MASTER PLAN

Appendix

Appendix D. **Runway 2-20 Extension Analysis**

MASTER PLAN

APPENDIX D

Runway 2-20 Extension Analysis

1. OVERVIEW

In a letter dated May 28, 2015, the FAA provided the following comments on the extension to Runway 2-20 at Truckee Tahoe Airport (TRK or the Airport): "The Draft Airport Master Plan will need to provide a detailed justification for the proposed 405-foot extension and 100-foot widening, on Runway 02-20, based on the Critical Aircraft (Citation V) performance characteristics. There should also be a discussion on the target planning horizon for this proposal and the expected level of National Environmental Policy Act (NEPA) documentation that may be required."

Appendix D was created to provide this analysis and justification. FAA guidance in Advisory Circular 150/5325-4B – Runway Length Requirements for Airport Design (AC 150/5325-4B) was followed and data from a private charter operator is presented to help justify extension.

2. RUNWAY 2-20 EXTENSION JUSTIFICATION

The selected forecasts show that operations by turboprops and business jets will increase over the next 15 years. The FAA Aerospace Forecasts 2015-2035 shows national jet and turboprop operations growing at 2.9 percent over the next 20 years, compared to piston aircraft decreasing by 0.5 percent. It is expected that activity at TRK will follow this trend.

Master Plan forecasts show that Runway 2-20 will need to accommodate more operations by turboprops and business jets in the future. It is expected that many of these operations will use Runway 20 because it is equipped with a straight-in instrument approach with the lowest minimums (1-mile), and favored by the prevailing winds. As activity on Runway 2-20 increases, additional length and width are recommended for the purpose of safety and efficient operations.

The existing length of Runway 2-20 imposes some operational restrictions on the Cessna Citation V design aircraft, forcing limitations to takeoff payloads and fuel when it is necessary to use this runway. Extending Runway 2-20 would likely encourage operators to use the runway. This will help distribute aircraft operations between Runway 2-20 and Runway 11-29, and help mitigate noise impacts on nearby residences – particularly west of the approach end of Runway 11. Detailed analysis of noise impacts on these residences is presented in Chapter 4.

The primary goals in extending Runway 2-20 are to increase safety margins for jet and turboprop operators and distribute aircraft operations to help disperse noise and overflight impacts away from residential areas.

2.1 Preferred Runway 2-20 Alternative

The preferred alternative for Runway 2-20 is to increase the length of the runway to at least 5,000 feet. Industry standards for charter companies generally cite 5,000 feet of runway length as a benchmark for being able to land and depart on.

To accomplish this, Runway 2-20 would be lengthened to the south and declared distances would be applied for operations in both directions. Lengthening to the north is impractical due to steep terrain at the approach end of

Runway 20. The preferred alternative extends Runway 2-20, 465 feet to the south so total length of the runway equals 5,055 feet. The landing threshold for Runway 2 is displaced 611 feet from the proposed runway end. The proposed alternative for extending Runway 2-20 is presented in Chapter 4 (page 4-21). Runway 2-20 should also incorporate RDC B-II design upgrade.

The application of declared distances and threshold displacement shifts the Runway 2 RPZ north, onto Airport controlled property, and off of Highway 267. This approach conforms to FAA interim RPZ guidance by eliminating an incompatible land use (Highway 267) from the RPZ, and moving the RPZ onto Airport property. The future layout of Runway 2-20 and declared distances, with runway design surfaces and airspace surfaces, are presented on Sheet 8 of the airport layout plan (see Appendix C). Extending Runway 2-20 to 5,055 feet and widening to 100 feet increases safety margins and should improve traffic dispersion across the surrounding area.

3. RUNWAY LENGTH ANALYSIS

FAA guidance in AC 150/5325-4B is the standard for determining appropriate runway length at airports. This AC prescribes steps and formulas to determine runway length, based on various inputs: the critical aircraft and fleet mix, airport elevation, temperature, and other aircraft and runway conditions. The goal of the process is to plan runway length that is suitable for the forecasted critical design aircraft.

AC 150/5325-4B outlines a five-step procedure to help determine recommended runway lengths for a selected list of critical design aircraft.

- **Step 1 – Identify the list of critical design airplanes that will make regular use of the proposed runway.**

The existing and future critical aircraft at TRK is a medium-sized business jet, the Cessna Citation V (Model 560). Other aircraft that are prominent at TRK and fall within the turboprop/jet category include: Beechcraft King Air and Super King Air series, Cessna 441 and Cessna Citation jets (500 series).

- **Step #2 – Identify the airplanes that will require the longest runway lengths at maximum certificated takeoff weight (MTOW).**

The Cessna 560 series is the aircraft that regularly uses TRK that requires the longest runway length. Other aircraft operating at TRK that require similar runway lengths are other small and medium jets, with a certified MTOW under 60,000 pounds. Aircraft with a MTOW over 60,000 pounds rarely operate at TRK.

- **Step #3 – Use table 1-1 and the airplanes identified in step #2 to determine the method that will be used for establishing the recommended runway length.**

Table 1-1 in AC 150/5325-4B shows that the airplane weight category that should be analyzed for runway length at TRK is 'over 12,500 pounds but less than 60,000 pounds'. Four different graphs developed by the FAA will be used in Step 4 that will indicate preferred runway length for aircraft within this weight class family.

- **Step #4 – Select the recommended runway length from among the various runway lengths generated by Step #3.**

Four runway length graphs are developed by the FAA for operations by aircraft over 12,500 pounds but less than 60,000 pounds. These graphs are contained in Figures 3-1 and 3-2 in AC 150/5325-4B.

Figure 3-1 in AC 150/5325-4B takes into account aircraft that comprise the "75 percent of the fleet" category and the recommended runway lengths for these aircraft. The "75 percent of the fleet at 60 percent useful load" curve provides a runway length sufficient to satisfy the operational requirements of approximately 75 percent of the fleet at 60 percent useful load.

Figure 3-2 in AC 150/5325-4B provides recommended runway lengths for 100 percent of the fleet of aircraft over 12,500 pounds but less than 60,000 pounds.

A list of aircraft provided in AC 150/5325-4B shows that aircraft that fall into the 75 percent of the fleet are the prevalent jets operating at TRK. However, aircraft within the other 25 percent of the fleet do use TRK. Both graphs in Figures 3-1 and 3-2 are used to evaluate runway length for TRK. The distinction between the tables is that airplanes listed in table 3-2 require at least 5,000-foot runways at mean sea level and at the standard day temperature of 59° F.

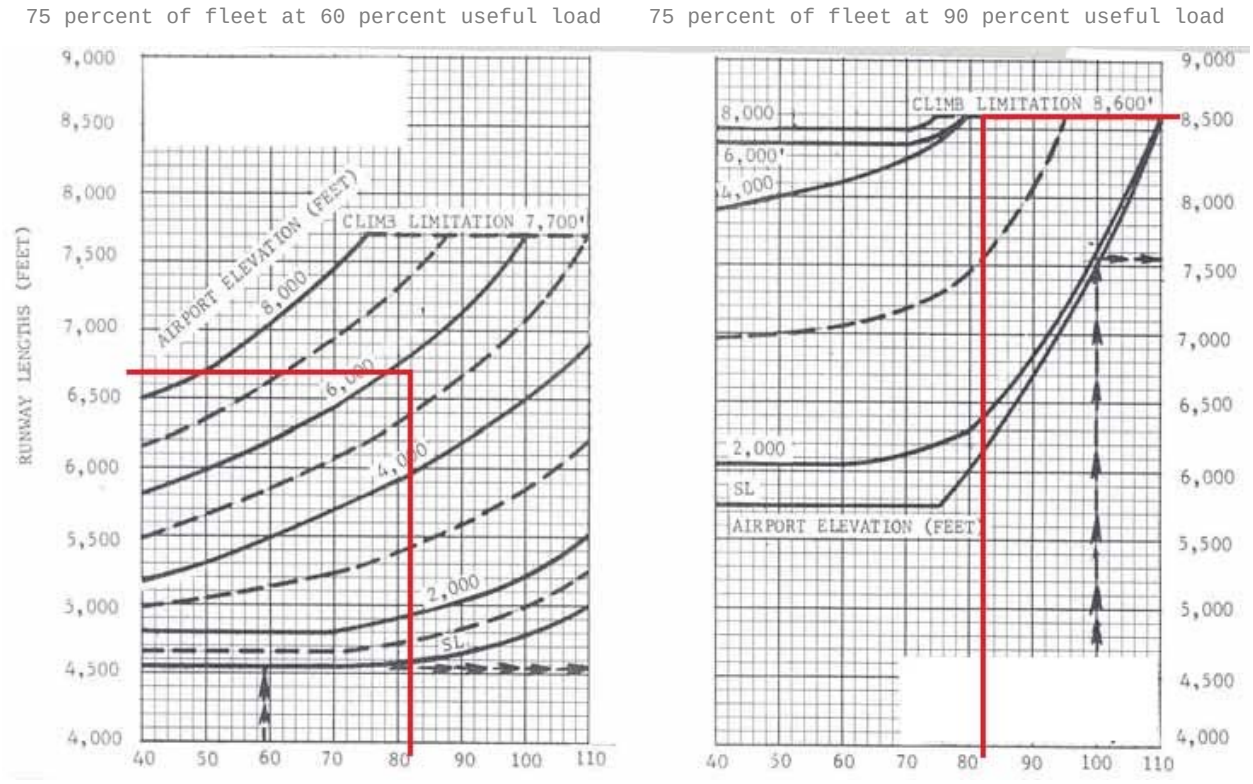
The design procedure requires the following information: airport elevation above mean sea level, mean daily maximum temperature of the hottest month at the airport, the critical design airplanes under evaluation with their respective useful loads.

- **Airport Elevation: 5,904 feet MSL**
- **Mean Maximum Temperature: 82.3 degrees Fahrenheit (July)**

Temperature source: Western Regional Climate Center, Station ID: Truckee Ranger Station, CA #049043

Aircraft that comprise the "75 percent of fleet" category can be accommodated by the runway lengths in Figure 3-1 from AC 150/5325-4B.

AC 150/5325-4B Figure 3-1: 75 Percent of Fleet at 60 or 90 Percent Useful Load:



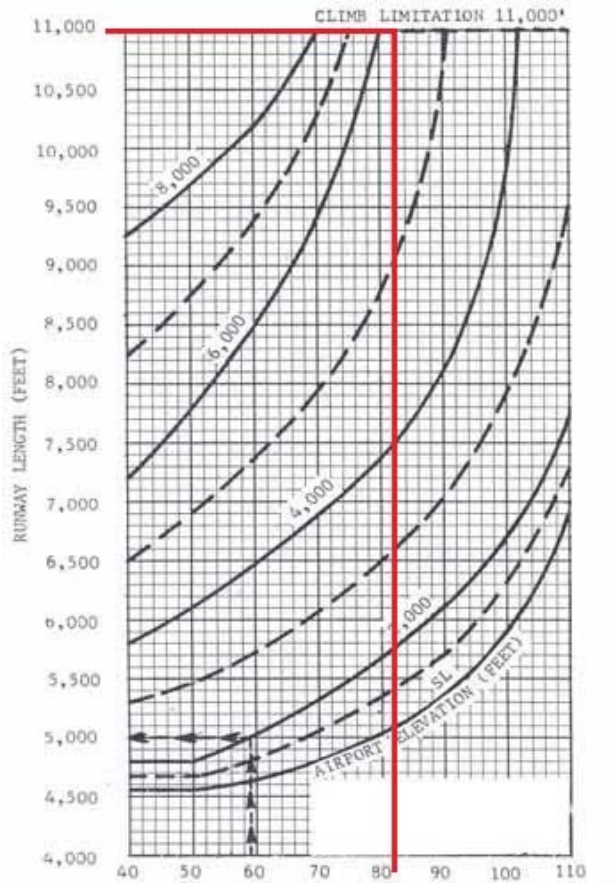
The red lines indicate performance parameters for an airport with TRK temps and elevation. Based on temperature and Airport elevation, the following lengths are recommended for 75 percent of the fleet (greater than 12,500 pounds and less than 60,000 pounds):

- **75 percent of fleet at 60 percent useful load = 6,700'**
- **75 percent of fleet at 90 percent useful load = 8,600' (climb limitation)**

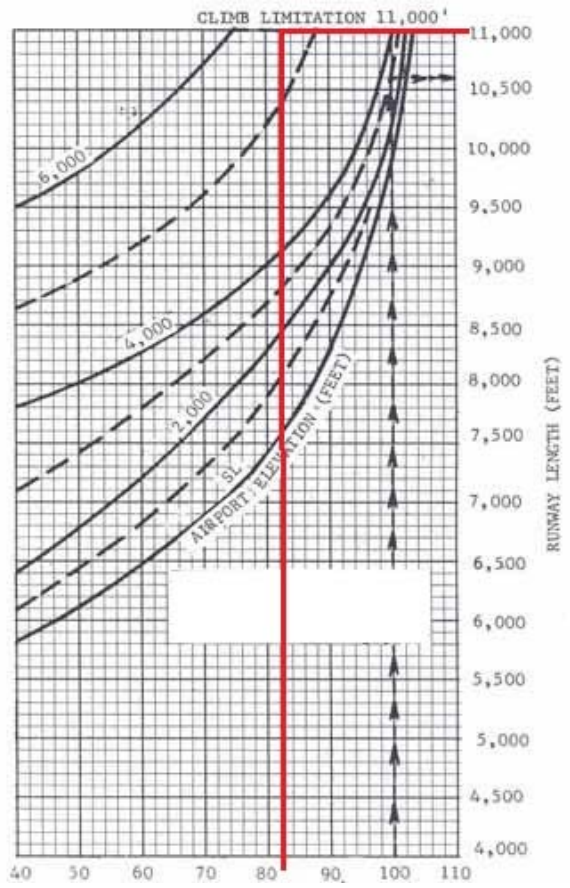
AC 150/5325-4B Figure 3-2, provides the remaining airplanes beyond that of table 3-1 that comprise the "100 percent of fleet" category.

AC 150/5325-4B Figure 3-2: 100 Percent of Fleet at 60 or 90 Percent Useful Load:

75 percent of fleet at 60 percent useful load



75 percent of fleet at 90 percent useful load



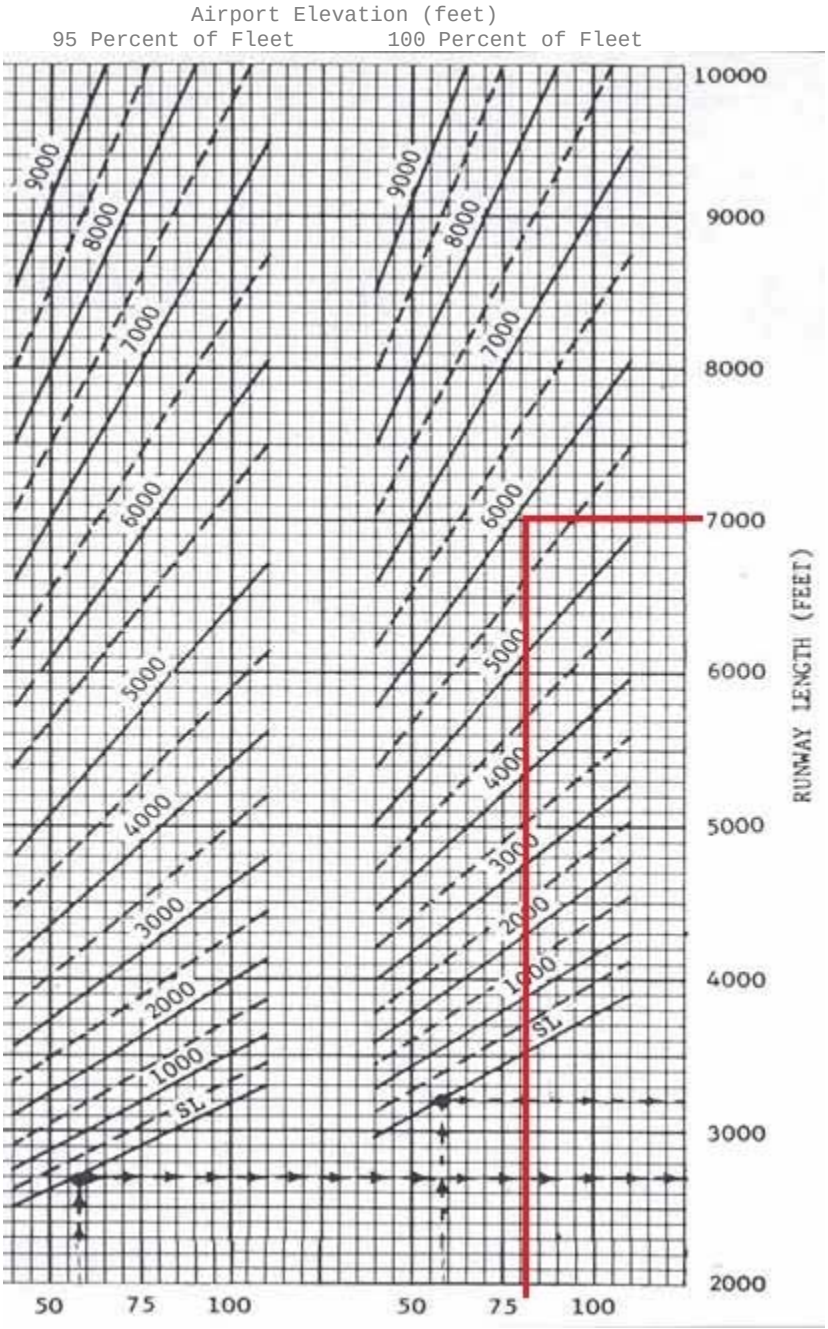
Mean Daily Maximum Temperature of Hottest Month of the Year in Degrees Fahrenheit

The red lines indicate performance parameters for an airport with TRK temps and elevation. Based on temperature and Airport elevation, the following lengths are recommended for 100 percent of the fleet (greater than 12,500 pounds and less than 60,000 pounds):

- **100 percent of fleet at 60 percent useful load = 11,000' (climb limitation)**
- **100 percent of fleet at 90 percent useful load = 11,000' (climb limitation)**

At elevations over 5,000 feet above mean sea level, the recommended runway length obtained for small airplanes from may be greater than those obtained by Figures 3-1 and 3-2. In this case, the requirements for the small airplanes govern. For airport elevations above 3,000 feet (915 m), the 100 percent of fleet grouping in Figure 2-1 from AC 150/5325-4B is used for this analysis.

AC 150/5325-4B Figure 2-1. Small Airplanes with Fewer than 10 Passenger Seats:



The graph above shows runway length requirement for small aircraft (less than 12,500 pounds MTOW) at TRK is 7,000 feet. A sample list of these aircraft provided in AC 150/5325-4B include: Raytheon B80 Queen Air, Raytheon E90 King Air, Raytheon B99 Airliner, Raytheon A100 King Air (Raytheon formerly Beech Aircraft), Mitsubishi MU-2L, Swearigen Merlin III-A, Merlin IV-A and Metro II.

This runway length is greater than what was acquired for 75 Percent of Fleet (greater than 12,500 pounds and less than 60,000 pounds) at 60 percent useful load. This is relevant for the runways at TRK since these aircraft also operate one regular basis and are more likely to operate on Runway 2-20. This provides more justification for lengthening Runway 2-20, since the prevailing wind favors operations on Runway 2 and the the runway has GPS approach with 1-mile visibility minimums.

- **Step #5 – Apply any necessary adjustment to the obtained runway length**

The runway lengths obtained from Figures 3-1 and 3-2 in AC 150/5325-4B are based on no wind, a dry runway surface, and zero effective runway gradient. Two formulas are provided in AC 150/5325-4B to calculate runway length adjustments for runway gradient and wet runways.

Effective Runway Gradient (Takeoff Only): The runway lengths obtained from figures 3-1 or 3-2 are increased at the rate of 10 feet for each foot of elevation difference between the high and low points of the runway centerline.

The ends of Runway 2-20 are currently at the same value: 5,890 feet above mean sea level. There is not expected to be a major change in either runway end elevation when the runway is extended. Therefore, no runway length adjustment is necessary for effective runway gradient.

Wet and Slippery Runways: (Applicable Only to Landing Operations of Turbojet-Powered Airplanes). The runway 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. The runway lengths for turbojet powered airplanes obtained from the “90 percent useful load” curves are also increased by 15 percent or up to 7,000 feet, whichever is less.

Values obtained from Figures 3-1 and 3-2 for the “60 percent useful load” are greater than 5,500 feet, and the runway requirements from Figure 3-2 for “90 percent useful load” are more than 7,000 feet. No runway length adjustment is applicable at TRK for wet runways.

Analysis above shows the required runway length at TRK for various aircraft, based on Airport elevations and the average maximum temperature of the hottest month, ranges from 6,700 feet to 11,000 feet.

3.1 Supplemental Runway Length Analysis

A private charter jet company (NetJets) that regularly operates at TRK provided calculations for runway length requirements of the Cessna 560 series at Truckee. NetJets calculations used the same variables and values (mean maximum temperature and airport elevation) but looked specifically at the aircraft model, as opposed to the previous analysis that looked at a group of aircraft. NetJets analysis for the Cessna 560 follows.

Runway requirements for the Cessna 560 series at MTOW, 82.3° F, 5900 feet elevation, unlimited runway, 15° and 7° flaps:			
Aircraft Model	**Flaps**	**Weight**	**Runway Length Required**
CE560E	15°	16,630 lbs. (MTOW)	6,750’
	7°	16,630 lbs. (MTOW)	7,282’
CE560EP	15°	16,830 lbs. (MTOW)	6,816’
	7°	16,830 lbs. (MTOW)	7,359’
CE560XL	15°	18,937 lbs.*	5,985’
	7°	19,380 lbs.*	8,662’
CE560XLS	15°	19,824 lbs.*	6,177’
	7°	20,200 lbs. (MTOW)	8,430’

*Note: that the elevation placed climb limitations on the Excel fleets during calculations.

This table shows that runway lengths required for the Cessna 560 series are greater than 5000 feet, from 6,000 to 8,600 feet at TRK during the hottest month.

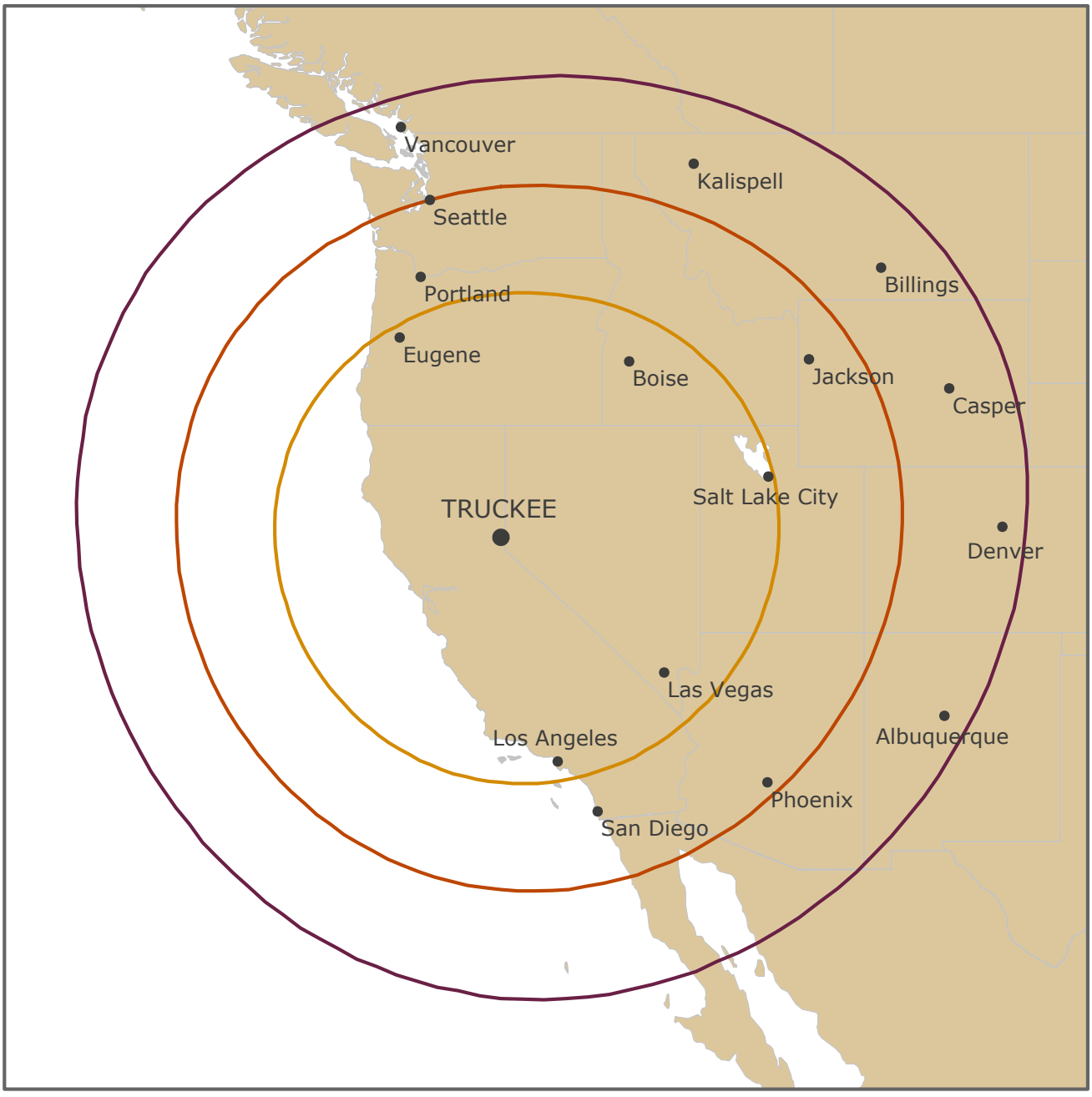
The calculations for maximum takeoff weight at 82.3° F, 5,900 feet MSL on a 5,000 foot runway:					
Airport Elevation	**Mean Max Temperature**	**Runway Length**	**Aircraft Model (15° flaps)**	**Allowable Takeoff Weight**	**Percent of MTOW**
5,904 feet MSL	82.3° F	5000’ (Dry)	CE560E	14,933	90%
			CE560EP	15,048	89%
			CE560XL	17,524	87%
			CE560XLS	18,136	90%

Based on a 5,000-foot runway at TRK NetJets was able to calculate range rings for departures from TRK for 2, 4, and 6 passengers. The range rings graphics are presented below. At 5,000 feet, the operator is more likely to reach typical destinations at conventional takeoff weights.

NETJETS®

Citation Encore

Approximate Maximum Range from Truckee Departing at 28°C/82°F**



The maximum range approximations shown above are based on the aircraft operating at high speed cruise under standard atmospheric and wind conditions* with standard NetJets fuel reserves.

** ISA conditions & 85% statistical annual winds*

*** Also assumes a runway length of 5,000ft using NetJets standard departure procedures from KTRK.*

Map Key

- 2 passengers
- 4 passengers
- 6 passengers

Note: The information contained in this document is intended for comparison purposes only and is not to be used for actual flight planning. Actual performance is subject to day of flight conditions.

NETJETS®

Citation Encore+

Approximate Maximum Range from Truckee Departing at 28°C/82°F**

The maximum range approximations shown above are based on the aircraft operating at high speed cruise under standard atmospheric and wind conditions* with standard NetJets fuel reserves.

** ISA conditions & 85% statistical annual winds*

*** Also assumes a runway length of 5,000ft using NetJets standard departure procedures from KTRK.*

Map Key

- 2 passengers
- 4 passengers
- 6 passengers

Note: The information contained in this document is intended for comparison purposes only and is not to be used for actual flight planning. Actual performance is subject to day of flight conditions.

NETJETS®

Citation XLS

Approximate Maximum Range from Truckee Departing at 28°C/82°F**

The maximum range approximations shown above are based on the aircraft operating at high speed cruise under standard atmospheric and wind conditions* with standard NetJets fuel reserves.

** ISA conditions & 85% statistical annual winds*

*** Also assumes a runway length of 5,000ft using NetJets standard departure procedures from KTRK.*

Map Key

- 2 passengers
- 4 passengers
- 6 passengers

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4. NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) DOCUMENTATION

For this Master Plan, alternatives for extending Runway 2-20 were analyzed at planning level detail. The selected extension to Runway 2-20 is in the conceptual planning stages. Design and environmental documentation is expected between 5 and 10 years after this Master Plan is approved. At that time, more project level analysis will be competed.

Although it may be possible to qualify for a Categorical Exclusion, an Environmental Assessment will likely be required for compliance with NEPA. A cultural resources investigation prepared as part of the CEQA documentation identified one historic cultural resource located in an area that might be affected by the runway extension that is potentially eligible for inclusion in the California Register of Historic Resources (California Register). A project-level design would be needed to determine whether the potentially eligible cultural resource would be affected. If the historic resource would be affected consultation would be needed to determine if the project would qualify for inclusion in either the California Register or the National Register of Historic Places. A biological reconnaissance prepared as part of the CEQA documentation identified a wetland feature that may qualify as Water of the US under the Clean Water Act. Depending on the amount of wetlands identified during project level analysis, the project may qualify for either a nationwide or local permit. This will then determine if a Categorical Exclusion or an Environmental Assessment will be required. No threatened or endangered species were identified within the area affected by the runway extension. However, endangered or threatened animal species were identified that may transit or forage on the project site.

5. CONCLUSIONS

Based on terrain limitations (step terrain to the north, wetlands to the south), lengthening Runway 2-20 to a total of 5,055 feet is likely the longest practical length. The application of declared distances will keep runway critical areas (the RPZ) on Airport controlled property.

Analysis above shows the recommended runway length at TRK ranges from 6,700 feet to 11,000 feet. Lengthening to at least 5,000 feet will provide greater safety for aircraft. Due to its mountain location, TRK is subject to periods of low visibility and winter weather (rain, snow, and icing); therefore a longer runway with the lowest instrument minimums will enhance safety and operational utility of the Airport.

Based on Airport records, and detailed in Chapter 2, there tends to be a greater amount of jet and turboprop activity in summer when temperatures are highest. Chapter 2 also shows there has been a shift in fleet mix distribution from piston to turboprops and jets. This trends is expected to continue in the future, as shown in the FAA Aerospace Forecast 2015-2035. These aircraft will likely utilize Runway 2-20 on a more regular basis.

Runway length analysis from NetJets shows that at 5,000 feet, the Cessna 560 can depart with sufficient fuel to reach common destinations from TRK. However, greater length is required for the Cessna 560 at MTOW.

Also from AC 150/5325-4B: “Over the years business jets have proved themselves to be a tremendous asset to corporations by satisfying their executive needs for flexibility in scheduling, speed, and privacy. In response to these types of needs, GA airports that receive regular usage by large airplanes over 12,500 pounds MTOW, in addition to business jets, should provide a runway length comparable to non-GA airports. That is, the extension of an existing runway can be justified at an existing GA airport that has a need to accommodate heavier airplanes on a frequent basis.”

For these reasons, Runway 2-20 should be lengthened to the maximum practical length based on terrain (5,055 feet) to provide greater safety for all aircraft operating on it. This may also have the secondary effect of moving some air traffic arriving or departing on Runway 11-29 and help alleviate some noise impacts on residences west of the Airport. Design and planning for the extension to Runway 2-20 will likely take place in 5-10 years.