EAGLE COUNTY
Regional Airport

EAGLE COUNTY REGIONAL AIRPORT
MASTER PLAN

CHAPTER 4

4.0 FACILITY REQUIREMENTS

This chapter of the Airport Master Plan (AMP) identifies future requirements for airport facilities that will allow for appropriate airside and landside development over the 20-year planning period. By comparing an airport's existing conditions (documented in Chapter Two) with its predicted growth (presented in Chapter Three), future requirements for runways, taxiways, aprons, hangars, terminal areas, and other related airport facilities can be identified for the short-, intermediate-, and long-term planning periods.

This chapter identifies the facility requirements for the Eagle County Regional Airport (the Airport or EGE) through the year 2042. It will serve as input into Chapter Five, *Alternatives Analysis & Development Plan*, which will present an examination of the development alternatives designed to meet any current and projected deficiencies which will ultimately result in the best strategy to meet the needs of the Airport, its users, and the community over the planning period.

The Facility Requirements analysis identifies airside and landside development deficiencies that should be planned for over the next 20 years.

The process and steps taken in evaluating existing and future facility requirements are presented in the following sections:

- Airport Development Context and Considerations - previous and current initiatives related to the Airport's development are reviewed to provide further context in shaping recommended facility requirements for this AMP.
- Airfield Requirements - critical airfield components including the runway, taxiways, approaches, and navigational aids are evaluated to identify any existing deficiencies or anticipated needs.
- Passenger Terminal Requirements - an analysis of the existing passenger terminal and ground transportation system helps the Airport plan for airline passenger growth identified within the forecast chapter.
- General Aviation and Support Facility Requirements - general aviation and support facility needs are reviewed to identify next steps for the Airport's significant transient user and based aircraft-owner contingent.

Note that the Federal Aviation Administration (FAA) provides guidance for the planning and design of airport facilities through Advisory Circulars (AC) that promote airport safety, economy, efficiency, and sustainability. Many of the facility requirements identified for EGE incorporate FAA planning and design standards presented in FAA AC 150/5300-13B, *Airport Design*, and FAA AC 150/5060-5, *Airport Capacity and Delay.* Other FAA ACs and industry principles were used to develop sections of this chapter and are cited throughout the document.

4.1 AIRPORT DEVELOPMENT CONTEXT AND CONSIDERATIONS

Strategic development initiatives identified in previous studies and outreach programs that are potentially relevant to this AMP include the following:

- *EGE Airport Master Plan (2014)*
- *EGE Terminal Area Plan (2016)*
- *Colorado Aviation System Plan (2020)*
- *Airport Tenant and User Survey (2022)*

These studies are summarized in the following sections. The relevant findings, recommendations, and development plans included in each of these studies and the role that they may play in the current master planning process are also presented.

4.1.1 2014 EGE Airport Master Plan

The 2014 EGE Airport Master Plan highlighted several development recommendations including a new parallel taxiway, various terminal improvements, several southside development initiatives, and a variety of general aviation improvements on the north side of the airfield. Several of these recommendations have either been or are in process of being implemented including hangar development on the north side, the overall rehabilitation of Taxiway A scheduled for 2023, as well as the design and construction of the new parallel taxiway on the north side of Runway 7-25. Other Master Plan projects that have been implemented in a modified manner include the construction of a deicing pad on Taxiway A, the construction of general aviation hangars on the west side of the terminal area, and the construction of the terminal concourse. The remaining development plan for the 2014 Master Plan will be considered as part of this effort.

The 2014 EGE Airport Master Plan outlined a phased future development plan for the Airport that has been actively implemented in the nine years since the plan was completed. Shifting priorities to better accommodate the current growth projections and needs of the Airport may redefine and realign some of the remaining projects included in the 2014 effort.

4.1.2 2016 EGE Terminal Area Plan

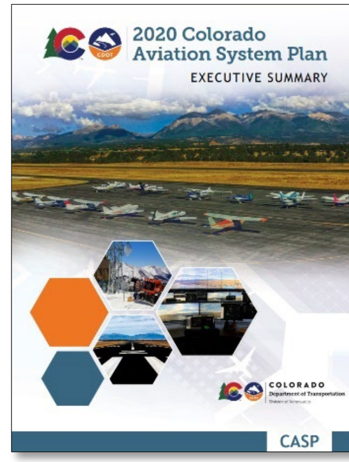
The 2016 Terminal Area Plan was a direct result of the 2014 EGE Airport Master Plan and considered planning requirements for elements of the commercial service terminal area, including the building, roadway network, and transportation facilities. A series of conceptual designs were evaluated and considered before establishing a project implementation plan for the future of the terminal building. Since this plan, the terminal has undergone an airside expansion project that created a new gate area for the airlines and passengers, while mostly leaving pre-screening areas untouched.

2016 EGE Terminal Area Plan

The 2016 Terminal Area Plan provided a series of valuable alternatives for future development around the commercial service components of the Airport. This AMP will directly address and update these areas of the plan to better match the aviation landscape and its changes over the past seven years.

4.1.3 2020 Colorado Aviation System Plan

The 2020 Colorado Aviation System Plan (CASP) established airport roles, performance measures, and facility and service objectives to evaluate all aeronautical facilities in CDOT's airport system. Having a defined role as a Commercial Service-level airport that has the most demanding facility and service objectives, EGE currently meets 20 of the 25 objectives (see **Figure 4-1**). Objectives that were identified as deficiencies include runway length (10,000' requirement), precision approach (ILS), runway markings (precision), apron tie downs (43 spaces needed), and electric vehicle charging stations. (It should be clarified while the Airport lacks a precision approach, its Runway 25 has precision approach runway markings. The Airport also has more than the 10 tiedowns identified in the table particularly when incorporating capacity provided by the fixed base operator (FBO); the Airport and its tenants actively work to provide appropriate tiedowns as required. Additionally, since the publishing of the plan in 2020, electric vehicle charging stations are progressively being installed on the Airport with the County managing four EV charging stations and two rental car companies currently operating a total of six additional stations.)



2020 Colorado Aviation System Plan

Figure 4-1: 2020 CASP - EGE Airport Report Card

Objective Category	Commercial Service Objective	Current Condition				Meets 2020 Objective?
Airfield						
ARC	C-III/C-II	D-IV				Yes
Runway Length	Align with Master Plan	9,000 feet (10,000 feet)				No
Runway Width	150 feet/100 feet	150 feet				Yes
Runway Strength	60,000 pounds	75,000 lbs SW; 140,000 DW; 255,000 lbs 2D				Yes
Taxiway	Full parallel	Full parallel				Yes
Runway Markings	Precision	Non-precision				No
Lighting/NAVAIDS						
Approach	Precision	Non-precision				No
Visual Aids	ALS, rotating beacon, lighted wind cone, REILs, VGSIs	MALSR, rotating beacon, lighted wind cone, REILs, VGSIs				Yes
Runway Lighting	HIRL or MIRL	HIRL				Yes
Weather Reporting	On-site ASOS or AWOS	AWOS-3PT				Yes
Airport Facilities						
Terminal (CS and/or GA)	Acceptable ratio of terminal square footage and commercial apron for passenger enplanements and commercial operations	Minimum required terminal square footage:	108,000 sq ft	Terminal building square footage:	120,000 sq ft	Yes
Apron Tie-Downs	Tie-downs for 20% of based aircraft fleet plus 50% of weekly average overnight transient storage during peak season	20% of based aircraft fleet plus 50% transient aircraft fleet:	43	Total tie-down spaces:	10	No
Hangars	Hangars for 80% of based aircraft fleet and 50% of weekly average overnight transient storage	80% of based aircraft fleet:	73	Number of based aircraft hangar spaces:	84	Yes
		50% of transient aircraft fleet:	24	Number of transient aircraft hangar spaces:	25	
Dedicated Maintenance/SRE Storage Building	Yes	Yes				Yes
Electric Vehicle Charging Stations	Yes	No				No
Perimeter Security	Full perimeter fencing with security gates and appropriate signage	Full perimeter fencing with security gates and appropriate signage				Yes
Services/Other						
Jet A Fuel	Full service	Full service				Yes
AvGas Fuel	Full service	Full service				Yes
Aircraft De-icing	De-icing facilities including fluid collection	De-icing facilities including fluid collection				Yes
Courtesy Car	Yes	Yes				Yes
Sustainability Plan	Yes	Yes				Yes
Minimums for All Airports						
Restroom (24-hr accessible) ✓	Cell Phone Service ✓	Airport Layout Plan (ALP) ✓				Wi-Fi Service ✓

Source: Image from CDOT 2020 CASP

The CASP is an important tool designed to help ensure safety, efficiency, and effectiveness of the state aviation system. The Airport must balance those development options presented in the CASP with the needs of its local user base, its projected growth, and any inherent physical limitations. Those deficiencies identified in the CASP should be considered where feasible in the CIP but should not necessarily take precedence over projects evaluated as part of this AMP.

4.1.4 2022 Tenant/User Survey

As part of this AMP, airport tenants and users were surveyed in the Fall 2022 through Spring 2023 so the Airport could better understand their current and anticipated use of EGE facilities. Questions for the survey were developed with a focus on several general user groups; responses are presented below based on these groups.

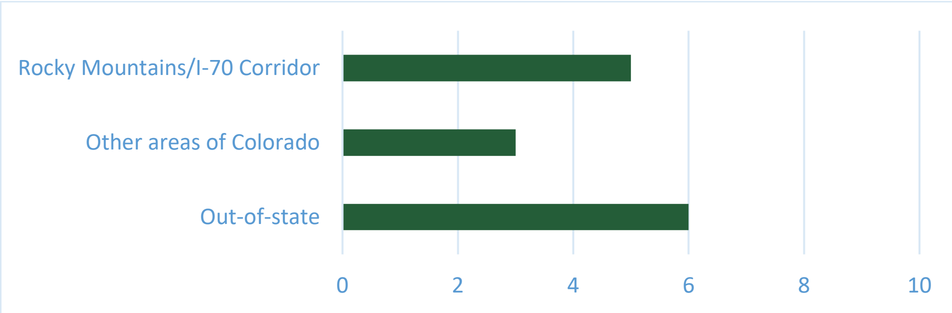
Pilots and Aircraft Owners

General aviation pilots and owners of aircraft at EGE were surveyed to gauge their use, the quality of current facilities at the Airport, as well as the need for future facilities. Of the 14 respondents, nine operated single-engine piston aircraft, three operated jets, while the two other respondents originated from the Army National Guard High-Altitude Aviation Training Site (HAATS) or did not indicate an aircraft type. Responses from pilots and aircraft owners are summarized in the following bullet points and figures.

- Eleven of 14 respondents indicated they anticipate their annual aircraft operations to increase.
- Ten of 14 respondents indicated they choose to fly out of EGE due to proximity and convenience.
- Six of 14 respondents indicated aircraft operating restrictions with examples varying between runway length, weather, terrain, activity levels, and aircraft storage capabilities.
- Eight respondents own hangars at the Airport while five lease a hangar at EGE. Eight respondents indicated they require additional hangar space, which was split evenly among owners and lessees.

Based on responses from pilots and aircraft owners as shown in **Figure 4-2**, the activity originating from EGE is not concentrated in any one market. This makeup of activity is likely representative of the mix of local pilots with aircraft that fly recreationally and others that may own or use aircraft for business or vacation travel.

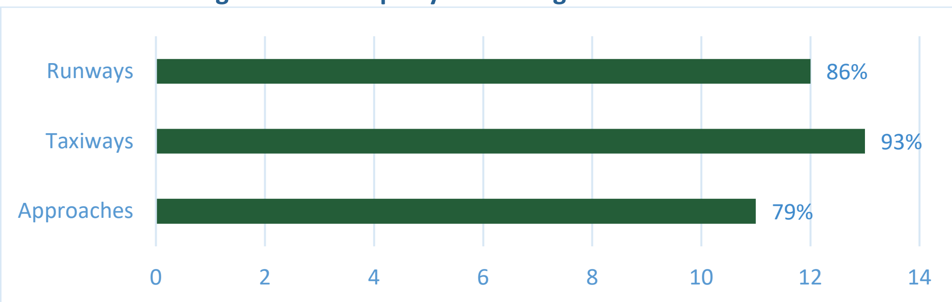
Figure 4-2: Pilot Activity by Geography



Source: Jviation, a Woolpert Company

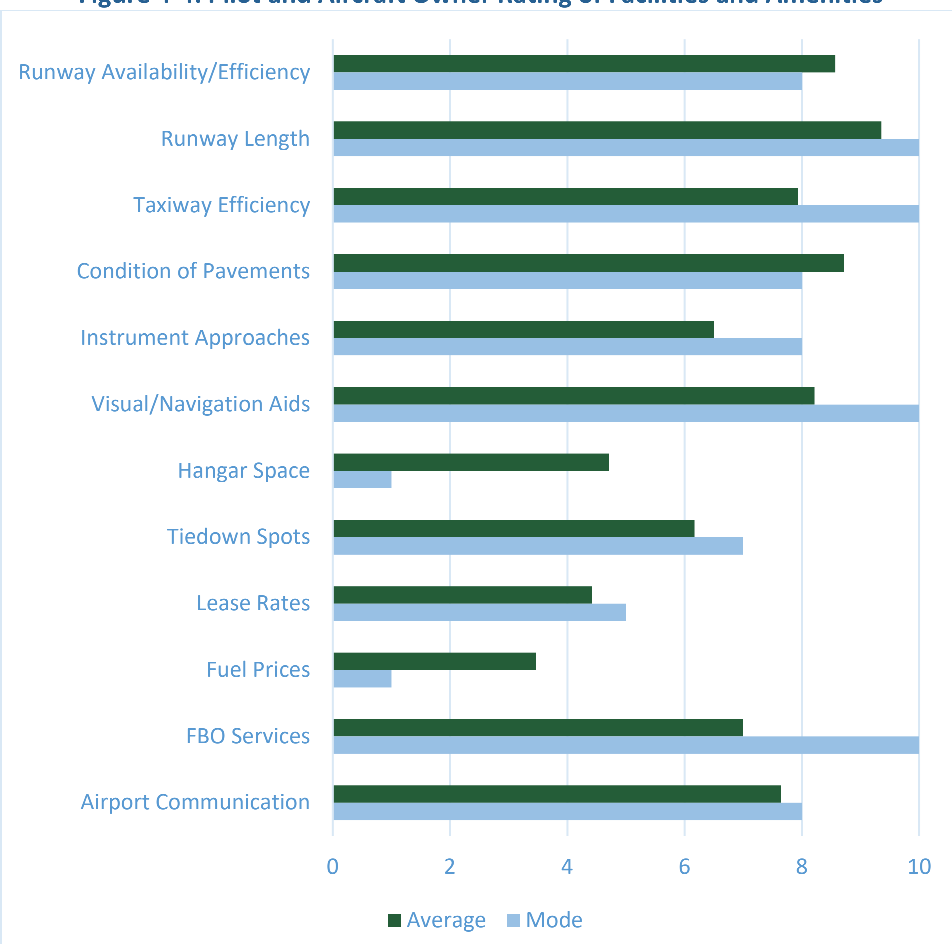
Pilots and aircraft owners were asked to assess the adequacy of the Airport's existing airfield facilities as well as to rank the quality of facilities and amenities on a scale of 1 to 10, with 10 being the highest quality. **Figure 4-3** presents respondents' results with respect to airfield facility adequacy while **Figure 4-4** provides the average response score and the mode (i.e., the ranking that appears the most) assessing the quality of each Airport's facility and amenity.

Figure 4-3: Adequacy of Existing Airfield Facilities



Source: Jviation, a Woolpert Company

Figure 4-4: Pilot and Aircraft Owner Rating of Facilities and Amenities



Source: Jviation, a Woolpert Company

As reflected in the responses, many of the pilots and aircraft owners at EGE generally have a positive view of the Airport's existing airside facilities. Elements that are directly in the Airport's ability to control such as the pavements, runway, taxiways, and navigational aids are all highly rated, whereas facilities that the Airport has limited ability to address due to terrain, spatial, administrative, and/or financial constraints (e.g., instrument approaches, fuel pricing, lease rates, aircraft storage availability, etc.) are generally lower rated.

Businesses and Terminal Tenants

EGE hosts a variety of businesses and tenants that include airlines, ground transportation service providers, concessionaires, as well as a wide range of general aviation support service providers. Survey responses for several of these tenants are detailed below.

Airlines – Five airline representatives responded to the survey and provided insights into potential areas of improvement available to the Airport. Three respondents stated that baggage carousel expansion was a necessary component of any terminal redevelopment while two respondents noted a general need for more space in the front of the terminal area. With specific regard to baggage, TSA screening capacity was listed as a primary concern, particularly during winter peak travel season. The overall lack of space including equipment parking and poor ventilation were also listed as concerns in the baggage makeup area.

Separate from the baggage and terminal space concerns, three respondents stated that there was a need for more jet bridge-equipped gates. Another highly specific request noted by two respondents included the need for an onsite lavatory waste dumping facility (otherwise known as a triturator) to adequately meet aircraft waste processing requirements.

Rental Cars – Six respondents from five different rental car agencies responded to the survey. Three of those respondents noted that the terminal counter areas either needed to be expanded or renovated based on existing use.

Other specific needs included the desire for a light maintenance area for oil and tire changes, an expansion of the ready/return lot, an increased number of electric vehicle charging stations, and an expansion of the carwash facility to improve capacity, efficiency, and processing rates. Gated exits were also noted as a potential improvement to assist management of the rental car parking lots.

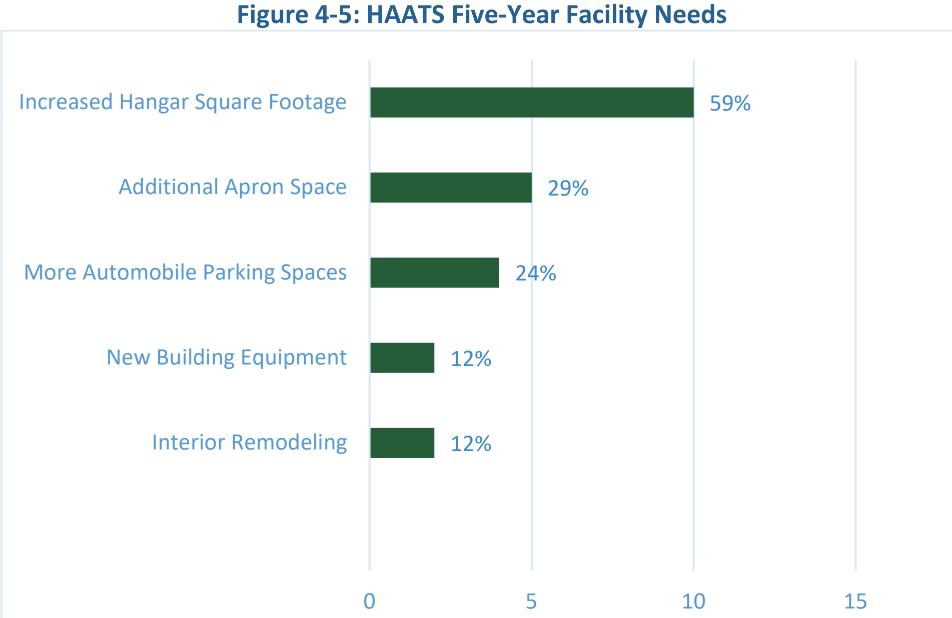
Other Businesses and Tenants – Other respondents noted the importance of the Airport in providing jobs to year-round members of the community and the connections the Airport provides to locations around the United States and throughout the world. One respondent noted the importance of the future parallel taxiway on the north side of the runway for expanding development area and providing additional airside connectivity and efficiency. The Airport's location as a primary access point to a world-renowned resort community was noted by multiple respondents. Conversely, that proximity has also led to concerns over the cost of living for employees working at the Airport in that wealthier visitors and secondhome owners often leads to corresponding increases in the cost of living for Eagle County and adjacent communities.

Army National Guard High-Altitude Aviation Training Site (HAATS)

Based on responses from personnel stationed at HAATS, the facility currently accommodates 35 employees and anticipates growth to 50 employees within the next five years. Responses from personnel are summarized in the following.

- All 17 respondents drive to and park an automobile at the Airport.
- Five of the 17 expressed interest in taking public transit or riding a bike to the Airport.
- When asked which type of bike facility would be most important in allowing them to ride to the Airport, 12 responded that a paved, non-motorized trail would be best.
- Twelve of the 17 respondents indicated that the HAATS space at EGE is sufficient for the organization's current needs. When asked if the space would be sufficient in five years, only 4 respondents indicated that the current space would be adequate. **Figure 4-5** summarizes responses with respect to facility needs over the next five years.

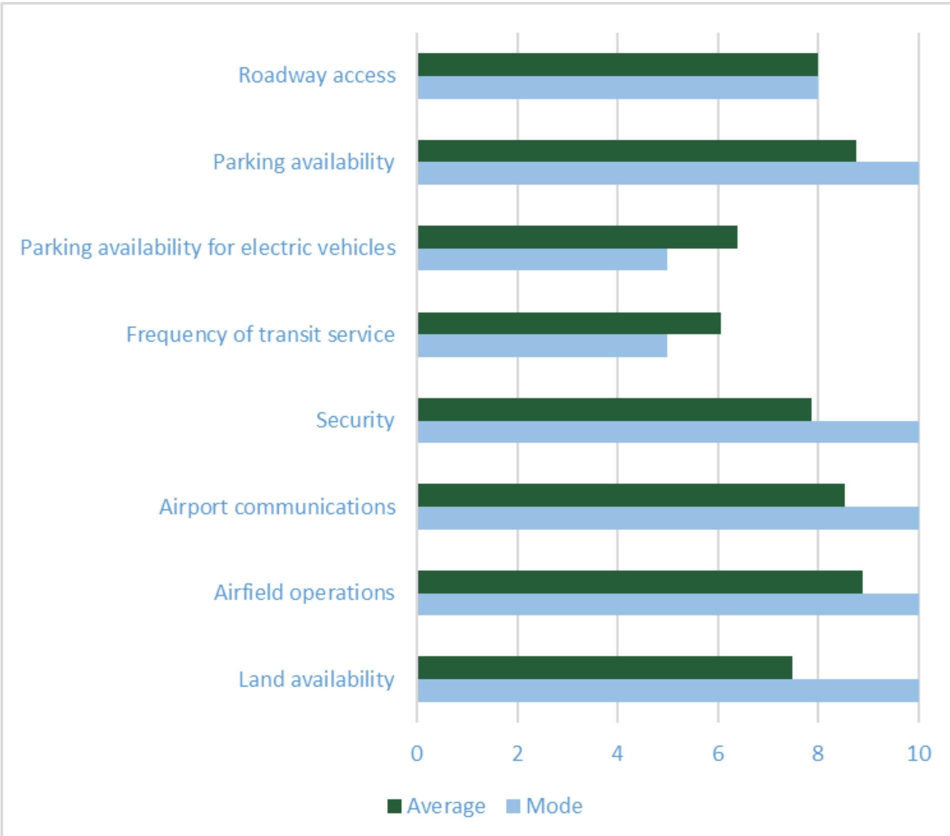
Figure 4-5: HAATS Five-Year Facility Needs



Source: Jviation, a Woolpert Company

HAATS personnel were also asked to rank the quality of facilities and amenities on a scale of 1 to 10, with 10 being the highest quality. Concerns regarding parking for electric vehicles as well as the cost of parking were noted as needing improvement by respondents. Availability of public transit was also noted, but based on responses to interest in public transit, this does not appear to a major concern among respondents. **Figure 4-6** provides the average response rank as well as the mode for each category.

Figure 4-6: HAATS Rating of Facilities and Amenities



Source: Jviation, a Woolpert Company

Commercial Passengers

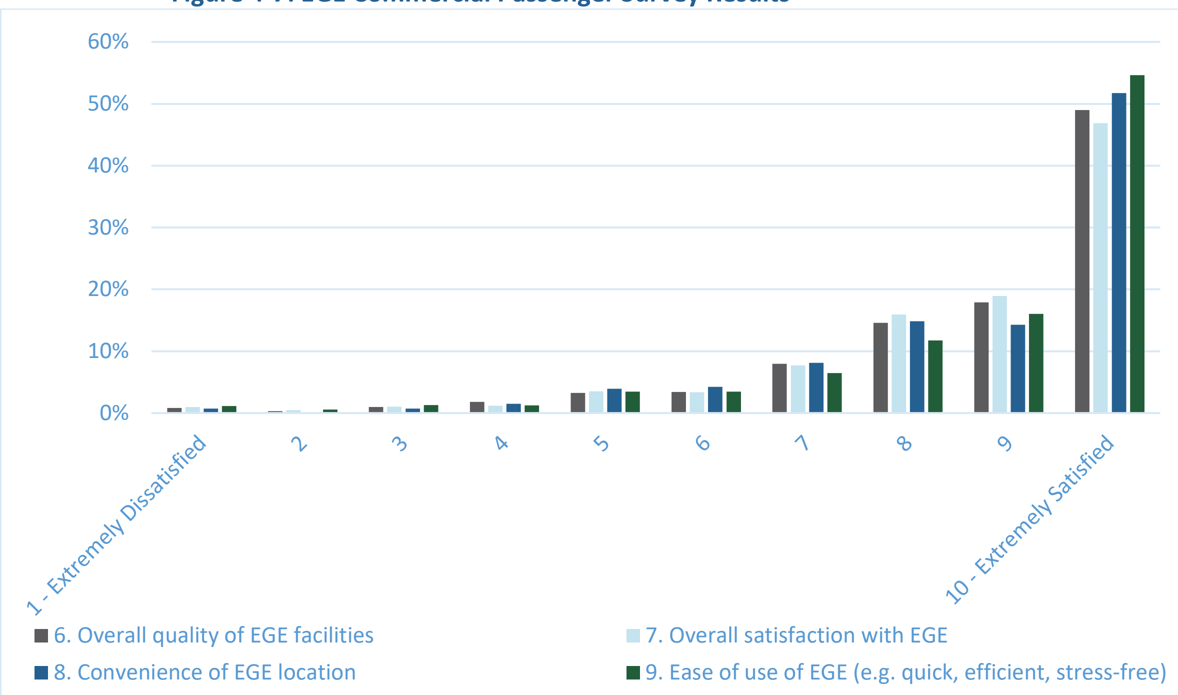
A survey focused on commercial passengers was published on the Airport's Wi-Fi within the commercial terminal building during the peak winter travel season in 2022/2023. Nine specific data points were requested of those taking the survey for which a total of 40,892 responses were solicited. The nine data requests are listed below:

1. How did you get to EGE today?
2. How much interest would you have in using the local public bus (ECO Transit) or other shared ride service to get to/from EGE in the future?
3. Recognizing that there are other airports in the region, why did you choose EGE for this trip?
4. (If you have used other airports) Why did you use other airports on those trips to/ from Eagle County?
5. Were you aware that EGE is a financial supporter of the Good Traveler Program, which helps airports and travelers offset the carbon impacts of travel?
6. Please rate your satisfaction with the overall quality of EGE facilities

7. Please rate your satisfaction with your overall satisfaction with Eagle County Regional Airport
8. Please rate your satisfaction with the convenience of EGE location
9. Please rate your satisfaction with the ease of use of EGE (e.g., quick, efficient, stress-free)

Of those nine data points, the last four have the greatest potential to provide direct input into this Airport Master Plan. The results of those data points are presented in **Figure 4-7**. In general, it can be stated that EGE commercial service passengers are currently very satisfied with the quality, convenience, and ease of use of the Airport.

Figure 4-7: EGE Commercial Passenger Survey Results



Source: EGE; Jviation, a Woolpert Company

Additionally, of the 487 specific comments received from passengers, the majority largely centered on the following:

- Reducing security wait times
- Adding food service and concession options
- Reducing baggage claim wait times and congestion
- Suggestions related to various specific service improvements
- A wide range of facility and service complements

The following word cloud also provides a visual representation of those comments (see **Figure 4-8**). The cloud shows words mentioned at least three times and the size of the word is proportionate to the number of times a word is used.

Figure 4-8: EGE Commercial Passenger Survey Results – Word Cloud

Source: EGE; Jviation, a Woolpert Company

The Tenant and User Surveys provide valuable insights from those that use the Airport's facilities most frequently. Incorporating this feedback into considerations during the development of alternatives will help ensure that user desires and concerns regarding airport facilities and operations are addressed in the AMP.

4.2 AIRFIELD FACILITY REQUIREMENTS

An airport's airfield or airside is generally comprised of runway(s), taxiways, aprons, and critical elements that directly support their operation.

Appropriate airfield facilities are needed to accommodate aeronautical activities at airports in a safe, efficient, and effective manner. These must meet the requirements associated with existing and future activity levels and types, various other airfield component requirements, as well as being consistent with current local, state, and federal design standards. Airfield facilities generally include those that support the transition of aircraft between flight and ground operations and/or the movement of aircraft between parking/storage areas and appropriate flight operation facilities (i.e., runways). Note that the planning and design of an airport is primarily based on an airport's role, number of annual and peak hour operations, and the design aircraft that use the facility.

This section of the AMP examines factors influencing the existing layout and design of airfield facilities to identify current and future facility requirements. Airfield facility requirements have been developed for the following airfield functional components:

- Airport Climatology
- Airfield Capacity
- Critical Aircraft and Airport Reference Code (ARC)
- Runway System

- Taxiway System
- Airfield Safety Areas
- Part 77 Surfaces
- Navigational Aids
- Airfield Marking, Lighting, and Signage

4.2.1 Airport Climatology

Understanding the climate is critical for safe aircraft operations in that pilots rely on historical and real-time weather reporting to safely plan flights and evaluate their aircraft's performance at a given airport. Climatology at an airport influences a variety of design and layout decisions ranging from runway alignment to positioning of hangar doors. Weather is particularly important at EGE given its extreme weather conditions, high elevation, single runway, and challenging mountainous terrain.

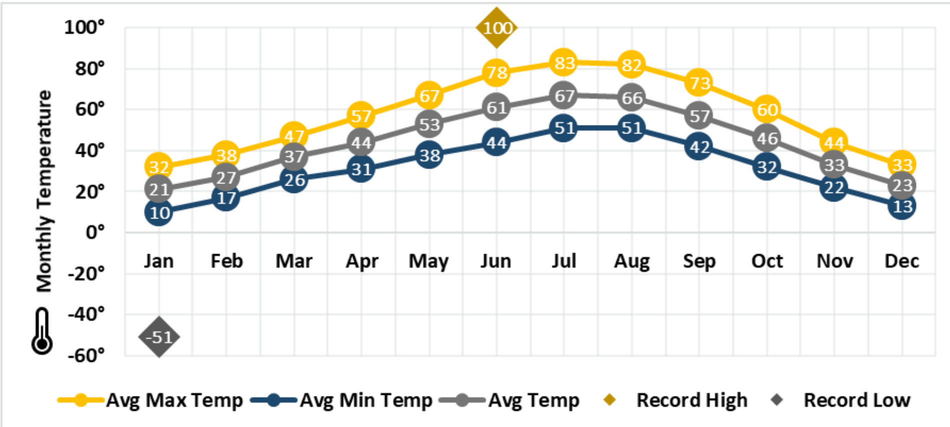
Temperature and Precipitation

National Oceanic and Atmospheric Administration (NOAA) weather data for EGE was collected and analyzed for a 30-year window from 1980 through 2010 (note that newer data was not available from NOAA for these metrics.[1]) Based on this data, the hottest day of the year at EGE occurs in July with an average high of 83°F and average low of 51°F while the coldest day usually occurs in January with an average high of 32°F and low of 10°F (see **Figure 4-9**). The highest temperature recorded at EGE was 100°F in June 1990, while the lowest recorded temperature was -51°F in January 1963.

Snow and precipitation at EGE will vary significantly throughout the year. Historically, the largest amounts of snow have fallen in December followed by November and February (**Figure 4-10**). Total monthly precipitation that includes snow and other weather events at EGE are shown in **Figure 4-11** (a rule of thumb is that 12 inches of snow equals 1 inch of liquid precipitation). Despite the typical significant snow fall totals experienced at EGE during the winter, the wettest month in terms of precipitation totals is July followed by September, April, and October, with each month averaging more than an inch of precipitation.

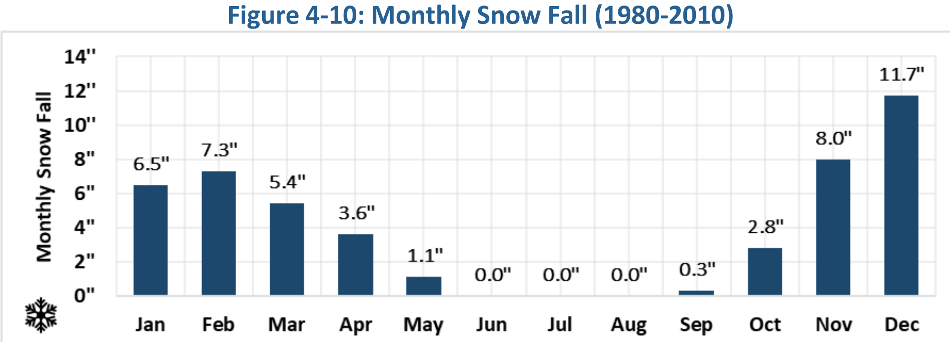
[1] https://www.ncei.noaa.gov/products/land-based-station/us-climate-normals

Figure 4-9: Monthly Temperature (1980-2010)



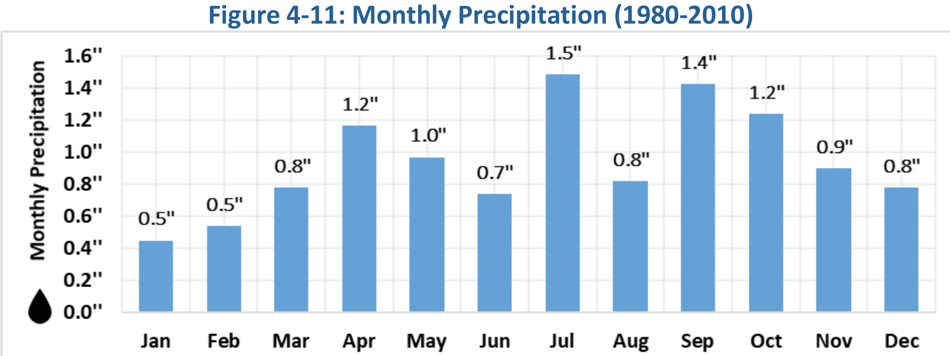
Source: NOAA

Figure 4-10: Monthly Snow Fall (1980-2010)



Source: NOAA

Figure 4-11: Monthly Precipitation (1980-2010)



Source: NOAA

Clouds and Visibility

Understanding cloud cover and horizontal visibility at an airport is important in that it is a critical factor in determining if a pilot will be able to land at or depart from that airport. A cloud ceiling is the height of the base of the lowest clouds that covers more than half of the sky. For pilots using the automated weather data read out, the ceiling is the lowest measured *overcast* or *broken* cloud layer. When there is no measurable cloud ceiling, the sky is defined as *clear*. Horizontal visibility is simply the greatest distance (how far) an object can be seen on the ground. Listed in **Table 4-1** are the visibility and ceiling criteria for the four common flight rule categories.

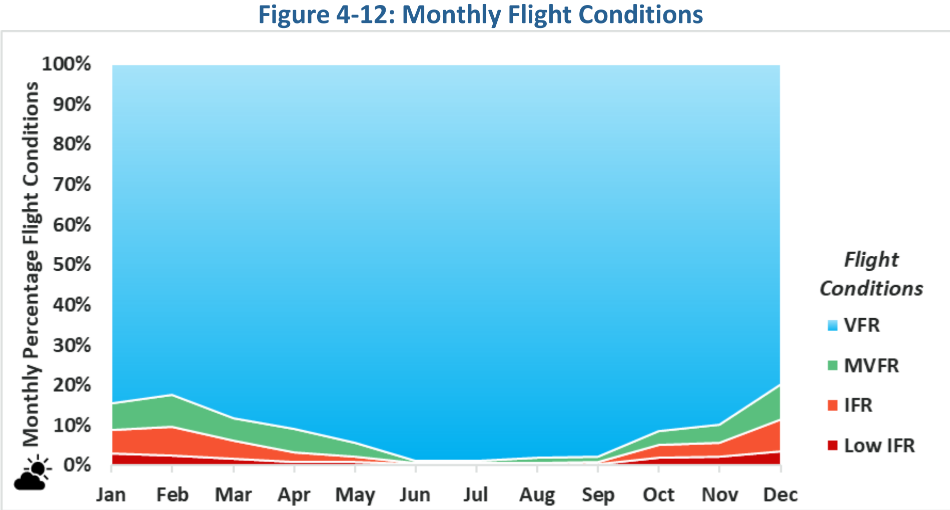
Table 4-1: Visibility and Ceiling Criteria

Category	Horizontal Visibility	Cloud Ceiling
Visual Flight Rules (VFR)	Greater than 5 miles	3,000’ and above
Marginal Visual Flight Rules (MVFR)	3 miles to 5 miles	1,000’ to less than 3,000’
Instrument Flight Rules (IFR)	1 mile to less than 3 miles	500’ to less than 1,000’
Low Instrument Flight Rules (LIFR)	Less than 1 mile	Less than 500’

Source: FAA

Incremental data from January 2012 through September 2022 were obtained from the EGE AWOS, and these data were cleaned and then analyzed. Depicted in **Figure 4-12** is the percentage of time within each month that the weather conditions were VFR, MVFR, IFR, and LIFR.

Figure 4-12: Monthly Flight Conditions



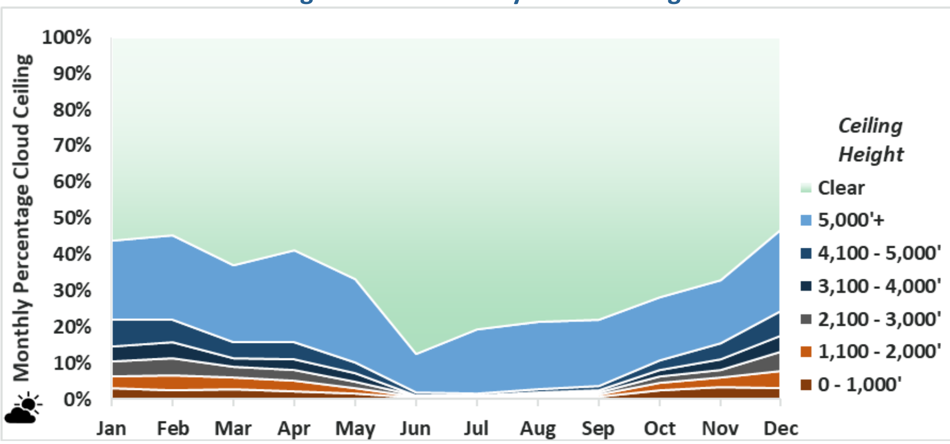
Source: EGE; Jviation, a Woolpert Company

Generally, the summer months (June, July, and August) have a higher percentage of VFR conditions. Winter months tend to have the highest percentage of IFR and LIFR conditions: January (8.8%), February (9.7%), December (11.5%). Averaged across the entire year, EGE conditions were VFR 91.4% of the time, MVFR 4.2%, IFR 3.0%, and LIFR 1.4%. More than 90% of the time, conditions at EGE permit flights under visual rules.

For pilots flying during reduced visibility, certain instrument approach procedures to the airport have ceiling requirements; this requires clouds to be above a certain height to allow an aircraft to land. Thus, examining typical height cloud bases is useful to determine if improved approaches may be beneficial. The cloud ceiling height, defined as when the clouds are overcast or broken, is measured in feet above ground level (AGL) of the airport.

Cloud cover at EGE varies throughout the year with clearer conditions and higher clouds prevailing from June through September (**Figure 4-13**). The winter and spring months have the lowest percentage of clear skies and highest occurrence of low cloud layers.

Figure 4-13: Monthly Cloud Ceiling

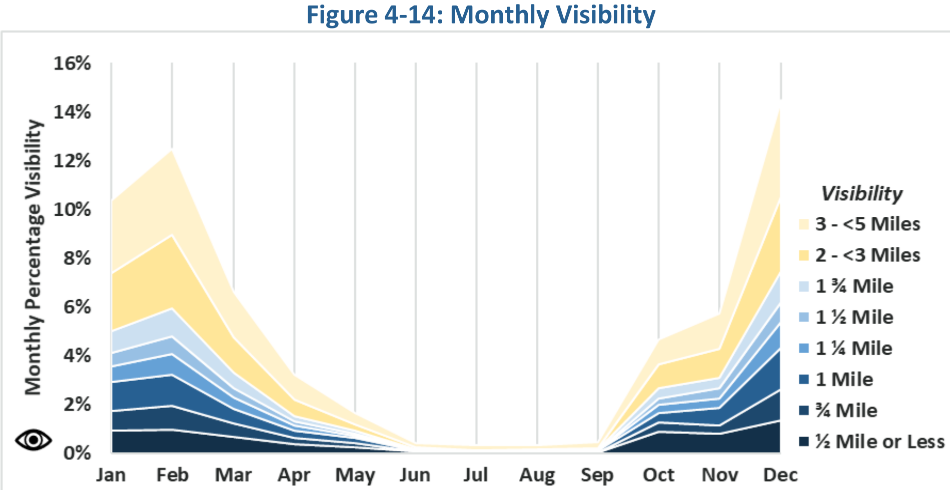


Source: EGE; Jviation, a Woolpert Company

Over the past decade, EGE has experienced clear skies 68 % of the time with an overcast or broken cloud cover at 32%; however, the cloud ceiling was below 5,000' AGL only 12% of the time. When the sky was not clear, the cloud ceiling was most often between 5,000' to 25,000' (20% of the time), followed by a ceiling between 4,100' to 5,000' (3%), 3,100' to 4,000' (2%), 2,100' to 3,000' (2%), 1,100' to 2,000 (2%), and 1,000' and below (2%).

Similar to cloud cover, instrument approach procedures also have visibility minimums. **Figure 4-14** charts the monthly percentage of time each visibility range occurred at EGE. To visualize the small differences between groups, this chart does not include when visibility was five miles or greater; on average, visibility at EGE was beyond five miles 95.1% of the time.

Figure 4-14: Monthly Visibility

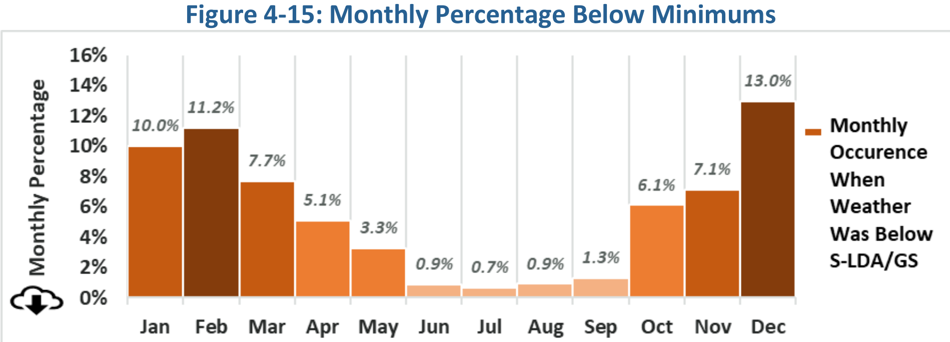


Source: EGE; Jviation, a Woolpert Company

Just as with cloud cover, the summer months provide the best visibility. During these months (June, July, August, and September), the visibility was below 1-mile only 0.03% of the time. During the busy winter months (December, January, and February), the visibility was below 1-mile 2.1% of the time.

For an instrument rated pilot to employ an instrument approach procedure, the minimums of both the ceiling and visibility must be met - if either one is below the procedure's minimums, it cannot be utilized. Thus, combining when either the ceiling or visibility are limiting factors results in determining how often a landing at EGE is not possible. **Figure 4-15** presents the percentage of time each month that either the cloud ceiling and/or visibility were below the lowest published minimums to EGE's public published instrument approach procedure for Runway 25 (S-LDA/GS). (It should be noted that EGE is currently working to establish new public approaches with lower minimums; these are anticipated to be published in 2023 and 2024. Additionally, there are privately-developed approach procedures at EGE with lower approach minimums, but they are not available for use by the public.)

Figure 4-15: Monthly Percentage Below Minimums



Source: EGE; Jviation, a Woolpert Company

As shown above, the months of December, February, and January had the highest percentages of time (at 13.0%, 11.2%, and 10.0%, respectively) when the conditions were below the published minimums for that instrument approach procedure. The summer months had extremely low percentage of times (from 0.7% in July to 1.3% in September) when the cloud ceiling and visibility were below the minimums.

Over the course of the entire year, the cloud cover and/or visibility was below the lowest public instrument approach minimums an average of 5.5% of the time with the most impacted months being the busy winter tourist season. This indicates that the Airport experiences notably worse weather when aircraft activity demand is highest; **thus, there is a need for improved public instrument approach procedures at EGE that have lower cloud and visibility minimums.**

Wind Direction, Speed, and Gusts

Aligning the primary runway of an airport with the predominant wind direction increases the safety of operations and makes landing and taking-off easier for pilots. An understanding of the local airport's wind conditions provides insight into potential pilot behaviors, such as favoring certain runway ends, and justification for airport improvements to assist landing and taking off.

Heavily influenced by the surrounding mountainous terrain, the prevailing winds at EGE are reflected in a heat map below (**Figure 4-16)**. Each column represents 100% of the observations of wind in that speed category (0-3 knots, 4-6 knots, etc.). Yellow represents the most common directions for a given speed category with blue representing the least common. The heat map coloring visualizes how the winds at lower speeds (i.e., less than five knots which is approximately 62% of the time) are more evenly dispersed. As wind speed increases, wind direction tends to become more focused, originating from fewer directions.

Aircraft operate most safely when they fly into the wind; thus, airports are specifically designed to maximize the amount of time aircraft will fly into the airport area's prevailing winds.

Figure 4-16: Wind Direction and Speed Heat Map

Wind Direction	Wind Speed (knots) 1 - 3	4 - 6	7 - 10	11 - 16	17 - 21	22+
0 - 10°	0.7%	0.5%	0.5%	0.4%	0.2%	0.1%
10 - 20°	0.7%	0.6%	0.5%	0.5%	0.2%	0.1%
20 - 30°	1.0%	0.8%	0.5%	0.4%	0.2%	0.1%
30 - 40°	1.6%	1.0%	0.7%	0.4%	0.2%	0.1%
40 - 50°	2.1%	1.5%	1.1%	0.4%	0.2%	0.0%
50 - 60°	3.0%	3.5%	2.4%	1.0%	0.4%	0.1%
60 - 70°	4.6%	5.9%	6.3%	2.2%	0.4%	0.1%
70 - 80°	6.5%	9.7%	11.2%	2.9%	0.7%	0.1%
80 - 90°	8.3%	11.8%	12.1%	2.7%	0.7%	0.2%
90 - 100°	8.9%	11.5%	7.8%	1.4%	0.2%	0.3%
100 - 110°	9.1%	9.1%	4.2%	0.8%	0.3%	0.1%
110 - 120°	8.5%	6.0%	1.8%	0.3%	0.3%	0.3%
120 - 130°	6.2%	3.7%	0.9%	0.3%	0.1%	0.3%
130 - 140°	4.8%	2.3%	0.7%	0.5%	0.2%	0.2%
140 - 150°	3.9%	1.8%	0.6%	0.3%	0.1%	0.2%
150 - 160°	3.0%	1.4%	0.6%	0.3%	0.2%	0.3%
160 - 170°	2.3%	1.3%	0.6%	0.4%	0.3%	0.3%
170 - 180°	1.6%	1.2%	0.7%	0.6%	0.5%	0.5%
180 - 190°	1.4%	1.0%	0.9%	0.9%	0.9%	0.8%
190 - 200°	1.3%	1.3%	1.6%	2.3%	3.3%	2.8%
200 - 210°	1.2%	1.3%	2.3%	5.3%	7.8%	8.4%
210 - 220°	1.2%	1.4%	3.3%	8.3%	13.0%	14.6%
220 - 230°	1.2%	1.6%	4.2%	11.2%	14.9%	20.8%
230 - 240°	1.3%	1.8%	4.4%	10.6%	15.3%	17.5%
240 - 250°	1.8%	2.3%	5.2%	10.1%	10.9%	12.3%
250 - 260°	2.2%	2.8%	4.9%	7.9%	8.0%	5.5%
260 - 270°	2.2%	2.9%	4.8%	7.5%	6.7%	4.2%
270 - 280°	1.8%	2.4%	4.8%	7.0%	4.9%	2.9%
280 - 290°	1.6%	1.8%	3.6%	4.7%	3.2%	1.8%
290 - 300°	1.3%	1.5%	2.2%	3.1%	1.3%	0.9%
300 - 310°	1.1%	1.2%	1.5%	1.7%	1.6%	1.6%
310 - 320°	1.1%	0.9%	1.2%	1.2%	0.8%	0.4%
320 - 330°	1.0%	0.7%	0.7%	0.8%	0.8%	0.7%
330 - 340°	0.7%	0.5%	0.5%	0.9%	0.5%	0.7%
340 - 350°	0.6%	0.5%	0.4%	0.6%	0.2%	0.2%
350 - 360°	0.6%	0.5%	0.4%	0.4%	0.2%	0.1%

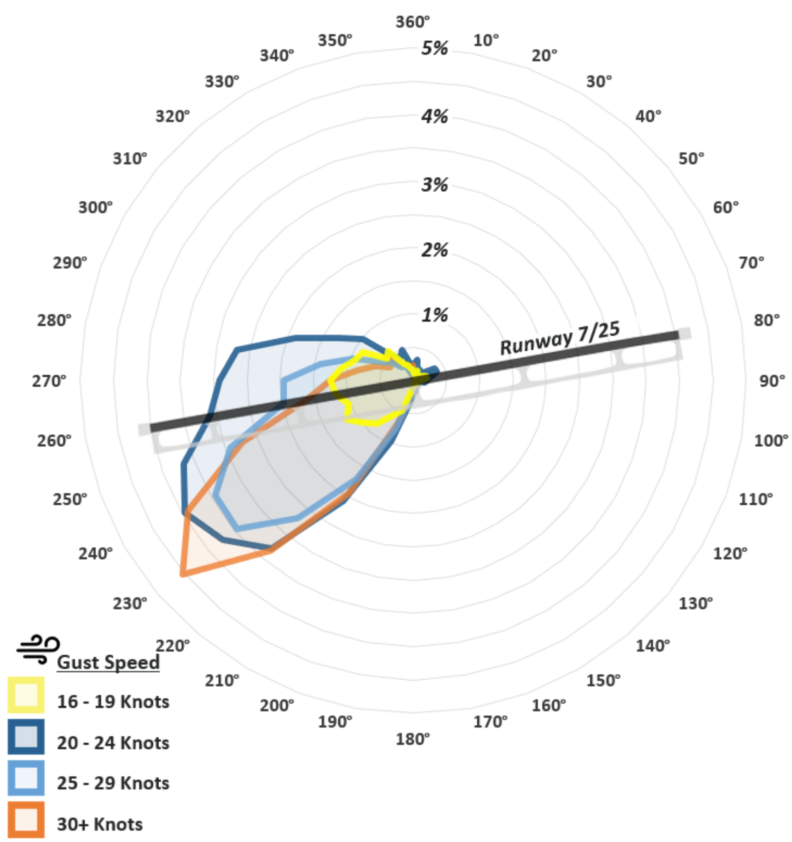
Source: FAA ADIP; Jviation, a Woolpert Company

About 80% of the strongest winds (i.e., 17 knots or greater) originated between 210° and 270°. As wind speeds increase, the direction tends to move more in alignment with EGE's Runway 7-25. Lower and moderate winds are more likely to be severe crosswinds.

Wind gusts are an additional challenging variable pilots must incorporate when landing or taking-off, and are characterized by rapid fluctuations in the wind speed with a variation of 10 knots or more between peaks and lulls. In the past decade, the highest recorded gust at EGE was 81 knots in February 2016. Typical wind gust patterns are charted in **Figure 4-17** which breaks down recorded gusts into four speed categories: 16-19 knots, 20-24 knots, 25-29 knots, and 30 and above knots. Winds under 15 knots are not categorized as gusts. The runway configuration at EGE is overlaid for reference.

For the lower gust speeds, those between 16-19 knots and 20-24 knots, the direction is typically from the west, primarily from the southwest but also occasionally from due west and northwest. As gust speed increases, 25 knots and faster, the direction shifts to primarily southwest. For the highest strength gusts, pilots are likely to be dealing with partial crosswinds. This is an indication of the importance of runway width to provide a higher margin of safety to pilots since a crosswind runway is not present nor feasible at the Airport.

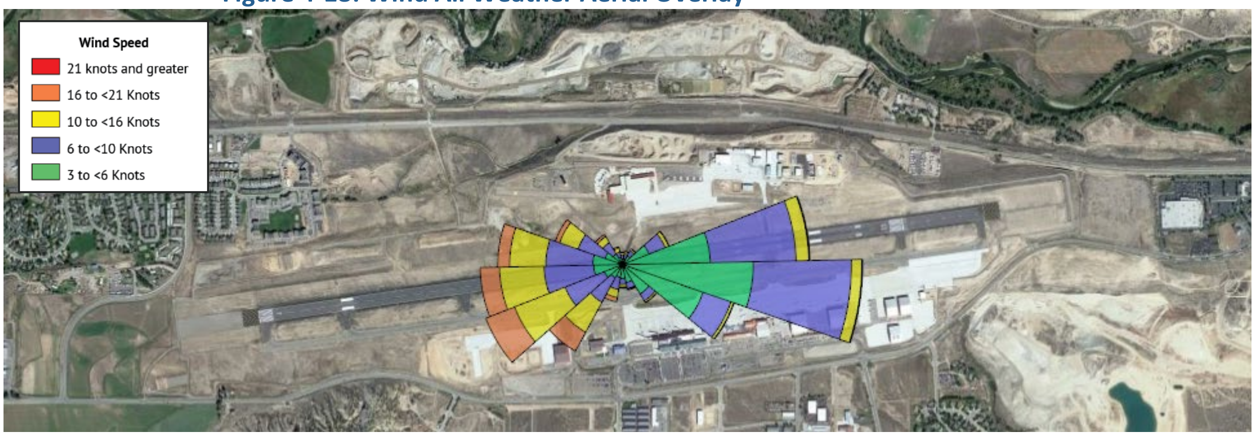
Figure 4-17: Gust Direction Map



Source: FAA ADIP; Jviation, a Woolpert Company

Wind direction and speed can be graphically overlaid on an aerial image of the Airport to visualize how winds align with the runway and neighboring terrain and development. **Figure 4-18** provides a visual representation of winds during all weather conditions and demonstrates that the majority of winds originate from the west or east, with stronger winds more often from the west. This data covers the period from January 2012 through September 2022. Generally, when the wind is blowing, it is aligned or at least partially aligned with the runway. Note that the wind favors using Runway 7 only 1% of the time when winds are above 10 knots.

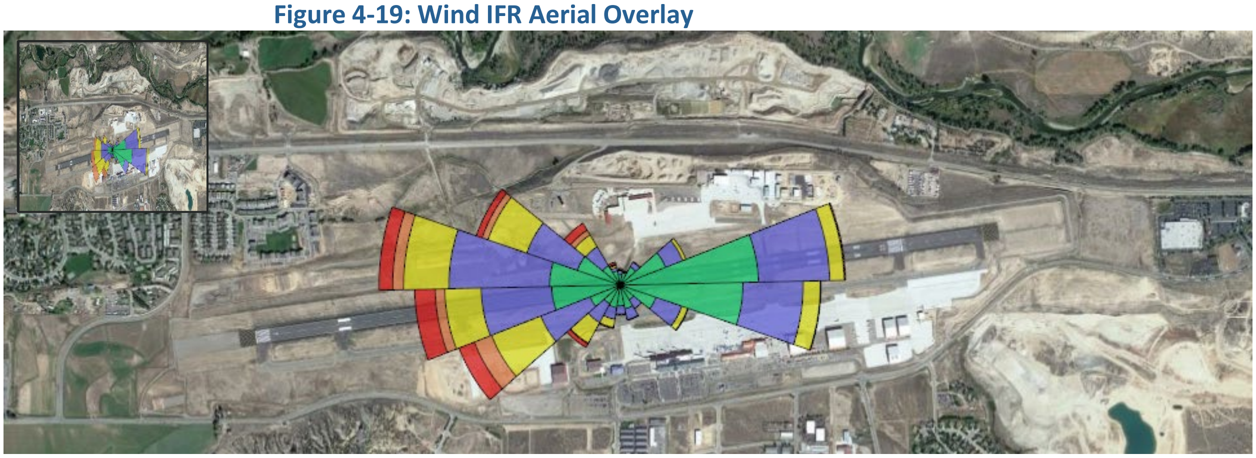
Figure 4-18: Wind All Weather Aerial Overlay



Source: FAA ADIP; Jviation, a Woolpert Company

Figure 4-19 overlays wind speed and direction during all IFR conditions. These are times when the weather is more challenging for pilots and accommodating crosswinds are critical. There is a notable change in wind direction during IFR weather, as the stronger wind blows from the west still, but with more northwest directions than during all weather conditions.

Figure 4-19: Wind IFR Aerial Overlay



Source: FAA ADIP; Jviation, a Woolpert Company

Crosswind Coverage

FAA Advisory Circular 150/5300-13B, *Airport Design*, states that "The desirable wind coverage for an airport is 95% of the time based on the total number of weather observations during the recording period of at least ten consecutive years." To calculate crosswind coverages, wind data from NOAA's Integrated Surface Database (ISD) was downloaded from the FAA's Airport Data and Information Portal (ADIP). The FAA's ADIP is the official source of wind data for runway wind coverage calculations. This data includes hourly observations from the on-site AWOS over a 10-year span from 2013 through 2022.

Listed in **Table 4-2** are the FAA allowable crosswind component speeds for each runway design code. Based on the diverse traffic that historically operates at EGE, the 10.5-, 13-, 16-, and 20-knot crosswind components are all applicable.

Table 4-2: Crosswind Components

Runway	Allowable Crosswind Component
A-I and B-I (including small aircraft)	10.5 knots
A-II and B-II	13 knots
A-III, B-III, C-I through D-III, D-I through D-III	16 knots
A-IV and B-IV, C-IV through C-VI, D-IV through D-VI	20 knots

Source: FAA

Runway 7-25 is typically operated as unidirectionally, with flights arriving from the east to Runway end 25 and departing to the west. This also coincides with the majority of the wind, especially stronger winds and gusts. Arrivals from the west or departures to the east are especially challenging due to the terrain, wind, and lack of procedures.

Wind data from a 10-year timeframe is used to establish crosswind coverage for the runway. If the primary runway does not provide a minimum of 95% wind coverage, a crosswind runway may be warranted.

Although rare, aircraft can operate from Runway 7 under specific circumstances. If such a flight utilizing Runway 7 must be accommodated, other flights within 60 miles must be notified and placed in a holding pattern. This creates delays and can increase the chance for a diversion. As such, the crosswind component calculations were performed with Runway 7-25 designated as both bidirectional and unidirectional.

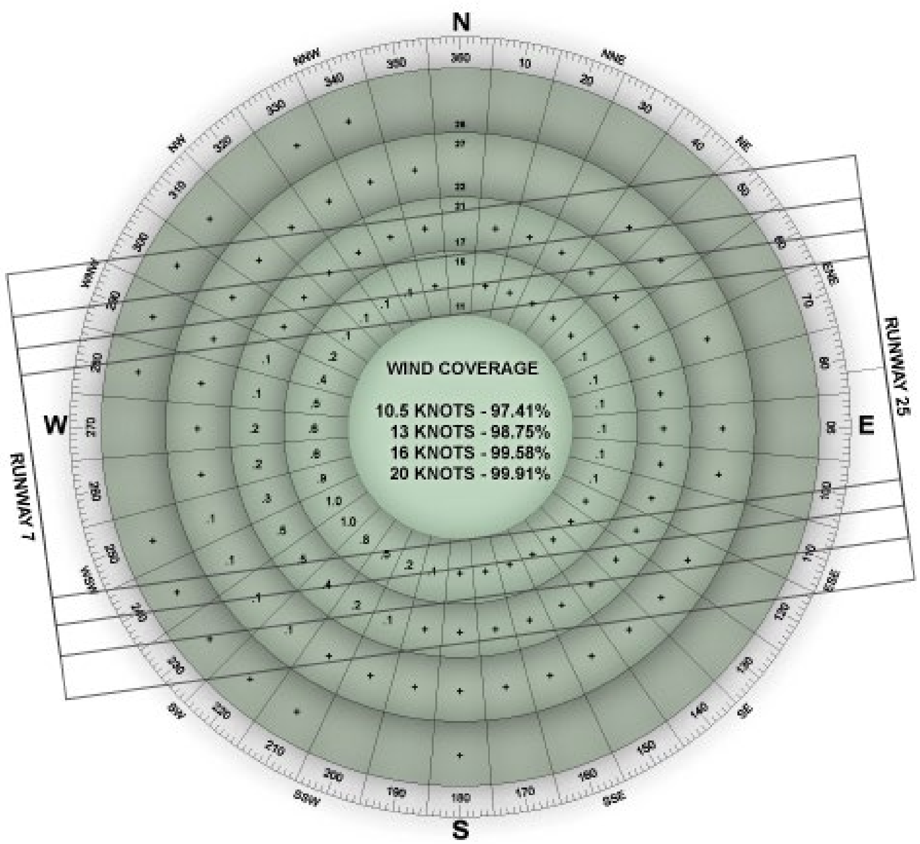
Table 4-3 lists the calculated crosswind coverages provided by Runway 7-25 under multiple weather scenarios. During All Weather, IFR, and VFR conditions, as a unidirectional runway, Runway 7-25 falls well short of the recommended 95% crosswind coverage. When operated bidirectionally, Runway 7-25 surpasses the 95% threshold in all scenarios. Wind roses for Runway 7-25 as bidirectional during all weather and IFR conditions are included in **Figure 4-20** and **Figure 4-21**.

Table 4-3: Crosswind Component Wind Coverage

Conditions	10.5 Knots	13 Knots	16 Knots	20 Knots
Bidirectional Runway				
All Weather: Runway 7-25	97.41%	98.75%	99.58%	99.91%
IFR: Runway 7-25	98.64%	99.33%	99.74%	99.94%
VFR: Runway 7-25	97.35%	98.72%	99.58%	99.91%
Unidirectional Runway				
All Weather: Runway 7-25	71.26%	71.38%	71.48%	71.51%
IFR: Runway 7-25	68.26%	68.30%	68.33%	68.33%
VFR: Runway 7-25	71.45%	71.57%	71.67%	71.71%

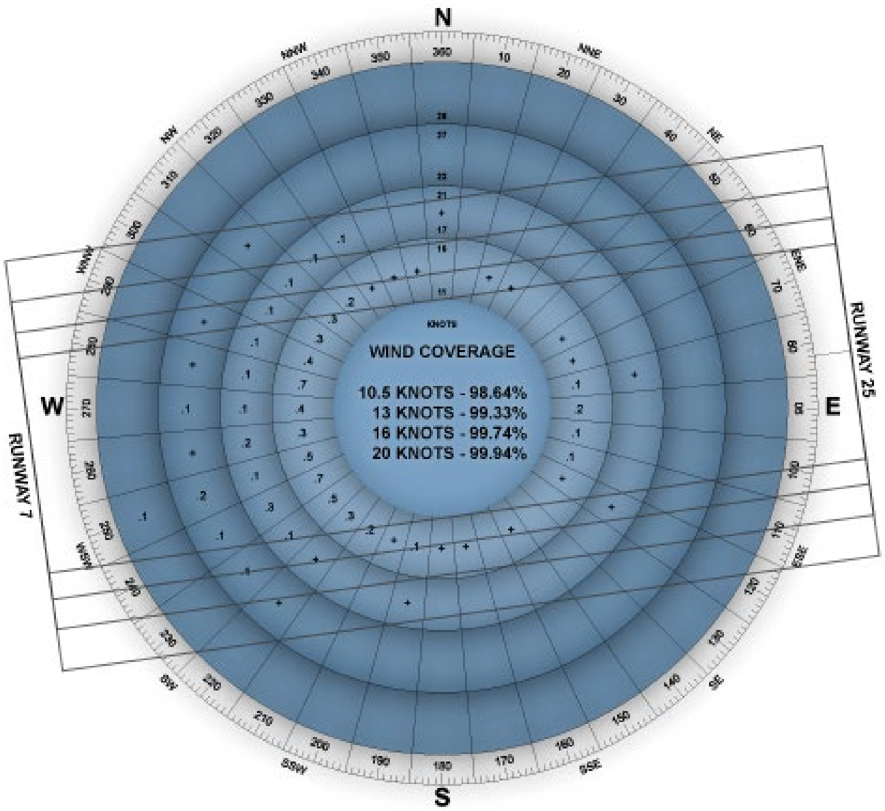
Source: FAA ADIP

Figure 4-20: All Weather Bidirectional



Source: FAA ADIP

Figure 4-21: IFR Wind Rose Bidirectional



Source: FAA ADIP

The weather analyses demonstrate the absolute need for Runway 7-25 at EGE to be kept and maintained to a level that serves all traffic, with enhancements, such as additional runway width and approach lighting, wherever possible. No crosswind coverage is warranted at EGE.

4.2.2 Airfield Capacity

Airfield capacity generally refers to the maximum number of aircraft operations (takeoffs and landings) that an airfield can accommodate within a given time period under specific conditions, including VFR and IFR conditions.

The potential implications of future activity levels on airfield capacity, congestion, and delay are important considerations in identifying future facility development plans at EGE. Airfield capacity is defined as the maximum number of aircraft operations that an airfield configuration can accommodate during a specified interval of time when there is continuous demand for service (i.e., an aircraft is always waiting to depart or land). This is referred to as the airfield's ultimate capacity or its maximum throughput rate. In lay terms, this refers to how many aircraft operations a particular airport can accommodate before arrival or departure delays become problematic or unreasonable.

The methodology used in this AMP focuses on Annual Service Volume (ASV), a term commonly used by FAA as a quantifiable measure of an airport's annual operating capacity as well as its VFR and IFR hourly capacities (note that these various capacities are not based on the current specific circumstances of EGE, rather they are based on generalized airfield modeling of airports with similar airfield configurations). It is an important tool in the short- and long-range planning process. As described in FAA AC 150/5060-5, the FAA's long-range planning model for determining airfield capacity combines standardized runway-use configurations with the Airport Fleet Mix Index to determine airport capacity and ASV.

Runway Configuration No. 1 from FAA AC 150/5060-5

Based on the Airport's operation with a single runway, the capacity figures for that configuration are described in **Table 4-4**. Additionally, its Airport Fleet Mix Index has been calculated to be 70, meaning that its ASV is 205,000 operations. While EGE's total annual operations are projected to increase from 55,974 in 2022 to 68,648 in 2042, these totals remain far below the ASV as calculated by the FAA. **Table 4-5** compares the current (estimated) and projected level of operations at EGE against the ASV over the planning period.

Table 4-4: Runway-Use Configuration and Capacity

Airport Fleet Mix Index	Hourly Capacity Ops/Hr (VFR)	Hourly Capacity Ops/Hr (IFR)	Annual Service Volume (ASV)
0-20	98	59	230,000
21-50	74	57	195,000
51-80	63	56	205,000
81-120	55	53	210,000
121-180	51	50	240,000

Source: FAA AC 150/5060-5, Airport Capacity and Delay, Figure 2.1

Table 4-5: Airfield Demand v. Capacity

Year	Projected Operations	ASV	Ratio of Annual Demand to ASV
2022	55,974	205,000	27.3%
2027	63,165	205,000	30.8%
2032	64,993	205,000	31.7%
2037	66,821	205,000	32.5%
2042	68,648	205,000	33.5%

Source: FAA AC 150/5060-5, Airport Capacity and Delay;, Jviation, a Woolpert Company

FAA Order 5090.3B, *Field Formulation of the National Plan of Integrated Airport Systems (NPIAS)*, indicates that improvements for airfield capacity purposes should begin to be considered once operations reach 60-75 percent of the ASV. Upon reaching 80 percent of the ASV, it is recommended that the planned improvements undergo design or construction. Based on the previous table, EGE will not approach either of these thresholds within the planning period; thus, no capacity improvements are required.

EGE's existing facilities are adequate for meeting both existing and future capacity requirements. It is also well below the standard necessary to begin investigating making improvements.

4.2.3 Airport Design Requirements

The FAA defines a wide variety of airport dimensional design requirements to promote safety and efficiency at airports across the United States. These requirements encompass all facets of an airport (e.g., runways, taxiways, aprons, buildings, airspace, etc.) and they can change over time as FAA standards evolve, local airport operational patterns change or other factors are introduced. So, it is important that an AMP review the critical design criteria to ensure compliance and/or to identify areas of potential improvement. This section recognizes the existence of those standards as detailed in FAA AC 150/5300-13B and notes that these individual standards will be discussed within individual facility sections below. It is also critical to note that these standards are driven by EGE's current and projected Critical Aircraft that was identified in the previous chapter.

Airport design requirements generally refer to FAA standards and recommendations for the geometric layout and engineering design of runways, taxiways, aprons, and other facilities at civil airports, ensuring safety, efficiency, and compliance with regulatory guidelines. They can significantly influence future development potential at an airport.

Critical Aircraft and Airport Reference Code (ARC)

As discussed in Chapter Three, *Aviation Activity Forecast*, the Critical Aircraft is defined by the FAA as the largest aircraft or aircraft family anticipated to utilize an airport on a regular basis, defined as those conducting at least 500 annual operations. The Airport Reference Code (ARC) is a coding system used to relate airport design criteria to the operational and physical characteristics of the types of aircraft intended to operate at an airport. Note that the combination of the design aircraft and the ARC serves as the basis for establishing existing and future design standards.

Boeing 757-200

The previous chapter identified the recommended Critical Aircraft and ARC for EGE to be that of a D-IV. The Aircraft Approach Category (AAC) of D was selected to reflect use by jets such as the Gulfstream IV, G550, and G650 while the Airplane Design Group (ADG) of IV was chosen to represent use by larger passenger carrying aircraft such as the Boeing 757-200.

Gulfstream G650

With respect to identifying a particular aircraft model to serve as the Airport's Critical Aircraft, there is not one D-IV aircraft model that operates frequently enough at EGE to meet the 500-annual operation threshold. However, through examination and application of approach and design components independently, a composite Critical Aircraft with an ARC and Runway Design Code (RDC) designation of D-IV was well supported and approved by the FAA.

The ARC for EGE is designated as D-IV, based on a grouping of aircraft with similar characteristics. This ARC will serve as the basis for all FAA Airport Design Criteria.

4.2.4 Runway System

Runway system facilities required for EGE to adequately meet existing and future aviation activity are based on the types and numbers of aircraft projected to use the runway system. Components of the runway system examined in this facility requirements analysis include the following and are described in detail below:

- Configuration/Orientation
- Runway Length
- Runway Width
- Runway Safety Area
- Runway Object Free Area
- Runway Object Free Zone

A runway refers to a defined rectangular area on an airport, typically paved, that provides aircraft with the necessary space and clearance for both takeoff and landing operations

- Runway Protection Zones
- Blast Pads
- Runway Pavement Strength

At a minimum, all components of the runway system should be designed and constructed in accordance with the airport design standards developed by the FAA and as detailed in FAA AC 150/5300-13B. It should also be noted that while FAA design standards can be exceeded, any costs associated with that exceedance are not reimbursable by the FAA (i.e., the airport sponsor or other local sources typically would have to fund that portion in excess of the federal standards). The federal airport design standards are directly driven by the Critical Aircraft and the current quality of the available instrument approaches to the runway:

- Aircraft Approach Category (AAC) – **D**
- Airplane Design Group (ADG) - **IV**
- Runway Visibility Minimums – **Not Lower than 1 mile**

A summary of these FAA airport design standards and how EGE's current Runway 7-25 compares to those standards is provided in **Table 4-6**.

Table 4-6: FAA Runway Standard Specifications

Runway Design Standards Categories	FAA Standards (D-IV, Not Lower than 1 Mile Minimums)	Runway 7-25
Runway Width	150'	150'
Shoulder Width	25'	25'
Blast Pad		
- Width	200'	200'
- Length	200'	200'
Runway Safety Area (RSA)		
- Width	500'	500'
- Length Beyond End	1,000'	1,000'
Runway Object Free Area (ROFA)		
- Width	800'	800'
- Length Beyond End	1,000'	1,000'
Appr. and Dep. Runway Protection Zone (RPZ)		
- Inner Width	500'	500'
- Outer Width	1,010'	1,010'
- Length	1,700'	1,700'
Runway Obstacle Free Zone (OFZ)		
- Width	400'	400'
- Length Beyond End	200'	200'
Runway Centerline Separation		
- Parallel Taxiway Centerline	400'	400'
- Hold Line Markings	250'	316'

Source: FAA AC 150/5300-13B, Appendix G, Table G-10

The following sections provide specific details regarding the various components associated with the runway environment and how these are applied to EGE.

Runway Configuration and Orientation

Runway orientation is primarily influenced by weather conditions and particularly by wind direction. While constraints on available airport land do not allow for the option of a crosswind runway, the current runway system meets and exceeds FAA guidelines for wind coverage. As previously shown in **Table 4-3**, Runway 7-25 maintains an adequate crosswind component that exceeds 95% for the design aircraft in All Weather, IFR, and VFR conditions; therefore, Runway 7-25 has been determined to be appropriately aligned and the Airport does not require a crosswind runway

The Airport's current runway system, configuration, and orientation is suitable for Critical Aircraft operations based on existing weather conditions; no action is required.

Runway Length

The purpose of this section is to analyze the length of the existing runway length to determine if it is adequate to accommodate the aircraft fleet currently operating and projected to operate at EGE, and if not, what those lengths should be. It should be noted that runway length requirements are dependent on numerous variables that include airport elevation, temperature, wind velocity and direction, ambient air temperature, aircraft design, length of haul, runway surface condition (wet or dry), runway gradient, the presence of obstructions, among other factors. In short, in practical application, specific runway length requirements must be generated for each flight that originates at any airport. That being stated, generalized runway length requirements can be established that are designed to accommodate the preponderance of aircraft operations at an airport.

The runway length analysis is the culmination of the evaluation of runway system requirements. Required runway length is influenced by weather, elevation, and aircraft performance.

EGE's Runway 7-25 has a current total length of 9,000 feet with a 1,000-foot threshold displacement on the approach end to Runway 25. This displacement is required to provide adequate clearance from area terrain for aircraft landing on that runway end. While the current runway length allows the Airport to adequately serve a wide range of air carrier and general aviation aircraft, it is particularly impacted by the airfield elevation, surrounding obstructions, and the runway gradient. The surrounding terrain also dramatically impacts runway length potential in terms of both the amount of space available for actual runway construction, and the airspace clearance requirements associated with the runway end locations.

While the FAA does not provide specific standards for runway length, FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design*, provides guidance to assist in determining the recommended runway length for an airport based on many of the factors described above. The process employed for determining runway length requirements for EGE considered both commercial air service aircraft as well as general aviation aircraft. The primary methodology was based on the specific aircraft planning manuals for five commercial air service aircraft that typically operate and/or are projected to operate at EGE. These critical aircraft represent the highest operational demand given the destinations where they commonly operate.

While the existing runway length of 9,000 feet does not typically limit these critical aircraft, the terrain surrounding EGE restricts aircraft from departing with a full payload (i.e. fuel/cargo/baggage/passengers). For aircraft to clear terrain in close proximity to the airfield, operators must reduce payload to allowable takeoff weights. These reduced payloads result in takeoff weights below manufacturer specified maximum certified takeoff weights. **Table 4-7** provides a generalized estimate of the runway takeoff weight limitations and impacts associated with the existing 9,000-foot length of Runway 7-25 for these five relevant commercial air service aircraft. It should be noted that this analysis considered both EGE's high elevation as well as an adjusted standard day temperature as dictated by the manufacturers' manuals. In short, each aircraft is capable of taking off from EGE at close to, if not exceeding 90 percent of its MTOW.

Table 4-7: Critical Aircraft Runway Takeoff Weight Analysis

Aircraft	MTOW (unconstrained and certified by manufacturer)	Standard Day Chart Temp	Limited MTOW based on Existing RW 7-25	Percent Limited MTOW based on Existing RW 7-25	Approximate Runway Length Requirement at 100% MTOW
Canadair RJ700	72,750 lbs.	61 F	66,500 lbs.	91%	12,000'
Boeing 737-700	154,500 lbs.	62 F	152,000 lbs.	98%	10,200'
Airbus A319	168,653 lbs.	63 F	158,000 lbs.	94%	13,000'
Airbus A321neo	206,132 lbs.	63 F	180,000 lbs.	87%	15,500'
Boeing 757-200	255,500 lbs.	61 F	225,000 lbs.	88%	12,750'

Source: FAA Advisory Circular 150/5325-4B, Aircraft Planning Manuals

General aviation comprises a large percentage of EGE operations, accounting for over 80% of its annual operations in 2022. In particular, business jets are a key contributor to these annual operations. While the existing runway length adequately serves the majority of commercial air service aircraft that operate at EGE, albeit with slight penalties, runway length requirements for larger business jet aircraft can also exceed the existing 9,000-foot length at elevation. Per the FAA AC, larger general aviation aircraft can require between 8,040 feet and 11,860 feet of takeoff length depending on the aircraft type and the payload. Thus, similar to commercial aircraft operating at EGE, they would likely have to operate with a slight penalty due to the runway length as well as the surrounding terrain.

In general, based on an evaluation of landing field length requirements for commercial air service as well as general aviation aircraft, the Airport's available runway length of 9,000' is deemed to be adequate to meet the needs within the planning period.

However, it is important to acknowledge that aircraft performance is constantly changing, especially in regard to commercial aviation. Airlines are constantly adjusting their aircraft fleet in response to emerging trends that arise from changing economic climate and technological advancement. With a continued trend towards larger aircraft and less frequent flights, it is important for the runway to adequately serve critical aircraft and ensure minimal disruption to airport users. While the runway adequately serves existing conditions, this may not hold true in the future. Therefore, it is prudent to continue carrying forward the recommendation from previous master plans of reserving space to allow for expansion of the existing runway to 10,000 feet if the need were to arise from future aircraft use.

EGE's Runway 7-25 adequately meets the requirements of the Airport's existing and projected aircraft operations; no action is required. However, It is recommended that the future extension of the west end of Runway 7-25 continue to be depicted on the ALP. This protects the land and airspace in the event that future demand warrants the need for an extension.

Runway Width

The minimum width of a runway as defined in FAA AC 150/5300-13B is a function of the ARC and the instrument approaches available for that runway. With an existing width of 150 feet, Runway 7-25 meets the design requirements for its existing and future Critical Aircraft of D-IV; thus, the existing width is sufficient to accommodate demands throughout the planning period.

Runway 7-25 is 150 feet wide, meeting the requirements for the Airport's existing and future Critical Aircraft; no action is required.

Runway Safety Area

The Runway Safety Area (RSA) is an FAA airport design standard defined in FAA AC 150/5300-13B; it is a defined surface surrounding a runway that is specifically prepared and suitable for reducing the risk of damage to airplanes in the event of an undershoot, overshoot, or excursion from the paved surface. An RSA should be cleared and graded and have no potentially hazardous ruts or surface variations. This area should also be adequately drained through appropriate grading or by storm sewers, and under dry conditions, capable of supporting snow removal equipment, aircraft rescue and firefighting equipment, and the occasional passage of aircraft without causing structural damage. General requirements for grading of the RSA are 0 to -3-degree grade for the first 200 feet from the runway end with the remaining longitudinal grade ensuring that no part of the RSA penetrate the approach surface or drop below a -5-degree grade.

An RSA refers to a defined surface surrounding the runway, designed to enhance safety by providing a buffer zone that minimizes the risk of damage to aircraft in the event of a runway excursion, undershoot, or overshoot, and supports aircraft rescue and firefighting operations.

For Runway 7-25 at EGE (**Figure 4-22**), the existing and future RSA is required to be 500 feet wide throughout the length of the runway and extend 1,000 feet beyond the runway ends.

Figure 4-22: Runway 7-25 RSA

Source: Jviation, a Woolpert Company; Google Earth

EGE meets all RSA requirements; no action is required.

Runway Object Free Area

The Runway Object Free Area (ROFA) is an FAA airport design standard defined in FAA AC 150/5300-13B; it is a two-dimensional area surrounding the runway that must be cleared of above-ground objects protruding above the nearest point of the RSA elevation. Exceptions to this requirement include objects that need to be in the ROFA for air navigation or aircraft ground maneuvering purposes. Objects non-essential for air navigation or aircraft ground maneuvering purposes are not to be placed in the OFA.

A ROFA refers to a defined two-dimensional area centered on the runway centerline, intended to protect aircraft by ensuring that no fixed objects, except those mounted on frangible connections, are located within this area.

For Runway 7-25 at EGE (**Figure 4-23**), the existing and future ROFA is required to be 800 feet wide throughout the length of the runway and extend 1,000 feet beyond the runway ends.

Figure 4-23: Runway 7-25 ROFA

Source: Jviation, a Woolpert Company; Google Earth

EGE meets all ROFA requirements; no action is required.

Obstacle Free Zone

The runway Obstacle Free Zone (OFZ) is an FAA airport design standard defined in FAA AC 150/5300-13B; it is a volume of airspace intended to protect aircraft in the early and final stages of flight. OFZ clearance standards prohibit taxiing and parked airplanes and other objects, except frangible NAVAIDs or fixed-function objects, from penetrating this zone.

An OFZ refers to a defined volume of airspace centered on the runway centerline, which must remain clear of obstacles to ensure the safety of aircraft operations during takeoff and landing

For Runway 7-25 at EGE, the existing and future OFZ is required to be 400 feet wide throughout the length of the runway and extend 200 feet beyond the runway ends.

EGE meets all OFZ requirements; no action is required.

Runway Protection Zones

RPZs refer to a trapezoidal area at ground level beyond the end of a runway, designed to enhance the safety of aircraft operations by protecting people and property on the ground.

Runway Protection Zones (RPZ) are an FAA airport design standard defined in FAA AC 150/5300-13B; they are trapezoidal in shape and centered on the extended runway centerline. The function of the RPZ is to enhance the protection of people and property on the ground. To ensure that RPZs remain clear of incompatible uses, the FAA recommends that the land included in the RPZ should be owned by the Airport or protected via an avigation easement. This gives the Airport the right to control the presence and height of objects as well as the use of the land within the RPZ. FAA Advisory Circular 150/5190-4B, *Airport Land Use Compatibility Planning*, recommends that existing incompatible land uses within an RPZ be removed when those uses would enter the limits of the RPZ as the result of:

- An airfield project (e.g., runway extension, runway shift)
- A change in the Critical Aircraft that increases the RPZ dimensions
- A new or revised instrument approach procedure that increases the RPZ dimensions
- A local development proposal in the RPZ (either new or reconfigured)

The size of an RPZ for a runway end is a function of the Critical Aircraft and the visibility minimums established for that end. Essentially, the greater precision of the approach (and the lower the visibility minimums for landing), the larger the resulting RPZ. The location of an RPZ is 200 feet prior to or beyond the end of the runway pavement that is usable for takeoffs and landings. So, an RPZ on a given runway end protects for aircraft approaching and landing on that runway end as well as protecting for aircraft that are departing and taking off from the other runway end. It must be noted that if a runway has a displaced threshold (like Runway 25 at EGE), the RPZ on that end that is designed to protect for approaching aircraft and the RPZ designed to protect for departing aircraft are sited in different locations, each starting 200 feet off the end of usable pavement for that function.

Figure 4-24, **Figure 4-25**, and **Figure 4-26** reflect the current and future RPZs for Runway 7-25 at EGE.

The Approach and Departure RPZs at EGE generally meet current FAA standards; no action is required other than these areas should be kept free of future incompatible land uses. Additionally, to the degree practicable, existing incompatible land uses should be progressively removed.

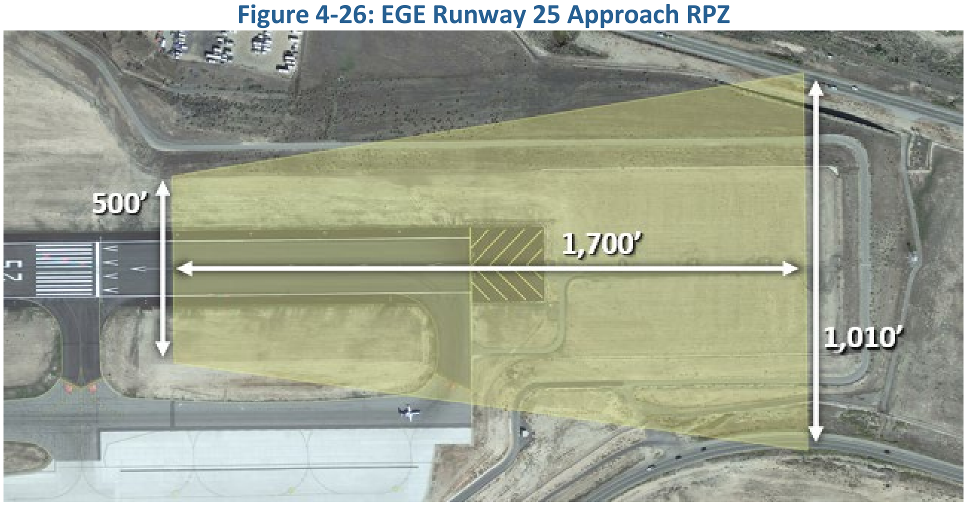
Figure 4-24: EGE Runway 7 Approach RPZ / Runway 25 Departure RPZ

Source: Jviation, a Woolpert Company; Google Earth

Figure 4-25: Runway 7 Departure RPZ

Source: Jviation, a Woolpert Company; Google Earth

Figure 4-26: EGE Runway 25 Approach RPZ



Source: Jviation, a Woolpert Company; Google Earth

Blast Pads

A runway blast pad is a paved surface adjacent to a runway end designed to reduce the erosive effect of jet blast and propeller wash during takeoff operations. EGE has 200-foot by 200-foot blast pads at each runway end, which is consistent with FAA airport design criteria.

Figure 4-27: Runway 25 Blast Pad

Source: FAA, Google Earth

EGE meets all blast pad requirements; no action is required.

Runway Pavement Strength

Runway pavement strength represents the load-bearing capacity of the pavement. To ensure safe aircraft operations and minimize pavement damage, it is important that runway pavement strength be sufficient to support the heaviest aircraft expected to use the runway on a regular basis. Runway pavement strength is typically expressed based on common landing gear configurations. A listing of these configurations (and example aircraft) includes the following:

- **Single-wheel** – each landing gear unit has a single tire; example aircraft include light general aviation aircraft and some business jet aircraft.
- **Dual-wheel** – each landing gear unit has two tires, example aircraft include the Boeing 737, Airbus 319/320/321neo, CRJ 100/200, Cessna Citation Latitude, Dassault Falcon 90, and Gulfstream G650.
- **Dual-tandem** – each main landing gear unit has four tires arranged in the shape of a square, example aircraft including the Boeing 757.

The aircraft gear type and configuration dictates how aircraft weight is distributed to the pavement and determines pavement response to loading. The published pavement strength of the EGE runway is presented in **Table 4-8**.

Table 4-8: Runway Pavement Strength

Landing Gear Configuration	Published Pavement Strength	Surface Type & Condition	Pavement Condition Index (PCI)*	Pavement Classification Number (PCN)	Pavement Classification Rating (PCR)
Single-wheel (SW)	75,000 lbs.	Asphalt, Excellent Condition	PCI = 85-100	45/F/B/X/U	464/F/B/X/T
Dual-wheel (DW)	140,000 lbs.				
Dual-tandem (DTW)	255,000 lbs.				

Source: Jviation, a Woolpert Company, FAA 5010 Airport Master Record
* PCI based on CDOT, Colorado 2022 IDEA (Field inspection 6/13/2022).

The heaviest aircraft that routinely operates at EGE is the Boeing 757-200, with a Maximum Takeoff Weight (MTOW) of 255,500 pounds. Given the limited number of daily flights when averaged throughout the year, combined with the fact that most larger aircraft operating at EGE generally do so under their MTOW, pavement strength is considered to be adequate throughout the planning period. While the existing pavement strength of Runway 7-25 is sufficient to meet existing and future demands, on-going maintenance is critical to preserve strength and pavement life.

The pavement strength of Runway 7-25 is adequate to meet the requirements of aircraft forecasted to operate at EGE throughout the planning period; no action is required. To maintain its functionality and to maximize its longevity, the runway must be consistently maintained.

4.2.5 Taxiway System

A taxiway system should be designed to facilitate safe and efficient aircraft movement between the runway and developed aviation-related areas such as aprons, pilot and passenger amenities, aircraft parking and storage facilities, and other accommodations. EGE has a system that consists of a full parallel taxiway, various runway exit taxiways, and several apron taxiway entrances. Ideally, the taxiway system should allow an aircraft to taxi to an associated runway in the most direct manner without having to change speed, or cross active runways.

Taxiways refer to defined paths on an airport, typically paved, that connects runways with aprons, hangars, terminals, and other facilities, allowing aircraft to move safely and efficiently between these areas

Taxiway system facility requirements for EGE to adequately serve existing and future aviation activity are primarily based on the aircraft projected to use the taxiway system and the design standards prescribed in FAA AC 150/5300-13B. Components of the taxiway system examined in this facility requirements analysis include the following:

- Runway/Taxiway Separation Requirements
- Taxiway Dimensional Standards
- Taxiway System Capacity and Design

For the purposes of this evaluation, Taxiway Design Group (TDG) 4 is used for all taxiway standards, as this represents the Airport's Critical Aircraft. The TDG is a combination of the distance from the cockpit to the main gear (CMG) and width of the main gear (MGW). These distances impact cockpit visibility and aircraft maneuverability on the airfield and thus are used in determining taxiway standards. Specific facility requirement recommendations for taxiway design components are identified in the following sections.

Runway/Taxiway Separation

Runway/Taxiway separation requirements are defined in FAA AC 150/5300-13B. EGE has a full-length parallel taxiway, Taxiway A, on the south side of Runway 7-25. There is a 400-foot separation between the centerline of the runway and that of the taxiway, which complies with the applicable runway/taxiway separation standards as reflected in **Table 4-6.**

The separation between the centerline of Runway 7-25 and the centerline of Taxiway A meets the FAA standard of 400 feet; no action is required. Any future parallel taxiway development must similarly meet that FAA runway separation standard.

Taxiway Dimensional Standards

Taxiway dimensional standards are defined in FAA AC 150/5300-13B and include measurements that account for physical taxiway characteristics as well as safety related areas. The following taxiway-related dimensional standards are important to the design of the taxiway and safety of the aircraft using them:

- **Taxiway Width** – Pavement width of the taxiway is intended to support the weight of the aircraft while taxiing to or from the runway.
- **Taxiway Shoulder** – The taxiway shoulder reduces the possibility of blast erosion and engine ingestion problems associated with jet engines that may overhang the edge of taxiway pavement. Soil with turf not suitable for this purpose requires a stabilized or low-cost paved surface.
- **Taxiway Safety Area (TSA)**– The taxiway safety area is a defined surface alongside the taxiway suitable for reducing the risk of damage to an airplane unintentionally departing the taxiway. The taxiway safety area must be clear of ruts or humps, graded to provide water run-off, capable of supporting snow and emergency equipment, and free of objects (objects over 3 inches must be supported on frangible mounts).
- **Taxiway Object Free Area (TOFA)** – The taxiway object free area is an area around the taxiway intended to enhance the safety of aircraft by having the area free of objects, except those objects that need to be located in the area for air navigation or aircraft ground maneuvering purposes.

The Critical Aircraft grouping at EGE falls under TDG 4 and ADG IV dimensional standards as shown in **Table 4-9**.

Table 4-9: Taxiway Dimensional Standards

Item	Taxiway Design Group (TDG)							
	1A	1B	2A	2B	3	4	5	6
Taxiway Width	25’	25’	35’	35’	50’	50’	75’	75’
Taxiway Shoulder	10’	10’	15’	15’	20’	20’	30’	30’

	Airplane Design Group (ADG)					
	I	II	III	IV	V	VI
Taxiway Safety Area (TSA) Width	49’	79’	118’	171’	214’	262’
Taxiway Object Free Area (TOFA) Width	89’	124’	171’	243’	285’	335’

Source: FAA Advisory Circular 150/5300-13B, Table 4-1 and Table 4-2.

All the taxiways at EGE meet current taxiway dimension standards. Taxiway A is 75 feet wide and maintains the appropriate safety clearances. In the future, the TDG and ADG will remain 4 and IV, respectively, and taxiways will not require dimensional standards beyond what currently exists. Any future taxiway development should be designed to these standards to provide an adequate margin of safety to airfield operations.

All EGE taxiways meet or exceed the federal design standards associated with Taxiway Design Group 4 and Airplane Design Group IV; no action is required. These design standards should be applied and maintained on all existing and future taxiways at EGE.

Successful taxiway geometry encourages pilots to make the safe decision while maneuvering in critical airfield areas.

Taxiway System Capacity and Design

The existing taxiway system at EGE is considered to be generally adequate to meet the needs of the existing Airport. While adequate, the FAA also has a variety of taxiway design requirements identified in FAA AC 150/5300-13B that are intended to enhance the overall safety of taxiway operations and minimize opportunities for runway incursions. Many of these requirements are relatively new (circa 2012) and were not in effect when most of EGE's pavements were constructed. These design principles for taxiway system layouts are identified in **Table 4-10**.

Table 4-10: FAA Taxiway Design Principles

Design Principle	Summarized Definition
Steering Angle	Design taxiways such that the nose gear steering angles is < 50 degrees
Fillet Design	Traditional filet design standards have been replaced. New filet design more effectively reflects aircraft wheel tracks
Standardize Intersection Angles	90-degree turns are standard 30, 45, 60, 90, 120, 135, and 150-degree preferred intersection standard angles
Concepts to Minimize Runway Incursions	
Increase Pilot Situational Awareness	Utilize the "three-node concept". Pilot should have three or fewer choices at an intersection (left, right, straight)
Avoid Wide Expanses of Pavement	Wide pavement requires placing signs far from a pilot's eye
Limit Runway Crossings	Reduces the opportunity for human error
Avoid "High Energy" Intersections	Located in the middle third of the runways. Limit the runway crossings to the outer thirds of the runway
Increase Visibility	Provide right angle intersections for best pilot visibility. Acute angle runway exits should not be used as runway entrance or crossing
Avoid "Dual Purpose" Pavements	Runways used as taxiways and taxiways used as runways can lead to confusion
Indirect Access	Eliminate taxiways leading directly from an apron to a taxiway
Hot Spots	Limit the number of taxiways intersecting in one spot

Source: FAA Advisory Circular 150/5300-13B

The taxiway system at EGE meets most of these design recommendations. Presently, there is a full parallel taxiway on the south side of Runway 7-25, along with seven (7) exit taxiways connecting the runway to the adjacent taxiway system. There are access taxiways from both the commercial service/fixed base operator (FBO) apron on the south side of the Airport and the general aviation apron on the north side.

Even so, the taxiway system needs some improvements.

- There is no direct access to the runway ends for aircraft located on the north side, requiring runway crossings to utilize the runway via existing Taxiway A.

The planned construction of a new parallel taxiway (Taxiway B) to the north of Runway 7-25 would rectify this significant issue.

- The Airport does not have any high-speed taxiway exits for Runway 7-25; as the Airport experiences busier peak hour periods on its lone runway, a new high-speed taxiway exit is one option to reduce runway occupancy time and increase operating efficiency.
- Existing Taxiways A3, A4, and A5 require shifting to eliminate direct access to the runway from aprons as directed in the previous table. A minor shifting of Taxiway A2 on the apron is also required.
- Coincidental with those shifts is confirmation that any runway crossings are limited to the outer thirds of the runway as indicated in the previous table. Any midfield crossings would have to be justified based on operational needs.

All proposed improvements to the taxiway system are illustrated on the Airport Layout Plan (ALP) as shown in Chapter Six.

The Airport's simple airfield geometry combined with most operations occurring on Runway 25, provide limited areas for improvement to the taxiway system that were not already considered in previous ALP updates. The planned Taxiway B, a partial parallel taxiway, will assist in general aviation access to the north side of the airfield and increase safety by limiting runway crossings.

4.2.6 Obstructions and Airspace

An airport's infrastructure extends beyond the ground and into the air. An airport must ensure that its airspace remains clear of obstructions to airspace surfaces that could compromise safety.

In addition to the primary airport infrastructure on the ground, the FAA requires airports to consider airspace infrastructure that surrounds the airport. Specifically, through various federal regulatory resources the FAA defines and establishes the standards for determining obstructions that affect airspace near an airport. These standards apply to the use of navigable airspace by aircraft to existing or planned air navigation facilities (airports). This is enforced primarily through the implementation of imaginary airspace surfaces that are sized based on the criteria they are designed to protect. Specifically, imaginary airspace surfaces are geometric shapes the size and dimensions of which are based on the category of each runway for existing and planned airport operations, the types of instrument approaches, and their enabling regulatory document. A penetration to these surfaces is an "obstruction," which can be an existing or proposed manmade object, an object of natural growth, or terrain.

For the purposes of this AMP, there are three primary regulatory documents (and their associated airspace surfaces) to be considered

- Title 14, Code of Federal Regulations (CFR) Part 77, *Safe, Efficient Use, and Preservation of the Navigable Airspace*, defines five imaginary surfaces: Primary, Approach, Horizontal, Conical, and Transitional surfaces. Penetrations to these surfaces can result in objecting having to be lighted or removed, or runways relocated or shortened.
- FAA AC 150/5300-13B, *Airport Design,* defines airspace surfaces that are separate from 14 CFR Part 77 and are defined by each runway's current approach type. To establish the location of a runway threshold, the

associated approach surface must be clear of all obstructions. If it is not clear, either the obstructions must be removed, or the runway threshold must be relocated until its associated approach surface is clear.

- FAA Order 8260.3B, *U.S. Standard for Terminal Instrument Procedures (TERPS)* defines a wide variety of airspace surfaces that are designed to establish and maintain safe operating conditions around an airport for aircraft utilizing a defined instrument approach. Obstructions to a TERPS surface can result in operational impacts to the instrument approach that could include a raising of minimums, making the approach unavailable in certain conditions, or decommissioning the instrument approach altogether.

An obstructions analysis has been conducted as part of this Airport Master Plan and will be reflected in the Airport Layout Plan (ALP) set (see Chapter Six). To help ensure safe operations on and around the Airport, and in conformance with its grant assurances, it is recommended that EGE continue to be diligent in preventing and removing obstructions from its critical airspace surfaces.

4.2.7 Navigational Aids (NAVAIDs)

Navigational aids (NAVAIDs) are any visual or electronic device, airborne or on the ground, that provide point-to-point guidance information or position data to aircraft in flight. Airport NAVAIDs can provide guidance to the airport or to a specific runway end at the airport. An airport is equipped with NAVAIDs providing specific capabilities; for example, precision, non-precision, or visual approaches, based on airport operational needs, safety considerations, and planning/design standards. The type, mission, and volume of aeronautical activity in association with meteorological, airspace, and capacity considerations determine an airport's eligibility and need for various NAVAIDs.

NAVAIDs comprise a range of tools designed to assist pilots in locating and acquiring the runway environment, particularly during inclement weather conditions.

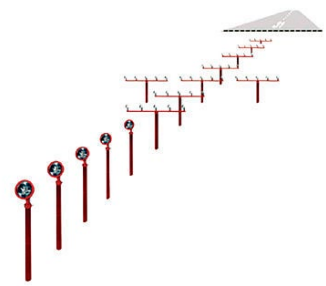
NAVAID facility requirements are primarily determined by the needs of aircraft operators frequently using the airport and typical weather-related and operational characteristics in the airport area. These factors as they relate to EGE and the visual landing aid facility requirements identified for the Airport are reviewed in the following.

Visual Aids

Visual landing aids provide aircraft guidance to and alignment with a specific runway end, once the airport is within a pilot's sight. Visual landing aids typically include equipment associated with approach lighting and visual approach aids. Approach lighting systems provide the basic means to transition from instrument flight to visual flight for landing. The variety of approach lighting systems are similar in that each provides a series of signal lights starting in the approach area and extending for 2,400 feet to 3,400 feet to the runway threshold. The visual landing phase of flight, in both visual and instrument conditions, is also facilitated by visual approach aids which provide pilots with basic visual glideslope information during final approaches.

Existing visual landing aids at EGE include the following:

- **Wind Cone** – The Airport has a wind cone to the west of taxiway connector B4, near the center point of Runway 7-25. The wind cone provides pilots with wind direction and velocity information as they land or takeoff. Although sufficient for the planning period, the wind cone should be routinely inspected by the Airport and replaced when tattered or torn.
- **Approach Lighting System (ALS)** – Current ALS at the Airport includes a medium intensity approach lighting system with runway alignment indicator lights (MALSR) at the approach end of Runway 25 that is owned and maintained by the FAA.



MALSR

- **Visual Approach Aids** - Visual glide slope indicators (VGSI), examples of which include visual approach slope indicators (VASIs) and precision approach path indicators (PAPIs) are common types of visual approach aids. A VGSI is a system of lights located adjacent to a runway that provide a pilot with proper approach angle information. Using the VGSI light system, a pilot can determine if the aircraft is high or low on the approach path and take corrective action. The Runway 25 approach end at EGE is equipped with a four-light PAPI system on the right side of the runway that is owned and maintained by the FAA. The Runway 7 end is equipped with runway end identifier lights (REILs) consisting of one high intensity flashing strobe light on each side of the runway threshold – these are owned and maintained by the Airport. REILs are not necessary for runways equipped with ALS.

Existing visual landing aids at EGE are adequate based on the current airfield configuration, approach capabilities, and activity characteristics. Any shifts in thresholds or runway extensions will require the visual landing aids to be shifted accordingly to maintain approach capabilities.

Instrument Approaches

EGE currently has two public instrument approach procedures (an LDA to Runway 25 and an RNAV (GPS) circling approach) as well as several privately developed approaches utilized by the airlines. Approach minima for the procedures are based upon several factors, including obstacles, navigation equipment, approach lighting, and weather reporting equipment. Due to the mountainous terrain that surrounds the Airport, approach minimums are relatively high.

Generally, instrument procedures at mountain airports have been limited to straight approaches as dictated by the inherent characteristics of ground-based electronic signals; however, current technologies available to procedure designers and new equipment on aircraft allow for improved access potential. The U.S. national airspace system is in transition from ground-based navigational aids to procedures defined by bringing multiple methods of space-based navigation and flight deck automation together. Mountain airports where terrain is a factor and weather is also dynamic are places where the benefits of this new suite of technologies can provide positive effects. In some cases, legacy ground-based navigational facilities can be removed.

Given this new reality, EGE should pursue the establishment of new and/or improved instrument approaches designed to optimize the application of current automation and navigational technology. In order to provide the best possible coding in the procedures so that the highest percentage of aircraft can benefit from the technology that matches their level of on-board automation, it is recommended that a full set of three procedures be developed:

1. A procedure that serves airlines and the highest-capability private aircraft
2. A procedure that would be used by the next tier of private aircraft
3. A procedure that provides the broadest level of access by the remainder of the private aircraft fleet as well as potentially for those aircraft operated by commercial air carriers.

The common denominator of the three approaches will be to combine space-based navigation and flight deck automation for higher navigational precision. The primary benefit of this approach is that aircraft will be able to automate the trajectory planning and match aircraft speed, engine thrust, and descent rates for optimal flight control. This optimal flight control means more predictable navigation and descents and those benefits can help during low visibility conditions.

While existing instrument approaches at EGE are generally adequate based on legacy technologies and approach design, it is recommended that the Airport establish new approaches that leverage current navigational technologies and flight deck automation to modernize its approaches as well as to improve its operational capabilities.

4.2.8 Airfield Marking, Lighting, and Signage

The safe movement of aircraft and other airport vehicles about the airfield is facilitated by airfield marking, lighting, and signage. Airfield areas that are properly marked, lighted, and signed allow pilots to navigate to their destinations efficiently and safely. The ability of the Airport Traffic Control Tower (ATCT) to safely manage ground traffic is also aided by these facilities.

- **Runway Markings** – Runway markings are designed according to the type of approach available on the runway. FAA AC 150/5340-1M, *Standards for Airport Markings*, provides guidance related to airport pavement markings. Runway 25 currently has precision runway markings that include runway designation, centerline, threshold marking, aiming point, touchdown zone, and side striping. Runway 7 has non-precision markings that include runway designation, centerline, threshold marking, aiming point, and side striping (see **Figure 4-28**).

  The markings on all runways are currently in good condition and are compliant with existing standards. The airport airfield maintenance crew should actively monitor, inspect, and repaint markings as they degrade over time. Any runway or taxiway development should incorporate re-striping to meet/maintain current FAA marking standards.

Figure 4-28: Runway Markings

Source: Jviation, a Woolpert Company; Google Earth

- **Airport Lighting** – Airport lighting systems aid pilots in locating an airport and safely conducting aircraft operations during nighttime and other low-visibility conditions. Existing airport lighting systems at EGE including the following:

  Airport Rotating Beacon – Since it is a lighted, land-based airport, EGE is equipped with a beacon consisting of alternating white and green light that is visible for several miles at night. It serves as universal identifier of an airport and operates during evening hours as well as instrument meteorological conditions. The Airport's rotating beacon is located on top of the ATCT on the north end of the airfield near the HAATS facility.

  Runway Edge Lighting – Runway 7-25 is equipped with high intensity runway edge lighting (HIRL) providing pilots with further identification of runway pavement limits during periods of reduced visibility.

- **Taxiway Edge Lighting** – Like runway edge lighting, taxiway edge lighting identifies the limits of paved taxiway areas and facilitates the effective movement of aircraft on the ground during periods of reduced visibility. Taxiways serving all runways at EGE are equipped with medium intensity taxiway lighting (MITL). Existing lighting systems at the Airport are sufficient for the planning period. Any new taxiways should be equipped with similar lighting systems and any current lighting systems associated with existing taxiways undergoing rehabilitation should be updated as required, including upgrades to more energy-efficient LED lighting systems.
- **Airfield Signage** – Airfield signage provides pilots with directional ground instruction to enable them to identify their location on the airfield as well as directions to other airport facilities. Signage also facilitates the airport traffic control's responsibility of safe and efficient ground control on the airfield. Directional signage aids pilots in locating runways, taxiways, apron areas, and mandatory holding positions. Review of the existing airfield signage layout drawings shows that EGE meets current airfield signage requirements. On-site inspection of these signs should be conducted on a routine basis to ensure that these signs are properly maintained and meet FAA standards. Future airfield facilities should include corresponding signage to properly

direct pilots and aid ATCT in the management of ground movement on the airfield.

- **Electrical Generators** – Many of the Airport's existing electrical generators are approximately 20 years old and are quickly reaching the end of their useful lifespan. Specific to the airfield, it has been reported that the lighting vault generator and the ATCT generator will need to be replaced in the near term.

EGE's existing airfield lighting, markings, and signage meet current FAA standards; no action is required beyond maintaining, updating, and/or replacing those systems to ensure they remain in good condition. Upgrades of older airfield lighting systems to brighter and more energy efficient LED systems should be undertaken as opportunities become available. The lighting vault generator and the ATCT generator will need to be replaced in the near term.

4.3 LANDSIDE FACILITY REQUIREMENTS

4.3.1 Commercial Air Service Terminal Building Requirements

A commercial air service passenger terminal is comprised of multiple elements; the amalgamation of these results in the totality of the terminal's ability to meet passenger, tenant, and user demands. The capacity of each element of a terminal facility can vary depending on the acceptable level of crowding and processing time. For example, a passenger traveling on business may be less tolerant of congestion or delay than a passenger traveling for pleasure. In many cases, the degree of acceptability itself may also vary depending on the configuration of the terminal space and the level of amenities provided. Thus, beyond just simple space and throughput modeling, there are elements of a terminal's "capacity" that can be rather subjective, and the preservation of passenger convenience remains an important criterion.

An airport's landside is generally comprised of all other facilities not on the airside, including terminal facilities, hangars, aprons, road access and parking, and other facilities that support airport operations.

EGE's commercial air service terminal has been the subject of multiple programming and planning efforts which have thus far resulted in the expansion of the concourse in 2019. It is also the airport facility that is most susceptible to major impacts arising from minor changes. For example, an airline scheduling change of just 30 minutes has the potential to require an additional gate, significantly add to the hourly throughput of passenger screening, and overload a secure holdroom. At EGE, this is magnified during the peak tourism season when travel facilities are nearly at capacity. Any delay or change in schedule can create substantial burdens and constraints on facilities, significantly impacting hourly throughput. In between these heavy schedule banks, the terminal is more than adequate to accommodate airport traffic. However, since airline schedules are notoriously unpredictable, they cannot be relied upon to serve as a sound basis to project needs associated with short- and the long-term growth. For this reason, annual enplanements and peak activity based on today's operation carried forward are the most reasonable indicators of future activity levels. (Note that airport management should continue to evaluate the adequacy of each functional area of the terminal and analyze airline scheduling changes for their impact to these areas.)

The following areas of the passenger terminal building are evaluated based on a comparison of their existing capacities to demand:

- Aircraft Gates
- Airline Functional Areas
- Concession Space
- Public Space
- Security, Administrative and Other Support Areas

Aircraft Gates

Aircraft gates are fundamental elements of a commercial terminal building in that they facilitate connecting aircraft with passengers; thus, the number of gates required at a terminal will drive the sizing requirements of many other elements of the overall building. In order to standardize the definition of "gate" and to provide a consistent means for evaluating apron utilization, the Narrow Body Equivalent Gate (NBEG) index has been employed for this analysis. This index normalizes the gate requirements of a diverse range of aircraft (e.g., small commuters to large aircraft) so they are effectively equivalent to the apron capacity of a typical narrow body aircraft gate. The amount of space each aircraft requires is based on maximum wingspan.

EGE currently has a total of ten commercial service aircraft parking positions on the apron. Of that total, four (Gate 1 through Gate 4) have jet bridges, Gate 5 is primarily used for irregular operations (IROPs), Gate 6 is actively utilized as a ground load position while Gate 7 is used as a ground load position only if required. Similarly, Gate 8 is only occasionally utilized as a ground load position, but it has also been designated as the gate to accommodate future international aircraft carrying passengers that must be screened by U.S. Customs and Border Protection (CBP) upon disembarking. Gate 9 and Gate 10 are rarely used for commercial air service activities with the area primarily being utilized by the FBO to accommodate parking for transient general aviation aircraft.

In terms of parking specific aircraft types, Gates 1, 2, 3, 6, 7, and 8 are all capable of accommodating the Boeing 757-200, the largest aircraft operating at EGE (**Figure 4-29**). All other gate positions have a maximum capability of accommodating the smaller narrow body aircraft (e.g., Boeing 737 series, Airbus, 319/320, and the full range of regional jets) that operate at the Airport.

Figure 4-29: Boeing 757 at Gate 6

Source: Jviation, a Woolpert Company

EGE currently has an adequate number of commercial air service gates to meet its existing and future demand. It is recommended that the Airport continue to monitor the potential need for additional jet bridges and to maintain control of all ten gate positions, including Gates 9 and 10 to meet possible long-term needs.

Airline Functional Areas

Areas for airline operations represent the heart of the terminal complex. This section examines key areas typically required and leased by airline tenants to support their operations. Airline functional area characteristics are primary factors in determining the size, configuration, and functional relationship of areas in the passenger terminal. Existing airline functional areas and their ability to meet current demand levels are presented below. It should be noted that this is essentially a high-level spatial requirements analysis based on industry planning standards (some of which have been adjusted to better account for local factors). It also assumes that areas are designed appropriately and efficiently; it does not account for inherent design flaws that may naturally impair operations regardless of the areas allocated for their use.

Ticket Counter (area)

The ticket counter area refers to the area occupied by the ticket counters, ticket agents, and the ticket counter baggage belts (**Figure 4-30**). Based on the industry standard depth of 10.5 feet and the typical planning factor of 3.6 square feet per peak hour enplaned passenger, the ticket counter area at EGE should be approximately 2,000 square feet to accommodate existing passenger demand (EGE peak hour passenger enplanement projections have been previously provided in Table 3-9 of Chapter Three, Aviation Activity Forecast. For 2022, the peak hour enplanement projection was 554). The Airport's existing ticket counter area measures approximately 1,500 square feet; this is deemed to be undersized to accommodate existing peak hour demand that will only increase over time as peak hour passenger levels are forecasted to increase (to 731 by 2042). However, that must also be balanced with the understanding that those peaks only occur a portion of the day during the peak tourism season - for the remainder of the year, the existing area is adequate to meet demand.

Figure 4-30: EGE Ticket Counter Area

Source: Jviation, a Woolpert Company

Ticket Counter (length)

The ticket counter itself is used to facilitate direct passenger to agent/kiosk interaction for the purpose of processing passenger boarding passes and outbound baggage. There are 19 agent ticketing positions currently used for processing passengers and their baggage at EGE. In addition, there are 16 self-ticketing kiosks within the ticketing counter area. Existing ticket counters at EGE have an overall length of 140 linear feet. When applying a typical planning factor of 0.25 linear feet per peak hour enplaned passenger, it can be seen that the existing ticket counter linear footage meets the current peak hour demand requirements. However, as the peak hour passenger total is forecasted to increase from 554 to 731 by 2042, the result will be an increasing deficiency over time.

Ticket Counter Queuing

This space is comprised of the passenger queuing area directly in front of airline ticket counters. At EGE, this area measures approximately 2,450 square feet and include self-serve airline ticketing kiosks. Assuming the industry standard depth of 15 feet in front of the ticket counters and a planning standard of 7.0 square feet per peak hour enplaned passenger, an area of approximately 3,878 square feet is needed to meet current demand. As the peak hour passenger total increases over time, this area deficiency will increase when the need will be over 5,100 square feet by 2042.

Airline Ticket Office

This area is located directly behind the ticket counters and is leased to the airlines as office space. Because this is exclusive space for each airline, the space required in this area is a function of the number of airlines serving EGE. Existing airline office areas measure approximately 6,000 square feet and the projected need is currently 7,200 square feet, demonstrating a deficiency in accommodating existing needs. This assessment has been based on a planning factor of 13.0 square feet per peak hour enplaned passenger to calculate requirements for airline ticket office space. Note that this factor is slightly higher than the industry standard based on direct input from the airlines serving EGE that indicated the need for more office, mechanical, and general storage space.

Hold Rooms/Departure Lounges

The amount of space required for hold rooms or departure lounges is a function of the number and size of aircraft operating during the peak hour. There are currently six very active aircraft gates within the main terminal accounting for approximately 15,500 square feet of hold room area (**Figure 4-31**). This generally matches the existing requirement of 15,400 square feet based on a standard planning factor of 2,000 square feet per gate; thus, the existing EGE departure lounges are currently adequate to meet demands during peak periods.

Figure 4-31: EGE Departure Lounges

Source: Jviation, a Woolpert Company

Baggage Claim Area

Due to the checked bag fees imposed by most airlines, the current trend in the industry has been to check fewer bags. Nationally, the average passenger is carrying on more and checking less. However, as an airport largely serving outdoor recreation destination clientele, the checked bag counts remain very high at EGE and have recently increased with a greater number of international travelers visiting for longer periods of time (**Figure 4-32**).

This space category represents the area occupied by the baggage claim devices and the queuing area for active bag claiming measures approximately 15 feet out from the devices. At EGE, the total baggage claim area measures approximately 6,500 square feet. Based on industry standards, a planning factor of 15 square feet per peak hour deplaned passenger, the existing area is inadequate to meet the current peak hour demand of 8,310 square feet. This difference indicates that the existing area is inadequate to meet current demand and will become increasingly deficient over time.

Figure 4-32: EGE Baggage Claim

Source: Jviation, a Woolpert Company

Baggage Claim Frontage

This area represents the length of the baggage claim devices and is typically designed to accommodate the peak 20 minutes of baggage claim time. There are three baggage claim flat plate systems at EGE with an estimated total overall length of 255 linear feet on the public facing side. Applying a planning factor of 0.45 linear feet per peak hour deplaning passenger results in the existing frontage being generally adequate to meet existing demand; however, this will evolve into a deficiency over time as peak hour passenger numbers continue to increase.

Inbound Baggage Area

The inbound baggage area is used to feed bags to the baggage claim devices. There are three baggage delivery belts in the claim area with each flat plate delivery device measuring approximately 40 linear feet for airline baggage handlers to deposit bags on the secure side for a total of 120 linear feet. The existing belts are significantly deficient for meeting the existing peak hour demand based on standard industry planning metrics. Based on a planning ratio of 0.40 linear feet per peak hour deplaned passenger, EGE should currently have approximately 218 total linear feet of bag belt available.

Figure 4-33: EGE Inbound Baggage Area

Source: Jviation, a Woolpert Company

Baggage Service Offices

Baggage service offices are leased to the airlines for assisting passengers with lost/stolen baggage issues. EGE currently has a total of approximately 586 square feet of baggage service office space in the baggage claim area. This is slightly deficient of the goal of 803 square feet based on a ratio of 1.45 per peak hour passenger; this deficiency will increase over time. Note that this deficiency is accentuated during the winter peak season as passengers tend to have more and larger bags. (For all airline-related areas, the final allocation of space will largely depend on the needs of airlines and will likely be refined as terminal concepts are developed and airline requirements change.)

Outbound Baggage, Baggage Make-up Area

This area is located to the east of the airline offices and is used for the accumulation, storage, and make up of outbound baggage from the ticket counter areas as well as the loading of bags into carts pulled by tugs. As an airport largely serving outdoor recreation destination clientele, passengers at EGE tend to have a high average baggage count and a higher oversize baggage count than other airports. The current outbound baggage area at EGE measures approximately 19,800 square feet (including tug lanes) and is marginally adequate for meeting existing peak hour enplaned passenger demand, based on the industry standard of 20 square feet per peak hour enplaned passenger; however, this will evolve into a deficiency as peak hour passenger numbers continue to increase over time (**Figure 4-34**). With respect to tug operations, while often constrained in peak season, there is generally sufficient room for the tug trains to stage, load, unload, and pass each other with a reasonable amount of clearance.

As stated previously, this is a statistical analysis and does not account for any inefficiencies that reside in the overall system design. Note that continued evaluation should be conducted to maximum available baggage handling space and provide for future solutions.

Figure 4-34: EGE Baggage Make Up Area

Source: Jviation, a Woolpert Company

Concession Space

This component of the terminal complex includes those areas dedicated to commercial concessions that generate revenue for the Airport. These areas can include food/beverage, news/gift/sundry, rental car and transportation services, among other revenue-generating functions. The space in this category provides amenities that serve two vital functions: they provide passengers with desirable services, and they provide revenue to the Airport.

Food/Beverage

This area represents the total space for dedicated food and beverage concessions at EGE. The existing area occupied by this category totals approximately 2,800 square feet (including office and storage space) and is deemed generally adequate to meet existing demand (albeit with an inefficient flow) although its ratio 0.013 square feet per annual enplaned passengers is slightly lower than the industry standard of 0.02. As passenger levels increase over time, EGE will require additional food and beverage concessions.

Figure 4-35: EGE Food and Beverage Space

Source: Jviation, a Woolpert Company

Retail

This area includes existing general concession space utilized by newsstands, gift shops, and other sundry retailers. The existing area used for this function at EGE measures approximately 2,700 square feet. An additional 1,150 square feet is used for storage space to support these shops. Based on average supply/demand ratios at comparable airports of 0.015 square feet per annual enplaned passenger, this area at EGE is deemed to be marginally adequate to meet the current demand. As passenger levels increase over time, EGE will require additional retail and related storage space.

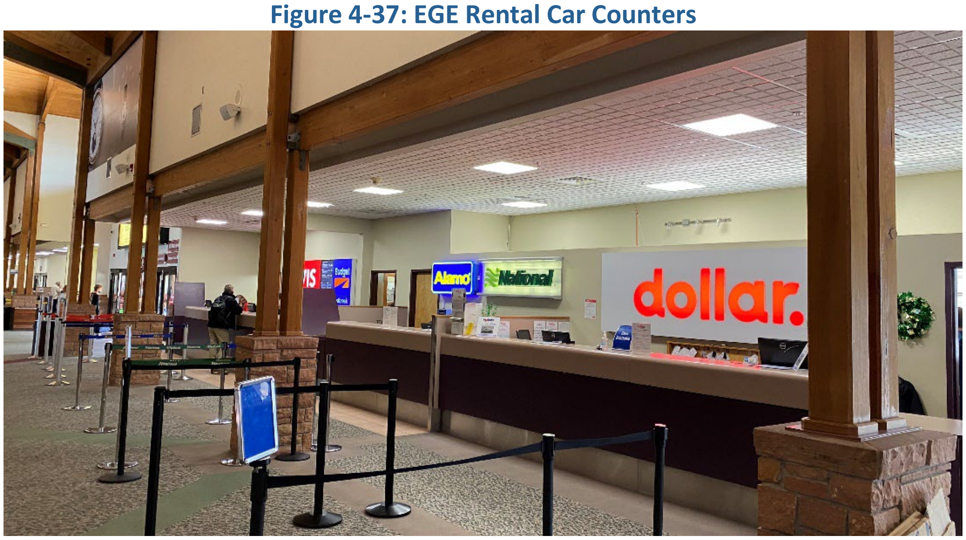
Figure 4-36: EGE Retail Space

Source: Jviation, a Woolpert Company

Rental Car/Ground Transportation

The rental car and ground transportation areas consist of counters and supporting offices for the on-Airport rental car agencies and round transportation providers that are located near the baggage claim area for the convenience of arriving passengers (**Figure 4-37**). The existing area at EGE totals approximately 2,000 square feet and is generally deemed adequate to accommodate the existing demand. Based on comparable airports, a typical planning factor of 0.002 square feet per annual deplaned passenger is anticipated for these areas, which is less than the existing EGE available space. However, it should be recognized that rental agencies have reported that they require additional counter and office space. It should also be noted that not all these operators are ideally located with at least one rental car agency located near airline ticketing rather than baggage claim. As passenger levels increase over time, EGE will likely require additional space for this function.

Figure 4-37: EGE Rental Car Counters



Source: Jviation, a Woolpert Company

Public Spaces

Circulation

This category represents the public circulation area to allow for movement of passengers, visitors, tenants, and employees within the terminal building. It consists of circulation areas in the concourse, in the vicinity of the departure lounges, movement areas within the check-in areas, corridors leading to functional areas, and other public movement areas. In total, EGE has approximately 31,600 square feet of public circulation space and based on planning standards, this amount is adequate to meet existing and most future requirements.

Restrooms

Restrooms at EGE are located both before security (located near the center of the main terminal complex) and beyond security on the first floor (located near the stairs on the west side of the terminal) and in the concourse on the second floor (near the departure lounges for Gates 1, 2, and 3). In total, public restrooms at the airport total approximately 2,300 square feet which translates to a planning factor of 3.1 square feet per peak hour enplanement; this is deemed to be slightly inadequate for current levels of activity. Note that the standard planning factor observed at other airports is 5.0 square feet per peak hour enplaned passenger, which is reasonably higher than the existing factor, implying that EGE is deficient in providing adequate capacity. Again, this deficiency will be accentuated as passenger levels increase in the future.

Security, Administrative and Other Support Areas

Security

This area is dedicated for the Transportation Security Administration (TSA) security checkpoints necessary to screen enplaning passengers, inspect outbound baggage through the Airport's Checked Baggage Inspection System (CBIS), and to provide space for TSA employees whose job functions require them to work in the secure public and non-public areas. Through discussions with Airport representatives, the following observations have been made:

- The existing TSA security area is generally adequate to meet existing peak conditions, although it is reported that the TSA offices are too small.
- TSA typically will operate three out of the four lanes since they have difficulty providing adequate local staffing to operate the fourth lane, even when it is required.
- To help alleviate staffing challenges, the Airport wants to pursue the installation of automated exit lane technology in the terminal.
- The existing CBIS is older technology and in need of efficiency upgrades.

Based on the current peak hour enplanement volume of approximately 554 passengers, the existing checkpoint has enough capacity to support the current demand based on four lanes and marginally adequate based on three lanes.

Administrative and Other Support Areas

This category of space includes airport administration and identification/badging offices as well as "back of the house" area that is generally not accessible to the public including building maintenance and areas for utilities and building mechanical functions. Through discussions with Airport representatives, the following observations have been made:

- Airport administration and badging offices are currently located in the ARFF building; they should ultimately be based in the terminal building. It is estimated that this would require approximately 6,000 square feet of space within the terminal building.
- There is a general need for consolidated information technology systems including security, Wi-Fi, flight information systems, parking systems, paging systems, and other support systems. The existing systems have grown organically over time without an overarching plan in place; new integrated systems need to be designed and implemented.

- The existing terminal has older boilers and HVAC systems that are nearing the end of their operational lives.
- Lighting system controls in the older, front-of-house areas of the terminal building are antiquated, operating on Windows 95 platform. (Note that the new concourse areas have their own upgraded and modern lighting control system.) Integrating the entire building into a single control system in the future is necessary and very needed.
- Many of the Airport's existing electrical generators are approximately 20 years old and are quickly reaching the end of their useful lifespan. The west terminal generator is aging out and will need to be replaced in the near term (Note that the east terminal generator was replaced in 2022 and is in excellent condition.)
- The terminal will need to incorporate sustainability elements in its future development, including the installation of solar panels and planning for the electrification of vehicles.
- Trash handling and processing is difficult due to location of trash interface in terminal/concourse in relation to dumpster/compactor location to the east of the terminal building.
- There is not a designated loading dock for the terminal, but it is a recognized need. Deliveries are either brought through the terminal from the east doors, or unloaded into the concession storage areas adjacent to the curbside check-in. The existing method for receiving deliveries requires utilization of the existing passenger circulation patterns, which can be difficult, especially during peak surges.

EGE's existing terminal building requires a wide variety of upgrades today and in the future for it to continue to meet the increasing and varying demands placed upon it by commercial air service operators and passenger. Although its concourse was recently renovated and expanded in 2019, much of the terminal's front-of-house facilities date back to the building's original construction in 1996. Baggage make-up and baggage claim both require significant renovations and expansions as do airline, concession, and other support facilities. However, it must be recognized that EGE is a highly seasonal airport that experiences extreme peaks during the winter season and even during a peak season day as most operations occur in a limited time window; thus, any proposed renovation and expansion of the terminal must be tempered with that fact so as to not overbuild based on those extreme peaks. Replace the west terminal electrical generator.

4.3.2 Regional Transportation Access

The roads and highways that provide access to EGE are adequate to handle both the current conditions and the future growth predicted in the FAA-approved forecast. Access to the Airport from I-70 can currently be gained via Route 6 from the west through the Town of Gypsum and from the east through the Town of Eagle. While the current configuration adequately serves airport users' needs, there is no direct access route from I-70 to the Airport.

A new interchange to connect I-70 and Cooley Mesa Road has been planned, and the required land was purchased by the County with financial assistance from the FAA for that eventuality. This future interchange is depicted on the current Airport Layout Plan and efforts to explore its feasibility continue.

Additionally, Eagle County and the Town of Gypsum have established plans for improvements to Cooley Mesa Road. Specifically, the road is planned for widening to four lanes from the current entrance to the Costco Wholesale building on the east to the west entrance to EGE. Additionally, the Sienna Lake roundabout has been planned on Cooley Mesa.

To protect future direct access from I-70 to EGE via a new interchange, it is recommended that the new I-70 Interchange continue to be depicted on the Airport Layout Plan. The future widening of Cooley Mesa Road and the establishment of the Sienna Lake roundabout should similarly be incorporated into future planning.

4.3.3 On-Airport Circulation Roadways

The EGE terminal area is served by a one-way terminal loop roadway, generally two lanes wide, which passes in front of the terminal and presents approximately 700 feet of terminal curb roadway. Direct access to the terminal loop roadway is provided by an intersection with Cooley Mesa Road, opposite Spring Creek Road. A secondary access to the terminal loop is provided by Eldon Wilson Road, an on-airport, two-lane, two-way road that runs from Cooley Mesa Road (opposite the intersection with Buckhorn Valley Boulevard) to the terminal loop road. The 2016 Terminal Area Plan reported, based on a limited traffic count sampling, that the eastern access point to the Airport tended to serve a larger total share of activity than the western access point. The reason posited for this is that more traffic accesses the Airport from the east (up the Valley), via the I-70 interchange at Eagle, than from the interchange at Gypsum. Contrary to those study results, Airport staff report that the western access point tends to be more active than the east.

The terminal curb portion of the loop roadway varies from three to four lanes in width. There are five crosswalks along the curb, which decrease by 125 feet the effective length that can legally be used by vehicles stopping to drop off or pick up passengers. Adjacent to the ticketing hall and curbside bag check facilities, the curb front east of the main entrance to the terminal is used primarily for passenger departures. The curb front west of the main entrance is in front of the bag claim hall and is for picking up passengers. Traffic volumes and demands for other ground transportation all follow passenger activity peaking characteristics with the overall peak season typically occurring from mid-December through early April and notable high peaks occurring during the Christmas holiday season, President's Day weekend, and multiple Spring Break windows.

Based on conversations with the Airport, its users, and previous planning efforts, multiple important observations, challenges, and considerations have been identified.

- Given its compressed daily airline schedule, EGE experiences higher peaking characteristics than other commercial service airports where air service is spread more throughout the day. Curbside congestion often occurs at departures during the busy midday hours of the winter peak season.

- Limousines, shared-ride vans, taxis, and transportation network companies (TNC) (e.g., Uber and Lyft) are the dominant transportation modes, bringing the largest share of passengers to the Airport.
- Airport staff consistently report that the western access point (across from Spring Creek Road) to the terminal building is more frequently used than the eastern access point (across from Buckhorn Valley Boulevard). It should be noted that the 2016 Terminal Area Plan indicated the opposite, although this was based on a limited traffic count sampling size that was undertaken during the third week of March (i.e., not during peak operational season).
- As reported in 2015, over 60 percent of the total traffic entering the airport drives past the terminal on its curb roadway, which is unusually high for a commercial service terminal area. This is likely attributable to the general layout of the on-airport roadway network that intuitively invites drivers to pass in front of the terminal to access user facilities, even if not required to do so.
- There are a number of roadway segments that carry both inbound and outbound traffic, which can be confusing to drivers, as the signing on such segments needs to provide two sets of information: information for traffic coming to terminal-area destinations, and information on where and how to exit the airport. As a rule, such overlapping traffic movements should be avoided.
- There are challenges where the loop road interfaces with the terminal curb front in that vehicles looking to drop off departing passengers are required to make a severe maneuver that crosses two lanes of traffic to access the curb front (**Figure 4-38**). To reduce the severity of that activity, the Airport has installed bollards to prevent that action. While that has improved safety, it has reduced the functionality of the curb front by requiring passenger drop offs to occur further to the west.
- Adjacent to baggage claim, vehicles tend to accumulate, with cars sometimes parked two deep and even occasionally three deep, causing constraints on the remainder of the terminal curbside roadway.
- The roadway in front of the terminal building can be a very challenging environment due to several existing design elements beyond the inherent confusion present in front of any terminal building. These include five large passenger crosswalks within a short distance (375 feet), a varying number of travel lanes that have multiple access points, shifts, adds, and merges, limited time for drivers to read signs, and make appropriate decisions. Bypass traffic also reduces the quality of service on the terminal curb by providing the friction of traffic looking to move quickly past the stopped vehicles and those seeking to find a place to stop or to move out of a stopped position. During peak periods, active Airport-provided traffic management is required to maintain appropriate flow in front of the terminal.
- Clearing and storage of snow during the peak winter season is a significant challenge. Roadways and parking lots must be designed in a manner that considers promoting efficient and effective snow removal operations.

Figure 4-38: EGE Departure Curb Front

Source: Jviation, a Woolpert Company

Much of the on-airport circulation roadways meet current demands during periods of peak activity with the exception of the terminal curb roadway. During peak periods of travel at the Airport, the passenger drop-off and pick-up areas become exceedingly congested. Curbside check-in is the major choke point, especially during the daily peak departure period of the busy season. Specifically, the Airport's existing 220 feet of curbside check-in is generally deficient in meeting the requirements during peak demand periods; this deficiency can be accentuated when other vehicles not checking passengers in occupy portions of that limited frontage for other purposes (e.g., waiting for passengers, accessing the terminal, etc.). To help manage and alleviate some of these issues, traffic management is required to prevent complete roadway obstruction during peak periods.

It is recommended that a strategic-level planning effort be undertaken to formulate a long-term plan to progressively redevelop the on-Airport roadway system to help alleviate current challenges and promote safety, efficiency, and effectiveness. This effort must emphasize solutions to curbside congestion with a particular focus on check-in activities.

4.3.4 Automobile Parking

Public parking and rental car parking (for ready cars, return cars, and cars being serviced) are the largest uses of the available landside area, utilizing approximately 27 acres of dedicated land . While much of this area is for parking away from the terminal area, the closest lots to the terminal contain almost 1,500 spaces, plus approximately 300 cars that can be accommodated in the rental car quick turn-around service area.

Site observations were made of the parking area on February 10, 2023, which was considered to be a peak operational day. Overall, all parking areas were utilized at an estimated 55 percent on the day during field observations. There were three parking lots with utilization rates over 70 percent, including the VVJC parking lot, employee parking lot, and short-term parking. Observation results are provided in **Table 4-11**.

Table 4-11: Parking Utilization (Observed on 2/10/2023)

Area	Available Spaces	Utilized Spaces	% Utilized
VVJC (close-in lot)	233	227	97%
VVJC (remote lot)	110	39	35%
Employee Parking	106	98	92%
Short-term Parking	233	175	75%
Administration Parking	14	6	43%
Long-Term Parking	464	194	42%
Rental Car Ready Lot	240	98	41%
Permit Parking	76	18	24%
30-Minute Parking	30	6	20%
TNC	10	1	10%
Cell Phone Waiting Lot	45	1	2%
Total	**1,561**	**863**	**55%**

Source: On-Site Observations (2/10/2023)

While there are no set standards for the level of service of parking facilities at airports, quality of service is generally related to walking distance, the ease of walking between a lot and the terminal, the availability of parking during peak times, and the ease of finding empty spaces when a lot is nearly full. Based on these criteria, EGE provides a reasonably good level of service for its passengers. The walking distances for short-term are a mean of 550 feet and maximum of 1,000 feet from the main terminal door. Lots tend to be full only during peak periods or, with respect to rental cars, at the start and end of the peak season. Lastly, the layout of the various lots is moderately efficient, with good visibility, aisles that run perpendicular to the terminal (for ease of walking within the lots with good wayfinding), and short aisles (21 stalls long, or 210 feet), all of which are favorable to ease of use. Lots generally have multiple entrances, multiple exits, and poor signage to exits.

Similar to the roadway circulation, conversations with the Airport, its users, and previous planning efforts, identified multiple important observations, challenges, and considerations.

- There are multiple lots with dedicated functionalities spread throughout the south side terminal and FBO areas. This inherently lends itself to design inefficiencies, multiple access points and roadways, confusing signage, and other challenges.
- Dwell times by personal vehicles are somewhat higher than the national norm for the departures curb due to larger parties carrying above average luggage counts (and oversized items such as skis). At the arrivals curb, dwell times are more than twice the national average due primarily to the congestion and level of service experienced in the baggage claim area.
- In general, the rental car facilities are overly spread out, which results in adverse impacts on customer service and operating efficiency.
- The rental car ready lot spaces are located in front of the ticketing hall on the east side of the terminal, yet users of that lot (i.e., arriving passengers) leave

the west side of the terminal near bag claim. This encourages crossing of arriving and departing passengers, which is inefficient and problematic.

- The rental car return lot is not well located or easy to follow. One consequence of the return lot location is that many users first drop off members of their party at the curb for check-in, while the driver returns the car and walks back to the terminal, this increases traffic in front of the terminal.
- Multiple rental car companies have reported that the existing quick turnaround facility is undersized and inefficient, resulting in significant delays in cars being processed.
- The rental car companies expressed concern that the three areas (ready, return, and service) are all separated by public roads. This increases the risk of crashes and incidents during shuttling of cars by rental car agents, which in turn increases insurance costs. The time and distance inefficiency of the arrangement is disproportionate to the small size of the airport. Combined with the Airport's heavy peaking characteristics, this tends to drive up operating costs and customer prices.
- Rental car companies expressed the desire for additional space and other facility enhancements including the installation of electric charging stations for electric vehicles.

In general, EGE's existing parking areas are adequate to meet existing demand levels, although there are times during the peak travel period where parking nears or exceeds capacity. During off-peak seasons, parking is more than adequate to meet the needs of airport users.

Several parking lots remain unpaved, including long term parking, winter overflow parking, and rental car overflow lots. Gravel parking lots do not provide for an efficient layout of parking as it is difficult to maintain proper parking separation and layout, as compared to paved parking. Additionally, unpaved parking does not provide for the best experience for airport users as conditions during inclement weather can deteriorate the parking lots, which is noteworthy because the busy season at EGE is when there is significant snowfall. At a minimum, long-term parking should be paved, with both overflow lots being paved over the long term.

Existing parking spaces are adequate to meet existing air carrier demand, although the lots will likely be deficient in meeting long-term future demand. Existing parking lot locations and configurations are inefficiently designed, and a strategic-level planning effort should be undertaken to establish a progressive plan to institute improvements over the long term. Additionally, multiple existing challenges associated with rental car operations must be addressed for the long-term benefit of the Airport and its users.

4.3.5 General Aviation and Other Support Facility Requirements

Existing general aviation facilities at EGE are located east and west of the passenger terminal complex as well as in the development area north of Runway 7-25. Facility requirements related to general aviation facilities at the Airport are developed based on an analysis of existing facilities, current and planned utilization of those facilities, projected aviation demand, and the ultimate development potential of space adjacent to the terminal building and on the north side of the airfield.

Requirements are identified for the following general aviation facilities:

- FBO Facilities
- Federal Inspection Services Facility
- Air Cargo Facilities
- Corporate Hangar Facilities
- Other Aircraft Storage Facilities
- Fuel Storage
- Deicing Operations
- Airport Traffic Control Tower
- Ground Support Equipment
- Snow Removal
- ARFF/Administration Building
- Emerging Technologies

Projections of aviation demand developed in Chapter Three estimated that the number of general aviation aircraft based at the Airport, the vast majority of which are stored in hangars, will increase from 96 to approximately 162 by the end of the planning period. This facility requirement analysis examines the ability of general aviation facilities at EGE to accommodate current and anticipated activity levels, and identifies those development needs necessary to adequately support the Airport's general aviation users.

FBO Facilities

EGE is currently serviced by Vail Valley Jet Center (VVJC), which serves as the Airport's sole FBO. Acquired by Signature Aviation in 2021, VVJC provides FBO functions such as aircraft fueling services, management of the transient aircraft apron, aircraft maintenance services, and manages a large portion of the hangar storage on the airfield. Additionally, VVJC provides space for other basic functions such as a pilot lounge, flight planning room, crew rest rooms, and bathrooms. Passenger services include catering, valet services for rental and personal cars, personalized concierge services, meeting and conference rooms, among others. The Vail Valley Jet Center is an award winning FBO, recognized throughout the nation as one of the top FBO's. Comments from recent airport surveys indicate that airport users are very satisfied with VVJC's customer service and ability to handle high amounts of volume during peak periods of operation.

FBO facilities at EGE primarily consist of aircraft maintenance hangars, aircraft storage hangars, and fuel storage facilities. VVJC has recently expanded operations to the west of the commercial terminal building and has long-term potential plans to expand operations to the north of Runway 7-25, all in an effort to accommodate based and transient jet aircraft well into the future. Projections of general aviation activity also anticipate growth in based aircraft, including based jet aircraft from the current fleet of 25 jets to 42, all of which will requires space and staff to service these aircraft. VVJC also handles ground transportation for clientele, which requires additional space for automobile storage.

It should also be recognized that an airport is not limited to having just a single FBO. Many, if not most, active airports have more than one FBO – this provides alternative service providers for users and encourages competition that can result in enhanced services, lower customer costs, and greater revenues for the airport. While EGE currently only has one FBO, it must remain open to the potential for the introduction of an additional FBO. This is not only consistent with best management practices, but it is also required by the FAA as part of its grant assurances for an airport to receive federal grant funding.

With Signature Flight Support's acquisition of Vail Valley Jet Center, the Airport should maintain communication with VVJC to anticipate any change in the based jet aircraft fleet and other facility requirements. The Airport should consider the potential introduction of an additional FBO.

Federal Inspection Services Facility

Given the current and projected increasing levels of international passenger traffic at EGE, the Airport is currently in process of designing and constructing a Federal Inspection Services (FIS) facility in concert with and approved by the U.S. Customs and Border Protection (CBP) agency. An FIS is a single facility that serves as the base of operations for CBP, immigration, and agriculture operations. All aircraft flying to the U.S. from foreign countries must be cleared by CBP and an FIS facility unifies both passenger processing and baggage/cargo processing for a safe and efficient flow of passengers and goods into and out of the U.S.

At EGE, the new facility will be approximately 20,000 square feet in size and will be attached to the current VVJC terminal building (**Figure 4-39**). The facility will be a combination of a partial renovation of the existing VVJC building and an overall expansion of the existing footprint. It will accommodate international passengers arriving at EGE that require customs clearing. Passengers will claim their bags and be processed sequentially through the building until they ultimately depart out the southeast corner of the building to the Airport frontage road. The new facility will also include a new electrical generator.

Figure 4-39: Future EGE FIS Facility

Source: EGE

The Airport should continue in its efforts to establish an FIS facility as planned.

Air Cargo Facilities

Currently, there is only limited air cargo activity at EGE and is primarily associated with cargo transported via commercial airlines or charter aircraft. Most cargo handled by UPS, FedEx, or USPS is typically shipped through established processing facilities on or near Grand Junction Regional Airport in Grand Junction, Colorado. Denver International Airport also provides some service and capacity to the EGE cargo market as well. Existing facilities at EGE adequately meet the demand of existing cargo operation and for levels forecasted in the future.

If demand for cargo were to increase, or if UPS or FedEx were to shift their operations to EGE, facility requirements should be reexamined to ensure an adequate level of service is maintained.

Aircraft Storage Facilities

EGE and VVJC maintain apron tiedowns and hangar space for both based aircraft and transient aircraft. The Airport currently accommodates significant demand from local aviation users as well as those visiting from outside the area. Storage options for these users depend on multiple variables including length of stay, aircraft type, availability, and other influencing factors. This section analyzes EGE's existing aircraft storage facilities and anticipated needs based on aviation activity forecasts.

Apron Tiedowns

Fourteen painted tiedown spaces are available on the north apron for single-engine and multi-engine piston aircraft. Since these spaces are further from VVJC and away from the main terminal area, these spaces are available for long-term lease by based aircraft. The south general aviation apron does not use marked positions and is used more often for aircraft that either arrive and depart the same day or stay for one night. The apron area near VVJC encompasses nearly one million square feet of storage and primarily accommodates jet aircraft.

Apron Tiedown Storage – In addition to providing permanent storage for based aircraft, aircraft tiedown positions managed by the Airport and VVJC also support the storage of based and transient general aviation aircraft at EGE. Transient, or visiting, aircraft tiedown requirements are impacted by the number of transient operations occurring at an airport. As the number of operations increase, the demand for itinerant apron tiedown space will also increase. To estimate the demand for transient aircraft tiedown positions at EGE, the following methodology was used:

- Estimate the total number of general aviation itinerant operations (defined as an arrival or a departure).
- To establish the average daily number of itinerant arrivals that may require a tiedown, the total number of general aviation itinerant operations was multiplied by 50 percent to reflect only arrivals; that number was then divided by 12 to establish a monthly average; and that number was then divided again by 30 to establish a daily average.
- Finally, that daily average was multiplied by 35 percent to reflect the total number of average day arrivals would be on the apron at any given time.

The results of this methodology, based on the planning activity levels developed for EGE, are summarized in **Table 4-12**.

Table 4-12: Tiedown Requirements

Year	Total Itinerant GA Ops	Peak Month Daily Itinerant Arrivals	Required Transient Tiedowns
2022	22,845	61	21
2027	25,780	69	24
2032	26,526	71	25
2037	27,272	73	26
2042	28,018	75	26

Source: Jviation, a Woolpert Company

If it is assumed that each transient tiedown requires approximately 3,600 square feet (average non-VVJC hangar size), then at the peak forecast year in 2042 with 26 anticipated transient tiedowns would result in just over 270,000 square feet of apron space that would be required. With nearly one million square feet of apron space across the Airport, EGE exceeds the necessary apron space anticipated in future forecast years.

Hangars

Storage needs for general aviation activity generally reflect local climatic conditions in combination with the size and sophistication of an airport's based aircraft fleet. Typically, the more valuable an aircraft is, the greater the desire to store it in a secure hangar facility. Aircraft storage at EGE is highly valued, especially during the peak winter season and periods of inclement weather. During the peak season, when hangar storage is at capacity, it is not uncommon for transient aircraft to drop off passengers and depart for other nearby airports that have available aircraft storage.

As discussed in Chapter Two, *Inventory of Existing Conditions*, EGE has nearly 400,000 square feet of hangar space available for based and transient aircraft. VVJC currently maintains approximately 250,000 square feet, or over 60 percent of that available space with more hangars currently being developed. Other notable hangar facilities are maintained by Vail Hangair, the Airport, and other smaller developers.

Vail Valley Jet Center manages the available corporate hangar facilities, which primarily store transient jet aircraft. VVJC is in the process of expanding its footprint in development areas to the west of the commercial terminal (with the potential of adding over 180,000 square feet of new hangar space), as well as on the north side of the Airport. As reflected in national trends and EGE's forecasts of aviation activity, corporate aviation will continue to be an important and growing component of general aviation activity at the Airport and VVJC plans to continue to meet those future demands for hangar space.

Since VVJC acts as the primary developer of corporate facilities at the Airport, their future facility needs are an important consideration in the master planning process. Based aircraft and transient general aviation operation projections developed for EGE anticipate an increasing amount of jet activity at the Airport. Examining development alternatives and having adequate planning in place will allow the Airport to more efficiently complete infrastructure development that may be necessary to support potential corporate hangars at EGE.

When considering the hangar needs of based aircraft, a rough estimate of future space required to store these aircraft can be developed using inputs from historic and current storage figures. From the last AMP, it is assumed that 75 percent of based aircraft are stored in hangars, and when subtracting VVJC hangars from the total square footage available, it leaves approximately 150,000 square feet for based aircraft. When divided by the estimated number of fixed wing aircraft in hangars, this results in approximately 2,500 square feet of space required per based aircraft. **Table 4-13** provides details on the inputs used to estimate based aircraft hangar needs.

Table 4-13: Hangar Requirements

Year	Fixed Wing Based Aircraft in Hangars	Hangar Space for Based Aircraft (Sq. Ft.)	Additional Hangars Required in Each Period
2022	61	150,000	
2027	72	177,800	8
2032	82	201,900	6
2037	92	227,800	7
2042	103	253,700	8

Source: Jviation, a Woolpert Company

An estimated number of additional hangars required in each five-year period was developed using the average hangar size of non-VVJC hangars at EGE, which is approximately 3,600 square feet. From the anticipated growth in based aircraft developed in the forecast, it is estimated that the Airport will need about seven to eight, 3,600 square foot hangars in each five-year interval moving forward, or approximately 25,000 square feet in hangar space.

Methods of accounting for based aircraft at airports present challenges in identifying necessary storage facilities. As mentioned in Chapter Three, an aircraft may be "based" at EGE but since Eagle is a popular destination for second homeowners, an aircraft may be stored elsewhere for a significant fraction of time. With this in consideration, based on the forecasted growth of both based aircraft and itinerant general aviation operations combined with the Airport's limited airside growth potential, it is recommended that new hangar development be evaluated on a case-by-case basis in conjunction with the FBO based on their knowledge and handling of itinerant aircraft.

Apron area, infill development, and expansion of hangar areas for corporate aviation should be protected and maximized in future development plans of the Airport.

Fuel Storage

Fuel storage at EGE is owned and operated by the Vail Valley Jet Center. There are eight fuel tanks with 197,000 available gallons of Jet A fuel storage. Seven of these tanks are located in the south side fuel farm, except for one 12,000-gallon tank on the north side. The 12,000-gallon AvGas fuel tank is located on the north side of the airfield and is self-serve. Note that VVJC fuel storage also includes the Signature Renew-branded sustainable aviation fuel (SAF), a sustainably sourced jet fuel that will reduce aircraft carbon emissions at the Airport. SAF is projected to affect a 25% reduction in CO2 emissions from jet-powered aircraft, driving an environmental benefit for the Central Rocky Mountains and beyond.

Per the Airport's Minimum Standards, VVJC must provide two metered, filter equipped dispensers for AvGas and Jet A, with minimum capacities of 12,000 gallons for AvGas and 75,000 gallons for Jet A. Each mobile dispensing truck is required to have a minimum capacity of 25,000 gallons for Jet A and 750 gallons for AvGas.

The Airport should continue to partner with VVJC to ensure fuel capacity is adequate for commercial service and general aviation operations.

Deicing Operations

Airline staff and VVJC apply deicing fluids to commercial service and general aviation aircraft at EGE. The application of these fluids is critical to aircraft operating safety. As mentioned in Chapter Two, deicing occurs on the east apron in a specially designed area with trench drains to capture runoff. Two types of deicing fluids are in use at EGE:

- Type I – A mix of Propylene Glycol and water which is heated to remove ice and snow from the aircraft. Type I is the deicing mixture.
- Type IV – A concentrated version of Propylene Glycol that is applied before departure to prevent ice upon takeoff. Type IV is the anti-icing mixture.

The Environmental Protection Agency (EPA) promoted 40 CFR 449, Airport Deicing Effluent Guidelines in 2012. This guidance requires primary airports with 1,000 or more annual jet departures to use non-urea-containing deicers. Airports with 10,000 annual departures in cold climate zones are required to collect 60 percent of aircraft deicing fluid. EGE achieves this mark through its existing trench drain and glycol waste storage system.

Airport Traffic Control Tower

Airport Traffic Control Tower services are provided through the FAA Contract Tower Program, which is currently managed by Serco. The FAA and the Airport work collaboratively to maintain the tower facility while Serco provides staffing. The Airport is responsible, along with the FAA, for upkeep and upgrades to equipment and maintenance.

Tower improvements should be programmed into the Airport's CIP as required by the FAA's Contract Tower Program.

Ground Support Equipment

Ground support equipment (GSE) at EGE is required and supplied by the airlines and VVJC. GSE includes aircraft tugs, deicers, ground power units, baggage carts, belt loaders, lavatory carts, and other serving vehicles. The majority of GSE is staged on the edge of the apron between the commercial terminal and the VVJC terminals, with additional space employed around the concourse and on the commercial apron south of aircraft parking Spots 1 and 2. The amount of space needed for GSE storage and parking is largely determined by the individual operators and is currently generally adequate (albeit unorganized) to meet the needs of existing operations. Due to a lack of dedicated storage space or a covered structure, all GSE maintenance and vehicle service work is currently done outside on the existing apron. Such service work is certainly hindered by inclement weather, cold, and the presence of snow and ice. Additionally, there is no system to protect from hazardous materials.

Beyond existing circumstance, three additional factors have the potential to significantly impact GSE operations and storage:

- The Airport is currently in process of constructing a Federal Inspection Services (FIS) facility attached to the existing VVJC terminal building. This expanded facility will directly impact the existing GSE storage area.
- As noted previously, the existing commercial air service terminal needs an expanded footprint to accommodate increased long-term service requirements. This expanded footprint will likewise directly impact the existing GSE storage area.
- GSE users led by the airlines are formulating plans for progressive replacement of their combustion-engine powered equipment with battery-powered electric vehicles. This transformation will not only require new dedicated electric charging stations, but it will also likely require an increased number in equipment pieces to account for equipment redundancy due to recharging inefficiencies. All of this will require additional dedicated space for GSE.

As demand increases and other pressures on GSE storage areas arise, new storage areas for this equipment must be identified to ensure that adequate facilities are provided. Additionally, it is recommended that dedicated space be provided for maintenance of GSE in proximity of the storage area(s).

Snow Removal

The existing Snow Removal Equipment (SRE) building, constructed in 2015, is over 26,000 square feet and stores much of the Airport's snow removal and airfield maintenance equipment and supplies (**Figure 4-40**). As outlined in Chapter Two, *Inventory of Existing Conditions*, the Airport maintains nine brooms, three blowers, and seven plows. The Airport reports that many pieces of equipment must remain stored outside or in an auxiliary storage unit on the north side. This is largely due to the need to store materials and supplies in the SRE building which prevents some equipment from being brought inside. An expansion of the existing SRE building to the north should be considered to alleviate this need. Alternatively, or additionally, the Airport could consider the construction of a new heated structure to be located in a vacant area to the west of the existing SRE building. The purpose of this new structure would be to house smaller fleet vehicles that are currently stored outside, airfield maintenance/snow removal materials that currently occupy space in other buildings, as well as housing other small equipment that is stored both inside and outside in various locations around the Airport.

Figure 4-40: EGE SRE Building

Source: EGE

Existing snow removal equipment meets Airport needs but should be replaced as equipment ages and becomes ineffective; an expansion of the SRE building capabilities should be planned.

ARFF/Administration Building

The Airport Rescue and Fire Fighting (ARFF) service operates out of a dedicated building near the commercial terminal apron, with 12,000 square feet of space. Part 139-certificated airports are required to provide ARFF services, which are grouped into Indices, A through E. EGE is Index C, which is based off the aircraft length of a Boeing 757-200.

Index C airports can meet minimum requirements with three vehicles – one carrying extinguishing agents and two vehicles carrying enough water and foaming agent so that the foam production from all three vehicles is at least 3,000 gallons; or two vehicles – one vehicle carrying the extinguishing agents and one vehicle carrying enough water and foaming agent so that the foam production carried by both vehicles is at least 3,000 gallons.

The Airport's Administration Offices are also located on the second floor of the ARFF building. There is also office space for on duty ARFF personnel on the first floor adjacent to the vehicle bays. This building adequately serves existing staff; however the layout of the existing administration offices does not allow for privacy and do not permit future growth.

The EGE ARFF is equipped with three fire trucks and one foam trailer, which meets the minimum standards of an Index C ARFF station. Airport administrative offices should be considered for relocation into an expanded commercial service terminal building.

Miscellaneous Requirements

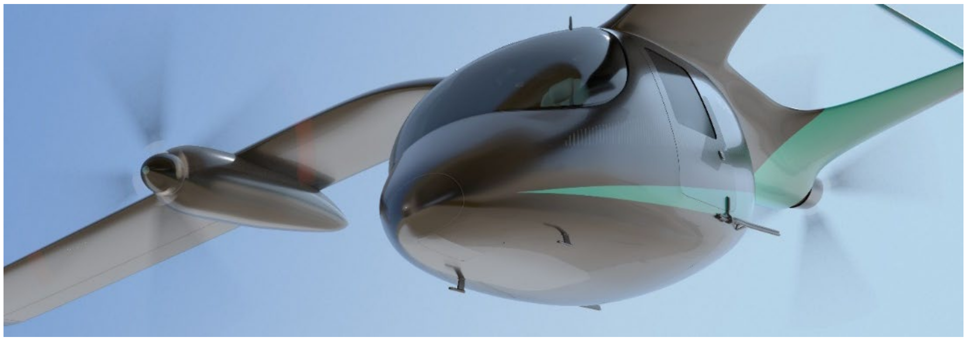
Waste Triturator

It has been recognized by the airlines that the Airport lacks appropriate lavatory waste disposal capabilities. Currently, airlines must either continue to carry the waste in their aircraft (which can become a challenge for aircraft capacity and interior odor on full flights on long flight legs) or employ a lavatory dump cart at EGE which creates its own challenges due to the lack of options to dispose of the waste. VVJC has its own triturator that processes waste from general aviation aircraft and stores it in a tank for subsequent pumping and removal for off-site processing.

Ideally, EGE would improve its airliner and FBO waste disposal processing by creating an automated, closed waste system that would consist of a quick-connect hose, a triturator (grinder), a potable water flush system, and a connection to the local sewer system.

EGE should pursue the construction of a waste triturator system tied to the local sewer system to support airliner and general aviation waste processing operations.

4.4 ANALYSIS OF ADVANCED AIR MOBILITY MARKET POTENTIAL AND INFRASTRUCTURE NEEDS ASSESSMENT



4.4.1 AAM Overview

Advanced Air Mobility, or AAM, is an emerging air transportation concept that primarily utilizes innovative electric vertical takeoff and landing (eVTOL) aircraft to move people and cargo. This emergent technology can expand access to transportation, particularly in areas underserved by aviation.

Advanced Air Mobility (AAM) refers to an emerging aviation ecosystem that leverages new aircraft and innovative technologies to provide more efficient, sustainable, and equitable transportation options

AAM is the umbrella term for Urban Air Mobility (UAM), which focuses on transporting people and cargo at low altitudes within urban and suburban areas, and Regional Air Mobility (RAM), which builds on UAM to provide inter-city and regional travel. AAM also includes other use cases such as air ambulance, firefighting, law enforcement, and special events.

AAM is not a single technology; rather, it is a collection of new and emerging technologies and new aircraft configurations being applied to the aviation system. The advent of distributed electrical propulsion (DEP) is the key element behind many of the major advancements in air mobility, especially vertical flight. As described by NASA, DEP "*technology is based on the premise that closely integrating the propulsion system with the airframe and distributing multiple motors across the wing will increase efficiency, lower operating costs, and increase safety.*" (Clarke, 2021)

Aircraft

AAM is becoming an all-encompassing acronym for aircraft and services that use DEP and can take off and land vertically, known as electric vertical takeoff and landing (eVTOL) aircraft. eVTOL capability is the predominant configuration for aircraft utilizing AAM technology. The Vertical Flight Society Aircraft Directory is tracking hundreds of concepts for electric and hybrid-electric VTOL aircraft, though many of these are in early conceptual stages. The leading original equipment manufacturers (OEM) are targeting the middle of 2020 to 2030 for entrance into service. (SMG Consulting, 2023) There are three main types of eVTOL systems that can be expected in significant volume if the eVTOL original equipment manufacturers (OEMs) deliver on the potential of safe, efficient, and cost-saving aircraft:

Multicopter – looks and flies much like a helicopter except with multiple rotors.

Lift and Cruise – uses rotors for vertical flight and transitions to propellers for horizontal flight.

Vectored Thrust – uses rotors or fans for both vertical and horizontal flight.

In general, these aircraft hold somewhere between four and eight passengers. The early entrants will be piloted, while later entrants hope to operate autonomously. Early eVTOL flight ranges are typically 60-150 miles, and cruise speeds are typically 100-200 miles per hour. **Table 4-14** provides a summary of existing manufacturers in the 2023-2024 eVTOL market collected from various sources.

Table 4-14: Key eVTOL Market Players

OEM	Platform	Mission	Passengers	Range	Airspeed mph	Key alliances
Archer Aviation	Vectored thrust	Air taxi, cargo	4 + pilot	100	150	Stellantis, United, U.S. military, Boeing, Wisk Aero
BETA Technologies	Lift and cruise	Air taxi, cargo, EMS	4 + pilot	250	100	UPS, Amazon, U.S. military
HEXA	Multicopter	Personal/ recreational	1 pilot or 1 passenger	60	63	
Joby Aviation	Vectored thrust	Air taxi	4 + pilot	150	200	Toyota, U.S. military, Delta, United
Eve Air Mobility	Lift and cruise	Air taxi	4 + pilot	60	125	Embraer, Porsche, Blade, United
Vertical Aerospace	Vectored thrust	Air taxi, cargo, public services (EMS)	4 + pilot	100	150	American, Virgin Atlantic
Lilium Air Mobility	Vectored thrust	Air taxi, regional	6 + pilot	155	155	NetJets
Supernal	Vectored thrust	Air taxi	4 + pilot	60	180	Hyundai
Wisk Aero	Vectored thrust	Air taxi	4 + no pilot	90	138	Archer, Boeing, Japan Airlines, Air New Zealand

Source: Jviation, a Woolpert Company, OEM websites, eVTOL.news, AAM Reality Index, other miscellaneous sources
All values are approximate. Range is in miles.

Infrastructure

During the early stages of AAM, eVTOLs will use existing aviation infrastructure, such as airports and appropriately sized heliports. Airports are an especially critical part of early AAM operations as they are existing facilities dedicated to aeronautical operations. Airports can also support the manufacturing, storage, and charging of eVTOL aircraft.

Airports have two main options for accommodating eVTOL operations - they can either integrate the operations into their existing traffic flow and have the aircraft land horizontally on runways (or at their own risk on apron space), or an airport can develop a segregated landing area specifically dedicated to eVTOLs.

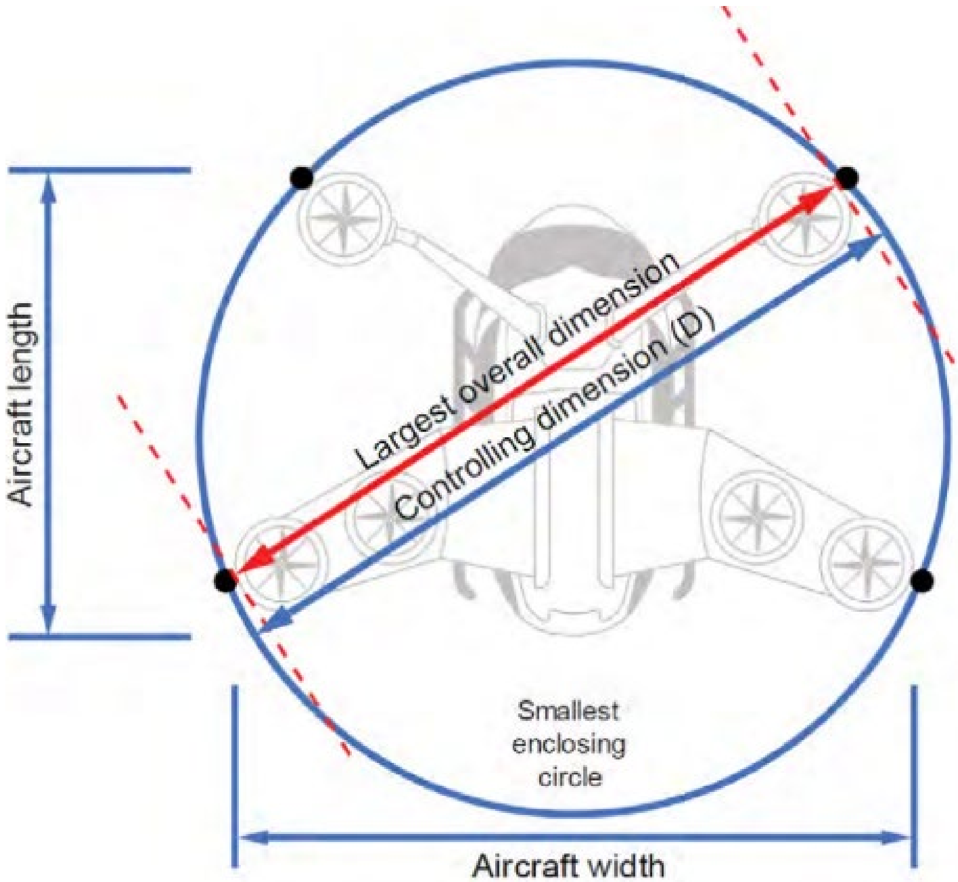
As the AAM market expands, the need for dedicated landing infrastructure for eVTOLs, known as vertiports, will arise. Heliports represent the most similar form of infrastructure; therefore, some OEMs have used FAA AC 150/5390-2D, *Heliport Design,* as a guide for developing eVTOL infrastructure. However, the FAAs heliport design AC does not account for the largely unknown performance characteristics of eVTOL aircraft. Beyond those characteristics, the heliport design AC does not include other unique considerations including, but not limited to, thermal runaway associated with batteries, hazardous materials from battery leaks or fires, firefighting to prevent electrical fires, electrical charging stations; and eVTOL rotor downwash and outwash.

Because of the unique designs and issues associated with emerging eVTOL aircraft, the FAA initiated research in 2020 to support the development of a new AC for vertiport design. Empirical data on eVTOL aircraft is limited given that, as of 2023, no eVTOL aircraft have received airworthiness certifications from the FAA. Because the data surrounding these aircraft is too limited to inform performance-based infrastructure, the FAA has released interim guidance for vertiport design. This guidance, FAA Engineering Brief (EB) 105, *Vertiport Design* (Federal Aviation Administration, 2022) or *EB 105*, is prescriptive and limited to electric eVTOL operations. An AC on Vertiport Design is expected to be published by 2025 or 2026.

Interim Infrastructure Guidance – EB 105

EB 105 uses the concept of a “design aircraft”—defined as the largest eVTOL aircraft expected to operate at a vertiport—for various landing area geometry. The aircraft's controlling dimension (D) is the diameter of the smallest circle enclosing the aircraft projection on a horizontal plane while the aircraft is in the takeoff or landing configuration, with rotors/propellers turning, if applicable (see **Figure 4-41**). Combined, the controlling dimension of the vertiport’s design aircraft defines the size of the landing geometry at the vertiport.

Figure 4-41: An eVTOL's Controlling Dimensions



Source: Jviation, a Woolpert Company

Touchdown and Liftoff Area (TLOF)

The TLOF is a generally paved, load-bearing area centered in the final approach and takeoff area, on which the aircraft performs a touchdown or liftoff. EB 105 Brief specifies that a TLOF should be 1D of the design aircraft. To accommodate the largest aircraft that could use the EB (with a controlling dimension of 50 feet), a TLOF would be 50 feet in diameter.

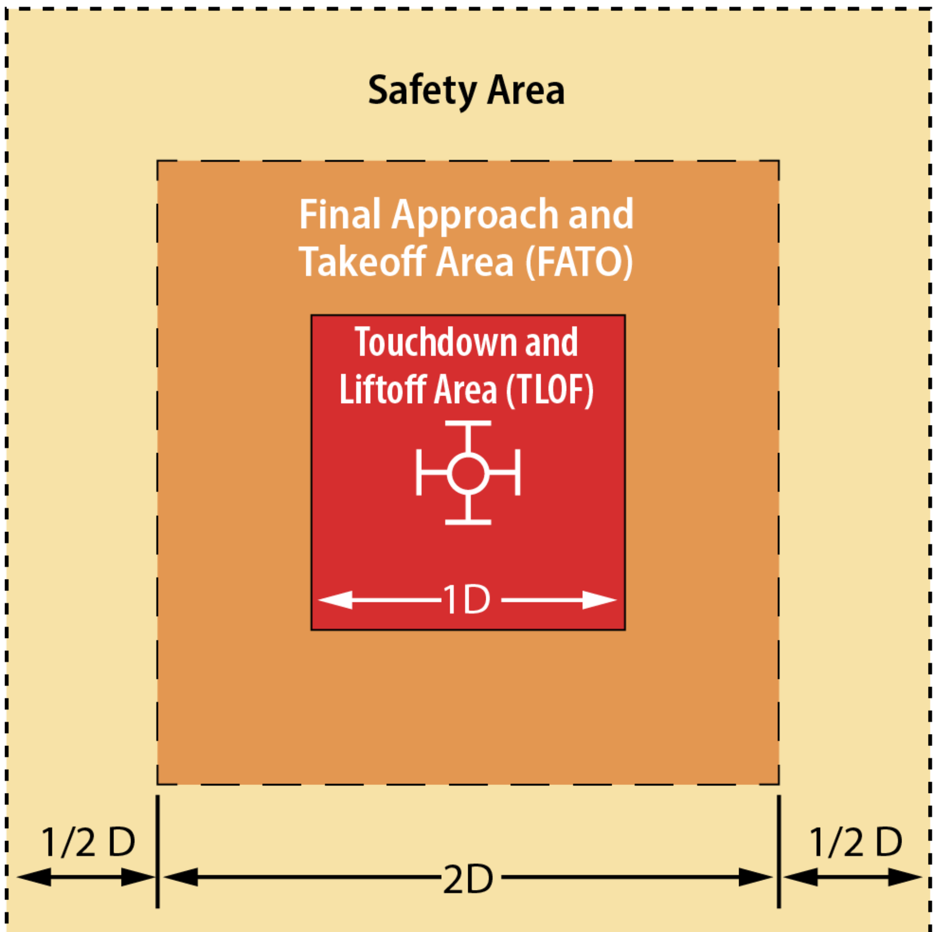
Final Approach and Takeoff Area (FATO)

The FATO is a defined, load-bearing area over which the aircraft completes the final phase of the approach, to a hover or a landing, and from which the aircraft initiates takeoff. EB 105 specifies that a FATO should be 2D of the design aircraft. Based on the largest aircraft that can use the EB, a FATO would be 100 feet in diameter. Two ingress and egress paths are required as close to reciprocal as possible but at least 135 degrees apart. See the Imaginary Surfaces section below for more details.

Safety Area (SA)

The SA is a defined area surrounding the FATO intended to reduce the risk of damage to aircraft accidentally diverging from the FATO. EB 105 specifies that a Safety Area should be 3D of the design aircraft. The SA would need to be 150 feet in diameter.

Figure 4-42: EB 105 Basic Landing Area



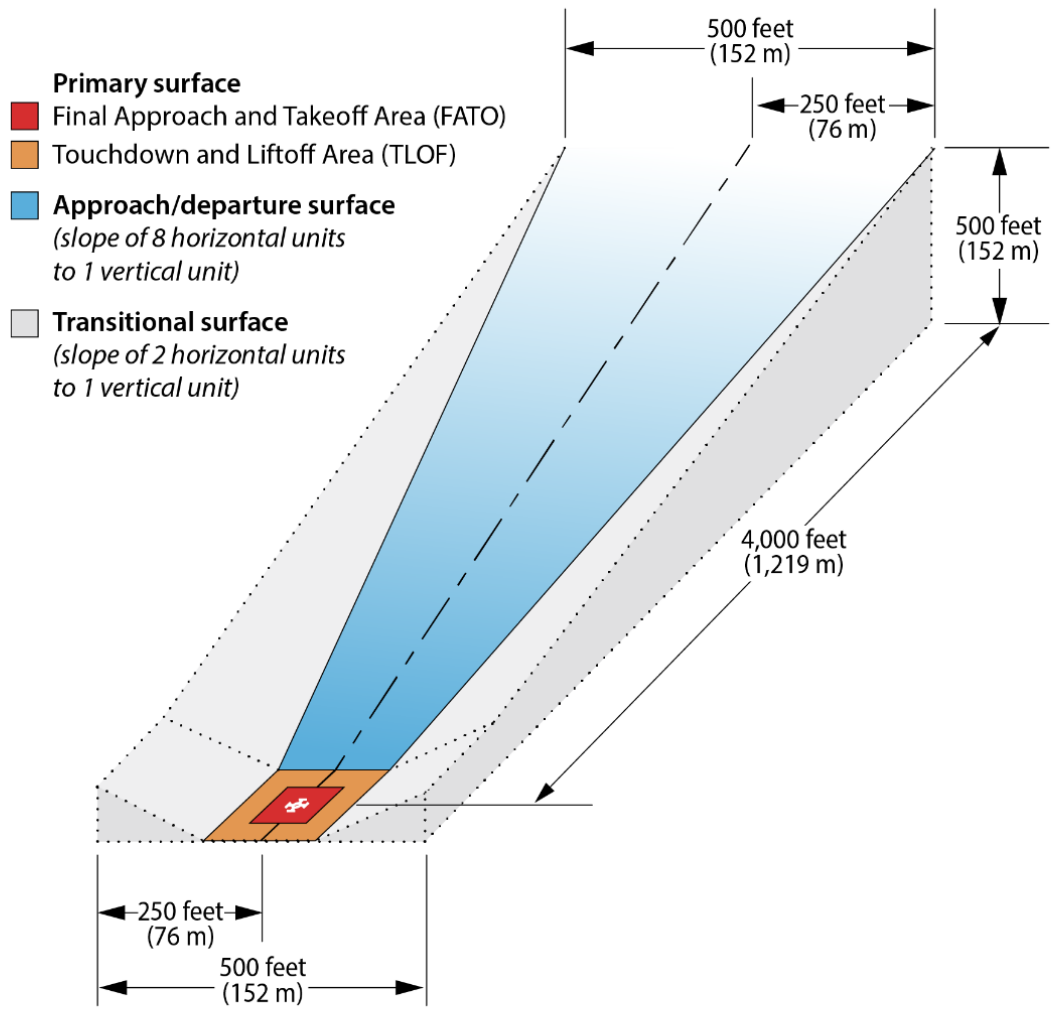
Source: Jviation, a Woolpert Company

Imaginary Surfaces

Imaginary surfaces are the imaginary planes defined in 14 CFR Part 77, *Safe, Efficient Use, and Preservation of the Navigable Airspace*, centered on the FATO and the approach/departure paths, which are used to identify the objects where notice to and evaluation by the FAA is required. Three relevant surfaces are presented in the Engineering Brief. The primary surface is a horizontal plane which coincides with the size, shape, and elevation of the FATO. The approach/departure surface begins at each end of the primary surface with the same width as the primary surface. It extends outward and upward at a slope of 8:1 horizontal units to vertical units for a distance of 4,000 feet and width of 500 feet The transitional surfaces extend outward and upward from the lateral boundaries of the primary and approach/departure surface at a slope of 2:1 horizontal units to vertical units for 250 feet horizontal from the centerline of the primary and approach/departure surfaces (see **Figure 4-43**).

Currently, any sponsor of a federally obligated airport pursuing an eVTOL vertiport or supporting infrastructure must update their ALP with the FAA, conduct the applicable environmental review required by the National Environmental Protection Act (NEPA), and submit an FAA Form 7460, *Notice of Proposed Construction or Alteration,* for an airspace determination. Non-federally obligated airport sponsors must submit FAA Form 7480-1, *Notice for Construction, Alteration and Deactivation of Airports*, at least 90 days prior to construction of a vertiport.

Figure 4-43: EB 105 Vertiport imaginary surfaces.



Source: Jviation, a Woolpert Company

On-Airport Vertiport Guidance

EB 105 contains specific guidance for siting on-airport vertiports. The guidance is summarized in **Table 4-15.**

Table 4-15: EB 105 On-Airport Vertiport Guidance

Summarized guidance	Practical implications
All federally obligated airport sponsors are to provide reasonable and not unjustly discriminatory access to all aeronautical users.	Any vertiport designed at a federally obligated airport should be built agnostically, so the landing facilities can accommodate a variety of eVTOLs. Thus, an on-airport vertiport should have a minimum of a 50-foot diameter TLOF, 100-foot diameter FATO, and 150-foot diameter Safety Area (including the FATO and TLOF) to account for the dimensions of nearly all eVTOL aircraft in development.
Locate the TLOF away from but with access to fixed-wing aircraft movement areas (runways, taxiways, etc.).	Any vertiport on an airport should be located outside of these movement areas.
The center of the FATO should be located outside of all object-free areas, safety areas, runway protection zones, and safety critical navigational aid areas.	Any vertiport on an airport should be located outside of these movement areas.
The center of the FATO should be located at least 300, 500, or 700 feet from the centerline of the runway, depending on the weight of the critical aircraft for that runway.	The critical aircraft of each runway (or the runway design code if critical aircraft is not available) at an airport should be used to determine appropriate vertiport minimum distance from that runway, as provided in EB 105.

Source: EB 105

Supporting Infrastructure

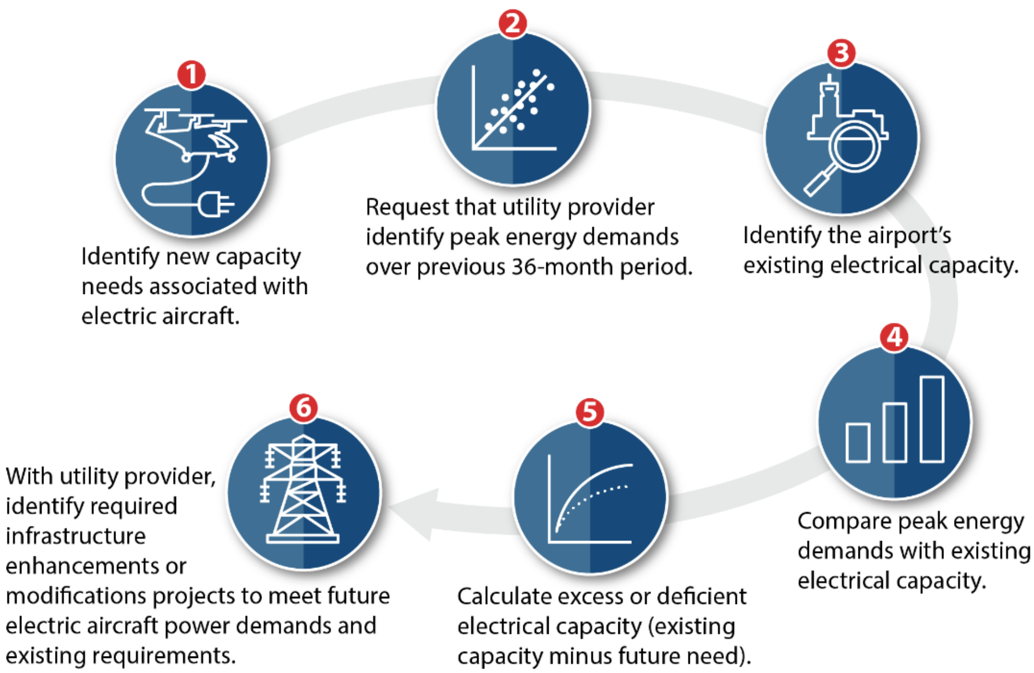
In additional to federal standards, this section describes several supporting infrastructure needs; however, these needs will vary based on the concept of operation and specific OEM using a facility.

Electric Capacity and Charging Infrastructure

Recent air mobility advancements focus on electrical propulsion; therefore, eVTOL aircraft will be powered by electric motors with specific electricity needs. It is important that EGE consult with their local electric utility to determine the current type and supply of electricity, as well as approximate levels of effort and costs associated with upgrading these components if needed. Holy Cross Energy is the Airport’s electric provider, and there are several electric sources available in the vicinity. As part of the recent construction of a deicing pad on the east end of the Airport, three-phase power was brought on to EGE, which will be critical for supporting the development of the high-capacity electric charging stations. This type of electricity supply is better suited to accommodate higher loads and is typically used by commercial and industrial facilities. In addition, Holy Cross is actively engaged in increasing capacity at the Airport. It is anticipated that this will enable the Airport to support the development of high-capacity electric charging stations while also meeting the power needs of other facilities.

Figure 4-44 illustrates a roadmap for coordination with Holy Cross to determine electrical needs at EGE.

Figure 4-44: Airport Electric Utility Coordination Process.



Source: Jviation, a Woolpert Company.

Electric infrastructure requirements will need to be holistically assessed based on eVTOL aircraft type, the number of charging stations that will be operating simultaneously, and the continuous power that is needed to support the desired frequency of eVTOL operations. Each OEM has different charging specifications for their vehicles. Early infrastructure should provide for high-voltage, fast charging at each aircraft parking position.

The NASA Astrobiology Institute (NAI)-NASA Urban Air Mobility Electric Infrastructure Study calls for 600 kW to futureproof the chargers. Regardless, early infrastructure should provide for high-voltage, fast charging at each parking position. Each OEM is different, but early contenders in this arena offer some insights into their charging needs.

Table 4-16: BETA (OEM) Battery Charging Information

Component	Requirement
AC Voltage Connection	480 Vac, 3 Phase, 60 Hz
AC Grid Current	420 Amps
Continuous Power	350 kW
Battery Charge Range	Up to 1000 Vdc
Continuous Charge Current	350 Amps
Charging Protocol	CCS

Source: BETA Technologies, 2023

Table 4-17: JOBY (OEM) Battery Charging Information

Component	Requirement
Component	Requirement
Voltage	150 – 1000 VDC
Current	300A per channel possible, depending on thermal conditions, coolant exchange flow rate, and temperature

Source: Joby Aviation, 2023

Table 4-18:Lilium (OEM) Battery Charging Information

Component	Requirement
Grid	Supply of ~1MW per inverter cabinet.
Transformer	~20kV downward transformation. Transformer size needed will be 1MVA per 1MW of connected load. Voltage-controlled is preferred; in instances where voltage fluctuation needs controlling, autotransformers can be added.
AC-DC Converter	800-900V output voltage.
Charging box	Maintain voltage and power and ensure load management. Needs to be able to handle ~1200A @ ~900V.
Plug	Operated by pilot or ground staff (potentially mechanically assisted). Needs to handle power and currents. Handle and cable must be liquid cooled.

Source: Lilium, 2023

Battery Cell Recycling

Waste buildup from large lithium batteries is likely to develop unless appropriately recycled. An EGE policy on battery recycling would assist in this process and help prevent environmental pollution.

Maintenance, Repair, and Overhaul (MRO) Services

eVTOL aircraft utilize cutting-edge electric propulsion technology, which requires high-voltage electrical components. These electrical components will require maintenance, repair, and overhaul companies (MROs) capable of these unique repairs. Because of the limited space on many busy airfields like EGE, MRO services are likely best suited at EGE, where ample space is available.

Airport Rescue and Fire Fighting and Electric Fire Safety (ARFF)

ARFF is required at Part 139 airports, including EGE. However, differences between traditional fuel fires and battery/electrical fires, toxic gas emissions, and high voltage electrical arcing are issues that will be unique to electric aircraft facilities. The operating requirements surrounding eVTOL flights would likely fall under Part 135, which does not require fire coverage at the airports these operators use. However, EGE would still respond to any aircraft fire on its property, so ARFF staff must be capable of adapting to these unique issues. Since no two eVTOL aircraft will have the same designs or even use the same batteries, the methods for dealing with thermal runaway will differ. Thermal runaway starts when the heat developed inside a battery cell surpasses the heat that it can dissipate. If the cause of disproportionate heat is not addressed, the condition continues to the next cell. This temperature increase affects other nearby batteries, and the rising heat continues to spread, thus the term “runaway.” Thermal runaway can present a huge problem for an operating vertiport. Even after the fire is initially extinguished, the potential for reignition is high and can last beyond 24 hours.

Official firefighting protocols for eVTOL aircraft have yet to be established, and these protocols may differ based on the aircraft. Still, several steps can be taken to best plan for electric aircraft firefighting at an airport. First, fire response personnel must be trained and equipped to fight electric aircraft fires. However, given the diverse designs and battery specifications across eVTOL aircraft, there are still unknowns about battery fire containment at vertiports. Battery/electrical fires pose different challenges than traditional fuel fires, including high voltage electrical arching, toxic gas emissions, and the potential for reignition during battery removal if the battery's stranded energy was not exhausted in the fire. Second, EB 105 includes details of on-site safety elements for vertiports, including firefighting considerations. It notes that prior FAA research on small lithium battery cells found that water and other foam fire extinguishing agents were more effective for suppressing lithium battery fires than gas or dry powder extinguishing agents, though it has yet to be determined if the case is the same for the large battery packs found in eVTOLs.

Additionally, the National Fire Protection Association (NFPA) is a U.S.-based international nonprofit that develops standards and guidance for fire safety. NFPA 418, Standards for Heliports, is the NFPA’s guidance for fire safety at heliports that has recently (2024) been updated to include vertiport considerations. The document contains firefighting considerations specifically for eVTOLs which EGE ARFF should adopt in the event of vertiport construction. This NFPA standard could be incorporated into the required recurrent ARFF training (every 12 consecutive calendar months). A vertiport located onsite should have a dedicated fire safety response plan developed in coordination with ARFF, airport management, and local fire departments. While the 2024 version of this document includes limited fire control measures and an explanation of thermal runaway for electric vehicle fires, EGE ARFF teams will need supplemental materials to bolster their knowledge of electric battery fires if a vertiport is built on EGE property.

High-speed data

At this stage in AAM, it is unclear how eVTOL operations will be integrated into the National Airspace System. Regardless, the development and deployment of high-speed data, like 5G, will ultimately be needed for vehicle-to-vehicle (V2V) communication for collision avoidance, aircraft separation, and deconfliction required for autonomous operations to occur. High-speed communications and data considerations are also needed to integrate the vertiport with the vehicle and airspace systems. This includes data for current weather conditions, aircraft advisories, and flight plan clearances.

EGE currently has high-speed broadband/telecom infrastructure provided by Comcast, the area’s broadband provider. This capacity is capable of supporting autonomous or remotely piloted aircraft and is considered a site standard in the technology and research and development sector. Additional navigational aids and dense obstacle data collection may ultimately be required to support the establishment of an Unmanned Aircraft System Traffic Management (UTM). UTM development would ultimately identify services, roles and responsibilities, information architecture, data exchange protocols, software functions, infrastructure, and performance requirements for enabling the management of low-altitude drone operations. This would better support autonomy by enabling beyond visual line of sight (BVLOS) operations, which involve UAS flying beyond the pilot's line of sight and is essential for many commercial and industrial applications of UAS. Such a UTM system will enable BVLOS operations by incorporating various technologies such as detect and avoid systems, communications systems, and airspace management

4.4.2 AAM Use Cases

The primary use cases for AAM at EGE include air taxi, air cargo, public/emergency services, and potential opportunities for supporting services and research/development. These use cases, and how they may pertain to EGE, are described below.

Air Taxi

Air taxi services have traditionally relied on small, fixed-wing aircraft and helicopters to transport passengers from one location to another. However, the high cost of service and the noise associated with these aircraft have limited the widespread adoption of helicopter air taxi services. eVTOL aircraft may provide a more viable option for vertical travel. These aircraft are purportedly quieter, more efficient, less complex, and less expensive to operate than helicopters. While independent validation of these claims is necessary, a significant reduction in noise as compared to helicopters may make eVTOLs more appealing for use in urban areas.

EGE receives significant number of visitors throughout the year to experience the extensive range of outdoor tourism and high-end resort experiences. These visitors arrive from around the world on both commercial and general aviation aircraft. However, their ultimate destinations often lie beyond the Town of Gypsum and thus, they must employ a rental car or some other ground transportation service to move them to their destination. These traditional means of ground transportation can be troublesome and time consuming. Given the location of the Airport with respect to ultimate destinations like Vail, Beaver Creek, or even Aspen, the demand for immediate access to such destinations from EGE that avoids interstates or highways will ultimately attract air taxi services from one or more eVTOL operators. In such a use case, a traveler to EGE could conceptually disembark from their flight, collect their luggage, walk to an eVTOL air taxi center where they would board an eVTOL aircraft that would then transport them to a vertiport located at their destination. Such a service could be especially useful during surge periods such as ski season, holiday periods, and other special events where demands for limited ground transportation resources can be overwhelming. Such an electric aircraft shuttle service that transports visitors to and from EGE to resort and other destinations would provide a timely, cost-effective, and sustainable means of travel for these surge events and alleviate pressure for these growing demands.

It must be recognized that none of these resort destinations currently have helipads available for use by air taxi services; they would have to be developed in the future.

Air Cargo

High demand for time-sensitive cargo can create a market for air cargo services to support the middle-mile (transport from a port to a distribution center) of cargo delivery. Most middle-mile delivery is currently accomplished on the ground with cargo vans and box trucks. Initial eVTOL aircraft designs coming to market are comparable in size to, and could serve to replace, cargo vans. Utilizing eVTOLs for this middle-mile transportation would allow for aircraft to land directly at cargo sorting and distribution facilities and cut out a lengthy process and allowing for a more streamlined procedure for time-sensitive deliveries.

AAM is likely to make cargo transportation more efficient. Companies like Pipistrel, BETA Technologies, and Elroy Air are designing eVTOLs with cargo in mind.

The viability of an eVTOL air cargo operation at EGE is likely limited to time-sensitive materials, though its use could enable faster deliveries of goods in those instances. EGE is not currently served by any type of air cargo operation, so a business case for air cargo eVTOL at the Airport would have to be evaluated.

Nevertheless, small, cargo-carrying uncrewed aerial systems (sUAS) are already in use in some markets for last-mile package delivery. Amazon, Walmart, and UPS, among others, are investing in last-mile package delivery using sUAS, enabling extremely quick delivery services.[2]

Public Services/Healthcare Delivery

eVTOLs can likely enhance numerous public and emergency services. While still in development, eVTOLs will likely be able to supplement the role that helicopters and small, fixed-wing aircraft have in public and emergency service due to their anticipated savings from lower maintenance costs and their greater reliability. Potential public service use cases include air ambulance, firefighting, natural disaster relief support, search and rescue, and law enforcement.

For the Town of Gypsum, which does not have a hospital, immediate access to emergency health care is of the highest importance. The closest hospitals to EGE are Valley View Hospital In Glenwood Springs, Vail Health Hospital in Vail, St. Vincent Hospital in Leadville, and Aspen Valley Hospital in Aspen, all of which have heliports allowing for life-saving air ambulance patient transport to or from the hospitals. Air ambulance services may expand their fleets to include eVTOLs due to the purported cost savings compared to helicopters. Another use case in this category is transporting doctors via eVTOL to and from remote hospitals or clinics to expand healthcare access. Because many doctors currently drive to and from these locations, they would benefit from eVTOL's increased speed and, theoretically, increase the

[2] https://www.insiderintelligence.com/insights/drone-delivery-services/

area that doctor can service in a given timeframe. It is worth noting that the heliport at McCullough-Hyde does not meet the design standards established in EB 105, and its viability to convert the facility into a heliport would warrant further study.

Supporting Services and Research/Development

Aside from commercial or governmental operations, there are numerous opportunities for research and development and other supporting services for AAM at EGE. These opportunities include electric aircraft maintenance, autonomous system research, and advanced airspace planning. Given its high-altitude location, EGE could experience demand for civil AAM pilot training, much like that of the High Altitude Army National Guard (ARNG) Aviation Training Site on the north side of the Airport. While autonomy will likely become a bigger piece of aviation, in the meantime, the need for newly trained pilots for electric aircraft, and especially eVTOLs will exist. One of the major challenges for the industry to achieve widespread commercial adoption of eVTOLs is the pilot shortage which already exists. The FAA is expected to eventually introduce specific training requirements for eVTOLs, but flights may be permitted to get underway under a series of exemptions from current rules governing commercial operations of fixed-wing aircraft and rotorcraft. [3]

Private / Recreational

A subset of OEMs is building eVTOL aircraft that are designed purely for recreational use under 14 C.F.R. Part 103 – Ultralight Vehicles. Part 103 is a limited category that includes aircraft not exceeding 254 pounds while empty and not capable of more than 55 knots airspeed at full power in level flight. eVTOLs that are certified with the FAA under the ultralight vehicle category will not require a pilot certificate, but they will not be permitted to fly over any congested area of a city, town, or settlement or over any open-air assembly of persons, nor will they be able to transport passengers or cargo for hire and are for recreational purposes only.

Another subset of OEMs plans to sell eVTOLs directly to private buyers, similar to the private jet and airplane market. As of this writing, Lilium Air Mobility has officially opened sales of its eVTOL jet in the U.S. market, making it the first OEM to do so. These sales will be done through a partnership with EMCJET and will enable individuals to purchase eVTOL aircraft like how they can purchase private jets today. Similar to the air taxi use case described above, individuals flying privately will look to travel regionally to the many communities in and surrounding the Vail Valley.

[3] https://www.futureflight.aero/news-article/2021-11-15/flight-training-evtol-aircraft-crew-set-start-under-existing-commercial

4.4.3 AAM Infrastructure Needs Assessment

The key components of development for eVTOL operations at EGE are incorporated in this section and includes considerations for the key pieces of infrastructure required to support AAM:

- Vertiport Infrastructure and Capacity Analysis
- Electrical Infrastructure
- Weather Monitoring Infrastructure
- Data Infrastructure
- Facility Infrastructure

It's important to distinguish between the different infrastructure needs for AAM development at the airport. For instance, as is noted below, an electric aircraft charging station is crucial to enabling AAM at the airport and should be given priority and implemented as early as possible. On the other hand, there are needs such as hangars or multiuse facilities for AAM tenants with the intention of reserving space for potential development in the future. These needs are not as time-sensitive and can be adjusted as the specific needs of potential tenants become clear.

Vertiport Infrastructure and Capacity Analysis

While vertiports are the focus of new eVTOL-related infrastructure, airports already have much of the existing infrastructure needed to support eVTOLs. An airport can either integrate eVTOL operations into their existing traffic flow utilizing existing airfield infrastructure, or segregate eVTOL operations at a dedicated landing facility for eVTOLs. The simplest option for an airport is to integrate eVTOL operations into the existing traffic flow. Because many of these aircraft can land horizontally, they can fly the runway’s approach and land like a fixed-wing aircraft. Alternatively, eVTOLs can land at airports as helicopters do today, by following airport protocols and landing vertically at their intended destination on the apron or on runways.

Another option is to construct a facility that segregates eVTOL operations from the rest of the airport’s operations. Building and locating a vertiport on airport property can be done so that it operates independently of the airport’s runway, thus minimizing the impact of the facility on the airport’s capacity.

To determine if segregated operations and an on-airport vertiport should be established, EGE’s airfield capacity was considered. As of 2022, EGE handled 55,974 annual operations or 27.3% of its annual capacity of 205,000 operations. By the end of the planning period, that percentage will increase to 33.5 percent. It is highly unlikely that EGE will increase to the 123,000 annual operations needed to reach 60 percent of its capacity and justify the planning and ultimate construction of a segregated vertiport facility. In fact, the most reasonable method to introduce such operations into EGE would be to utilize existing infrastructure to the greatest extent possible for as long as possible. Nevertheless, given the highly seasonal nature of operations of EGE where a high percentage of its annual operations are experienced in a four-month window, planning for a future vertiport location would be prudent.

A vertiport constructed on airport property means establishing a dedicated landing facility that adheres to FAA EB 105. This compliance requires dedicated space for the landing facility, the touch-down and liftoff, final approach and takeoff, and safety areas. Dedicated approach and departure surfaces must also be established and, like the approach and departure surfaces of a runway, should be clear of obstructions.

To construct a vertiport on EGE's property, the infrastructure or equipment must be depicted on the ALP and a Form 7460-1 submitted for an airspace determination prior to development. The FAA's review of the ALP and airspace determination must be completed prior to the start of operations. Additional information about vertiport infrastructure can be found in EB 105.

A dedicated vertiport is not currently needed for AAM operations at EGE but may be desired in the long term in response to progressively increasing operational levels and season demands.

Electric Infrastructure

Discussed previously, EGE appears to be adequately positioned to enhance its electrical capabilities to facilitate the introduction of eVTOL aircraft with relatively minimal effort. However, depending on the level of power that can be made available by Holy Cross Energy at the Airport, EGE should consider the development of a microgrid as supporting technology advances. Note that a microgrid is defined as a small-scale power grid that operates independently of primary power supplies to generate electricity for a localized area, such as a university campus, a hospital complex, a geographical region, or an airport. Specifically, a microgrid co-locates electricity generation and consumption. Unlike the utility grid, which generates electricity in a centralized power plant and then distributes it along hundreds of miles of transmission lines, a microgrid generates electricity on-site. For electricity generation, microgrids typically use some combination of back-up diesel generators and renewables such as solar panels or windmills. Microgrids can incorporate battery systems to store electricity and deploy it during outages or when grid demand spikes.

Installing an electric aircraft charging station is an important first step to enabling AAM at EGE. Three-phase electricity should be brought to the terminal area which will be needed to support the electrical requirements for the electric chargers.

Weather Monitoring Infrastructure

As noted in the Chapter Two, *Inventory*, the Airport has an Automated Weather Observation System (AWOS) III (AWOS III P/T). The AWOS is a suite of sensors that automatically measures, collects, and broadcasts weather data to help pilots and flight dispatchers prepare and monitor weather forecasts, plan flight routes, and provide necessary information for takeoffs and landings. In addition to the basic altimeter, wind speed, wind direction, temperature, dew point, and density altitude data, EGE's AWOS III P/T also reports visibility, cloud/ceiling data up to 12,000 feet and thunderstorm detection (30-mile radius). The AWOS III P/T is one of the most capable and useful airport weather reporting systems, and it is vital to enabling safe and efficient aircraft operations.

EGE's current weather system is adequate for supporting AAM operations for this time and venue.

Broadband/Data Infrastructure

Discussed previously, EGE appears to be adequately serviced with high-speed broadband/telecom infrastructure provided by Comcast. Longer term development and installation of 5G capabilities will also ultimately enhance EGE's capability to accommodate future AAM operations.

EGE's current broadband capabilities are adequate for supporting AAM operations for this time and venue. Additional navigational aids and obstacle data could be required to establish a UTM system over the long term

Facility Infrastructure

Planning for the introduction of AAM operations involves traditional airport layout planning, but effectively no additional buildings, aprons, taxiways, or vertiports are required for AAM operations to begin at EGE. However, given the potential for eVTOL operational development at the Airport combined with the constant potential for adverse weather conditions within the area, it is reasonable to assume that some eVTOL equipment would have to be brought into a hangar facility for storage and maintenance purposes.

To identify the potential need for additional facilities at EGE, several existing sites were reviewed including hangars owned by BETA Technologies hangar in Burlington, Vermont, and Joby Aviation in Marina, California. These provided insight into the requirements of an eVTOL hangar and multiuse building. Additionally, an in-development aircraft mechanic training facility at Cincinnati & Northern Kentucky International Airport (CVG) were reviewed to provide information on the footprint of a mechanical facility. The footprint of each of these facilities is shown in **Table 4-19**.

Table 4-19: AAM and Comparable Facility Footprints

Site	Type of Facility	Facility Footprint
BETA Technologies - Burlington, Vermont	Hangar/Multi-Use	~26,400 square feet
Joby Aviation - Marina, California	Hangar/Multi-Use	~ 30,200 square feet
Aircraft Mechanic School, CVG	Mechanic School	~32,000 square feet

Source: Google Earth, BETA Technologies, Joby Aviation, Epic Flight Academy

These sites provide benchmarks for the future potential facility requirements and development of AAM facilities at the Airport. Given the limited development areas for future hangars that are currently available at EGE, potential shared use of existing hangars may have to be explored on an as-needed basis. This would likely be most reasonable during the initial phases of eVTOL operational development where proof of its viability will be actively explored. Once it is deemed to be valid and other potential areas for development are identified on the Airport, a dedicated facility should be anticipated. Additionally, facility considerations should include space for eVTOL or other electric aircraft to safely navigate to and from the facilities. Depending on the ultimate location of the hangar, an additional taxiway may be needed to connect the new apron to the existing taxiway and runway.

EGE should assume the need for up to 30,000-square feet of hangar space for eVTOL storage and maintenance, as well as needed pavement to connect those facilities to the existing apron and airfield infrastructure. This hangar space requirement could be accommodated by sharing existing or planned hangar development in the short-term with long-term development of a dedicated facility occurring once the viability of the eVTOL operation is demonstrated.

Summary of AAM Infrastructure Needs

Table 4-20 identifies the key takeaways for each of the infrastructure needs for AAM at EGE.

Table 4-20: Infrastructure Roadmap Takeaways

Type of Infrastructure	Takeaway	Timeframe
Vertiport/Landing Infrastructure	Not critical for AAM operations in the short-term, but may be required in the long-term	As needs are identified
Electric Infrastructure	Critical for AAM operations to provide chargers	As soon as possible
Weather Infrastructure	AWOS III P/T is sufficient for AAM	N/A
Broadband/Data Infrastructure	A standard for site readiness to attract AAM tenants	As soon as possible
Facility Infrastructure	Use of and/or construction of a multiuse hangar building is desirable for attracting industry	Five - Ten Years

Source: Jviation, a Woolpert Company

4.5 SUSTAINABILITY

As discussed previously in Chapter Two, Eagle County developed a Climate Action Plan for the Eagle County Community in 2016 that provided recommendations for reducing the County's 2014 baseline inventory of greenhouse gas (GHG) emissions by 50 percent by 2030. The Plan was updated in 2020 with the same goal in mind. The Eagle County Airport recognizes its role within the County and reflects its overarching goal of reducing emissions. The Airport is not only committed to being a key participant in and contributor to the County's plan, but it is also committed to setting its own sustainability goals.

The following is a range of potential initiatives that reflect current best industry practices that could be progressively implemented over time as the Airport and its tenants propose new operations and development in the future. The list of initiatives is broken into seven categories, each focused on Eagle County's ultimate goal of reducing emissions and promoting sustainability. **Table 4-21** presents each category, a description of that category, and a listing of potential actions that could be undertaken over time to meet the goals of that category.

Table 4-21: Sustainability Categories and Potential Initiatives

Category: **Education and Outreach**
Description/Goal *Participate in community engagement and provide training for employees in relation to sustainability and GHG emissions* Potential Actions/Metrics ▪ *Require or offer sustainability training for airport employees and tenants* ▪ *Create and/or participate in stakeholder and community engagement plans/initiatives*
Category: **Energy, Energy Supply and GHG Emissions Reduction**
Description/Goal: *Pursue opportunities and infrastructure that promotes the reduction of energy consumption, supports alternative energy sources, and reduction in GHG emissions* Potential Actions/Metrics ▪ *Pursue on-site and off-site renewable energy sources - wind, solar, geothermal* ▪ *Map and calculate energy/carbon emissions footprint* ▪ *Develop and implement an energy/carbon reduction plan, including consumption monitoring, reduction targets and auditing to monitor progress* ▪ *Support the development of alternative fuels for aircraft including Sustainable Aviation Fuels (SAF) and supporting infrastructure* ▪ *Conduct energy audits to identify, prioritize, and implement building energy efficiency and building electrification projects (e.g. LED lighting)* ▪ *Replace combustion heating systems with high-efficiency electric heat pump systems* ▪ *Install on-site battery storage at airport buildings with rooftop solar for utility savings and resiliency during emergencies* ▪ *Explore geothermal options for long-term heating and cooling solutions with the potential to extend geothermal to the Jet Center as a service for generating revenue* ▪ *Implement benchmarking for airport buildings to monitor, manage and report on energy uses and GHG emissions*
Category: **Transportation and Mobility**
Description/Goal *Reduce local GHG emissions through the expansion of electric vehicles support and encourage multi-modal transportation systems*

Potential Actions/Metrics

- *Improve electric vehicle support (i.e. charging stations)*
- *Accessibility improvements (ADA compliant, bicycle lanes, walking paths, etc.)*
- *Upgrade airport vehicles and aging equipment to reduce emissions including the replacement of diesel fueled vehicles with alternate fuel vehicles (electric, hybrid, gas etc.)*
- *Build charging infrastructure, and electrify airport fleet and service vehicles (e.g. luggage tugs)*
- *Provide power supply for electrification of rental fleets*

Category: **Waste and Landfill**

Description/Goal

Set waste diversion goals and increase the promotion of recycling

Potential Actions/Metrics

- *Enhance recycling program and implement waste reduction and diversion processes as a part of an Integrated Solid Waste Management Plan*
- *Develop a market for waste (compost, concrete, asphalt, etc.) or reuse on airport*
- *Construct on-site stormwater collection and treatment facility*
- *Recycling available, visible, and effective throughout airport public areas and operations*

Category: **Climate Change Resiliency**

Description/Goal

Pursue infrastructure that promotes resiliency and reduction of natural resources

Potential Actions/Metrics

- *Reduce impacts of wildfires by installing on-site battery storage for airport buildings with rooftop solar*
- *Reduce airport drought related impacts by adopting innovative indoor and outdoor water efficiency programs and strategies*

Category: **Green Partnerships**

Description/Goal

Pursue opportunities to integrate green policies into leases, contracts, and develop climate related policies

Potential Actions/Metrics

- *Integrate sustainability language into Airport contracts/lease agreements*
- *Implement a Green Concessions Policy*
- *Adopt a Green Procurement Program*
- *Develop climate action policies (green procurement, benchmarking, etc.) in partnership with Eagle County Resiliency and other related departments*
- *Contribute to Energy Smart Colorado's ECO Credits program to offset airport GHG emissions*
- *Engage the Eagle County Natural Resources team about better ways to safeguard natural resources, wildlife, and water resources with respect to airport operations*
- *Extend the strategic focus of the County on GHG emission reduction to EGE's approach to sustainability and be coordinated with Eagle County's Resiliency and Facilities Departments*

Category: **Green Techniques**

Description/Goal

Develop a sustainability plan and integrate sustainability measures into the airport financial and operation practices

Potential Actions/Metrics

- *Develop a sustainability plan, documenting inventory and goals and defining what sustainability means to the Airport*
- *Integrate sustainability into CIP plan for sustainability*
- *Apply sustainable construction techniques such as using pervious pavement materials for sidewalks and parking lots to reduce surface runoff, using light colored materials and paints on building envelopes to reduce "heat island" effects and using air sealing insulation for high-performing building envelopes*
- *Use native on-site or locally produced construction materials such as aggregate to reduce transport distances and emissions*

Source: Jviation, a Woolpert Company

As a key part of and contributor to Eagle County, EGE has embraced the County's long-term goals for sustainability. The Airport should establish a reasonable plan for how it can thoughtfully and progressively employ industry standard best practices over time to help Eagle County achieve its sustainability goals.

4.6 FACILITY REQUIREMENTS SUMMARY

A summary of the facility improvements that need to be addressed during the planning period is provided below in **Table 4-22**. Selected improvements will be examined further in Chapter Five, *Alternatives Analysis & Development Plan*, to create and evaluate options to accommodate these facility requirements.

Table 4-22: Facility Requirements Summary

Facility	Identified Requirement
Airfield Facility Requirements	
Airport Climatology	No Action; crosswind runway not required
Airfield Capacity	No Action; current/projected aircraft operations fall well below the Airport's capacity
Airport Design Standards	No Action; Airport complies with all design standards
Runway System	Protect for potential 1,000-foot extension
Taxiway System	Implement taxiway improvements as described
Obstructions and Airspace	Ensure clearance of critical airspace to degree practicable
Navigational Aids (NAVAIDs)	Pursue instrument approach procedure improvements
Airfield Marking, Lighting, Signage	Upgrade airfield lighting to LEDs as available; replace the lighting vault generator.
Landside Facility Requirements	
Terminal Building	Pursue design to renovate and expand terminal as required; temper design based on heavy peaking characteristics of Airport market; replace the west terminal electrical generator.
Regional Transportation Access	Protect for potential future I-70 interchange; Cooley Mesa Road improvements
On-Airport Circulation Roadway	Conduct strategic planning effort to formulate long-term plan to progressively improve roadway system.
Automobile Parking	Conduct strategic planning effort to formulate long-term plan to progressively improve auto parking.
Terminal Building	Pursue design to renovate and expand terminal as required; temper design based on heavy peaking characteristics of Airport market
General Aviation and Support Facility Requirements	
FBO Facilities	No Action; VVJC meets current servicing needs; The Airport should consider the potential introduction of an additional FBO.
Federal Inspection Services (FIS) Facility	Construct FIS as planned
Air Cargo Facilities	No Action; monitor opportunities as available
Aircraft Storage Facilities	Transient apron space is sufficient but additional hangar space for based and transient aircraft should be planned
Fuel Storage	No Action; existing fuel storage meets the Airport's minimum standards
Deicing Operations	No Action; glycol storage and disposal methods meet requirements
ATCT	Continue to support tower maintenance; replace the ATCT generator
Snow Removal	Expand SRE building; Construct additional storage facility; replace SRE as required.
ARFF/Administration	Relocate administrative offices to renovated terminal; prepare for potential shift to meet Index C requirements.

Miscellaneous Requirements	Install waste triturator tied to local sewer system for use by airlines and FBO
Emerging Technologies	The Airport should be apprised of new developments related to eVTOL aircraft certifications and use cases.
Sustainability	
Sustainability Goals	Establish a reasonable plan for how EGE can thoughtfully and progressively employ industry standard best practices over time to help Eagle County achieve its sustainability goals.

Source: Jviation, a Woolpert Company