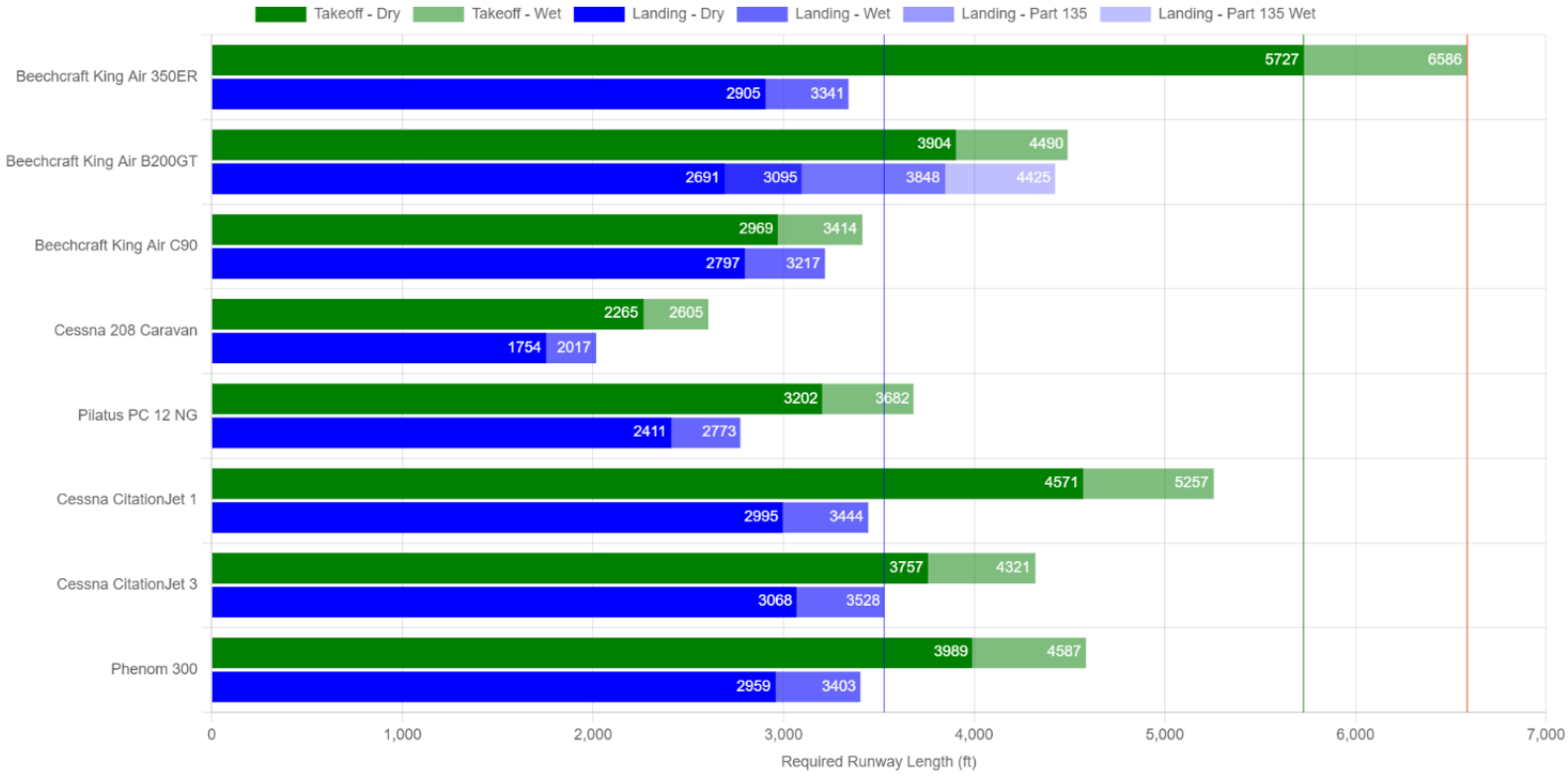
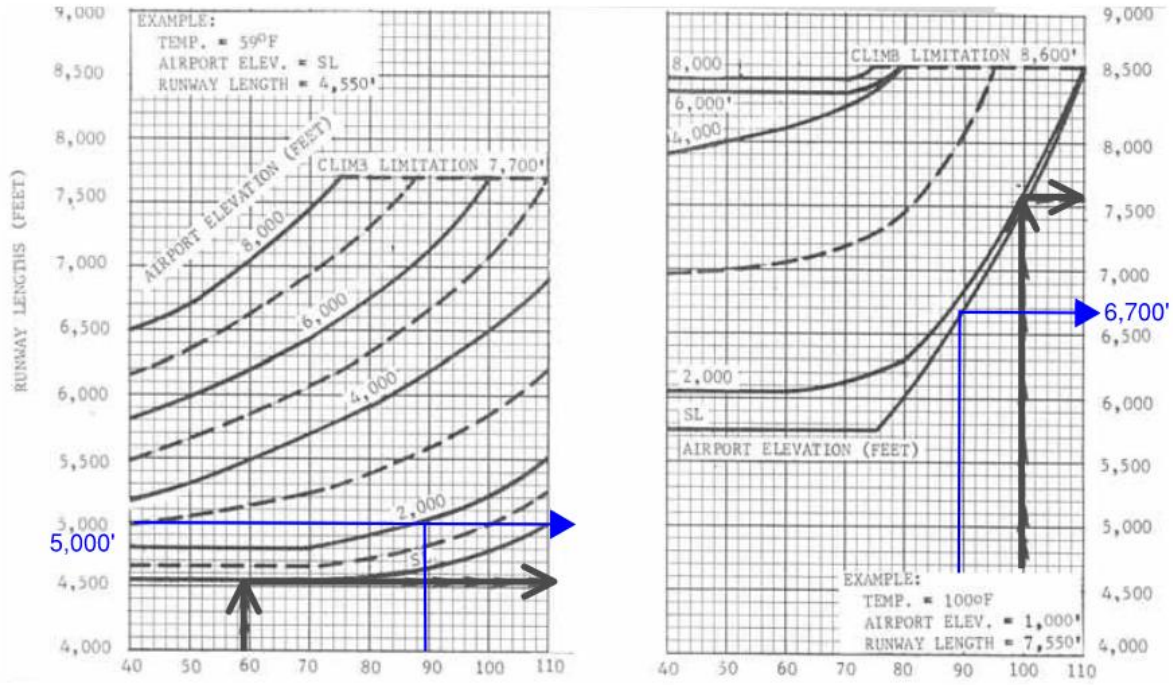


Figure D-5 (FAA Figure 3-1)- 75 Percent of Fleet at 60 or 90 Percent Useful Load

Sidney-Richland Regional Airport
Temperature: 87.8°F / 31.0°C - Airport Elevation: 1,985' MSL
Maximum Difference in Runway Centerline Elevation: 0.036 ft

Figure 3-1. 75 Percent of Fleet at 60 or 90 Percent Useful Load



Mean Daily Maximum Temperature of Hottest Month of the Year in Degrees Fahrenheit

75 percent of feet at 60 percent useful load **75 percent of feet at 90 percent useful load**

Runway Length at 60 Percent useful load **5,000 feet**
Runway Length at 90 Percent useful load **6,700 feet**

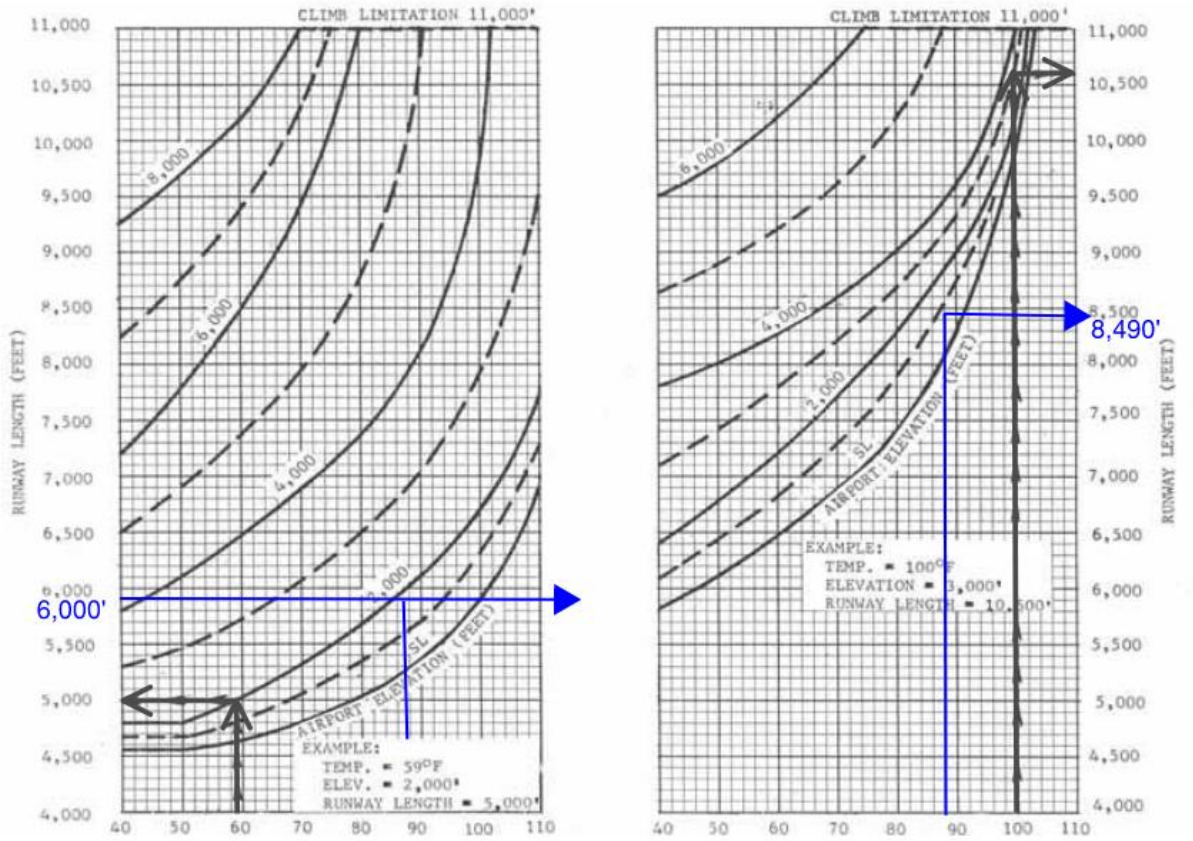
Figure D-6 (FAA Table 3-1)- Airplanes that Make Up 75 Percent of Fleet

Manufacturer	Model
Aerospatiale	Sn-601 Corvette
Bae	125-700
Beech Jet	400A
Beech Jet	Premier I
Beech Jet	2000 Starship
Bombardier	Challenger 300
Cessna	500 Citation/501Citation Sp
Cessna	Citation I/II/III
Cessna	525A Citation II (CJ-2)
Cessna	550 Citation Bravo
Cessna	550 Citation II
Cessna	551 Citation II/Special
Cessna	552 Citation
Cessna	560 Citation Encore
Cessna	560/560 XL Citation Excel
Cessna	560 Citation V Ultra
Cessna	650 Citation VII
Cessna	680 Citation Sovereign

Manufacturer	Model
Dassault	Falcon 10
Dassault	Falcon 20
Dassault	Falcon 50/50 EX
Dassault	Falcon 900/900B
Israel Aircraft Industries (IAI)	Jet Commander 1121
IAI	Westwind 1123/1124
Learjet	20 Series
Learjet	31/31A/31A ER
Learjet	35/35A/36/36A
Learjet	40/45
Mitsubishi	Mu-300 Diamond
Raytheon	390 Premier
Raytheon Hawker	400/400 XP
Raytheon Hawker	600
Sabreliner	40/60
Sabreliner	75A
Sabreliner	80
Sabreliner	T-39

Figure D-7 (FAA Figure 3-2)- 100 Percent of Fleet at 60 or 90 Percent Useful Load

Sidney-Richland Regional Airport
Temperature: 87.8°F / 31.0°C - Airport Elevation: 1,985' MSL
Maximum Difference in Runway Centerline Elevation: 0.036 ft



Mean Daily Maximum Temperature of Hottest Month of the Year in Degrees Fahrenheit

100 percent of feet at 60 percent useful load **100 percent of feet at 90 percent useful load**

Runway Length at 60 Percent useful load **6,000 feet**
Runway Length at 90 Percent useful load **8,490 feet**

Figure D-8 (FAA Table 3-1)- Remaining 25 Percent of Airplanes that Make Up 100 Percent of Fleet

Manufacturer	Model
Bae	Corporate 800/1000
Bombardier	600 Challenger
Bombardier	601/601-3A/3ER Challenger
Bombardier	604 Challenger
Bombardier	BD-100 Continental
Cessna	S550 Citation S/II
Cessna	650 Citation III/IV
Cessna	750 Citation X
Dassault	Falcon 900C/900EX
Dassault	Falcon 2000/2000EX
Israel Aircraft Industries (IAI)	Astra 1125
IAI	Galaxy 1126
Learjet	45 XR
Learjet	55/55B/55C
Learjet	60
Raytheon/Hawker	Horizon
Raytheon/Hawker	800/800 XP
Raytheon/Hawker	1000
Sabreliner	65/75

Note: Airplanes in tables 3-1 and 3-2 combine to comprise 100% of the fleet.