



Paine Field Master Plan 2040

Chapter 5 | Concept Alternatives

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PREPARED BY
Landrum & Brown, Incorporated



Contents		Page
5	Concepts and Alternatives	5-1
5.1	Introduction	5-1
5.2	Airside Development Alternatives	5-3
5.2.1	Runway Capacity and Length	5-3
5.2.2	Runway Exits	5-3
5.2.3	Taxiway System	5-6
5.2.4	Taxiway Deviations from FAA Design Standards	5-7
5.2.5	Conversion of Taxilane Echo into a Tower Controlled Taxiway	5-10
5.2.6	Aircraft Taxiway Operations Flows	5-10
5.2.7	West Side Parallel Taxiway	5-11
5.2.8	Runway Protection Zone Land Use	5-11
5.2.9	Decommissioned Runway 11-29	5-15
5.2.10	Capacity to Park ADG-V Aircraft	5-16
5.2.11	General Aviation Run-Ups	5-18
5.2.12	Summary of Airfield Recommendations	5-18
5.3	Terminal Development Alternatives	5-21
5.3.1	Alternatives	5-21
5.3.2	Passenger Terminal Recommendations	5-32
5.4	Landside Development Alternatives	5-35
5.4.1	Airport Access	5-35
5.4.2	Terminal Access Road	5-38
5.4.3	Terminal Loop Road (100 th St SW)	5-43
5.4.4	Terminal Curb Fronts	5-45
5.4.5	Airport Parking	5-47
5.4.6	Rental Car	5-49
5.4.7	Summary of Terminal Access and Landside Recommendations	5-49
5.5	Support Facility Alternatives	5-52
5.5.1	Approach	5-52
5.5.2	Air Cargo	5-54
5.5.3	Aircraft Deicing	5-55
5.5.4	Aircraft Fuel	5-57
5.5.5	Aircraft Maintenance, Repair and Overhaul (MRO)	5-59
5.5.6	Aircraft Rescue and Firefighting (ARFF)	5-60
5.5.7	Airport Support	5-61
5.5.8	Flight Catering	5-65
5.5.9	General Aviation (GA)	5-68
5.5.10	Ground Service Equipment (GSE)	5-70
5.5.11	Security	5-72
5.5.12	Urban Air Mobility (UAM)	5-72
5.5.13	Summary of Support Facilities Recommendations	5-75

List of Tables

Page

TABLE 5.2-1	EXPECTATIONS OF AIRPORT SPONSORS	5-12
TABLE 5.2-2	RUNWAY 16L RPZ - CONCEPTUAL ROADWAY ALTERNATIVES	5-14
TABLE 5.3-1	FAMILY ALTERNATIVES	5-21
TABLE 5.3-2	ADDITIONAL LEASED AND PAVED AREAS	5-23
TABLE 5.3-3	EVALUATION OF PASSENGER TERMINAL ALTERNATIVES	5-33
TABLE 5.5-1	SUMMARY OF SUPPORT FACILITY RECOMMENDATIONS	5-75

List of Exhibits

Page

EXHIBIT 5.1-1	TIMING FOR BALANCED CAPACITY	5-2
EXHIBIT 5.2-1	RECOMMENDED RUNWAY EXIT IMPROVEMENTS	5-5
EXHIBIT 5.2-2	EXISTING NON-STANDARD AIRFIELD GEOMETRY	5-8
EXHIBIT 5.2-3	ULTIMATE WEST PARALLEL TAXIWAY	5-11
EXHIBIT 5.2-4	AIRSIDE FLEXIBLE RAMP	5-16
EXHIBIT 5.2-5	ADG-V HARD STAND ALTERNATIVES	5-18
EXHIBIT 5.2-6	AIRFIELD RECOMMENDATIONS	5-20
EXHIBIT 5.3-1	POTENTIAL TAXIWAY FLOWS	5-23
EXHIBIT 5.3-2	TERMINAL ALTERNATIVE 1A	5-25
EXHIBIT 5.3-3	TERMINAL ALTERNATIVE 1B	5-26
EXHIBIT 5.3-4	TERMINAL ALTERNATIVE 2A	5-27
EXHIBIT 5.3-5	TERMINAL ALTERNATIVE 2B	5-28
EXHIBIT 5.3-6	TERMINAL ALTERNATIVE 2C	5-29
EXHIBIT 5.3-7	TERMINAL ALTERNATIVE 3A	5-30
EXHIBIT 5.3-8	TERMINAL ALTERNATIVE 3B	5-31
EXHIBIT 5.4-1	AIRPORT RD/100TH ST SW – EXPANDED SIGNAL ALTERNATIVE	5-36
EXHIBIT 5.4-2	AIRPORT RD/100TH ST SW – ROUNDABOUT ALTERNATIVE	5-37
EXHIBIT 5.4-3	100TH ST SW TERMINAL ACCESS ROAD – 2 MAP	5-39
EXHIBIT 5.4-4	100TH ST SW TERMINAL ACCESS ROAD – 4 MAP	5-40
EXHIBIT 5.4-5	NORTH PERIMETER ROAD CONNECTION ALTERNATIVE	5-41
EXHIBIT 5.4-6	SOUTH PERIMETER ROAD CONNECTION ALTERNATIVE	5-42
EXHIBIT 5.4-7	TERMINAL LOOP ROAD (100TH ST SW) - EXISTING	5-43
EXHIBIT 5.4-8	TERMINAL LOOP ROAD (100TH ST SW) – EXPAND EXISTING	5-44
EXHIBIT 5.4-9	TERMINAL LOOP ROAD (100TH ST SW) – SOFTEN CURVE APPROACH	5-45
EXHIBIT 5.4-10	TERMINAL CURB – TWO SEPARATED AT-GRADE CURBS	5-47
EXHIBIT 5.4-11	LANDSIDE RECOMMENDATIONS	5-50
EXHIBIT 5.5-1	EXISTING SUPPORT FACILITIES	5-53
EXHIBIT 5.5-2	AIR CARGO CONCEPT	5-54
EXHIBIT 5.5-3	AIRCRAFT DEICING LOCATIONS	5-55
EXHIBIT 5.5-4	FUEL FARM EXPANSION	5-58
EXHIBIT 5.5-5	MRO EXPANSION AREA	5-59
EXHIBIT 5.5-6	AIRPORT ADMINISTRATION ALTERNATIVES	5-62
EXHIBIT 5.5-7	AIRPORT MAINTENANCE ALTERNATIVE SITES	5-63
EXHIBIT 5.5-8	AIRPORT SUPPORT DEVELOPMENT – SOUTH OF EMC	5-64

EXHIBIT 5.5-9	FLIGHT CATERING SITES	5-66
EXHIBIT 5.5-10	GENERAL AVIATION EXPANSION SITES	5-69
EXHIBIT 5.5-11	FBO AND CORPORATE AVIATION EXPANSION SITES	5-70
EXHIBIT 5.5-12	GSE STORAGE AND MAINTENANCE SITES	5-71
EXHIBIT 5.5-13	URBAN AIR MOBILITY SITES	5-72
EXHIBIT 5.5-14	CONCEPTUAL URBAN VERTIPORT	5-74
EXHIBIT 5.5-16	RECOMMENDED SUPPORT FACILITIES	5-76

5 Concepts and Alternatives

5.1 Introduction

This chapter summarizes the alternatives prepared for Paine Field Airport (PAE). The alternatives are prepared on the basis of improving airport operations, addressing deficiencies and meeting traffic forecast demand. Facility requirements were presented in the prior chapter and developed to meet the demand levels for three Planning Activity Levels (PALs). The following chapter outlines the alternatives to meet the PAL 3 (4.3 million annual passengers [MAP]) demand level and beyond. To maintain a system of balanced capacity throughout the entire planning period, alternatives are developed for the primary components of PAE, including the following:

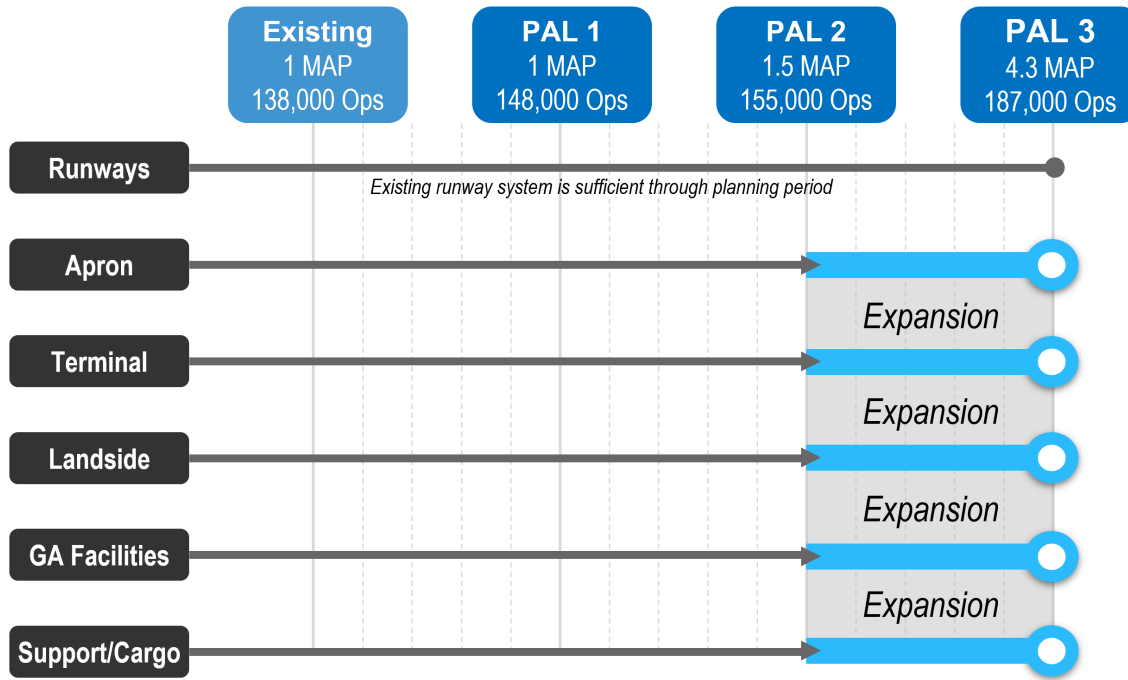
- Airfield – runway and taxiways
- Terminal – apron and terminal building
- Landside – parking, curbside and access roads
- Support Facilities
 - Air Cargo
 - Aircraft Deicing
 - Aircraft Fuel
 - Airport Rescue and Fire Fighting (ARFF)
 - Airport Support
 - Flight Catering
 - Corporate and General Aviation (GA) hangars
 - Ground Service Equipment (GSE) Maintenance, Storage, and Staging
 - Urban Air Mobility (UAM)

The alternatives were developed so that PAE operates under a system of balanced capacity.

Exhibit 5.1-1, *Timing for Balanced Capacity*, presents the timing when traffic demand outpaces capacity. In essence, all of the components of PAE will require expansion when passenger traffic approaches approximately 1.5 MAP or 155,000 annual operations, except for the runway system.

Each of the following sections presents the alternatives considered and the recommendations for each of the primary components of PAE listed above.

Exhibit 5.1-1 **Timing for Balanced Capacity**



Source: Landrum & Brown

5.2 Airside Development Alternatives

This section provides an evaluation of alternative ways to meet the airfield requirements identified in Chapter 4, *Facility Requirements*. This section will explore alternatives to accommodate increased demand and improve overall safety. In addition, concepts for improving the portions of the airfield that do not meet Federal Aviation Administration (FAA) standards were considered and recommendations made. The following airside facilities included in this portion of the analysis are:

- Runway Capacity and Length
- Runway Exits
- Taxiway System
- Taxiway Deviations from FAA Design Standards
- Runway Protection Zone (RPZ)
- Decommissioned Runway

5.2.1 Runway Capacity and Length

PAE has two parallel runways oriented in the north-south direction (16-34). The western Runway 16R-34L is 9,010 feet and 150 feet wide. The eastern Runway 16L-34R serves as a secondary parallel runway for smaller GA aircraft and is 3,004 feet long and 75 feet wide. Even though Runway 16L-34R is the secondary runway, it is the busier of the two runways serving much of the GA based and transient aircraft at Paine Field.

The facility requirements analysis identified that the existing runway system and length would be sufficient to accommodate demand through PAL 3. As a result, the need for an additional runways and runway length was not investigated in this Master Plan. The demand/capacity analysis, presented in **Appendix C**, indicated that PAE has enough runway capacity to accommodate future growth well beyond the 20-year planning timeframe. The distribution of aircraft operations for both runways at PAE will likely change when demand grows, specifically when passenger commercial aviation activity increases. Mixing slower moving GA aircraft into the traffic stream with faster moving jet aircraft presents operational restrictions, increased air traffic management workload, and increased separation requirements which ultimately will impact runway capacity and delays.

Alternatives to improve operational efficiency will be further explored in this chapter.

5.2.2 Runway Exits

The entrance/exit taxiways that connect a runway to the taxiway system are referred to as runway exits. The placement and type of runway exits influence the operational efficiency and capacity of PAE.

Chapter 4, Facility Requirements, describes the analysis using the Runway Exit Design Interactive Model (REDIM) and the potential runway exit improvements for Runway 16R-34L. The existing location of runway exits can be optimized and future high-speed exits should be designed for the anticipated commercial fleet, B737-9 and E175. The requirements analysis identified a total of four new high-speed exits to optimize the capacity of the runway, two exits in either flow direction.

5.2.2.1 Approach

Following the initial evaluation of the improved operational efficiency, alternatives further evaluated the potential improvements against the existing airfield functions, safety, and pavement condition of each

runway exit. The examination and recommendation for each taxiway connector and exits to Runway 16R-34L are detailed below, beginning in the south.

5.2.2.2 *Summary of Runway Exits*

Taxiway A10: the southernmost taxiway connector provides access to the Runway 34L threshold to maximize takeoff distance for aircraft departing to the north and provides the last useable runway exit for south flow aircraft. It is recommended this taxiway remain in place.

Taxiway A9: this taxiway is the second most southern taxiway, located 420' north of Taxiway A10. The existing location provides direct access from an apron area to the runway, which can lead to pilot confusion. However, based on coordination with FAA and the existing controlled access of this taxiway, no alternative conditions were required.

New High-Speed Runway Exit/Taxiway A8: as a result of the REDIM analysis presented in Chapter 4, a new high-speed exit is recommended to serve B737 arrivals in south flow. The new high-speed exits will replace the existing Taxiway A8.

Taxiway A7: this 90-degree runway exit provide exit capacity for the E175 and serves as a taxiway connector to the runway via Taxilane E. However, this non-standard airfield geometry should be corrected. The location of relocated Taxiway A7 should be coordinated with the optimal locations of the new high-speed exits.

Taxiway A6: this taxiway connector serves a portion of the existing arrivals from the south, providing reverse turn capability for aircraft heading into the terminal area or to Taxiway J. The geometry of the taxiway connector is a result of a previously decommissioned runway. The taxiway also provides access to the decommissioned Taxiway K6, currently leased by Boeing. FAA design standards require all runway crossing to occur perpendicular to the runway centerline, at 90-degrees to limit pilot confusion. Additionally, runway crossings within the middle third of the runway (high-energy area) should be avoided when an alternative crossing is available. Once the new Taxiway A high-speed exit is constructed, it is recommended that Taxiway A6 be removed.

New High-Speed Runway Exit/Taxiway A6: as a result of the REDIM analysis presented in Chapter 4, a new high-speed exit is recommended to serve E175 arrivals in south flow. The new high-speed exits will replace the existing Taxiway A6.

Taxiway A5: this runway exit is currently heavily utilized for non-commercial traffic using Runway 16R-34L. The geometry of the taxiway is a result of a previously decommissioned runway. In the future, the taxiway will be adjacent to a new north flow high-speed exit serving the E175. It is recommended that Taxiway A5 be removed when this new north flow high-speed exit is constructed.

New High-Speed Runway Exit/Taxiway A4: as a result of the REDIM analysis presented in Chapter 4, a new high-speed exit is recommended to serve E175 arrivals in north flow. The new high-speed exits will replace the existing Taxiway A4. Currently, Taxiway A4 provides space for GA engine run-ups. An alternative location will be discussed later in this chapter and will need to be in-place prior to the removal of Taxiway A4.

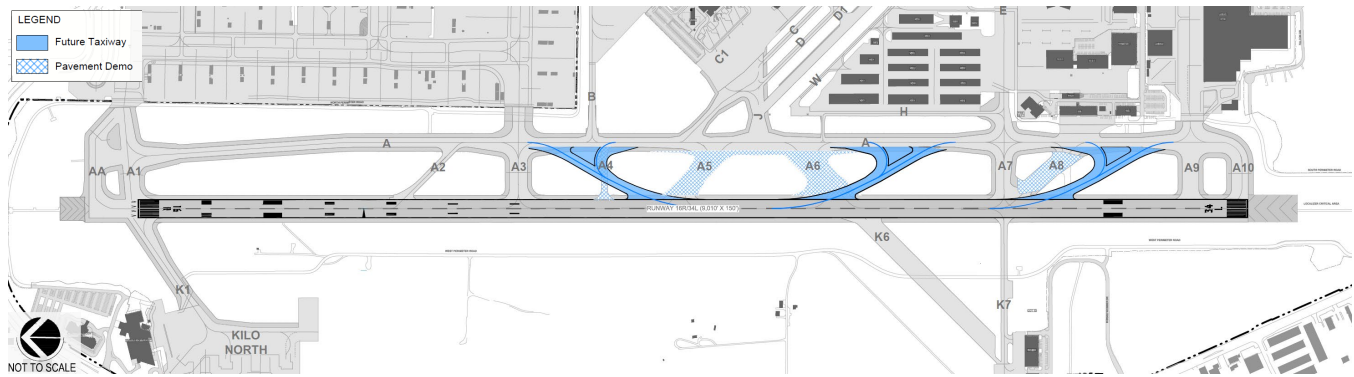
Taxiway A3: this taxiway connectors serves as direct access into the Boeing facility. However, based on coordination with FAA and the existing controlled access of this taxiway, no alternative conditions were required and will continue to serve Boeing's needs.

New High-Speed Runway Exit/Taxiway A2: as a result of the REDIM analysis presented in **Chapter 4, Facility Requirements**, a new high-speed exit is recommended to serve B737 arrivals in north flow. The new high-speed exits will replace the existing Taxiway A2.

5.2.2.3 *Recommended Runway Exit Improvements*

Based on the preceding analysis, the following runway exit improvements are presented in **Exhibit 5.2-1, Recommended Runway Exit Improvements**.

Exhibit 5.2-1 Recommended Runway Exit Improvements



Source: Landrum & Brown

5.2.3 Taxiway System

An evaluation of the existing taxiway system was completed in **Chapter 4, Facility Requirements – Taxiway Demand/Capacity**). The analysis focused on the demand capacity of the airfield, taxiway deviations from FAA standards, and FAA Hot Spots. This section will analyze alternatives to optimize the airfield capacity through the planning period and beyond. The following alternatives will be explored alternatives to strategically provide an ultimate taxiway system:

- FAA Hot Spots
- Taxiway Deviations from FAA Standards
- Conversion of Taxilane Echo into a Tower Controlled Taxiway
- Terminal Area Taxilanes
- Aircraft Taxiway Operations Flows
- West Side Parallel Taxiway

5.2.3.1 Approach

Following the initial demand/capacity analysis summarized in **Chapter 4** and detailed in **Appendix C**, the existing airfield (All Movement Areas) provides sufficient capacity to accommodate the projected operational demand through the planning period. However, airfield alternatives should be developed to maximize the ultimate taxiway system. PAE will continue to evolve as the demand for commercial operations increase. Alternatives will emphasize aircraft safety and aircraft operational routes to maximize efficiencies and limit the level of disturbance to non-commercial operations.

5.2.3.2 FAA Hot Spots

Hot Spots 1 and 2 at PAE were previously discussed in Chapter 4, this section discusses the alternative solutions for each.

Hot Spot #1

The first hot spot (HS-1) is due to a lack of visibility from the Airport Traffic Control Tower (ATCT) to the area between Taxiways A9 and A10. This indicates the controllers in the ATCT cannot clearly see aircraft moving along Taxiway A on the south side of PAE due east of Runway 34L end. This could cause miscommunication between aircraft entering/exiting the Runway 34L end. Line-of-sight “blind spots” are due to the airport maintenance facility (Building #221). Alternatives explored a range of options to improve the ATCT visibility, summarized below.

Airfield Option – this alternative would consider raising the airfield to provide sufficient visibility from ATCT. This alternative would need to consider the impact to operations, current condition of pavement, impact to adjacent tenants and airfield connections, and cost. This alternative would not impact the existing maintenance facility but would be a significant airfield project.

Camera Option – this alternative would provide direct line-of-sight visibility to the portion of Taxiway A via the installment of camera(s). The use of technology and video surveillance to maximize visibility of the airfield is a common practice that FAA can implement. This alternative would require close coordination with FAA and the ATCT employees. This alternative would not impact any of the existing facilities and may have a shorter implementation timeline and is likely the most cost-effective option.

Remove Obstacles Option – this alternative would provide visibility to HS-1 by demolishing the airport maintenance facility (Building #221). An alternative location for that facility would need to be identified in order to remove the facility. The location of Building #221 and its direct airside connection is ideal for airport maintenance. Coordination is required with the Airport Maintenance staff to provide an alternative location that can offer a similar level of efficiency.

No Action Option – this alternative assumes the HS-1 continues to exist and no action to mitigate is taken. This alternative assumes the level of safety is acceptable to continue operating PAE with this Hot Spot.

Recommendation

The Master Plan 2040 recommends working with FAA and ATCT employees to implement cameras to provide line-of-sight visibility minimums. The exact timing and implementation of this alternative will be determined by FAA and not be included in the development plan.

Hot Spot #2

PAE had identified a preferred alternative to mitigate the HS-2. The alternative removes the ability for aircraft to travel from Taxiway A northbound past Taxiway A1 and accessing Taxiway AA. The portion of Taxiway A between Taxiway A1 and AA will have the centerline striping and hold position markings removed. Aircraft traveling northbound on Taxiway A will be forced east on Taxiway A1 and directed around to Taxiway AA to access the runway. New Runway Guard Lights will be installed at the connector taxiways AA, A1, A7, A9. Additional modifications include; Taxiway Edge Lights, Realignment and removal of signs, and additional markings. Improvements are planned to begin summer of 2023.

5.2.4 Taxiway Deviations from FAA Design Standards

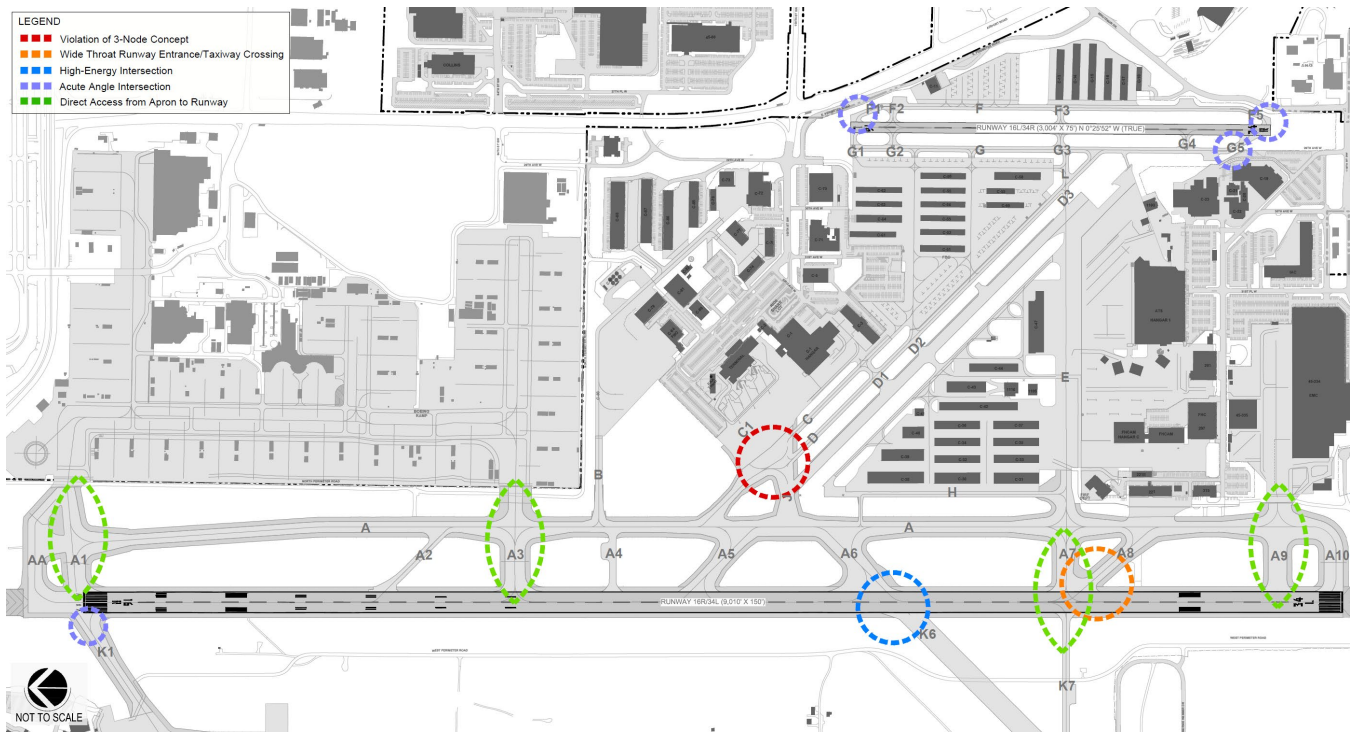
As outlined in Chapter 4, the FAA recommends specific taxiway and runway intersection layouts to enhance safety on the airfield. Deviations from these standards are common at airports across the country including PAE. The need to assess these and identify alternatives to mitigate them are focused around improving the safety of the airfield. The sections that follow present alternatives to address the following deficiencies, shown in **Exhibit 5.2-2, Existing Non-Standard Airfield Geometry**.

- Violation of 3-Node Concept
 - Taxiway intersection of C1, C, J, and D
- Wide Expanses of Pavement
 - Taxiway A7 and A8
- High Energy Intersection
 - Taxiway K6
- Acute Angle Intersection
 - Taxiway K1 at the Runway 16R end
 - Taxiway F1 at the Runway 16L end
 - Taxiway G5 and Runway 34R end
 - Taxiway F5 and Runway 34R end
- Direct Access from Apron onto Runway
 - Taxiway A1 from the Boeing Apron to the Runway 16R end
 - Taxiway K7 and A7 across Runway 16R-34L
 - Taxiway A3 from the Boeing Apron to Runway 16R

- Taxiway A9 from the EMC Hangar to the Runway 34L end

Please note, alternatives to improve the direct access conditions of Taxiway A3 and A9 will not be explored. Both taxiways have controlled access and no further analysis to improve the condition was required, based on condition with FAA during the Master Plan process.

Exhibit 5.2-2 Existing Non-Standard Airfield Geometry



Note: Alternatives to improve the direct access conditions of Taxiway A3 and A9 will not be explored, as they both taxiways have controlled access and no further analysis to improve the condition was required, based on condition with FAA during the Master Plan process.

Source: Landrum & Brown

5.2.4.1 Approach

Improving safety and efficiency was the driving methodology to developing the alternatives for the non-standard taxiway areas. Per FAA guidance outlined in AC 150-5300/13B, FAA expects implementation of new or revised standards (to correct the non-standard areas) to occur through the planning process.

Taxiway intersection of C1, C, J, and D (3-Node Concept): the intersection violates the three-node concept near the terminal area. The combination of four aircraft movement routes converging in a single area must be resolved. The terminal areas (building, apron, and associated taxilanes) will be redesigned to accommodate the projected demand. The existing non-standard intersection will be eliminated. Please refer to the terminal section of this Chapter for additional detail.

Taxiway A1 from the Boeing Apron to the Runway 16R End (Direct Access from Apron onto Runway): aircraft accessing the Runway 16R end from the Boeing ramp have direct access onto the

runway and can cause pilot confusion. Operationally, it is recommended that the direct connection, via Taxiway A1 to Runway 16R, be restricted and forced to use Taxiway AA. This procedural change will remove the need to physically correct the non-standard geometry.

Taxiway A7 and A8 (Wide Expanse of Pavement): the proximity of Taxiways A7 and A8 create a taxiway crossing and wide expanse of pavement, which should be avoided. As described in the Runway Exit section, this non-standard condition will be resolved with the relocation of the high-speed exit Taxiway A8. The alternative location will be shifted slightly south to avoid taxiway centerline crossing and improve pilot awareness. The new exit location is anticipated to support the B737 fleet and is needed in the planning period.

Taxiway A7 and K7 across Runway 16R-34L (Direct Access from Non-Movement onto Runway): Aircraft exiting Taxiway E have direct access onto the runway and can cause pilot confusion. Operationally, it is recommended that the direct connection be corrected by relocating Taxiway A7 to force an aircraft turn and improve pilot awareness.

Taxiway K1 at the Runway 16R end (Acute Angle Intersection): to improve pilot awareness for aircraft entering a runway, the FAA recommends airports to provide alternatives to correct any 90-degree runway entrance taxiways. Taxiway K1 enters Runway 16R at an acute angle and should be corrected in the future. The Master Plan recommends Taxiway K1 be realigned, and a standard 90-degree runway entrance taxiway be included in the Ultimate airfield configuration and will be reserved in the Airport Layout Plan. If the west parallel taxiway is realized sooner than expected, it is recommended the Taxiway K1 geometry be corrected as funds allow.

Taxiway K6 (High Energy Runway Crossing): this non-standard geometry involves a non 90-degree runway crossing within the middle third of a runway, identified as the high-energy zone. The recommended alternative removes Taxiway A6 when the new southbound high-speed exit is constructed. Furthermore, it is recommended that Taxiway K6 be redeveloped as opportunity warrants. It is not needed for airport operations and it is currently leased to Boeing, used for long-term parking positions.

Taxiway F1 at the Runway 16L End (Acute Angle Intersection): Taxiway F1 enters Runway 16L from the east at an acute angle. The acute angle mirrors the adjacent East Perimeter Road and Airport Road. To accommodate an alternative Taxiway F1 geometry to correct the acute angle, both roadways would require realignment and an extension of airport property. Considering the impacts to existing facilities and land constraints, no viable alternative was identified.

Taxiway G5 and Runway 34R End (Acute Angle Intersection): Taxiway G5 enters Runway 34R from the west at an acute angle and should be corrected in the future. An updated geometry will impact the lease limits of current Building C-19. The Master Plan recommends Taxiway G5 be realigned, and a standard 90-degree runway entrance taxiway be constructed.

Taxiway F5 and Runway 34R End (Acute Angle Intersection): Taxiway F5 enters Runway 16L from the East at an acute angle and should be corrected in the future. An updated geometry will require a relocation of Minuteman Drive and a relocation of the perimeter fence. The Master Plan recommends Taxiway F5 be realigned, and a standard 90-degree runway entrance taxiway be constructed.

5.2.5 Conversion of Taxilane Echo into a Tower Controlled Taxiway

As operations increase throughout the 20-year planning period (35% increase from base year), the airfield will likely look to optimize taxi flows to maximize efficiency. The distribution of aircraft operations for both runways at PAE will likely change when demand grows, specifically when passenger commercial aviation activity increases. However, the desire to mix GA aircraft into the west runway traffic stream will continue to be present throughout the planning period.

The need to provide viable connections routes between each runway will intensify as demand grows. The current airfield accommodates crossfield aircraft flows via Taxiway D (serving mainly GA traffic) and Taxilane E (serving midfield tenants and GA traffic). As the terminal building and associated apron grows, it is recommended that the crossfield routes (via Taxiway D) is maintained to allow the ATCT to manage the airfield.

The Master Plan considered an alternative to convert existing Taxilane E (from the non-movement area) into a Taxiway (ATCT controlled, Movement Area) to provide additional crossfield flows within the ATCT controlled movement area. The change would have impacts to the existing tenants lease lines, vehicle service roads, and access road for General Aviation users. The West Ramp and associated hangars have only a single access point into their facilities, supplied by the Gate S9 (near ARFF Facilities). This gate allows them to cross the active Taxilane in the non-movement area and avoid communication with ATCT. If the taxilane was converted to a taxiway, it would be very challenging to accommodate an alternative access point to serve the West Ramp tenants.

Based on coordination with PAE operations, it was recommended that the existing Taxilane E remain a taxilane through the planning period. Beyond the 20-year planning period, Taxilane E is the logical location to accommodate crossfield flows, while preserving expansion space for the terminal area, and should be reserved as a taxiway in the ultimate configuration.

5.2.6 Aircraft Taxiway Operations Flows

The results of the simulation analysis (**Appendix C**) indicate that PAE has enough runway capacity to accommodate future growth well beyond the 20-year planning timeframe. However, to improve operational efficiency at PAE, the following airfield infrastructure were recommended as a result of the airfield demand/capacity analysis.

- Airfield taxilane/taxiway improvements for improved traffic flow, and
- High-speed runway exits taxiway improvements to reduce occupancy times.

The improved network of runway exits, and high-speed runway exits were described earlier in this chapter.

5.2.6.1 Taxiway Recommendations to Optimize Traffic Flow

The following additional taxiway improvements are recommended:

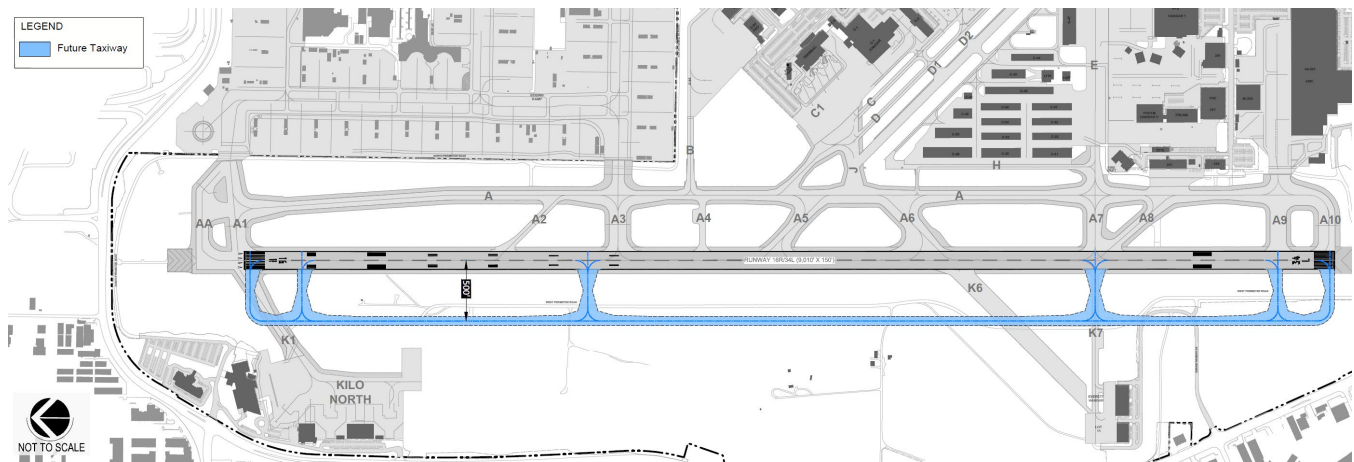
- Provide dual taxilanes in the terminal area
 - To help accommodate the commercial peaks in the terminal area, dual taxilanes should be reserved to allow for efficient operations. Further detailed in the terminal section
- Convert portion of decommissioned runway to terminal area taxiway

- This terminal area taxiway (south of the deicing facilities) will provide east-west connectivity for both GA and Commercial operations. Additionally, the taxiway will support deicing operations.
- Retain Taxiway D and Taxiway C to facilitate GA movements

5.2.7 West Side Parallel Taxiway

The amount of available land to accommodate new development is limited. The undeveloped land west of Runway 16R-34L is a logical area to attract and handle both aviation and non-aviation related development. This area is recommended to be strategic reserved for future development in the Master Plan. Despite being outside of this planning window, to help facilitate and promote access to the airfield, the Master Plan recommends preserving the space to develop a full length western parallel taxiway along Runway 16R-34L. The ultimate taxiway centerline will be offset 500 feet from the runway centerline and land reservations west of the taxiway will protect for ADG-V movements along the taxiway, see **Exhibit 5.2-3, *Ultimate West Parallel Taxiway***. Additional runway exits and taxiway connectors will be provided to accommodate a range of aviation related developments on the west side of PAE. Coordination with the existing Glide Slope Antenna is required if the project advances the design stage.

Exhibit 5.2-3 Ultimate West Parallel Taxiway



Source: Landrum & Brown

5.2.8 Runway Protection Zone Land Use

The four Runway Protection Zones (RPZ's) at PAE current have existing land use incompatibles within its limits. Draft Advisory Circular 150/5190-4B, Airport Land Use Compatibility Planning states that the FAA expects airport sponsors to seek all possible opportunities to eliminate, reduce, or mitigate existing incompatible land uses. Examples may include land acquisition, land exchanges, right-of-first refusal to purchase, agreements with property owners on land uses, easements, or other such measures.

The FAA expects the airport sponsor to take active steps to prevent or mitigate proposed incompatible land uses. The FAA will not always require an airport sponsor to acquire land in order to meet the RPZ

standard. However, the FAA does expect the airport sponsor to actively seek opportunities to prevent or mitigate risks associated with proposed incompatible land uses within the RPZ.

The ability for an airport sponsor to control or have influence on the land within their RPZ's is association with ownership. Amount of owned land within each of the PAE RPZs is detailed below.

- Runway 16R RPZ
 - 29% Owned, 71% Unowned
- Runway 34L RPZ
 - 82% Owned, 18% Unowned
- Runway 16L RPZ
 - 62% Owned, 38% Unowned
- Runway 34R RPZ
 - 85% Owned, 15% Unowned

Table 5.2-1 Expectations of Airport Sponsors

Type of Land Use Control	Expectations of Airport Sponsor
If the airport sponsor owns or has total land use control (e.g., sponsor is the land use control authority and regulates land use in the local jurisdiction)	Because the sponsor has total land use control, the FAA considers it a reasonable expectation that the sponsor will establish and enforce the necessary zoning controls to enable it to address existing incompatible land uses when the opportunity arises.
If the sponsor has potential influence (e.g., Airport Authority without zoning control)	Because the sponsor has at least some influence over land use control, the FAA considers it a reasonable expectation that the sponsor will seek to establish the necessary zoning controls to enable it to address existing incompatible land uses when the opportunity arises.
If the sponsor has no land use control (i.e., RPZ land falls in another jurisdiction)	Even though the sponsor has no land use control, the FAA still considers it a reasonable expectation that the sponsor will actively watch for opportunities to establish the necessary zoning controls to enable it to address existing incompatible land uses when the opportunity arises. FAA will consider financial assistance to a public-sector sponsor for land acquisition even if they have no land use control, but only if the sponsor can demonstrate that they are taking all appropriate steps available to enhance control and mitigate existing risks.

Sources: FAA Draft Advisory Circular 150/5190-4B, *Airport Land Use Compatibility Planning*. Landrum & Brown.

The Master Plan recommends the Airport actively monitor land use conditions and object publicly to proposed incompatible land uses within their RPZ's, and to make it a high priority (financially or otherwise) to acquire land within their existing RPZ's or otherwise establish land use controls that prevent incompatible uses.

Additionally, the County has sections within the Snohomish County Code (Chapter 30.32E, Airport Compatibility¹) to protect to protect public use airports in the county from nearby incompatible land uses and development by:

1. *Establishing criteria to be used to identify and discourage incompatible uses in the vicinity of public use airports;*
2. *Identifying areas where incompatible uses should be discouraged;*
3. *Notifying property owners if their property is located adjacent to a public use airport that they may experience impacts from airport operations and may be subject to use, height, or other limitations;*
4. *Discouraging the siting of uses that attract birds, create visual hazards, discharge particulate matter in the air that could alter atmospheric conditions, emit transmissions that would interfere with aviation communications or instrument landing systems, or otherwise obstruct or conflict with aircraft patterns;*
5. *Identifying potential aeronautical hazards and preventing or minimizing the adverse impacts to the safe and efficient use of navigable airspace by requiring proof of an airspace analysis pursuant to Federal Aviation Administration regulations before issuing permits for projects that are proposed for development adjacent to public use airports;*
6. *Recognizing and supporting county public use airports as essential public facilities and significant economic resources; and*
7. *Encouraging economic development opportunities and aviation-related uses adjacent to airports in urban growth areas.*

5.2.8.1 *RPZ Incompatibility Alternatives Analysis*

An alternatives evaluation process (to evaluate alternatives to mitigate incompatible land uses) is required for airports planning to introduce new incompatible land uses into their RPZs. These “trigger event” may include a runway extension, RPZ dimension change, a new or revised instrument approach procedure, or a local development within the limits of the RPZ.

The main access point into PAE and terminal area is located within the Runway 16L RPZ. As passenger demand increases, it is likely the Airport Road/100th St SW intersection will require expansion to maintain an acceptable level-of-service. **Table 5.2-2**, outlines roadway alternatives that were considered to mitigate the RPZ incompatibilities.

¹ SCC 30.32E.010, <https://snohomish.county.codes/SCC/30.32E.010>.

Table 5.2-2 Runway 16L RPZ - Conceptual Roadway Alternatives

Conceptual Alternative	Description	Evaluation/Findings
Relocate Interchange	This option would relocate the main intersection into PAE, to be located outside of the Runway 16L RPZ.	<p>The Airport Road/100th St SW intersection serves as the main access point into PAE, serving both the existing tenants and passengers. A relocated intersection would be constructed north of the current location and would impact several existing tenants and environmental sensitive areas.</p> <p>Beyond the planning period, it is possible the entire access system will require analysis as the existing roadway networks have little room to expand. The Master Plan recommends alternatives access points and the ground transportation network into the terminal be re-evaluated if the passenger demand exceeds the manageable limit of the current configurations.</p>
Displace/Shift Runway	This option considers relocating arrival and departure thresholds on the north end of Runway 16L-34R, to a location that removes the intersection conflict with the RPZ.	To avoid Airport Road, the Runway 16L threshold would need to be relocated by approximately 1,300 feet. This will reduce the runway to an unstable length and require additional runway pavement on the Runway 34R end. This additional pavement would require a closure/relocation of Beverly Park Road as it would be inside the limits of the relocated RPZ. Additionally, additional land would be required (not currently owned by the airport) to meet standards. For these reasons, this option was not considered viable.
Roadway Covering	This option considers the installation of roadway covering overtop of the intersections to lower the risk the vehicles and people on the ground.	The installation of a roadway covering, or tunnel would improve the safety of the vehicles and people on the ground, spanning the entire area within the RPZ. This option would require the depression of the entire area, likely resulting in impacts to environmental sensitive areas and ground water. For these reasons, this option was not considered viable.

Sources: FAA Draft Advisory Circular 150/5190-4B, *Airport Land Use Compatibility Planning*. Landrum & Brown

As passenger demand increases, it is recommended that roadway expansion (within the Runway 16L RPZ) be closely coordinated with FAA to confirm project scope.

5.2.9 Decommissioned Runway 11-29

The decommissioned runway (Runway 11/29) is now used for apron parking and storage for aircraft, through a lease with Boeing. The airfield pavement and grass area combine for approximately 12 acres of developable land when the lease expires in 2025. The site is not required to serve an immediate or specific long-term need. This section evaluates a range of possible land use alternatives to occupy this land area.

5.2.9.1 Approach

The following guiding principles were employed in developing the best land use alternatives.

Guiding Principles

- **Strategic Investment:** As traffic volumes at PAE grow, PAE must be able to accommodate commercial opportunities that present themselves. Therefore, this area should be unencumbered and allow flexibility for future aeronautical land uses.
- **Enhance Airport Operations:** Given that this site area is in a critical area on the airport careful consideration of current airport operations must factor into the specific land uses. Additionally, as the airport grows, the alternatives must ensure the efficient operation of the airport.

5.2.9.2 Decommissioned Runway Land Use Alternatives

The following lists the possible land use alternatives to develop on the 12-acre decommission runway site:

- 1) Continue Boeing lease beyond 2025
 - This alternative considers extending the Boeing lease when it expires in 2025. It is recommended that a financial analysis be completed to determine the appropriate length duration for the new contract. This alternative allows PAE to continue the existing revenue stream while maintaining flexibility to serve unknown airport need in the future. No additional infrastructure is required for this alternative.
- 2) Reserve for GA
 - This alternative reserve the decommission runway for GA, expanding upon the existing central and west ramps. This approach would function as a strategic reserve, compared to meeting a demand need. The recommended GAn expansion sites to meet the Master Plan demand are outlined later in this chapter.
- 3) Reserve for future Terminal/Landside Support
 - This alternative reserve the site for future passenger terminal and ground transportation support. The space requirements to accommodate a growing commercial terminal are the most demanding and required the greatest investment. As the terminal expands, the alternative considers reallocated facilities to the site to allow for passenger terminal expansion.
- 4) Reserve for Airside Parking
 - This 12-acre area would be paved to support apron related functions and to maintain operational efficiency. Airside functions could include, but not limited to; daily aircraft parking, engine run-ups, wash bays, GSE storage, remain overnight aircraft parking, and storage. Additionally, the ramp will provide space for GA engine run-ups. This function will

need to be in-place prior to the removal of Taxiway A4 (existing General Aviation run-up) location.

Based on conversations with the Master Plan committees (Technical Stakeholder and Steering Committees) and airport operations, it is recommended that the 12-acre site (location of decommissioned runway 11-29) be reserved for Airside Parking. This allows PAE to support daily airside needs and provide leasable aircraft parking positions as needed, depicted in **Exhibit 5.2-4, Airside Flexible Ramp**.

Exhibit 5.2-4 Airside Flexible Ramp



Sources: Landrum & Brown

5.2.10 Capacity to Park ADG-V Aircraft

The Master Plan evaluated areas to accommodate parking positions for up to two ADG-V aircraft in the future. The hard stand(s) will give PAE to ability to handle ADG-IV and ADG-V aircraft as needed. The

parking positions are not intended for regular use, but rather to support special events and intermittent occurrences for aircraft larger than ADG-III. The following assumptions were used in this analysis:

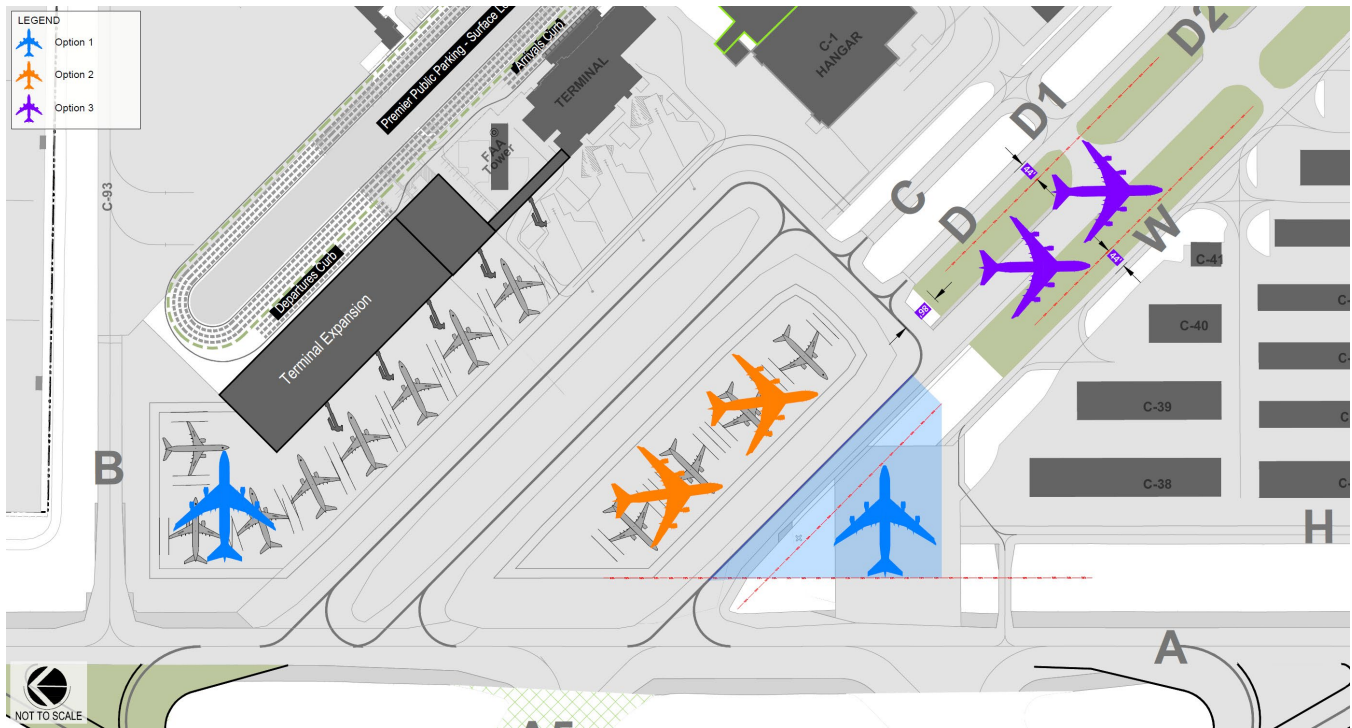
- Parking positions were prioritized east of the commercial runway and close to the terminal area
- Boeing 777 (ADG-V) was used for the analysis
- Assumed two parking positions in the future, likely one being preferred in the near-term
- Parking positions should be independent of terminal area movement, as to not interrupt commercial operations

5.2.10.1 ADG-V Hard Stands Alternatives

The following lists the alternatives to develop two ADG-V hard stands, depicted in **Exhibit 5.2-5, ADG-V Hard Stand Alternatives**:

- 1) Utilize Terminal Ramp and Build New Parking Position
 - This alternative utilizes the full buildout of the terminal ramp to park one ADG-V aircraft at the end of the facility. This hard stand would impact a total of three inactive ADG-II positions. A new parking position would be constructed at the interaction of Taxiway A and W, estimating 100,000 sf of new apron. Position would be accessed from Taxiway A and is not dependent on the construction of future projects.
- 2) Park at Centralized Deicing Pad
 - This alternative would utilize the centralized deicing pad after its completion. Use of these two parking positions would displace a total of four ADG-III hard stands. This alternative would not be available during deicing conditions.
- 3) Park at Flexible Ramp (Decommissioned Runway)
 - This alternative would utilize the flexible ramp (Master Plan project) that will be constructed upon the decommissioned runway. The alternative is dependent on the completion of that project. Improvement to pavement conditions and operations routes will likely be required. Furthermore, operations/movements for each parking position will be dependent upon one another.

Exhibit 5.2-5 ADG-V Hard Stand Alternatives



Sources: Landrum & Brown

Based on conversations with the Master Plan committees (Technical Stakeholder and Steering Committees) and airport operations, it is recommended that the development of a new pad (intersection of Taxiway A and W) be prioritize for the near-term. The location for a second ADG-V position will be coordinated in the future.

5.2.11 General Aviation Run-Ups

General Aviation users operating on the instrument runway (Runway 16R-34L) perform engine run-up operations on the Taxiway A4 bump out. The Master Plan recommends the removal of Taxiway A4 to improve runway occupancy time with a south flow high-speed exit. The following locations can alternatively provide the functional area to support general aviation run-ups in the future:

- New ADG-V parking positions (intersections of Taxiway W and Taxiway A)
- Flexible Ramp (Decommissioned Runway)
- Run-up at hangar

5.2.12 Summary of Airfield Recommendations

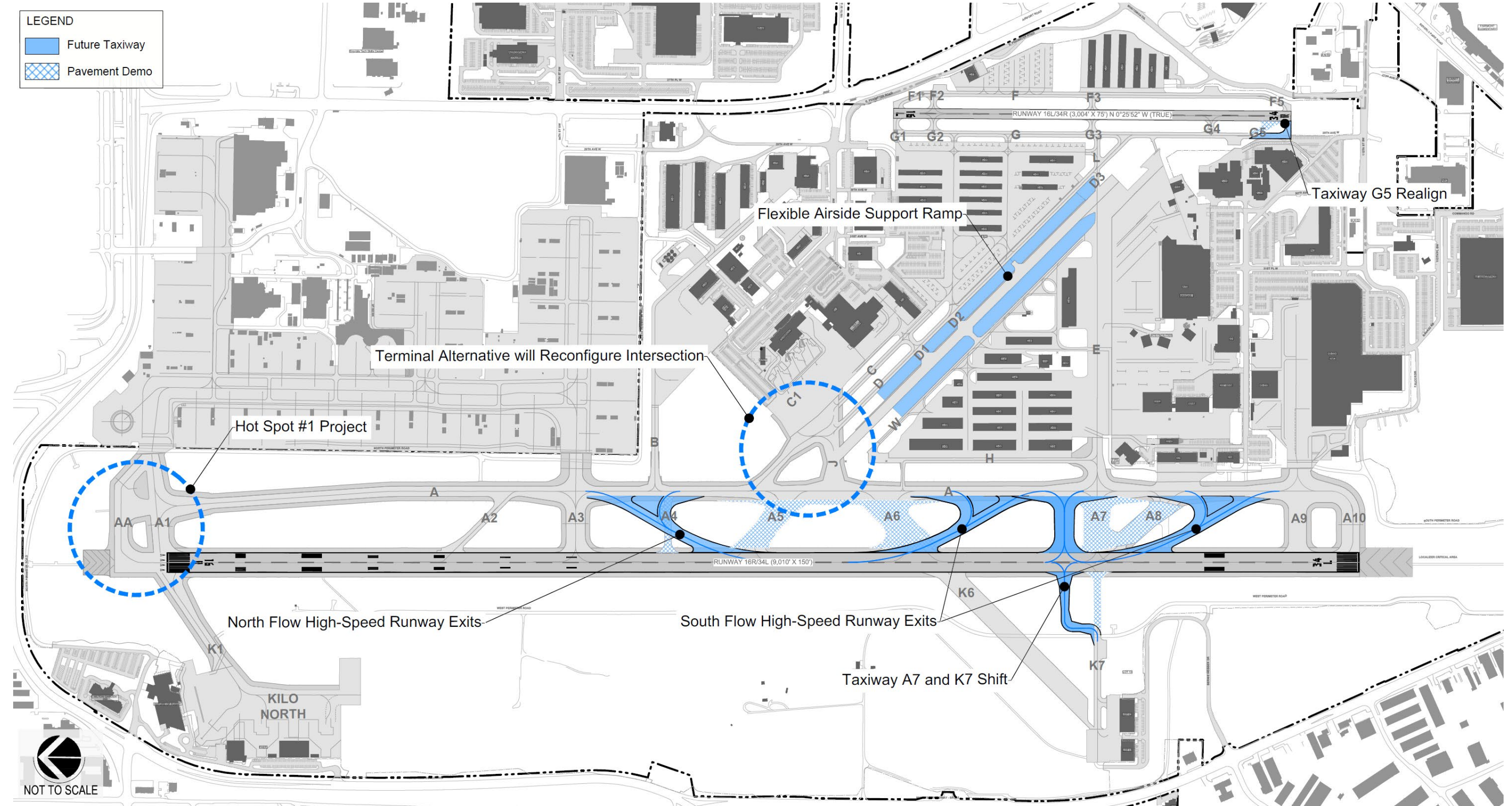
Based on the analysis in the preceding sections, the following airfield improvements are recommended by this Master Plan to accommodate demand through PAL 3:

- Provide two high speed exits for Runway 16R arrivals (removes Taxiway A9 and A6)

- Provide two high speed exits for Runway 34L arrivals (removes Taxiway A2 and A4/A5)
- Implement Airport preferred alternative to resolved Hot Spot 2
- ADG-V new parking positions
- Construct flexible airside ramp in decommissioned runway site
- Realign Taxiway intersection of C1, C, J, and D (3-Node Concept)
- Shift Taxiway A3
- Shift Taxiway A7 and K7
- Remove Taxiway A9
- Reconfigure Intersection - Taxiway G5 and Runway 34R end

These recommendations are shown on **Exhibit 5.2-6, *Airfield Recommendations***.

Exhibit 5.2-6 Airfield Recommendations



Source: Landrum & Brown

5.3 Terminal Development Alternatives

This section identifies several possible passenger terminal alternatives. The purpose of the passenger terminal alternatives is to define the amount of land needed to satisfy the future terminal area requirements. The actual configuration and design of the passenger terminal and the associated apron area may be undertaken by Propeller – the private developer and operator of the current passenger terminal who has the first right of refusal for expansion when demand occurs. If Propeller does not have the desire or financial ability to expand when demand occurs, then the County or its designee may undertake the expansion. The intent of this section is therefore to ensure there is adequate land available for whichever terminal layout and design when demand occurs. The alternatives therefore need to be flexible.

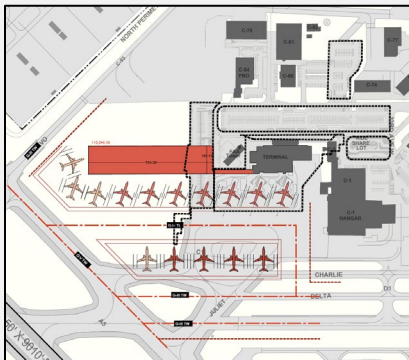
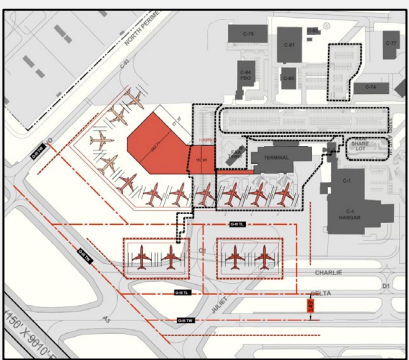
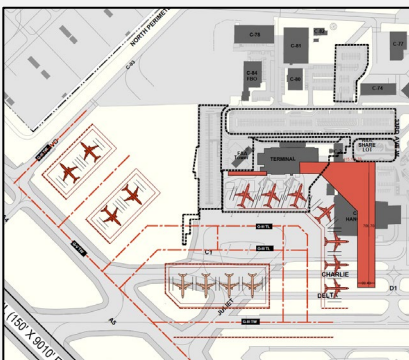
Each terminal alternative must meet the following facility requirements.

- Provide 200,000 sf (or a two-story 100,000 sq. ft. footprint) of additional terminal Building. It is also assumed that the passenger terminal will be a two-level structure
- Provide a total of seven contact gates
- Provide a total of 15 aircraft parking positions (seven contact plus eight remote positions)
- Accommodate deicing capabilities (four Off-Stand, or seven On-Stand)

5.3.1 Alternatives

To meet the requirements, three families of terminal alternatives were developed and are shown in **Table 5.3-1, Family Alternatives**, each with varying benefits and constraints.

Table 5.3-1 Family Alternatives

Terminal Alternatives		
Family 1 Linear Extension (to the North)	Family 2 L-shape Extension (to the north)	Family 3 L-shape Extension (to the south)
		

Source: Landrum & Brown

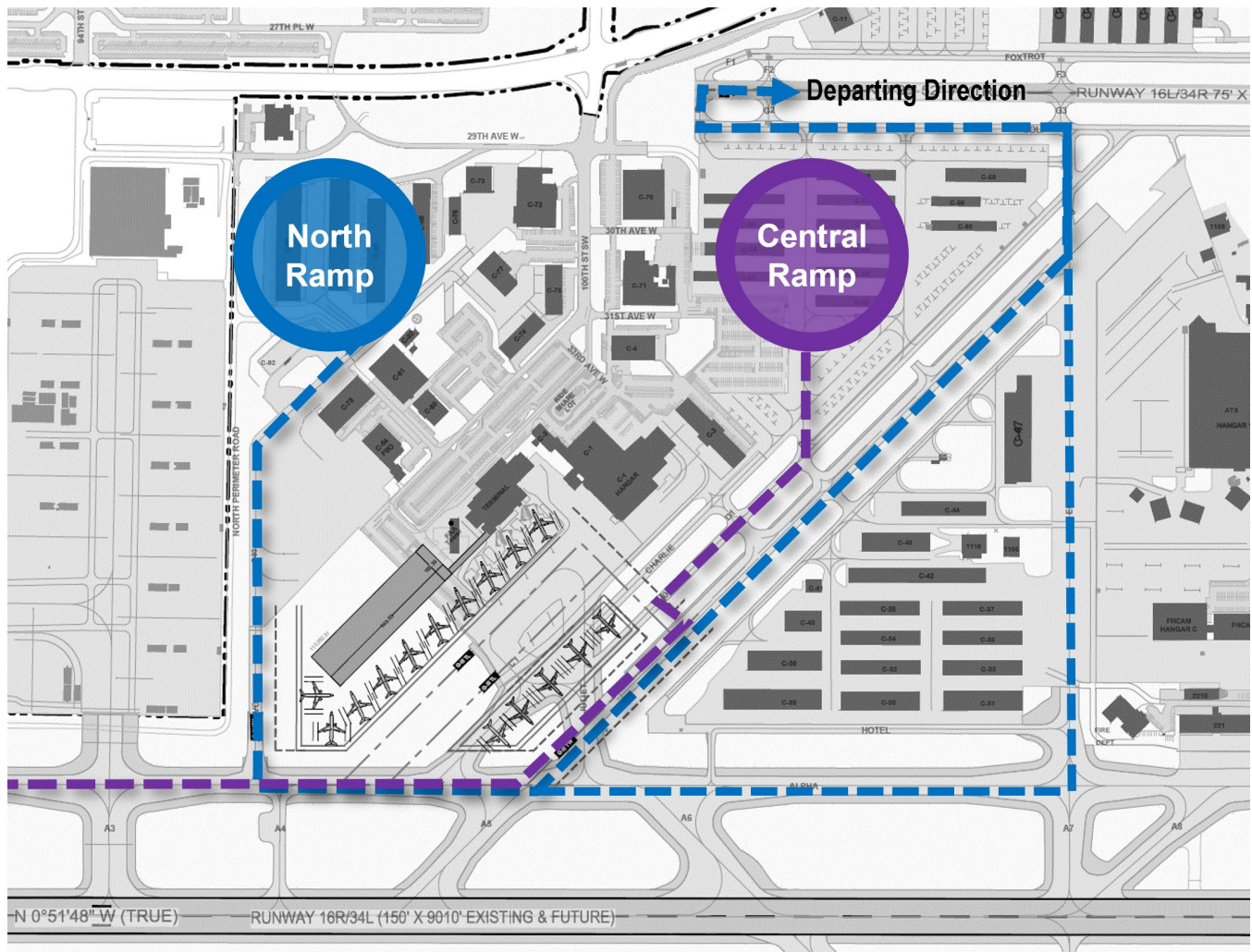
Additionally, and in consultation with PAE staff, the following criteria were used as a means of evaluating the preferred family of alternatives.

- Expansion Flexibility – addresses the ability of the alternatives to expand in different ways without adversely affecting the existing terminal configuration or its operations
- Airfield Circulation – ensures that the existing and future airfield taxiing operations within the terminal precinct as well as to and from each of the two runways remain operational efficient and safe and do not affect capacity or create bottlenecks
- Landside and Curbside Efficiency – ensure proper vehicle flows to and from the passenger terminal along the access road and the terminal curbside as well as ensuring adequate parking facilities and connections to other modes of transportation, including mass transit and light rail.
- Level of Service to Passengers – ensures optimal passenger walking distances within the passenger terminal as well as to the curbside and parking facilities and ensures intuitive passenger flows, wayfinding and amenities
- Disruption to Existing Infrastructure – minimizes interruption to existing infrastructure and airport operations during the construction of the passenger terminal
- Environmental Issues – minimizes any known environmental issues
- Capital Cost (to County) – minimizes potential costs to the County, recognizing that the Capital costs inside the lease lines will be undertaken by Propeller.

In each of the alternatives, the airside taxiway access between the two runways must be maintained either through Taxiway D and Taxiway C or through the partial use of the decommissioned runway. Additional, Taxiway W may be used to improve connectivity. The specific taxi flows were discussed in the airfield alternatives section.

Exhibit 5.3-1, *Potential Taxiway Flows* shows the potential taxiway flows between the two runways and GA. The flow diagram evaluates the *worst-case scenario* of North Ramp users using Runway 16L-34R and Central Ramp users using Runway 16R-34L, depicting how movements may be managed.

Exhibit 5.3-1 Potential Taxiway Flows



Source: Landrum & Brown

Each of the alternatives also requires additional pavement for the aircraft parking and taxiing, and each alternative also differs in terms of how much additional leased area will be required. As shown in **Table 5.3-2, Additional Leased and Paved Areas**, the Family 2 alternatives require the lease amount of additional paved area and leased area (2A and 2B). Further discussion of the alternatives is provided further.

Table 5.3-2 Additional Leased and Paved Areas

Alternative	Incremental Leased Area	Incremental Pavement Area
1A	820,000	719,389
1B	843,500	739,505
2A	768,000	741,272

2B	703,200	714,344
2C	823,380	885,809
3A	1,305,870	854,424
3B	975,050	907,660

Source: Landrum & Brown

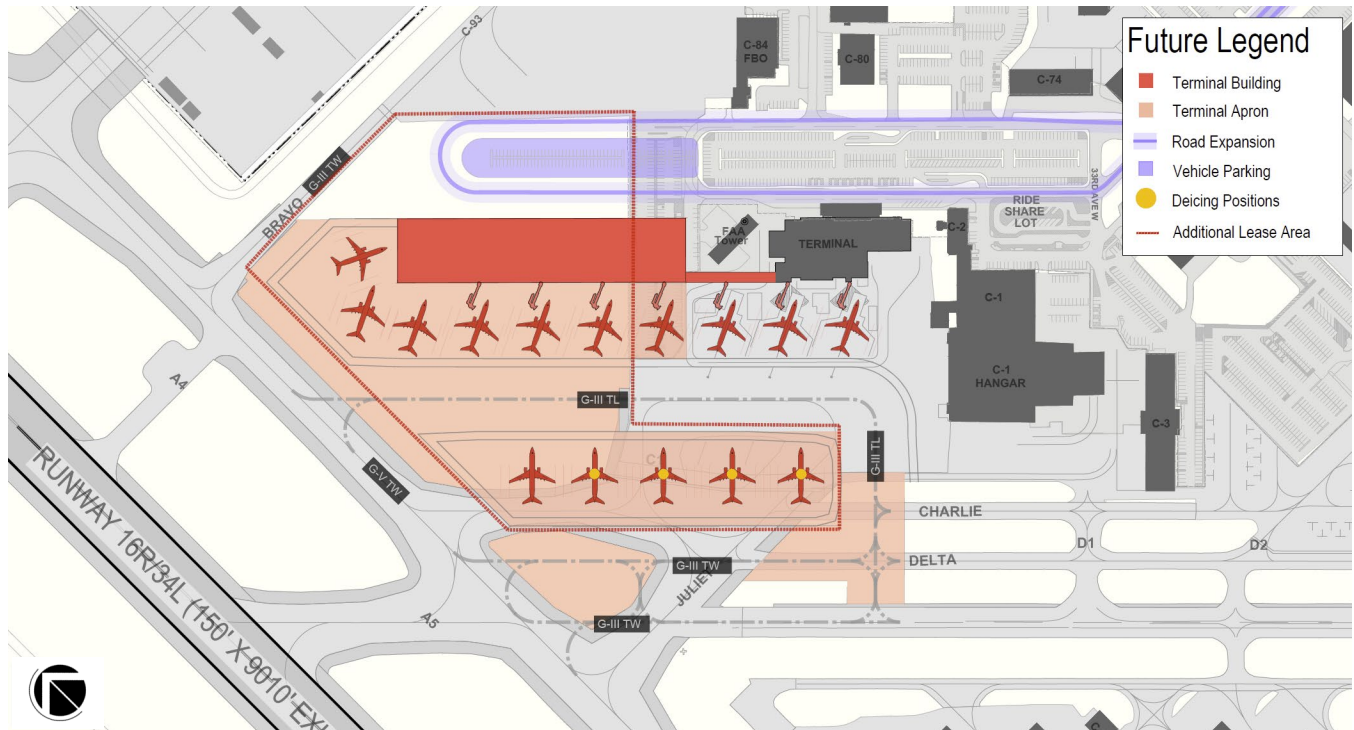
5.3.1.1 Family 1 Alternatives

Two Family 1 alternatives were developed. Both alternatives are linear extensions to the north with the primary difference being the aircraft flows from the runways to their respective parking positions. Both alternatives include an approximately additional 100,000 sq. ft passenger terminal footprint (200,000 sq. ft of total terminal area) and 10 contact positions and 5 inactive/remote positions. Deicing is assumed to occur at the remote parking pads.

Alternative 1A

In Alternative 1A, as shown in **Exhibit 5.3-2, Terminal Alternative 1A**, there is a single taxilane between the contact positions and the remote positions. While there is flexibility in enabling access from the primary runway to Taxiway Delta, a single taxilane behind the contact stands does not provide the greatest operational flexibility as aircraft may end up waiting for other arriving or departing aircraft along the same taxilane.

Exhibit 5.3-2 Terminal Alternative 1A



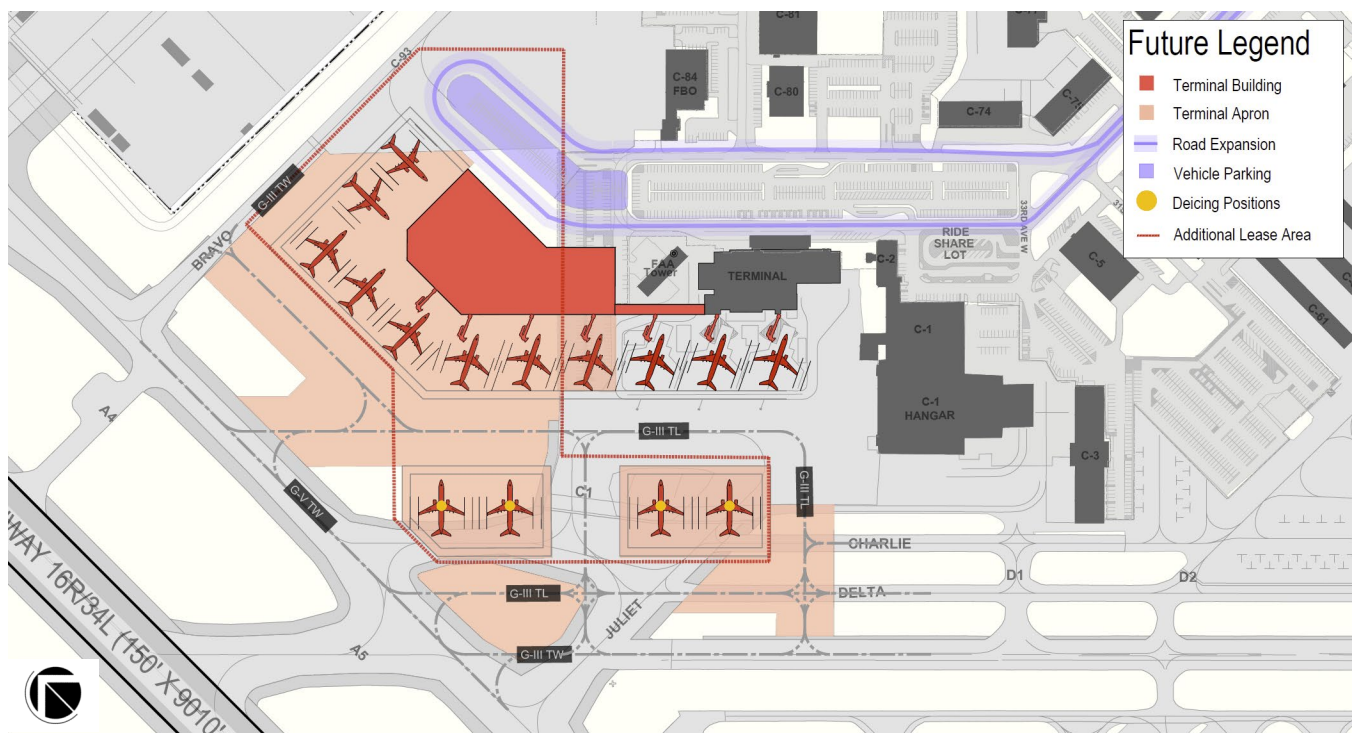
Source: Landrum & Brown

Alternative 2A

Alternatives 2A, as shown in **Exhibit 5.3-4, Terminal Alternative 2A**, contains 11 contact stands and 5 remote stands. Similar to Alternative 1A, it contains a single taxilane behind the contact stands and a dual taxiway behind the remote stands. Access from the runway to the general aviation area is maintained along Taxiway Delta. As indicated in Alternative 1A, a single taxilane behind the contact stands does not provide the greatest operational flexibility as aircraft may end up waiting for other arriving or departing aircraft along the same taxilane.

With this terminal layout, the curbside and access road and associated parking area circulate around a tight curbfront that will require further analysis during the design stage.

Exhibit 5.3-4 Terminal Alternative 2A



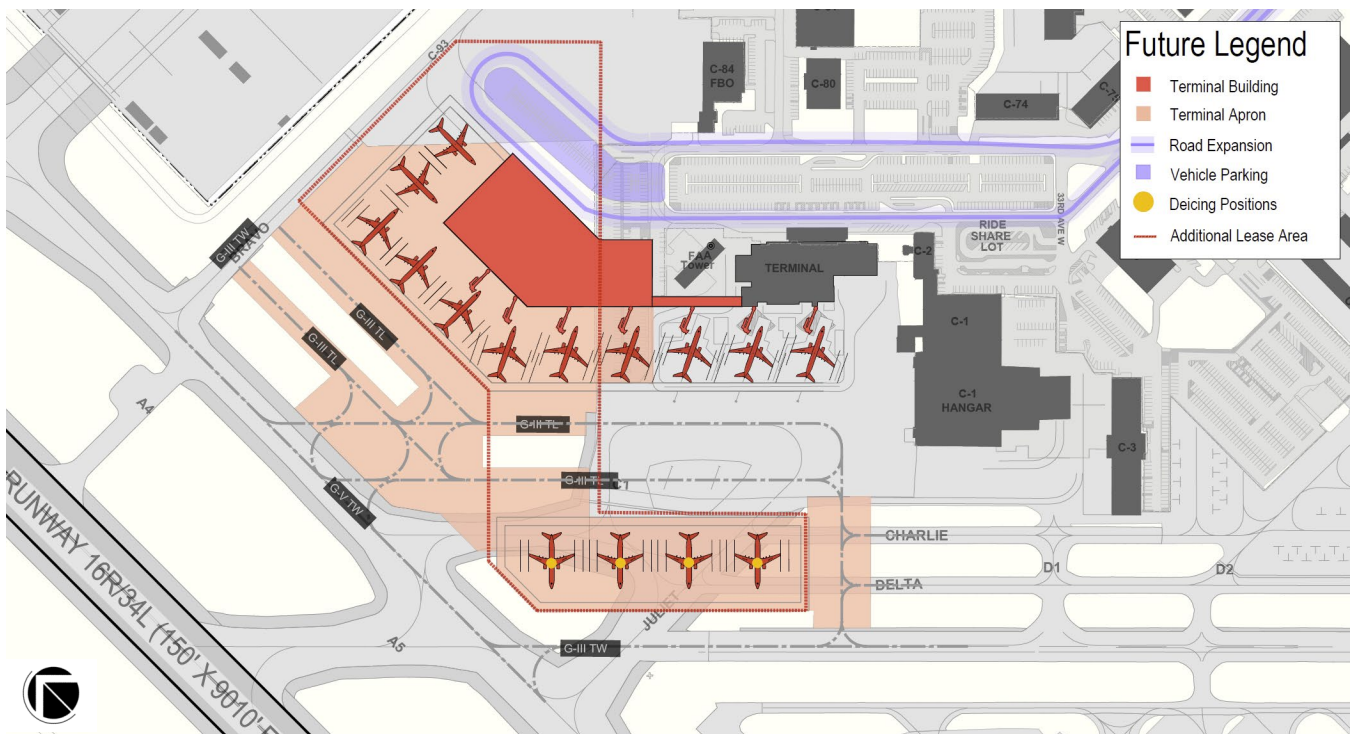
Source: Landrum & Brown

Alternative 2B

Alternative 2B, as shown in **Exhibit 5.3-5, Terminal Alternative 2B**, is similar to 2A except that there is a dual taxilane between the contact and the remote positions. This provides additional operational efficiency that Alternative 1A and 2A do not provide. It does, however, require the partial use of the decommissioned runway as a taxiway so that aircraft can gain access to the secondary runway or general aviation hangars to the east.

With this terminal layout, the curbside and access road and associated parking area circulate around a tight curbfront that will require further analysis during the design stage.

Exhibit 5.3-5 Terminal Alternative 2B



Source: Landrum & Brown

Alternative 2C

Alternative 2C, as shown in **Exhibit 5.3-6, Terminal Alternative 2C**, is similar to 2A and 2B except the passenger terminal expansion only contains 9 contact stands but includes 6 remote stands. The airside taxiing flows are similar to Alternatives 1A and 2A in that there is a single taxilane behind the contact stands and access from the primary runway to the general aviation area is maintained along Taxiway Delta. Similar to Alternatives 2A and 2B, this terminal layout, the curbside and access road and associated parking area circulate around a tight curbfront that will require further analysis during the design stage.

Exhibit 5.3-6 Terminal Alternative 2C



Source: Landrum & Brown

5.3.1.3 Family 3 Alternatives

The Family 3 alternatives take a very different approach from the prior alternatives. In these alternatives, the passenger terminal expansion occurs to the south. In both Alternative 3A and 3B, as shown in **Exhibit 5.3-7, Terminal Alternative 3A** and **Exhibit 5.3-8, Terminal Alternative 3B**, there are 7 contact stands and 8 remote stands. Both have dual taxilanes behind the contact stands. The primary difference is the configuration of the passenger terminal.

Alternative 3A and Alternative 3B

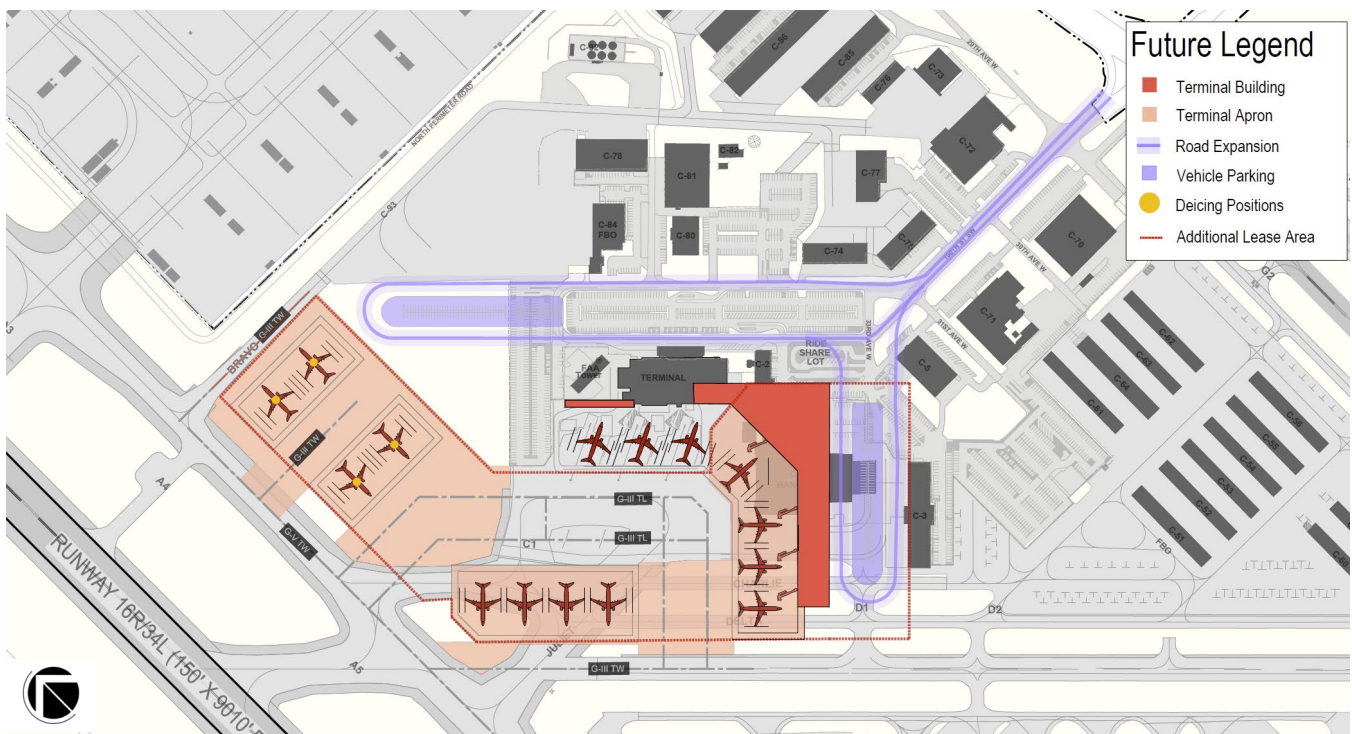
These alternatives also include an approximately additional 100,000 sq. ft passenger terminal footprint (200,000 sq. ft of total terminal area). Deicing is assumed to occur at the remote parking pads. In both Alternative 3A and 3B, there are 7 contact stands and 8 remote stands. Both have dual taxilanes

behind the contact stands. The primary difference is the configuration of the passenger terminal. The taxiing flows around these terminal layouts is similar.

The initial passenger terminal expansion will likely need to occur with the next 5+ years. This means that Building C1, C2 and C1 suite E will need to be demolished to accommodate this growth. Given that the County recently entered into renewed lease arrangements with several of its tenants in these facilities, a terminal expansion in this direction is not preferred. The costs to undertake the Family 3 Alternatives would be far greater than the other alternatives. There would also be significant disruption to current airport operations as tenants in these facilities would need to be relocated.

Additionally, in both these alternatives the landside areas, including the curbfront and parking are highly constrained and minimized in comparison to the Family 1 and 2 alternatives.

Exhibit 5.3-7 Terminal Alternative 3A



Source: Landrum & Brown

5.3.2 Passenger Terminal Recommendations

Based on the criteria provided previously, the passenger terminal configurations that are optimal are Alternative 1b and 2B, or variations on those concepts. Additional commentary is provided below.

It is also important to note that Propeller Airports has the first right of refusal to expand the existing terminal so the County will not be responsible for the planning, design configurations of the passenger terminal area and airside parking areas (contact and remote parking); however, it is important that the County understand the total area requirements that will be needed to accommodate future passenger demand. **Table 5.3-3, *Evaluation of Passenger Terminal Alternatives***, presents a qualitative evaluation of the Passenger Terminal alternatives.

Expansion Flexibility – All the alternatives meet the required demand and all, but the Family 3 alternatives can expand in an efficient manner without adversely affecting the existing airport operations. It is likely that over the course of the planning period, Propeller or another entity may expand the passenger terminal in two phases.

Airfield Circulation - From a taxiing flow perspective, Alternatives 1B, 2B and 3B provide the greatest degree of operational efficiency as a result of dual taxilanes behind the contact stands, while also maintaining the necessary remote stands. The only issue is that part of the decommissioned runway would need to become a taxiway with a connection to Taxiway Delta to ensure access from the primary runway to the General Aviation area and secondary runway. Alternatives 1A and 2A contain a single taxilane behind the contact stands, which may create congestion when an aircraft is pushing back at the same time as an aircraft is taxiing into an aircraft parking position.

Landside and Curbside Efficiency – While each alternative accommodates the necessary curbside requirements, none of them are ideal in terms of the available turning radii along the access road. The Family 1 alternatives are slightly better than the Family 2 alternative in that they are longer and simpler – with less turns. Family 3 is the worst as there is no additional extra curbside or parking provided.

Level of Service (LoS) to Passengers – The level of service for passengers for each of the alternatives is similar, except that the Family 3 alternatives may create issues when picking up or dropping off passengers due to a much smaller curbside. All the alternatives are likely to have appropriate processing capabilities within the terminal, and walking distances and potential passenger amenities are also likely to be similar.

Disruption to Existing Infrastructure – Family 1 and 2 alternatives are effectively greenfield sites and therefore there is very little disruption to any existing infrastructure. The Family 3 alternatives require demolition of existing buildings and parking are in the short-term which will cause significant disruption to airport operations.

Environmental Issues – From a high-level environmental perspective, the Family 1 and 2 alternatives are located in an open area with no known environmental issues. The Family 3 alternatives will require demolition and detailed environmental analysis for existing soil and groundwater contamination that has the potential to add cost and time to any proposed development in this area.

Capital Cost (to County) – The capital costs associated with the design and construction of a new and/or expanded passenger terminal area, the airfield parking positions, and additional landside roadway network will be similar across each of the Family of alternatives, with some exceptions. There is also a requirement to expand the electrical sub-station systems to accommodate the additional utility

demand for the passenger terminal. These costs will also be similar for all alternatives. However, the Family 3 alternatives also include demolition of existing facilities (Buildings C1, C2, and C1 Suite E), environmental remediation, potential costs associated with modifying existing leases, as well as costs associated with longer implementation schedules. Family 3 alternatives are therefore least desirable from a cost perspective.

Color codes of green (positive impact), yellow (neutral or no impact), and red (negative impact), respectively, were used to in the table below. Each evaluation criteria were weighted evenly and combined to determine a total score for each alternative.

Table 5.3-3 Evaluation of Passenger Terminal Alternatives

Criteria	Alternatives						
	Family 1		Family 2			Family 3	
	1A	1B	2A	2B	2C	3A	3B
Meets Demand	●	●	●	●	●	●	●
Expansion Flexibility	●	●	●	●	●	●	●
Airfield Circulation	●	●	●	●	●	●	●
Landside Efficiency	●	●	●	●	●	●	●
LOS to Passengers	●	●	●	●	●	●	●
Disruption to Existing Infrastructure	●	●	●	●	●	●	●
Environmental	●	●	●	●	●	●	●
Capital Cost	●	●	●	●	●	●	●
Overall Result	●	●	●	●	●	●	●

Source: Landrum & Brown

It is recommended that the County set aside the land and general configuration of land associated with the Alternatives 1B and 2B.

Stormwater control and drainage analysis should be considered as the design of this area advances. The addition of large amounts of impervious pavement may trigger a rework of the existing stormwater collection system. Further environmental analysis will be conducted during the project development stage.

5.4 Landside Development Alternatives

An evaluation of the existing ground transportation system was completed in **Chapter 4, Facility Requirements**. The analysis focused on the demand capacity of the airport access, terminal access and loop road, airport parking, terminal curb front, and rental car areas. This section will present alternatives to provided landside capacity through the planning period.

5.4.1 Airport Access

100th St. SW, located west of Airport Road serves as the only access and egress route for the airport terminal area. To evaluate the operational capacity of the access road, current and future traffic demands were modeled and analyzed at five-year intervals throughout the planning period, incorporating forecasted passenger estimates and a one percent annual compounding growth rate to account for background development in the area. Annual capacities were interpolated between the calculated 5-year intervals for comparison with forecasted passenger estimates. These results were evaluated against the existing airport entrance configuration and proposed future concepts discussed below.

Forecasted passenger levels are expected to exceed the capacity of the existing roadway and intersection between PAL 2 and PAL 3 (approximately 2033). Improvements to the following components were evaluated to increase capacity and accommodate anticipated terminal activity.

- Intersection of 100th St. SW at Airport Road
- Lane configurations of 100th St. SW between Airport Road and Terminal Loop

5.4.1.1 Airport Road and 100th St SW Intersection

The intersection of Airport Road at 100th St. SW is a signalized intersection with single left-turn lanes from all directions. The operational analysis indicates that the intersection, in its current configuration will reach an unacceptable level of service between PAL 2 and PAL 3 in approximately 2034, with delays of 60 seconds or more.

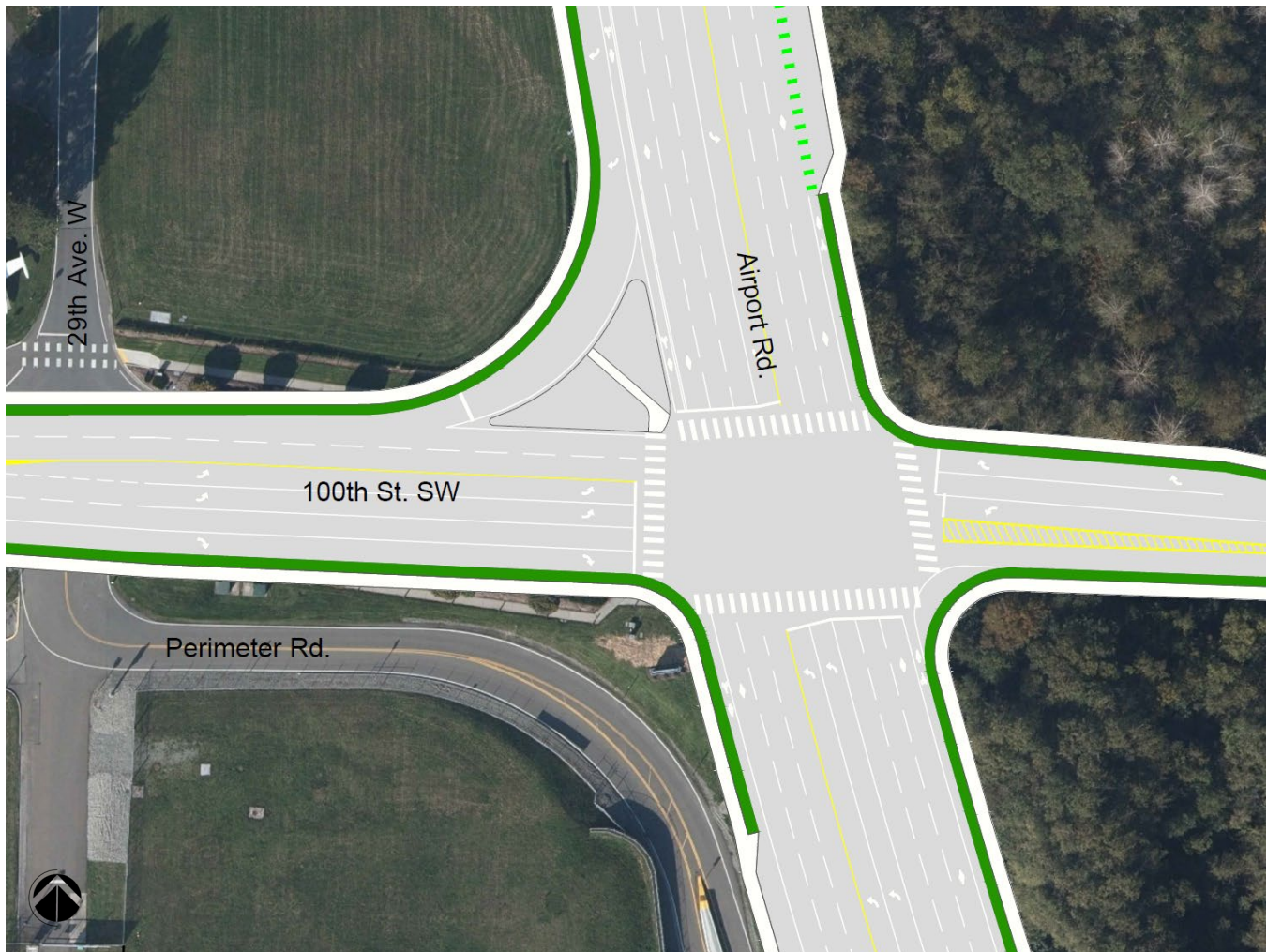
The following intersection configurations were evaluated against traffic demand over the planning period.

- Expanded Signalized Intersection
- Roundabout

A grade separated (elevated flyover) alternative was initially considered but was discarded due to its conflict with arrival and departure operations from Runway 16L.

Alternative - Expanded Signalized Intersection

An expansion of the existing signalized intersection was evaluated against anticipated traffic activity, depicted in **Exhibit 5.4-1, Airport Rd/100th St SW – Expanded Signal Alternative**. The operational analysis indicates that the primary movements that experience delay are the northbound left-turn and the eastbound left-turn movements. This alternative addresses delays by adding dual northbound and eastbound left-turn lanes and appurtenant receiving lanes, as well as converting the southbound right-turn lane to a yield movement. All other components of the intersection remain the same.

Exhibit 5.4-1 Airport Rd/100th St SW – Expanded Signal Alternative

Source: Landrum & Brown

Delays are anticipated to surpass acceptable levels of service late in the planning period between 2035 and 2040. Recommended solutions to address shortfalls in capacity and to reduce potential congestion include the following. They will need to be implemented before 2040.

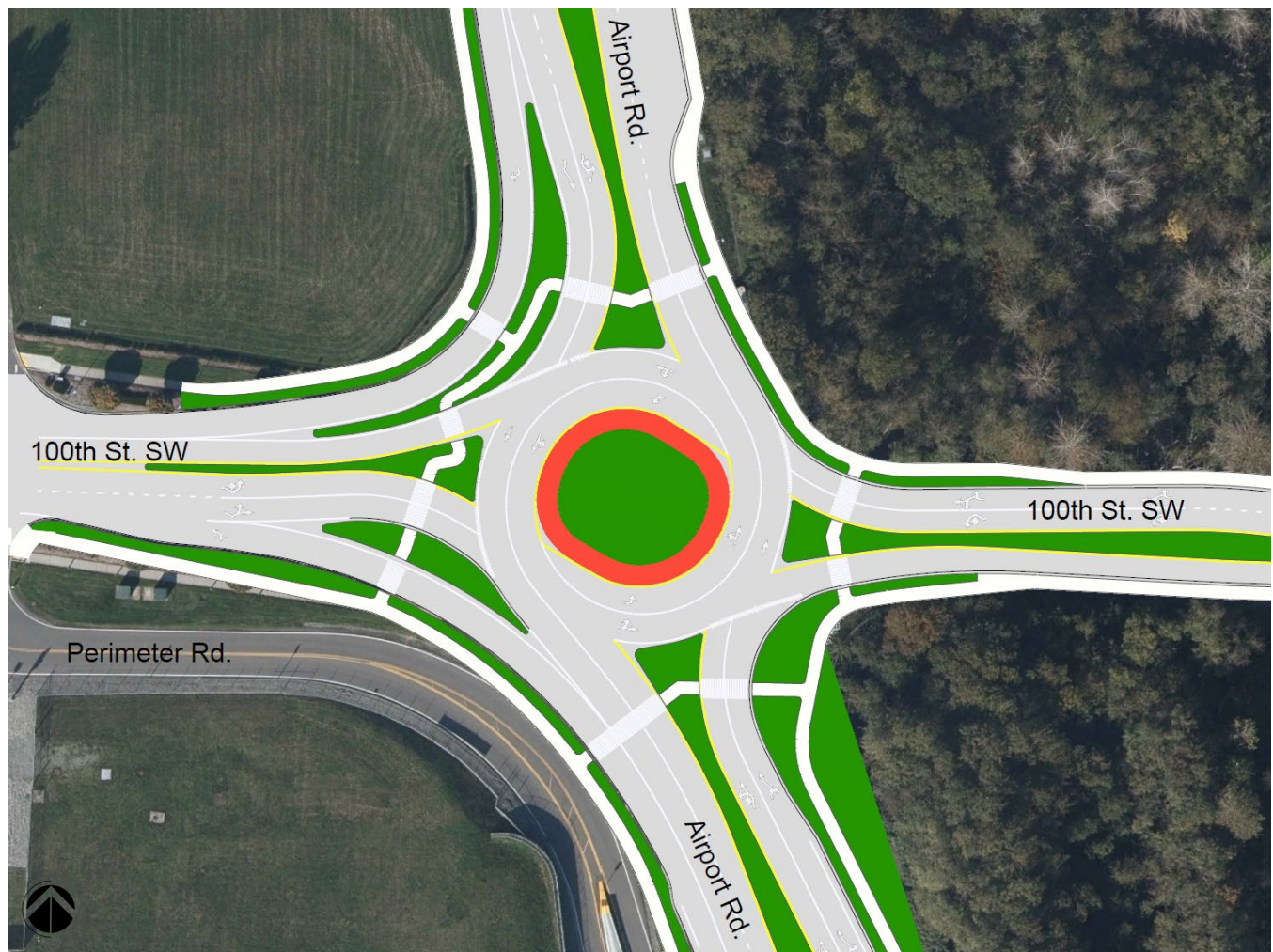
- Provision of additional signage indicating the use of the east Perimeter Road and Minuteman Drive as a means of airport egress, and
- Provision of additional surface parking facilities south of 100th St. SW and east of Airport Access Road with shuttle service to the terminal area
 - Parking areas may also serve bus, light rail, and other public mode of transit in the future
 - Provision of a cell phone staging lot within this area

The expansion of the existing intersection with dual northbound and eastbound left-turn lanes will impact other roads and intersections nearby. Specifically, the 29th St W intersection, north of 100th St SW will be restricted to right-turns only from westbound and southbound traffic. Access to Perimeter Road from 100th St. SW will be terminated, and an alternative route will be required. Alternatives to reroute Perimeter Road are discussed in the Perimeter Road section below.

Alternative - Roundabout

A roundabout alternative was developed to assess its ability to provide increased capacity compared to the improved signalized intersection, depicted in **Exhibit 5.4-2, Airport Rd/100th St SW – Roundabout Alternative**. Various roundabout sizes were evaluated, but all had similar configurations of two circulating lanes and slip/bypass lanes for the southbound to westbound right-turn and the eastbound to southbound right-turn. Operational analysis of the roundabout indicated that a 155-foot island diameter roundabout (approximately 210 feet to 215 feet total diameter) would likely provide sufficient capacity for up to four million passengers in 2040.

Exhibit 5.4-2 **Airport Rd/100th St SW – Roundabout Alternative**



Source: Landrum & Brown

While the roundabout alternative does have the potential to provide additional capacity, it does not accommodate the existing three-lane approaches, Bus Rapid Transit (BRT), and High Occupancy Vehicle (HOV) lanes on Airport Road. Those lanes would have to merge with the two general purpose lanes prior to entering the two-lane roundabout, diminishing the efficiency and effectiveness of the intersection, and the BRT and HOV routes. The roundabout concept is also incompatible with the light rail line and potential stop recently planned at this location.

Recommendation

The expanded signalized intersection is the recommended alternative for the Airport Road and 100th St SW intersection. While the roundabout alternative offers increased capacity compared to the signalized intersection, the incompatibilities with the existing BRT and HOV routes, and the planned light rail line in the Airport Road corridor make it a poor solution when considering the greater transportation system surrounding PAE.

The dual northbound and eastbound left turn lanes added to the signalized intersection will add sufficient capacity to accommodate forecasted demand until approximately 2038, at which time additional measures should be taken to increase capacity through the intersection and/or provide an alternative access to the terminal. It is recommended that implementing either a redistribution for non-passenger traffic via Minuteman Drive (southern access alternative) for non-passenger traffic or providing a parking/multi-modal area (away from the terminal area) that utilizes airport shuttle will provide sufficient capacity through the planning period.

5.4.1.2 Qualitative Assessment of Nearby Intersections

An informal qualitative assessment of the impacts that the forecasted growth in passenger activity would have on other nearby intersection along Airport Road was completed. The following observations are offered:

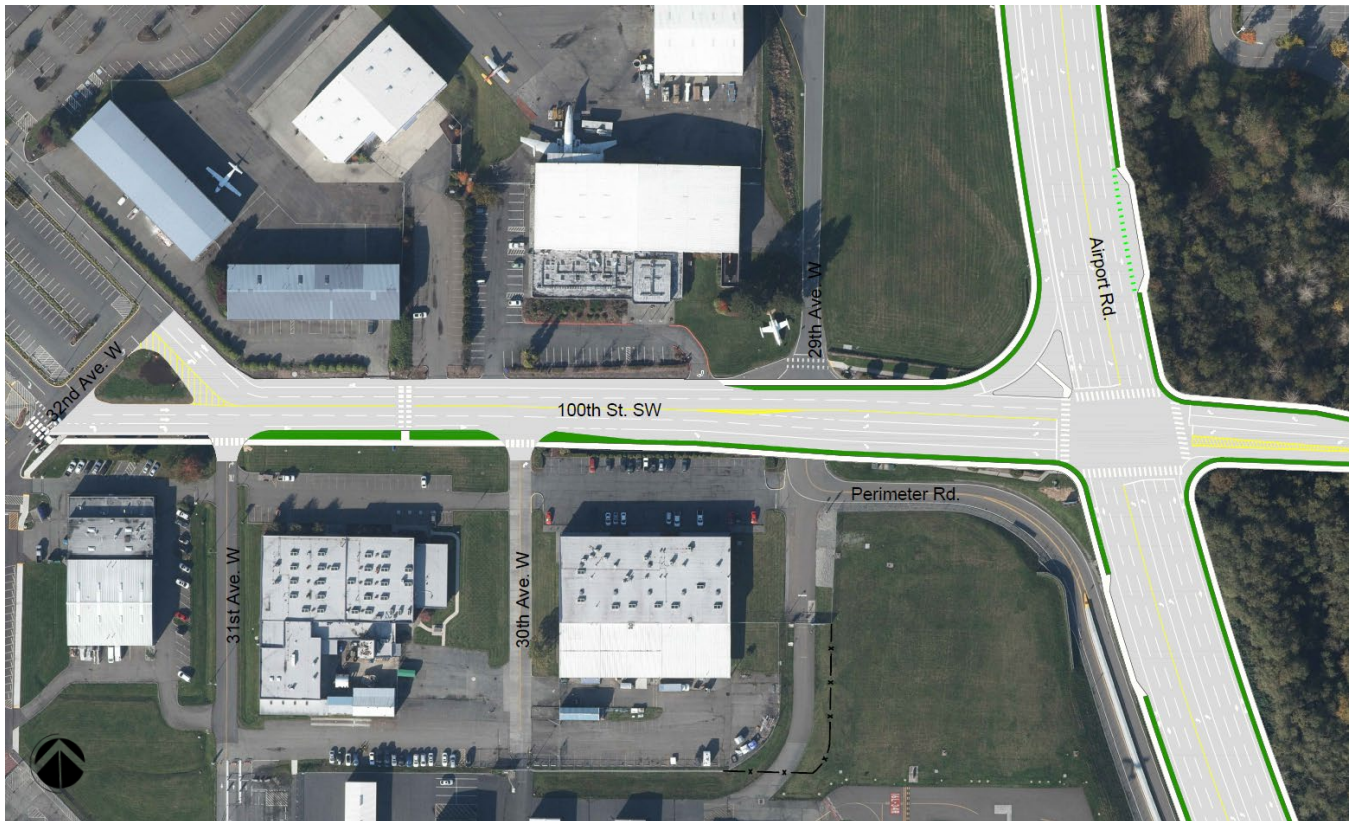
- The Boeing Freeway ramps are mostly free movements or have minimal conflicts (westbound off and westbound on). The intersection with Casino Road was therefore used as a proxy since it is directly adjacent to the ramps and is a signalized intersection.
- The 94th St and Minuteman Road intersections are anticipated to operate acceptably under the 2040 conditions with the four-million passenger levels.
- The Beverly Park/Edmonds Road and Casino Road intersections are anticipated to operate at LOS F under the 2040 conditions with just background growth. These intersections would require improvements to address these operations. The trip generation from Paine Field with additional passengers is not anticipated to significantly change the need for roadway improvements or the type of roadway improvements.

5.4.2 Terminal Access Road

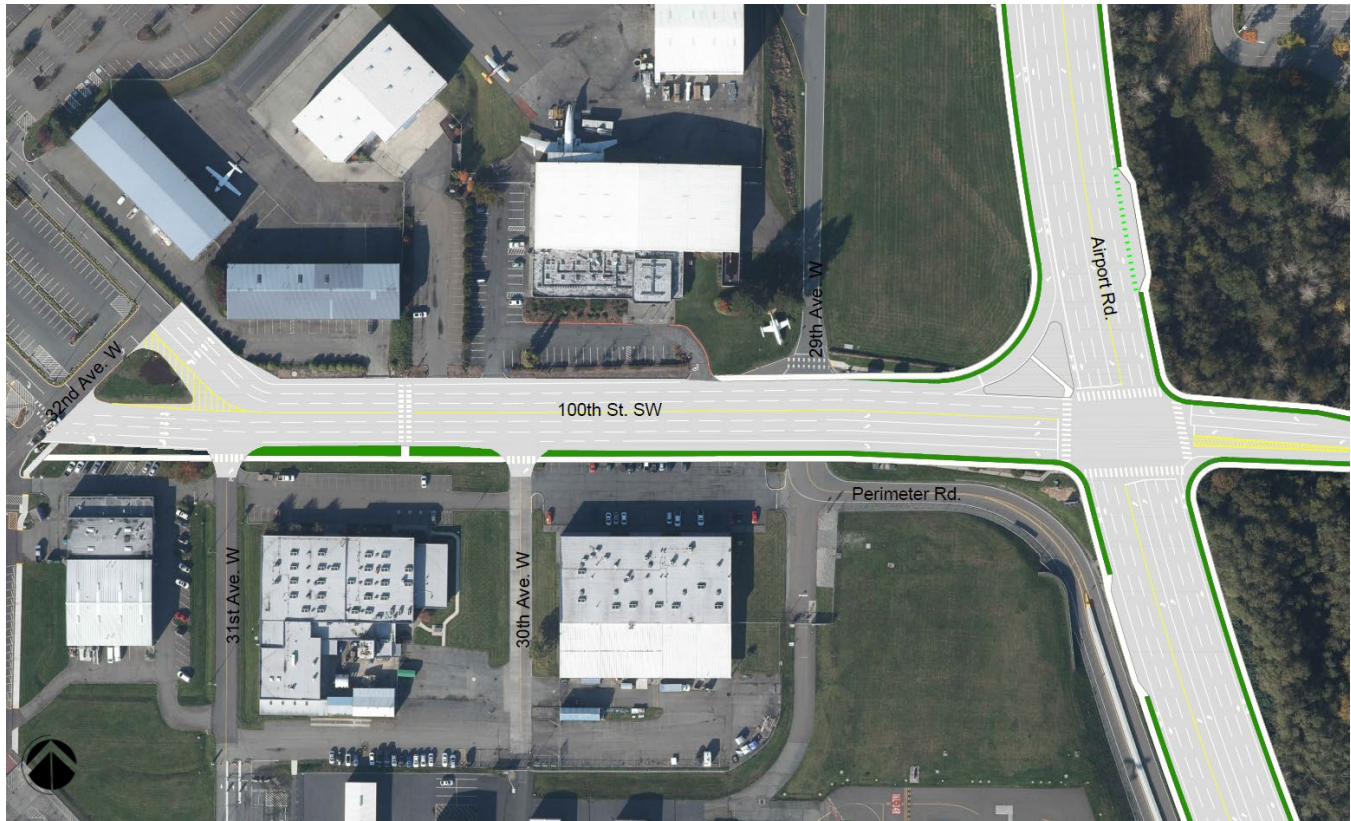
The existing terminal access road, 100th St SW, is the primary access and egress route between the terminal and Airport Road. The capacity of the road is expected to be surpassed by the time the terminal reaches two-million annual passengers. Hangar areas and taxilanes on the north, as well as Runway 16L and established businesses on the south limit options to reroute this road. Instead, it is proposed to widen the road in its current location to address forecasted capacity needs.

Operational analysis indicates that when the terminal reaches two-million annual passengers, anticipated after PAL 2, a second eastbound exit lane will need to be constructed, depicted in **Exhibit 5.4-3, 100th St SW Terminal Access Road – 2 MAP**. When the terminal reaches four-million passengers, anticipated in approximately 2039, additional eastbound and westbound lanes will be required, depicted in **Exhibit 5.4-4, 100th St SW Terminal Access Road – 4 MAP**.

Exhibit 5.4-3 100th St SW Terminal Access Road – 2 MAP



Source: Landrum & Brown

Exhibit 5.4-4 100th St SW Terminal Access Road – 4 MAP

Source: Landrum & Brown

5.4.2.1 *Perimeter Road*

The expanded signalized intersection concept identified as the recommended intersection alternative above will impact the connectivity of the existing Perimeter Road and 29th Avenue W. The proposed east bound right and left-turn lanes extend into the existing crossing and the southbound right-turn slip lane is extended further to the west. It is not recommended to retain the north-south connectivity between 29th Avenue W and Perimeter Road, crossing over 100th St SW. This connection may be utilized during off-peaks and should be limited to maximize 100th St SW capacity. As a result, the 29th Avenue W intersection with 100th St SW may be restricted to right turn only for southbound and west bound traffic. Left turns onto and off of 29th Avenue W are not recommended.

As stated, access to 100th St SW from Perimeter Road via 29th Avenue W is not compatible with the proposed intersection as the road expands. Removal of this connection will limit access to the T-hangar areas adjacent to Runway 16L-34R and from the south from Minuteman Drive. Access to the flight schools along 100th St SW is also impacted as vehicles approaching from the east can no longer turn left onto 29th Avenue W to access these facilities. In an effort to preserve access to these facilities, two alternatives were evaluated.

Alternative - North Perimeter Road Connection

The first alternative extends Perimeter Road west across the existing parking lots and connects to 31st Avenue W, depicted in **Exhibit 5.4-5, North Perimeter Road Connection Alternative**. This alternative improves access to the flight schools from the south and preserves access to 100th St SW from the south, though only to the east bound lanes. Access from the north is possible by entering 100th St SW westbound, navigating around the 'triangle' at 32nd Avenue W to 100th St SW east bound and then turning right at either 31st Avenue W or 30th Avenue W to enter the extended Perimeter Road. Traffic intending to continue north across 100th St SW from Perimeter Road will instead access north bound Airport Road from 100th St SW and reenter the property at 94th St SW.

Exhibit 5.4-5 North Perimeter Road Connection Alternative



Source: Landrum & Brown

Alternative - South Perimeter Road Connection

This alternative, depicted in depicted in **Exhibit 5.4-6, South Perimeter Road Connection Alternative**, adds a connecting road south of the flight schools that runs from 29th Avenue W, south of the flight schools, then north through the existing terminal parking lot where it connects to the 32nd Avenue W with access to 100th St SW and the terminal loop road. The existing security fence and gate on 29th Avenue W would be relocated south of the proposed road. Furthermore, the final location on

the access gate, access road, security fence, and potential pavement for queuing space must be considered in design.

This concept provides access to the flight schools from the south via 30th and 31st Avenues W and adds connectivity to terminal loop road at 32nd Avenue W. The T-hangar area is accessed either from the south via Perimeter Road at Minuteman Drive or from the north via west bound 100th St SW and 32nd Avenue W, where it meets the proposed road. Traffic intending to proceed north across 100th St SW will instead access north bound Airport Road from 100th St SW and reenter the property at 94th St SW.

Exhibit 5.4-6 South Perimeter Road Connection Alternative



Sources: Landrum & Brown

Recommendation

The South Perimeter Road Connection is the recommended alternative. This concept preserves much of the existing access and connectivity of the current configuration. When compared to the North Perimeter Road Connection alternative, the routing is less cumbersome, parking areas in front the businesses are preserved, and it puts less traffic on 100th St SW. This alternative also has the added benefit of providing an additional access route to the terminal loop and parking areas that could be used by rideshare services, and shuttle busses, potentially reducing the demand on 100th St SW.

However, it should be noted that rerouting of rideshare services and shuttle busses in this fashion was not modeled in the operational analysis and may merit additional study.

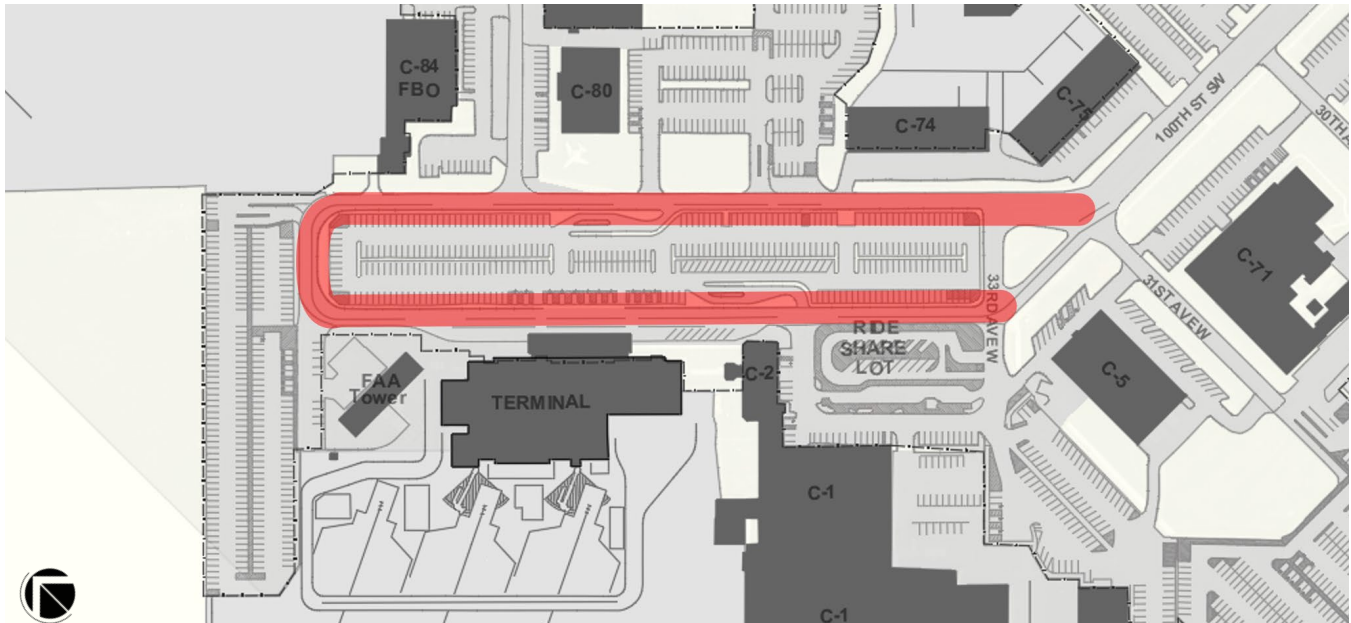
The timing of this perimeter road is unknown and should be coordinated as the demand on the entrance road (100th St SW) approaches its capacity limits. Additional coordination is required with the adjacent facilities and access gates to maintain amenities (parking/access/security). The alignment shown should be considered conceptual and will require additional design if realized.

Additionally, the Master Plan recommends options be considered in the future to removed non-passenger traffic from PAE's main access road (100th St SW). During the peaks, the road will be pushing the limits of an acceptable level-of-service as it serves 4.3 MAP. Alternative access points should be considered for existing tenants beyond the work done in this Master Plan.

5.4.3 Terminal Loop Road (100th St SW)

This section examines the internal terminal loop road that will provide access from 100th St SW into the terminal area and curb fronts. The existing terminal loop road serves one-way directional traffic around the Premier Lot 1, consisting of two travel lanes, depicted in **Exhibit 5.4-7, Terminal Loop Road (100th St SW) - Existing**. In order to serve the anticipated demand of the 4.3 million passenger terminal facility, the 2-lane road will need to be expanded to a four-lane road. Consistent with the existing configurations, all 4 lanes will be available to both terminal curb fronts. Signage is recommended to communicate lane access to both the departures and arrival curbs.

Exhibit 5.4-7 Terminal Loop Road (100th St SW) - Existing



Source: Landrum & Brown

5.4.3.1 Terminal Loop Road Alternatives

The existing 100th St SW terminal loop road is directly adjacent to the terminal, parking facilities, and provides access to several existing tenants. The existing configuration presents a logical expansion area to the north but will likely occur impacts to adjacent facilities. Alternatives were considered to limit impacts to existing infrastructures, while providing the needed roadway expansion to meet the capacity needed. For simplicity purposes, Terminal Alternative 1B was used in the preparation of the terminal loop road alternatives. The following configurations were considered to accommodate an expanded terminal loop road:

- Expand Existing Configuration
- Soften Curve Approach

Alternative - Expand Existing Configuration

This alternative follows the current geometry of 100th St SW and extends to the north (following the terminal expansion). As designed today, the 15-mph roadway is squeezed into its current site, utilizing minimal design curves around the north limits of the roadway as to not impact adjacent facilities. This alternative maintains the existing design curves, while expanding the road to four lanes and a similar configuration as to what existing today. **Exhibit 5.4-8, Terminal Loop Road (100th St SW) – Expand Existing**, depicts the conceptual alignment of this alternative.

Exhibit 5.4-8 Terminal Loop Road (100th St SW) – Expand Existing



Sources: Landrum & Brown

Alternative - Soften Curve Approach

This alternative considers a realignment of the north portion of 100th St SW to provide greater-than minimum design curves to the roadway. The concept will increase the length of the roadway and provide a larger turning radius compared to the existing design. The increased curve results in impacts to the Bravo Pad. **Exhibit 5.4-9, Terminal Loop Road (100th St SW) – Soften Curve Approach** depicts the conceptual alignment of this alternative and is recommended as the preferred.

Exhibit 5.4-9 Terminal Loop Road (100th St SW) – Soften Curve Approach



Source: Landrum & Brown

Recommendation

Compared to the softened curve alternative, the expansion of the existing configuration provides a lesser impact to existing tenants and maintains the capacity of Bravo Ramp. The Bravo Ramp may be a critical piece of apron during the construction of the terminal expansion and should not be impacted.

5.4.4 Terminal Curb Fronts

This section examines the alternatives to accommodate the terminal curbs along the front of the passenger terminal buildings. The existing curb is approximately 578 feet along the existing passenger terminal building, with two dedicated lanes for pickup/drop-off closest to the sidewalk. In order to serve the anticipated demand of the 4.3 million passenger terminal facility, a total of 2,394 feet of curbfront will be required and will accommodate a variety of vehicles including private vehicles, ride-share vehicles, taxis, limousines, mass transit buses, potential shuttles from light rail stops, buses for rental cars, lodging and remote lots.

5.4.4.1 Terminal Curb Front Alternatives

The alternatives will consider several different options to satisfy the additional curb capacity to meet the anticipated 4.3 MAP need. Alternatives will consider the number of curb fronts (single versus one on each building), impact to adjacent facilities (ATCT facility), elevations (at grade versus multi-level roads), and curbs away from the terminal sidewalk. At this level of design, alternatives do not consider the terminal building processing functionality (departures versus arrivals facility). The following terminal curb fronts were considered:

- Single At-Grade Curb (connecting two buildings)
- Two Separate At-Grade Curb's (connected via sidewalk)
- Grade Separated Curbs
- Inner and Outer At-Grade Curbs

Alternative - Single At-Grade Curb

This alternative considers a single at-grade curb connecting the two passenger terminal buildings. The single curb would provide 3-lanes of pickup/drop-off along the entire 900 feet of linear frontage. The single curb would allow drivers to operate curbside operations at any point of the curb, irrespective of terminal building function. However, a single continuous curb would be difficult to construct if the existing FAA Tower remained in its location. Furthermore, access to the FAA property would need to be provided elsewhere.

Alternative - Two Separate At-Grade Curbs

This alternative considers two dedicated at-grade curbs located adjacent to each of the passenger terminal buildings. The existing two-lanes would be expanded to three-lanes on the existing terminal and three-lanes would be constructed in front of the terminal expansion. This concept allows the FAA tower site to remain in place and maintain a point of access. Passengers would utilize the existing sidewalk to connect between the two terminal facilities. The two three-lane curbs can accommodate approximately 2,300 total feet of frontage to serve the PAL 3 demand.

Alternative - Grade Separated Curbs

This alternative considers elevating a roadway to create an upper and lower curb network, traditional at larger commercial airports. The concept would require additional land and complex solutions to accommodate the vertical transitions within the tight envelope. Additionally, a grade separated curb alternative would be complex to implement and more expensive compared to the other alternatives. For these reasons, this alternative was not explored any further.

Alternative - Inner and Outer At-Grade Curb

This alternative considers implementing an outer and inner curb along each of the terminal facilities. This concept is widely used at larger airports, providing separate corridors for the private and commercial traffic. This configuration requires sufficient land to accommodate the set of curbs, as well as the dedicated travel lanes. Additionally, this configuration requires pedestrian crossings to access to the terminal facility from the outer curb. Due to the site limitations and the traffic pattern weaving that may occur between the two facilities, the alternative was not explored any further.

Recommendation

Compared to the single at-grade curb alternative, the alternative to construct two separate at-grade curbs provides a lesser impact to existing FAA tower site and maintains passenger connections via the existing sidewalk. The relocation of the FAA tower or identifying an alternative access point into the site was not logical. **Exhibit 5.4-10, Terminal Curb – Two Separated At-Grade Curbs** depicts the conceptual alignment of this alternative and is recommended as the preferred.

Exhibit 5.4-10 Terminal Curb – Two Separated At-Grade Curbs



Source: Landrum & Brown

5.4.5 Airport Parking

This section examines the parking facilities supporting the passenger terminal and the alternatives to accommodate the anticipated demand of 4.3 million annual passengers. A total of four surface lots and the ride share/valet lot are located near the passenger terminal facility, providing a total of 971 parking spaces. To accommodate the projected demand, a total of 2,593 parking spaces will be required in planning period.

5.4.5.1 Airport Parking Alternatives

The ability to meet the parking demand needs on airport property, while providing the same level-of-service of close-in convenience that existing today, will be challenging due to the lack of available land and impact from an expanded terminal access road network. Alternatives will explore options to maximize the passenger experience of travelers utilizing the parking areas, attempting to locate them as close to the terminal as possible. The need to provide space for additional staging/operational space

for valet's and ride-share companies will compete for the available parking areas. Terminal Alternative 1B was used in the preparation of the airport parking alternatives and displaces the majority of existing Premier Lot 3.

The following airport parking alternatives were considered to achieve the demand:

- Expand/Construct New Surface Parking Lots
- Construct Parking Structure
- Off-Airport Parking

Alternative - Expand/Construct New Surface Parking Lot

This alternative considers the option to expand the existing surface parking lots (Premier Lots 1, Premier Lot 2, and Economy Lot 4) to satisfy the parking needs. To achieve this, each of the existing lots would require expansion beyond their current limits and acquisition of additional lease space. Additionally, the undeveloped (airport owned) 18-acre site at the southeast corner of the Airport Road and 100th St SW intersection will be required to support the parking needs. A surface parking lot will be developed in this alternative on the undeveloped piece of airport property, served by shuttles to the terminal area. Environmental mitigation will be required as nearly half of the site contains existing wetlands.

Alternative - Construct Parking Structure

This alternative considers the development of a parking structure to satisfy the parking needs. The development of a parking structure allows the existing surface lots to be maximized within the new terminal loop road configurations and provide sufficient parking spaces near the terminal. A parking structure would need to be approximately 4-6 levels to meet the parking needs in the terminal area.

There are two logical locations to support a parking structure are either located on the Premier Lot 1 site or located on the Premier Lot 2. Both of these locations would have direct access to the main terminal access road and could provide a direct connection to the terminal buildings via an elevated pedestrian walkway. Developing a parking structure in the Premier Lot 2 location (adjacent to the Everett Community College) is the preferred location, due to the site limitations of Premier Lot 1.

Alternative - Off-Airport Parking

This alternative considers maximizing the existing surface lots and meeting the parking demands off-airport property. This alternative is not preferred but would be considered to limit the impact to existing tenants as parking lots expanded and considered as a lower price option. Third-party parking companies will organically develop parking areas (outside of PAE property) naturally as demand increases but should not be the preferred option.

Recommendation

To provide the best level of service (walking distance to terminal) and meet parking demand needs within the terminal area, the Master Plan recommend the construction of a parking structure to satisfy the airport parking needs. A six-level parking structure on the Premier Lot 2 is the preferred location with a footprint of approximately 100,000 square feet. Coordination is required with the adjacent Everett Community College prior to the development of any structure. Additional space may be required to accommodate a designated pull-off road and queuing area to access the entry/exit tollbooths to be

constructed. Premier Lot 1 will be expanded north to maximize the number of spaces within the new terminal loop road configuration.

Additionally, the Master Plan recommended that the existing Ride Share Lot and Economy Lot 3 be reserved for valet, shuttles, and Ride Share companies in the future. The terminal adjacent Ride Share Lot can continue to function as a “quick-n-ready” lot, as the Economy Lot 3 can serve as a staging and queuing lot.

Furthermore, the Master Plan recommended space be reserved in the undeveloped 18-acre airport property (near Airport Road) to accommodate a cell phone lot. The location provides a quick access point into the terminal loop without putting additional stress on the internal roads.

5.4.6 Rental Car

As PAE continues to grow their commercial service and passenger traffic increases, it is recommended to reserve a space to accommodate rental car operations on airport property. The Master Plan recommended this space be reserved in the undeveloped 18-acre site near PAE’s main access point. The space should be large enough to store approximately 700 vehicles and supporting maintenance/storage facilities. The location would be served by shuttles, connecting passengers from the terminal building to the rental car lots.

5.4.7 Summary of Terminal Access and Landside Recommendations

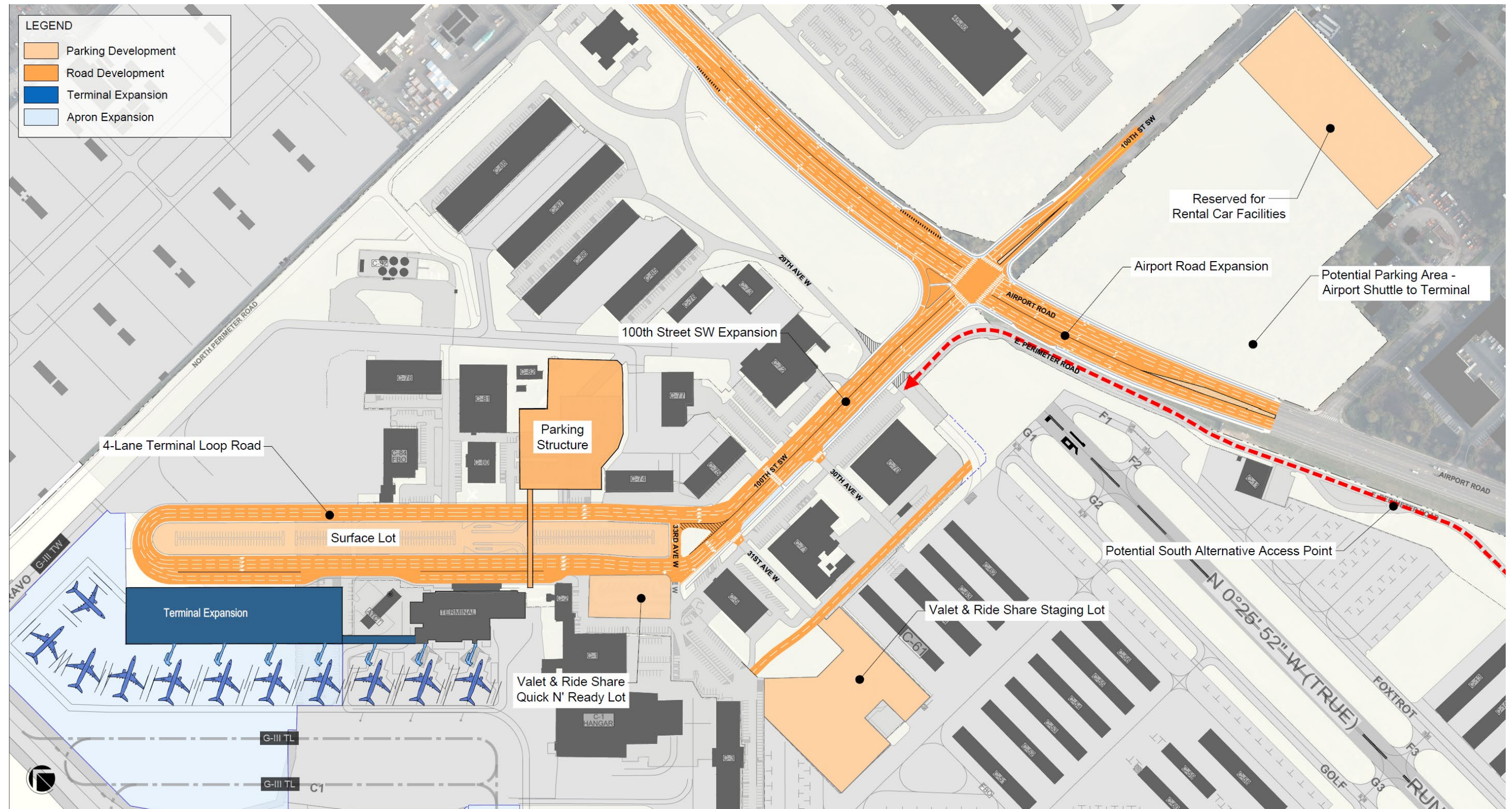
Based on the analysis in the preceding sections, the following landside improvements are recommended by this Master Plan to accommodate demand through PAL 3:

- Expand Signalized Intersection (Airport Road and 100th St SW Intersection)
- Expand Entrance Road (100 St SW)
- Expand Terminal Loop Road (100 St SW)
- Expand Terminal Curb Front
- Implement South Access Point for non-passenger traffic and Construct Back-of-House Road (to be determined)
- Construct Parking Structure
- Expand Premier Surface Lot
- Convert Economy Lot 4 into Staging Lot for Ride-Share/Valet
- Reserve/Construct Rental Car Facilities

These recommendations are shown on **Exhibit 5.4-11, Landside Recommendations**.

Please see **Chapter 6, Development Plan** for a phasing and financial responsibilities for the Master Plan projects.

Exhibit 5.4-11 **Landside Recommendations**



Source: Landrum & Brown

5.4.7.1 *Considerations to Extend Landside Beyond Planning Period*

The Master Plan focuses on providing a sufficient landside system to support the anticipated capacity demands of the planning period. Additionally, this section will provide additional alternatives to consider beyond the 20-year planning period. The main access point will experience delays as demands exceeds the anticipated 4.3 MAP, forcing alternative solutions to alter PAEs “front-door” to accommodate a future PAE. Possible solutions may include the following:

Providing a Second Access Point to the Terminal Area

A second access point from Airport Road would serve PAE beyond the 20-year planning period. This configuration would create a loop system, serving inbound traffic (via an access north of 100th St SE) and outbound traffic located along the 100th St SE alignment (existing access) will help facilitate the flow of traffic through the parking garage and through the terminal curb area. A loop system will circulate around the proposed parking garage that is proposed to be located northeast of the current terminal surface parking lot and will allow for inbound and outbound traffic to enter and exit the garage in different locations. A loop system allows vehicles utilizing the garage to divert before the terminal curb area and join the outbound lanes after the terminal curb area. This will support the reduction in the number of lanes needed along the curb area. Additionally, provisions can be made for vehicles returning to the terminal while remaining on the terminal property via an internal roadway connection.

A second access point should be coordinated with Boeing and the adjacent tenants. This solution would require additional land north of the existing terminal area. A new access configuration would completely reorganize the area.

Off-Site Passenger Access Nodes

This alternatives solution would remove demand on the roadways by providing off-site areas for passengers to park and connect to the terminal facility via bus, trolley, or other mass-transit type modes. This off-site access nodes would be located near mass-transits or off-site parking facilities, removing the need for their respective vehicles to clog the terminal loop system.

Promote Mass Transit and Light Rail Alternatives

The Sound Transit Everett Link Extension will give airport employees, tenants, and commercial service passengers another mass transit option of getting to and from the airport as well as the SW Everett Industrial Center. The arrival of the Everett Link will likely occur outside of the master planning window, but it could have a positive impact in decreasing traffic congestion. Any development being considered should have adequate sidewalks and curb fronts to accommodate Sound Transit and other forms of mass transit ridership.

5.5 Support Facility Alternatives

Support facilities serve specific roles at PAE, many of which have specific location requirements based on their respective functions, proximity to one another and whether they need to be located airside or landside located. The following sections present the support facilities alternatives developed for PAE. **Exhibit 5.5-1, Existing Support Facilities**, provides a summary of the locations of the support facilities analyzed in this Chapter. Section 4.7, Support Facilities, presented the results of the facility requirements analysis for the support facilities at PAE and is the basis for the development of alternatives for each of the support facilities. Alternatives for the Support Facilities and set asides for land areas include the following:

- Air Cargo
- Aircraft Deicing
- Aircraft Fuel
- Aircraft Maintenance, Repair Overhaul (MRO)
- Aircraft Rescue and Firefighting (ARFF)
- Airport Support
 - Airport Maintenance and Airport Administration
- Flight Catering
- General Aviation (GA)
- Ground Service Equipment (GSE)
- Police/Security
- Urban Air Mobility

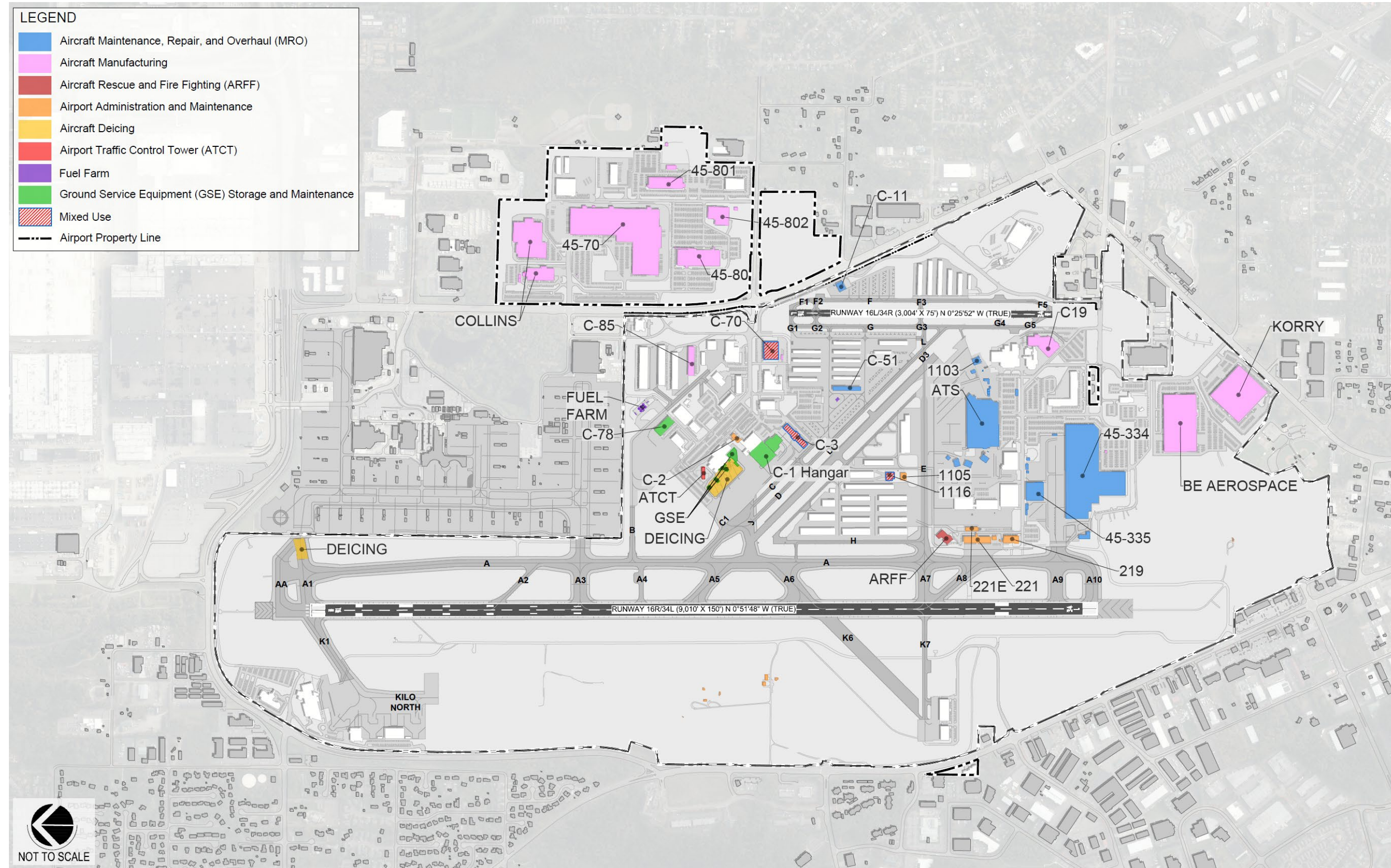
The following sections present the alternatives to provide the additional capacity needed to meet future aviation support facility demand. The development of alternatives for support facilities takes into consideration the necessary land areas, and the general configuration and layouts for future commercial development. The recommended alternatives described in this chapter will inform the updated Airport Land Use Plan and Airport Layout Plan (ALP).

5.5.1 Approach

The following criteria were used in evaluating the support facility alternatives. The criteria were developed in conjunction with the County and include the following

- Meets Demand – ensures that the facilities can accommodate future forecast traffic demand
- Expansion Flexibility – addresses the ability of the alternatives to expand in different ways without adversely affecting the existing facilities or their operations
- Airfield Circulation – ensures that the existing and future airfield taxiing operations near the support facilities remain efficient and do not affect capacity or create bottlenecks
- Disruption to Existing Infrastructure – minimizes interruption to existing infrastructure and airport operations during the construction of the passenger terminal
- Accessibility - Due to the variety of support facilities at PAE, efficient access to landside, and airside is required
- Environmental Issues – minimizes any known environmental issues
- Capital Cost (to County) – minimizes potential costs to the County

Exhibit 5.5-1 Existing Support Facilities



Source: Landrum & Brown

Alternative 1 – Retain Deicing Operations at Terminal Gates

Alternative 1 proposes that each of the seven terminal contact gates contain deicing pads. This alternative is convenient for passenger aircraft as each aircraft will deice at its dedicated gate. Deicing operations may therefore occur more quickly than if the aircraft deice at a dedicated deicing facility. Deicing at the contact gate, however, has the potential to contribute to delays and congestion at the gate if another aircraft is waiting to enter a contact gate where deicing is occurring. It also will require additional infrastructure and deicing equipment as deicing would need to occur at all seven contact gates.

Alternative 2 - Centralized Deicing Facility

Alternative 2 proposes a dedicated and centralized deicing facility near the passenger terminal building. The location of the proposed centralized deicing pad is surrounded by taxiways that allow aircraft to freely flow in and out as needed with the necessity to be tugged to a deicing position. It is proposed that a facility with 4 deicing pads be constructed by PAL 2. This alternative could be used in conjunction with Alternative 1, as there are already 2 contact gates where aircraft are currently deiced.

The centralized deicing pads also offer during non-winter weather the opportunity to park remote aircraft.

Recommendation

Deicing for passenger airlines at the terminal gate will require each gate to be equipped with de-icing capability and increase vehicle traffic on-ramp. Delays at the gate may occur independently from deicing operations locking the parking position for an uncertain period; due to the lack of flexibility and delays that may occur at the gate, therefore Alternative 1 is not recommended.

Alternative 2 proposes a centralized deicing pad location. A centralized deicing facility would alleviate delays and inefficiencies associated with deicing on-gate, create remote aircraft positions if necessary, and also consolidate and localize deicing contaminants. The proposed configuration is flexible, will minimize operational issues by allowing aircraft to enter and exit the deicing facility more quickly. This option would alleviate the congestion at deicing on-gate and on the east side of Taxiway A where aircraft line up in single file.

It is recommended that non-commercial deicing operations continue to occur on the east side of Taxiway A1 near the Runway 16R end. The position can accommodate aircraft up to a Boeing 737-500 and is used by GA and corporate aircraft.

Existing deicing fluid collection at the passenger terminal area and Taxiway A is collected and uses the Boeing Campus sewer conveyance system, where it is treated and sent to the City of Everett. It is assumed that the existing system connecting with Boeing will continue to be utilized. As deicing operations increase, the capacity of the existing system should be further evaluated to identify capacity deficiencies. Coordination with Boeing and the City of Everett is also required.

5.5.4 Aircraft Fuel

5.5.4.1 Commercial Air Service Jet-A Fuel

The fuel farm facility at PAE is located in the West of Hangar C-88 with direct access to the airside area and landside access through 29th Ave W. The facility currently sizes 13,400 square feet and provides an existing capacity of 360,000 gallons of Jet-A fuel with six aboveground tanks, which hold 60,000 gallons each. Propeller Aero Services (PAS) currently maintain a two-day supply, which is less than the industry standard for aviation fuel supply resulting in just 49,000 gallons. It is recommended that a commercial fuel provider should maintain a total capacity for three days' supply of aviation fuel resulting in 147,000 gallons. In this manner, PAE is assured that fuel is available during peak demand in the event of a disruption in the fuel delivery system.

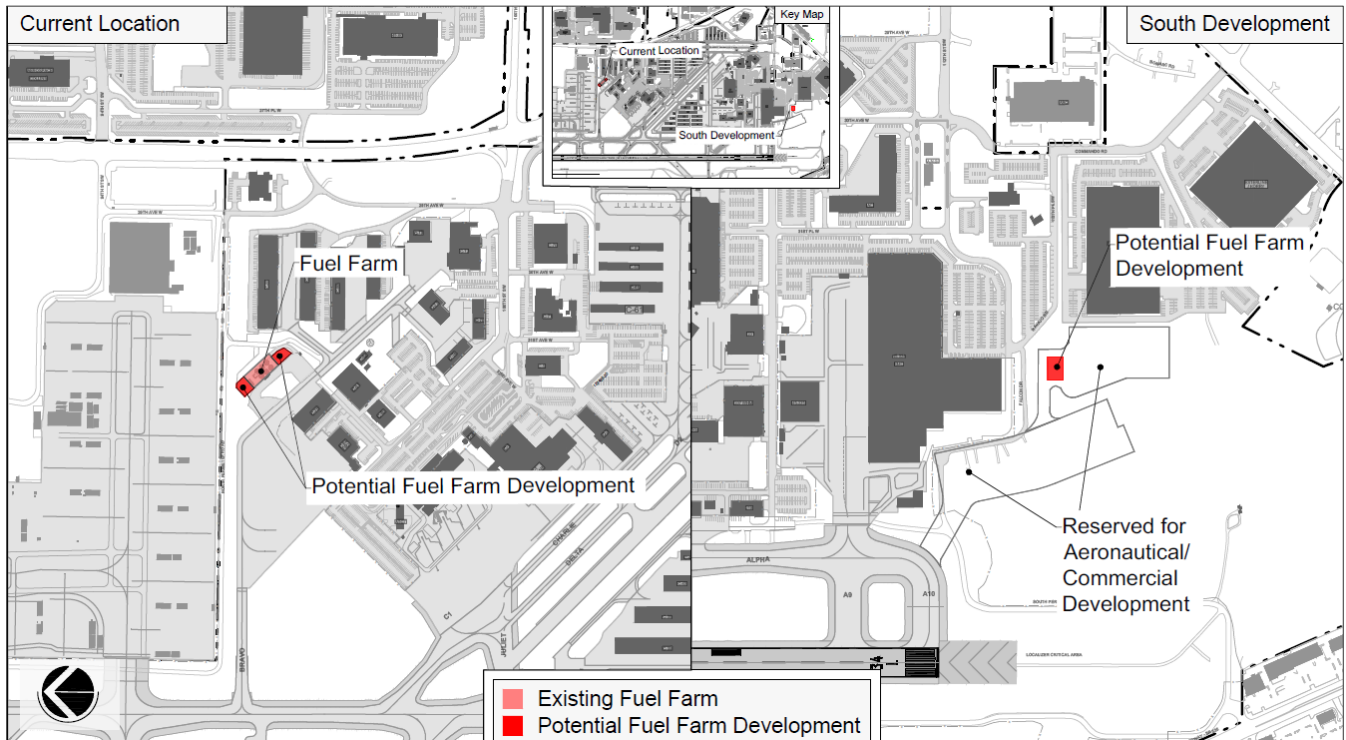
The existing facility meets the PAE demand of offering a 2-day fuel supply. The facility requirements analysis identified a projected daily commercial aircraft demand of 155,000 gallons of fuel storage in PAL 3 and 310,000 gallons for a two-day supply in PAL 3 respectively. It is anticipated that the existing fuel farm facility will be sufficient and will provide enough supply for a two-day fuel storage need. While no additional fuel tanks are projected to be required at the existing fuel farm, there is a land preservation plan that offers sufficient area for a fuel depot as a support if needed, no further development alternatives have been considered.

Exhibit 5.5-4, Fuel Farm Expansion, presents alternative expansion areas for one additional fuel depot area of approximately 9,400 square feet. The first alternative would be expand the fuel farm in its current location and maximize the site. An additional area is may be located on the southern side of the airfield, south of Building 45-334 - Everett Modification Center (EMC) and on the west of Rockwell Collins facilities. This site is connected to the corporate aviation development south of Taxiway A and the Runway 34L threshold with adequate airside and landside access. This future fuel facility may also accommodate hydrogen fuel.

Recommendation

The Master Plan recommends reserving area at the fuel farm existing site to handle any additional fuel needs. It is not anticipated to be needed during the planning period, however space north and south of the current fenced in area will be reserved to allow for expansion as needed.

Exhibit 5.5-4 Fuel Farm Expansion



Source: Landrum & Brown

5.5.4.2 General Aviation 100LL Fuel

The GA community is served by a 20,000-gallon aboveground tank located adjacent the main commercial fuel farm and a 3,000-gallon aboveground tank of 100LL located in the central ramp area west of hangar C-51 that is used as a self-service fueling area. This totals 23,000 gallons of 100LL aircraft fuel at PAE.

The facility requirements analysis identified a projected daily aircraft demand of 9,100 gallons of fuel storage in PAL 3 and 20,000 gallons to maintain a two-day supply in PAL 3 respectively. It is anticipated that the existing fuel farm facility and the self-service fueling station will be sufficient and will provide enough supply for a two-day fuel storage need. Similarly, to commercial Jet-A fuel, while no additional fuel tanks are projected to be required at the existing fuel farm and at the self-service fueling area throughout the planning period, the future fuel farm depot planned in the airport support and corporate aviation development area reserves space for extra fuel storage.

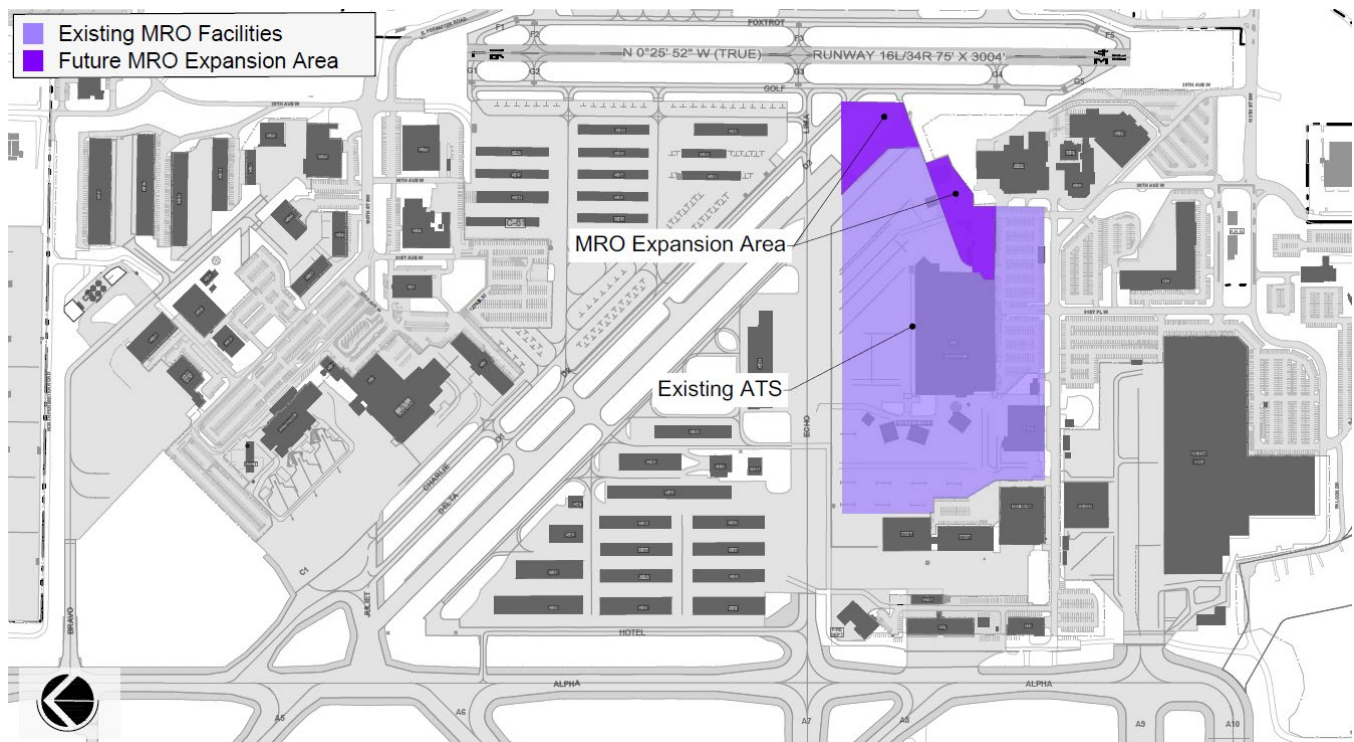
5.5.5 Aircraft Maintenance, Repair and Overhaul (MRO)

The major MRO tenant at PAE is Aviation Technical Services Incorporated (ATS), located on the south ramp. ATS performs airframe services for all major airlines; primary clients include Southwest Airlines, Delta, and Alaska Airlines. The entire ATS site is approximately 1.2 million square feet with several facilities, highlighted by the 325,000 square foot hangar.

As indicated by ATS, the current sizing of hangar facilities, warehouse, storage, fleet mix, and landside facility needs will be adequate over the planning period.

Additionally, ATS indicated that while the current apron is adequate, additional area would improve its airside operations. Preserving currently unused land east of the existing site is recommended as it is the most logical area to expand the apron without adversely affecting other airport operations. **Exhibit 5.5-5, MRO Expansion Area**, shows the limits of expansion of the ATS ramp.

Exhibit 5.5-5 MRO Expansion Area



Source: Landrum & Brown

5.5.6 Aircraft Rescue and Firefighting (ARFF)

The current ARFF Station at PAE is located adjacent to Taxiway Alpha, South of Taxilane Echo, North of 221 Building, and West of the Flying Heritage and Combat Armor Museum. This facility has full access to the airside, and controlled direct landside access is provided through 36th PL W and 109 St SW.

The current ARFF facility is located within an optimum location to meet FAA response times of three minutes. This time was found to be aligned to the guidelines and is determined as adequate from the time of the alarm to the time within at least one required aircraft rescue, and firefighting vehicle reach the midpoint of the farthest runway serving air carrier aircraft from its assigned post or reach any other specified point of comparable distance on the movement area that is available to air carriers. The facility is situated in an ideal spot, and no further development alternatives have been considered.

Based on the number of commercial aircraft operations and commercial aircraft type, the requirements show an existing ARFF Index B facility at PAE. PAE currently meets the FAA Part 139 requirements of Index C with the two extinguishing ARFF vehicles. The Index determines the type of aircraft rescue and firefighting equipment and quantity of fire-extinguishing agents needed for a required level of protection at PAE. The analysis shows that Index B is sufficient by PAL 1. The transition of Embraer aircraft 175 (E-175) to Boeing 737-900 and the increase in aircraft operations will determine an ARFF Index C facility by PAL 2 and PAL3, and such facility should be equipped with a minimum of two extinguishing ARFF vehicles.

The existing ARFF facility has a site footprint of approximately 58,700 square feet. The County has planned to expand the existing structure to improve the custom service to the airport and its tenants. The 3,400 square foot expansion (pending design) includes four additional sleeping rooms, an additional bath/shower room, an additional vehicle bay and possibly an additional conference room and support area. The expansion does not go outside of the current site limits of the ARFF. Design is planned for 2024, with construction planned for 2025.

5.5.7 Airport Support

Airport support facilities provide space for airport administration and airport maintenance. Airport administration includes office space while airport maintenance encompasses equipment storage, equipment maintenance space, deicing equipment, and other similar uses dedicated to keeping PAE in efficient operating condition.

There are currently seven total airport support facilities at PAE and are composed as follows:

- Airport Administration (2 facilities): C-2 and C-3 buildings
- Airport Maintenance (5 facilities): C-3, 221, 221E, 2019 and 1105 buildings for a total of 27,000 square feet

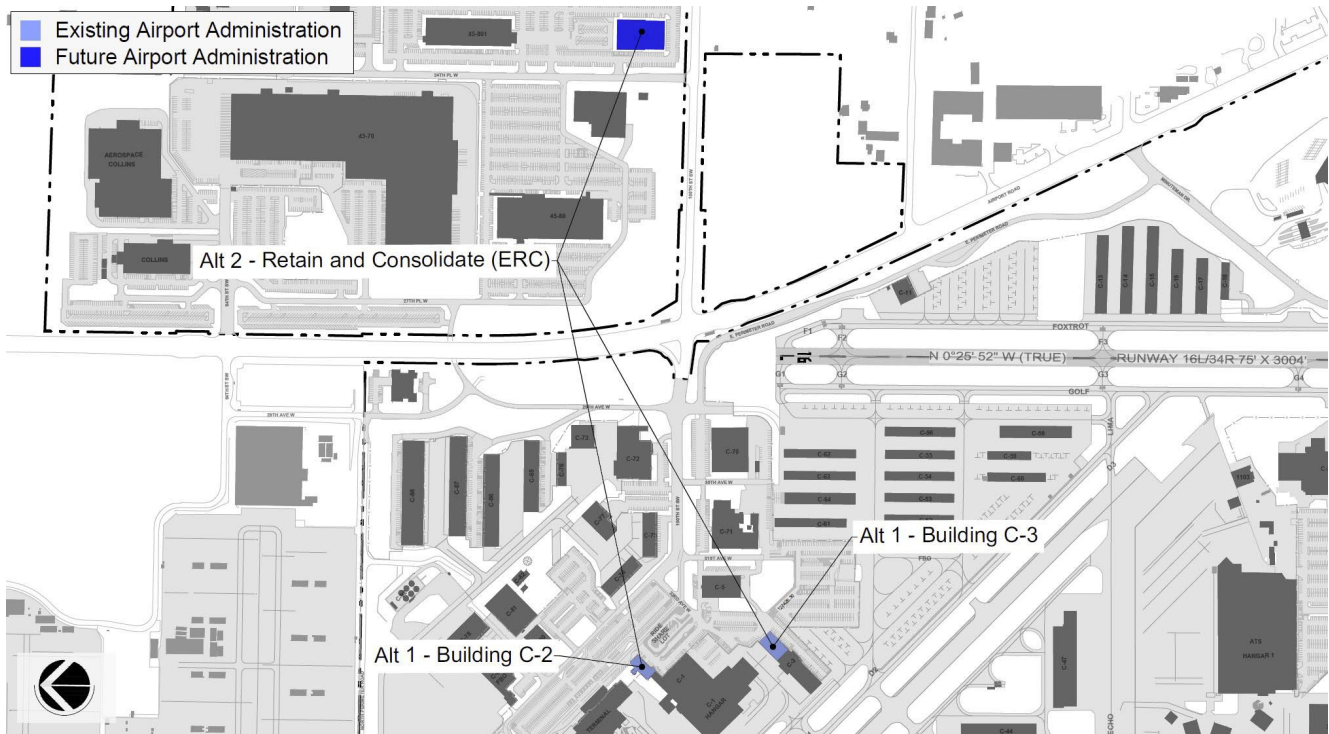
For efficient operation of airport maintenance facilities should be relocated and consolidated in two single campuses: one campus for airport administration and one for airport maintenance. Only those offices and equipment that need to be near the terminal building and on-airside directly will remain in their current location.

The current airport support facilities at PAE are located mainly near the passenger terminal building and in the south of the airfield. The alternative analysis in this section discusses multiple alternatives for each support facility for its future expansion or relocation and considers the desire to consolidate airport administration and maintenance in two on-airport single campuses. It is recommended that airport support facilities be consolidated in an area that provides landside and airside access.

5.5.7.1 Airport Administration

The current airport administration offices are located in C-2 and C-3 buildings. Administration functions in the C-2 building location occupy 6,390 square feet while offices in the C-3 building occupy 8,150 square feet. These facilities total a building area of approximately 14,540 square feet. **Exhibit 5.5-6, Airport Administrative Alternatives**, presents two airport administration alternatives and each is discussed further in this section.

Exhibit 5.5-6 Airport Administration Alternatives



Source: Landrum & Brown

Alternative 1 – Remain in Existing Location

Alternative 1 would allow airport administration facilities to remain in their two current locations. However, if administration offices remain in their locations, the combined areas in both buildings will be deficient by the end of the planning period. The deficit could be covered by expanding the shortfall into the vacant Employment Resource Center (ERC) building located in the Bomarc Business Park. This however, means that Airport Administration will be divided across three facilities – C-2, C-3 and the ERC which is not efficient.

Alternative 2 – Retain and Consolidate at Employment Resource Center (ERC)

Alternative 2 would consolidate the airport administration offices and services that do not require proximity to the airfield or direct airside access into the ERC building. The total area of one level of the two-level building is 27,700 square feet. This area will adequately accommodate the square footage needed throughout the planning period. Some small portion of either C-2 or C-3 would be needed for direct airside access.

Recommendation

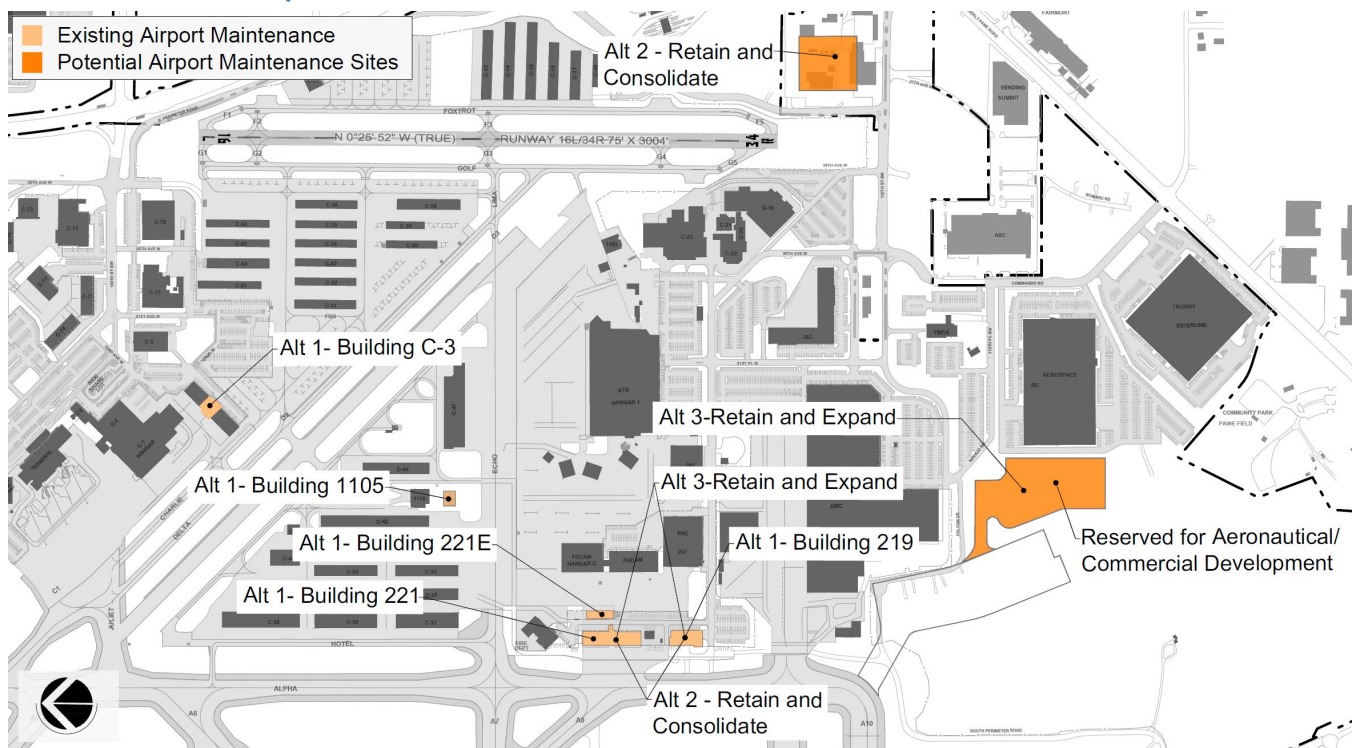
Alternative 2 is recommend as the preferred airport administration location as it frees up C-2 and C-3 for future uses while also consolidating administrative functions in the ERC building. PAE is in the process of proceeding with this option.

5.5.7.2 Airport Maintenance

Airport Maintenance facilities area allocated in C-3, 221, 221E, 2019 and 1105 buildings, mainly on the east side of Runway 16R-34L. By PAL 3 an additional 13,000 square feet is required. Additionally, landside vehicle parking will be required to support future expansion of these facilities.

The current airport support facilities at PAE are spread out across the airfield and generally the facilities are undersized. It is recommended that airport maintenance facilities are located in a consolidated area that provide landside and airside access. Two airport maintenance alternative sites were identified. The alternatives that are considered for airport maintenance facility development are discussed in this section and presented in **Exhibit 5.5-7, Airport Maintenance Alternative Sites**.

Exhibit 5.5-7 Airport Maintenance Alternative Sites



Source: Landrum & Brown

Alternative 1 – Maximize Existing Locations

Airport Maintenance Alternative 1 maintains the existing facilities; buildings C-3, 219, 221, 221E, and 1105. The existing sites are limited in their potential to accommodate additional expansion in the future. Additionally, the existing buildings are not easily expanded either given the age and condition of some of the facilities. This alternative is therefore does not lend itself well to support future growth.

Alternative 2 – Retain and Consolidated Campus

Airport Maintenance Alternative 2 includes maintaining buildings 219 and 221 and consolidating the remaining facilities to a site that is in an off-airport location owned by the National Air Guard (Southeast

of 34R Runway) in a site area of approximately 84,400 square feet and encompassed several vacant buildings that total up to 45,750 square feet. This site has the capability of consolidating the remaining airport maintenance facilities into a single location. The site would also benefit from landside access however, it does not provide adequate airside access nor proximity to some airside services.

Retaining buildings 219 and 221 in their existing location to provide airside access to facilities and services would enable future expansion potential.

Alternative 3 – Retain and Expand

Alternative 3 maintains buildings 219 and 221 as well as developing a new future development area totaling 135,000 square feet (with a potential to expand an additional 65,000 square feet to 200,000 square feet) to the southeast of Runway 34L and the South portion of Taxiway Alpha that is connected to the corporate aviation development. This alternative offers direct landside and airside access and is connected through the existing taxiway system. The area is reserved for Aeronautical/Commercial development. It offers significant expansion capability and is airside with direct landside access. **Exhibit 5.5-8, Airport Support Development - South of EMC**, presents the proposed location.

Exhibit 5.5-8 Airport Support Development – South of EMC



Source: Snohomish County Airport, 2021

Recommendation

Due to the landside access issues, lack of flexibility to expand the existing buildings, Alternative 1 is not recommended. Alternatives 2 and 3 offer sufficient space to meet the airport maintenance requirements and provide airfield and landside access. Alternative 2 is dependent on acquiring the National Guard site and availability of the site is currently being negotiated. Alternative 2 is recommended if the County acquires the Air National Guard site within the next 2 to 3 years and the costs to relocate to this site are less than Alternatives 3. Additionally, further analysis of the potential environmental issues should be undertaken, associated with; the vegetation and tree removal near the freshwater pond and wetlands; the proximity (approximately 500 feet north) to Paine Field Community Park and; the increase in impervious surface and stormwater management.

5.5.8 Flight Catering

There are limited flight catering operations at PAE. The current flight catering operation occurs through a service vehicle with prepackaged meals loaded directly onto the aircraft. As commercial service grows at PAE, it is recommended that provision be made for a traditional on-airport catering facility. PAE should provide space to prepare in-flight food and beverage items for departing passengers. The facility initially might be 2,900 square feet of building area and eventually need to grow to 9,100 square feet of building space by the end of the planning period. Since this function will be performed through a third-party operator, it is recommended that the facility should be located close to the terminal building with direct access to both airside and landside areas. Moreover, vehicle parking should be developed to support the new facility.

Exhibit 5.5-9, *Flight Catering Sites*, illustrates on-airport sites that have been identified as potential developments for the location of a flight catering facility and each of them are described further in this section.

Exhibit 5.5-9 Flight Catering Sites



Source: Landrum & Brown

Alternative 1 – New Facility

Alternative 1 is a brand-new flight catering land area located on a site of 35,200 square feet. This site is located in an existing unoccupied parcel and is relatively close to the terminal building with easy direct landside access and easy connectivity to the airside access. The site offers future expansion potential for potential growth beyond the planning period and does not adversely affect the expansion of any other facility nearby. A new facility in this location must coordinate with future landside improvements.

Alternative 2 – Vacant Building C-2

Alternative 2 includes the existing vacant portion of Building C-2. This building has a footprint of 28,500 square feet which is more than sufficient for PAL 3 and beyond. The facility is located close to the terminal building and does not affect further development of any other support facility or future expansion of the terminal building. The site offers landside and airside access. As the facility is occupied by other tenants, it would require some renovation to accommodate flight catering operations.

Alternative 3 – Redevelop Building C-3

Alternative 3 includes the redevelopment of the C-3 building. A portion of this building, approximately 12,700 square feet will become available soon which will be sufficient to meet requirements up to PAL 2. Expansion beyond this point is constrained by other facilities. Although the location provides airside and landside access and is in close proximity to the terminal building, its interior redevelopment is constrained and would require significant redevelopment.

Recommendation

Depending on the function of the actual facility being developed, different area configurations and proximity to other facilities or parts of the airfield may exist. It is recommended that either Alternative 1 or 2 be reserved as flight catering sites.

5.5.9 General Aviation (GA)

General aviation at PAE is scattered in various locations. By the end of the planning period (2040) it is estimated that a total land area of approximately additional 400,000 square feet of land is needed to accommodate based aircraft demand. As presented in the prior chapter, the hangar and land areas required are broken down as follows:

- 215,000 square feet of T-Hangar Land (97,700 square feet of hangar)
- 110,000 square feet of Box Hangar Land (34,900 square feet of hangar)
- 75,000 square feet of Tie-Down Area (21 aircraft parking spots)

In discussions with the County, key considerations for the future development of GA are as follows.

- Continued “Opportunity Based” development
- Prioritize east runway development (Runway 16L-34R) for GA users primarily

There are a number of potential sites where GA can grow. Expansion of the existing sites GA includes the following.

- **Central Ramp** - Involves an extension of approximately 13,000 square feet in a single lane of hangars located East of building C-62 and North of building C-56. This site is within a ramp that offers direct landside and airside connectivity to the taxiway system.
- **East Ramp** – Involves an extension of about 36,350 square feet with the ability to accommodate up to two rows of aircraft hangars.
- **South Ramp** – Incorporates a portion of the South Ramp that was never utilized as GA area. This site extension offers about 61,025 square feet and can accommodate approximately 14 tie-down aircraft spots and a taxilane for its connectivity to the taxiway system; however, this ramp would require landside access in its south portion. This location however would require significant building demolition and site remediation and would therefore require a detailed business case analysis to justify the development of this site for GA.
- **West Ramp** – Maximizes the capacity of existing buildings and areas. Building C-43 expands to the south by approximately 17,500 square feet and C-47 expands to the west by approximately 30,000 square feet. The additional sections of both buildings total 47,5000 square feet. The expansion of C-43 and C-47 hangars requires the relocation of buildings 1105 and 1116; the buildings are part of the airport support facilities and will be consolidated in a new airport support development. In addition, a tie-down ramp for 23 spots expands East of C-44 building and North of C-47 building. The existing and future expansion of this area creates issues related to automobile access to an active airfield and crossing Taxilane Echo.

Exhibit 5.5-10, *General Aviation Expansion Sites*, shows sites that have been identified as potential locations for GA to grow.

Exhibit 5.5-10 General Aviation Expansion Sites



Source: Landrum & Brown

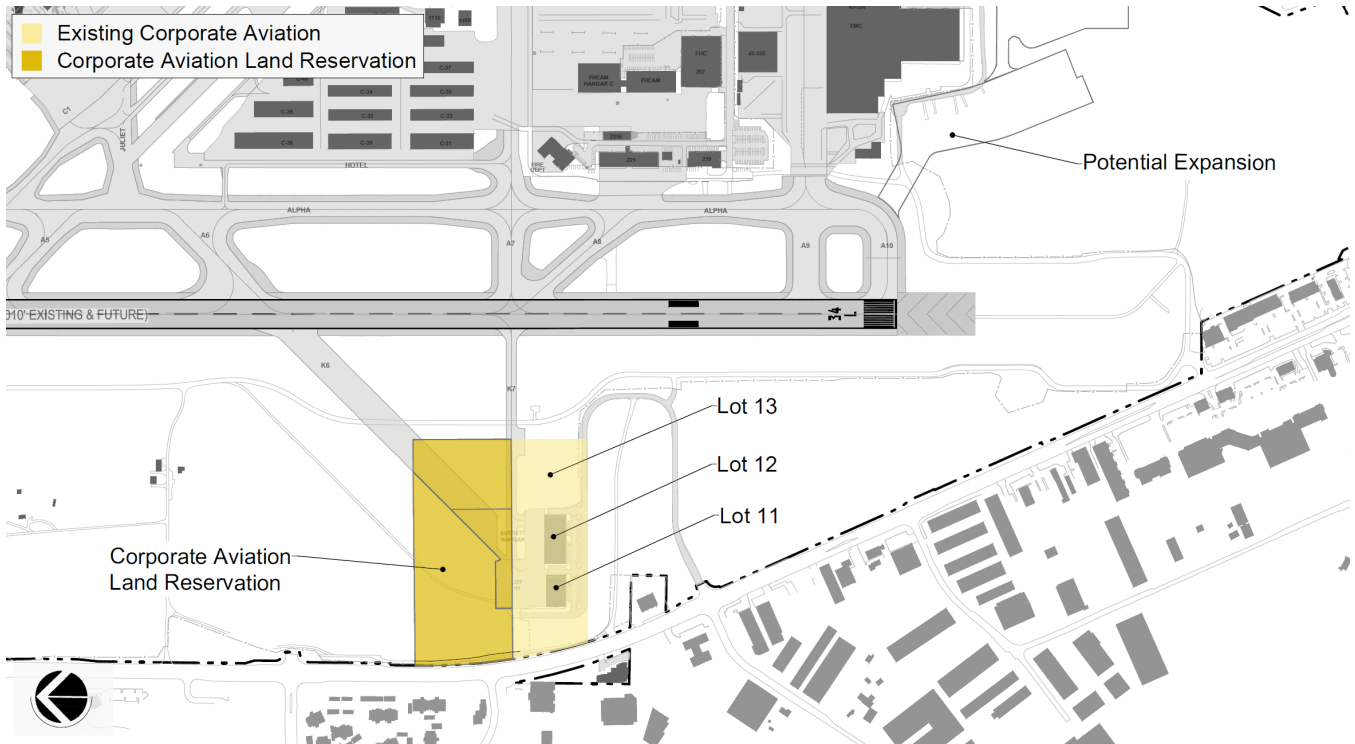
Exhibit 5.5-11, *FBO and Corporate Aviation Expansion Site*, presents the corporate aviation development plan and sites identified as potential locations for corporate aviation growth.

Plans have been developed by the County to provide corporate aviation expansion in the near future by developing an additional 7.4 acres to the southeast of Runway 34L, in the South portion of Taxiway Alpha. This proposed expansion is adjacent to a freshwater pond and wetland areas and could trigger the need for permitting depending on site design. There is also a mapped steep slope near the proposed entrance.

The FBO and corporate aviation lots at the southwest side of Runway 34L are located in Lots 11, 12, and 13. In addition to this area, and with the idea of providing continuity to these Lots, an area of 280,000 square feet is also reserved. It is possible that this area may encounter contaminated soils near the forested area and mapped steep slope between site and Mukilteo Speedway. Further investigation will be required during the project stage.

Both plans offer direct landside and airside access and are connected through the existing taxiway system.

Exhibit 5.5-11 FBO and Corporate Aviation Expansion Sites



Source: Landrum & Brown

Recommendation

The GA site locations that are recommended for future land designations include the areas highlighted in green in **Exhibit 5.5-10, General Aviation Expansion Sites**. They all offer logical and organic growth to the existing GA facilities and areas. Development of these sites will be contingent on a detailed business case and consideration of the associated capital costs to develop these sites. Additionally, the proposed future corporate aviation areas recommended are highlighted in **Exhibit 5.5-11, FBO and Corporate Aviation Expansion Sites**.

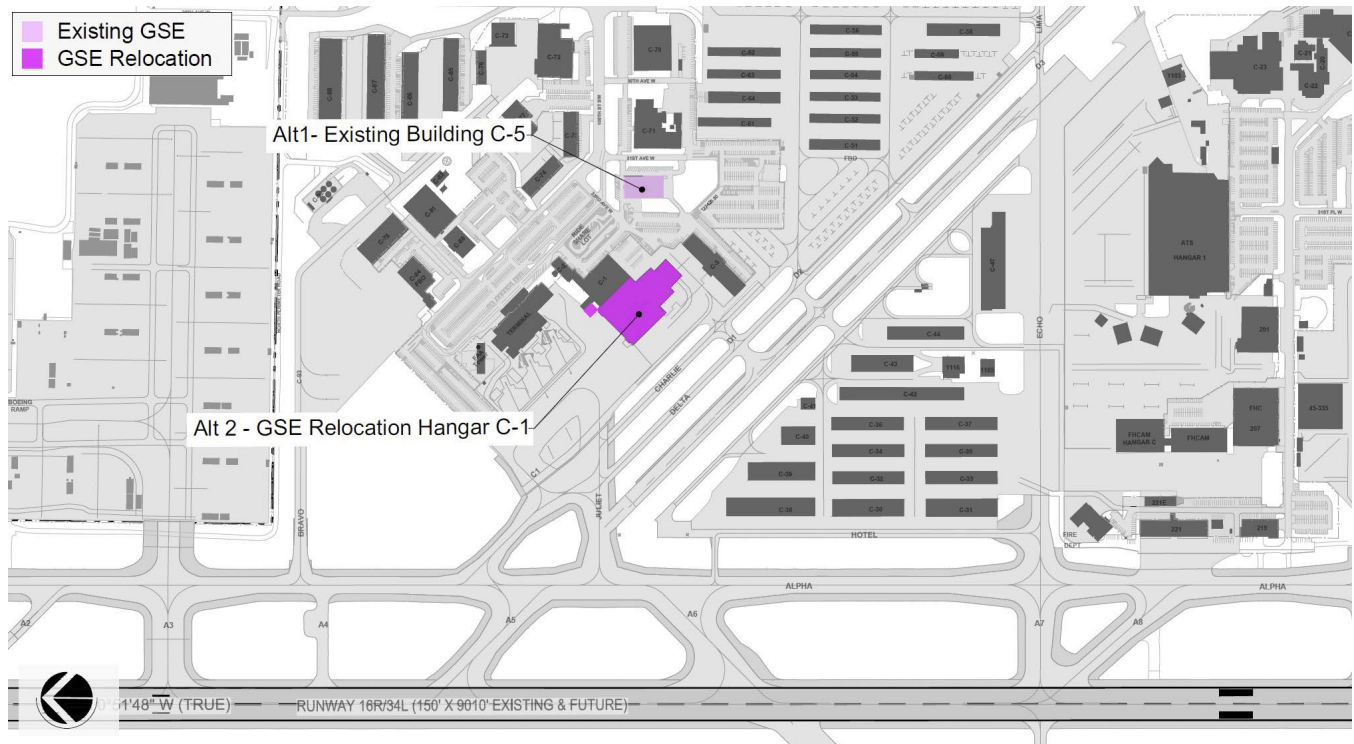
5.5.10 Ground Service Equipment (GSE)

GSE storage and maintenance are located near the Passenger Terminal area with direct airside access. Additional GSE will also need to be located close to the Passenger Terminal area. Ground handlers require a total of 5,380 square-feet of GSE Maintenance facility for office space, mechanical shops, and staging within a site size of 12,912 square feet by the end of the planning period.

Exhibit 5.5-12, GSE Storage and Maintenance Sites, shows on-airport sites that have been identified as potential locations for GSE Storage and Maintenance and each of them are described further in this section.

The current tenants (Alaska) have expressed interest to relocate to the vacant portion of the C-1 hangar. Zero Avia, the hydrogen-electric aircraft developer, have a lease for Building C-5.

Exhibit 5.5-12 GSE Storage and Maintenance Sites



Source: Landrum & Brown

Alternative 1 – Existing Building C-5

Alternative 1 proposes to retain GSE handlers at their existing building. The building includes 17,549 square feet for this purpose. Although the site has optimum landside access, it is constrained and expanding beyond the planning horizon will be difficult. Direct airside access is essential for GSE operations between the apron and the maintenance facility.

Alternative 2 – GSE Relocation to Hangar C-1

The C-1 hangar has a footprint of approximately 71,570 square feet. This facility is sufficient through PAL 3 and offers room for expansion if necessary and for future growth beyond the planning period. The facility provides landside access and direct airside access. This site will facilitate the movement of special equipment out of the airside for maintenance since some of this equipment is not authorized to circulate on public roads and as part of direct airside access will also reduce the movement of personnel and equipment between landside and airside.

Recommendation

Due to the airside access issues and lack of adjacency to the apron, Alternative 1 is not recommended. Alternative 2 is recommended as the designated GSE Storage and Maintenance facility location.

5.5.11 Security

Security is provided by the Sheriff and Operations organizations at PAE. Facilities consist of the Sheriff’s and Operations’ offices located in Building C-3 as part of the airport administration.

It is recommended that a portion of Bldg. C-3 remain for Police and Operations for airside access purposes.

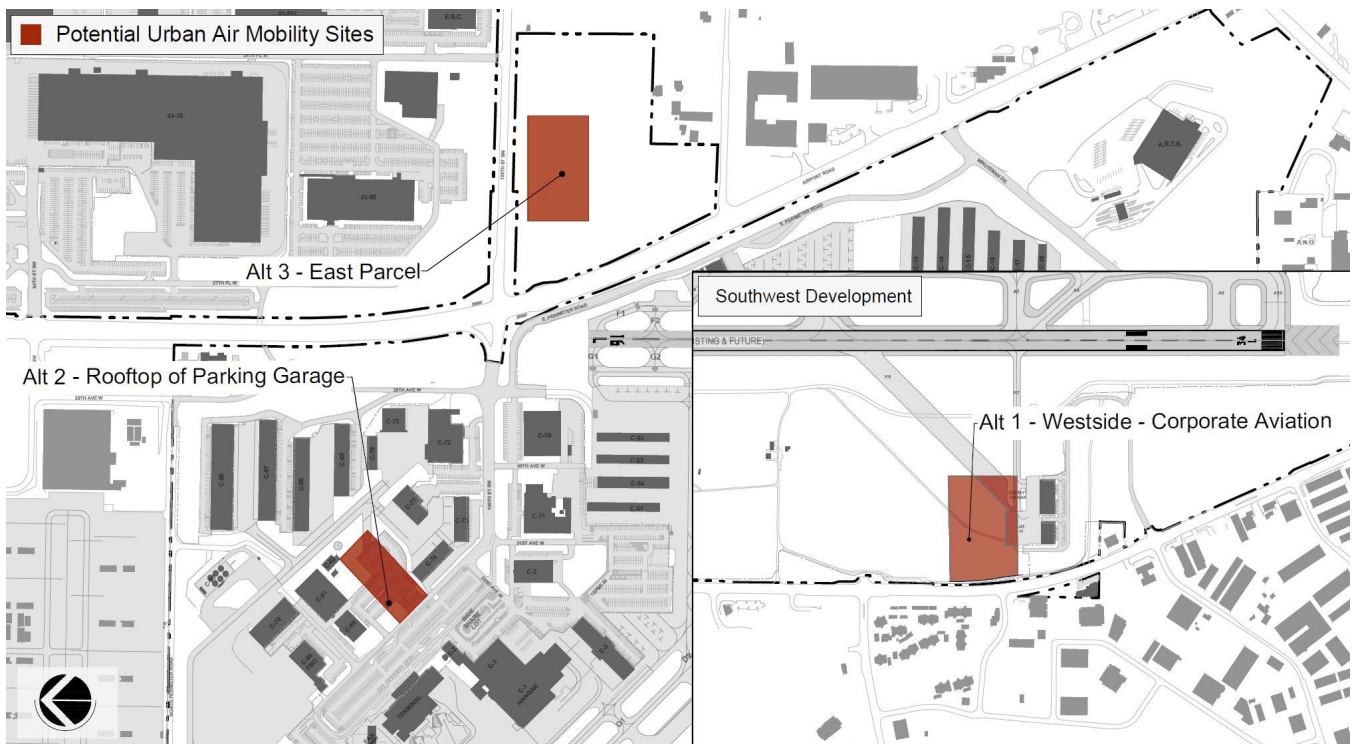
5.5.12 Urban Air Mobility (UAM)

UAM refers to all aerial mobility options in dense urban areas, which includes traditional helicopters and anticipated electric-propulsion aircraft. Various UAM services are now within reach because some electric-propulsion aircraft manufacturers have agreed with the FAA on the certification requirements for commercial operations.

Due to the significant interest from investors, local governments, and manufacturers, several UAM operators have announced new service launching within the next three to four years, using electric Vertical Takeoff and Landing (eVTOL) aircraft. Furthermore, this Master Plan considers that is appropriate to be proactive and get PAE prepared for potential UAM operations, users, and tenants.

Exhibit 5.5-13, *Urban Air Mobility Sites*, shows on-airport sites that have been identified as potential developments for the location of urban mobility facilities and each of them are described further in this section.

Exhibit 5.5-13 Urban Air Mobility Sites



Source: Landrum & Brown

Alternative 1 – Corporate Aviation Site

UAM is one of the services that Corporate Aviation would offer and therefore, UAM could be potentially located in the same site as the jets for corporate aviation. This site would provide continuity to the Lot 11 development, with an area of 300,000 square feet. Although UAM services does not necessarily require direct airside access, this site is connected to the airside through Taxiway Kilo 7 and landside access through Lot 11 with its access in Bernie Webber Dr.

Alternative 2 – Rooftop or Parking Garage

Vertiports are expected to be a combination of upgraded existing heliports and purpose-built new facilities, Due to the flexibility of operation that an UAM service offers, Alternative 2 is located on the top of the future terminal parking structure, right across the passenger terminal building. This location offers passenger connectivity to the terminal and is located in a surface of approximately 71,600 square feet.

Alternative 3 – East Parcel

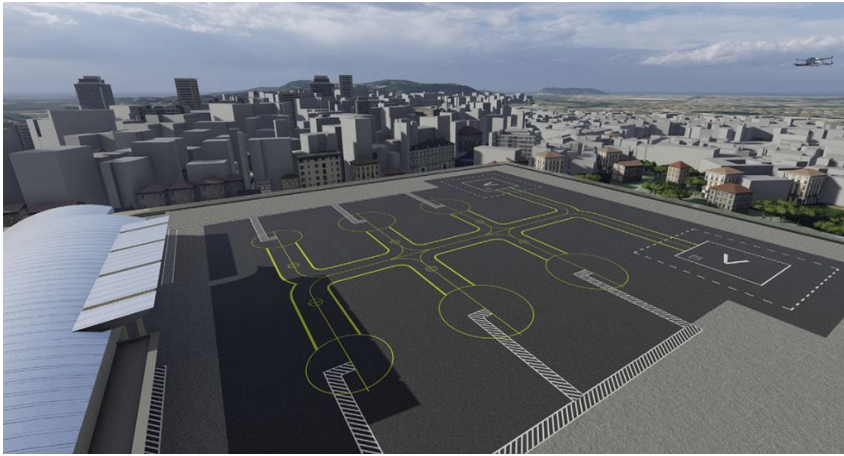
Similar to Alternative 2, Alternative 3 proposes its location on the top of the future terminal parking structure or on the ground. The site is located across the Airport Rd. This location offers passenger connectivity to the passenger terminal and the future regional light rail network planned by the City of Everett. The facility is in a surface area of approximately 132,680 square feet.

Recommendation

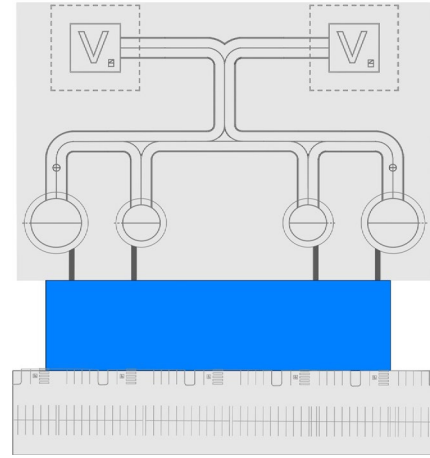
UAM service is a mode of transportation that offers connectivity to PAE's passengers. The new facility will offer an opportunity for emerging technology that requires landside connection. Because of proximity to terminal and easiness of passengers to be connected to the terminal building or to any other mode of transportation, it is recommended to that all three sites be set aside for aviation related commercial development activity. This will provide the County with the appropriate flexibility needed when UAM technology and its needs are further understood in the future.

As UAM services are not implemented in short-term, long-term timeline maintains site flexibility and ability to evolving UAM landscape and regulations. Before its implementation, it is important to conduct airspace survey to identify approach/departure routes to/from site and perform further studies to ensure sufficient space for aircraft movements. **Exhibit 5.5-14, Conceptual Urban Vertiport**, shows a conceptual image of a vertiport.

Exhibit 5.5-14 Conceptual Urban Vertiport



Source: Landrum & Brown



5.5.13 Summary of Support Facilities Recommendations

Table 5.5-1, Summary of Support Facility Recommendations, and **Exhibit 5.5-16, Summary of Support Facility Site Recommendations**, present the proposed development site locations and additional space requirements all of which meet or exceed the requirements identified in **Chapter 4, Facility Requirements**.

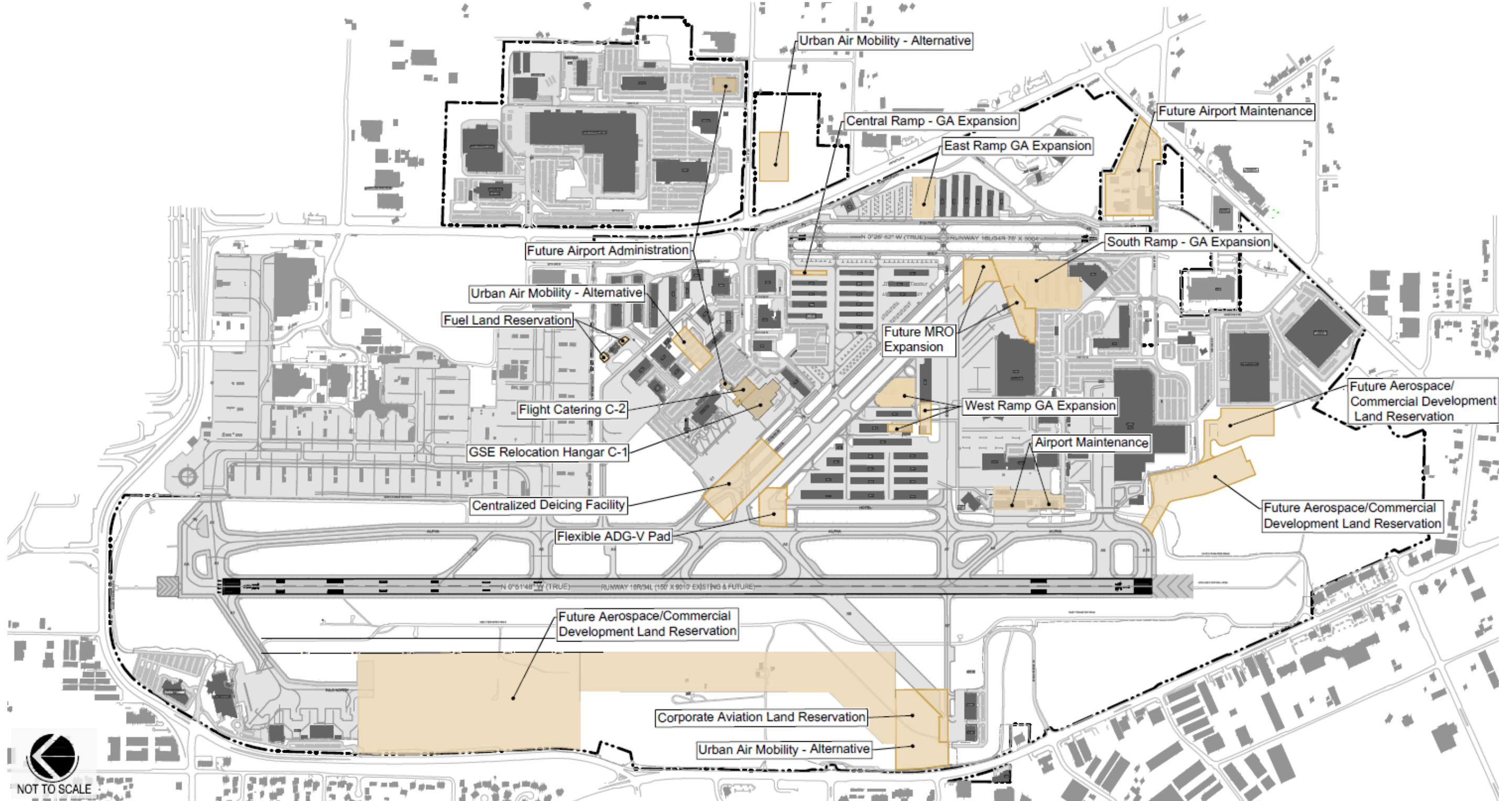
Table 5.5-1 Summary of Support Facility Recommendations

Facility	New or Additional Space Required – PAL 3	Proposed Development Sites
Air Cargo	N/A	Land South of Current Site
Aircraft Deicing	One Centralized Deicing Pad	4 Positions in Terminal Area
Aircraft Fuel	N/A	Existing Site
Aircraft Maintenance (MRO)	N/A	MRO Expansion Area
Aircraft Rescue and Firefighting (ARFF)	N/A	Existing Site
Airport Administration	26,558 ft ²	Employment Resource Center (ERC) and C-2 and C-3 Buildings
Airport Maintenance	84,286 ft ²	Buildings 219 and 221 and Air National Guard Site
Flight Catering	20,954 ft ²	Building C-2
General Aviation (GA)	400,000 ft ²	North, East, West, and South Ramps; and Buildings C-43 and C-47
Ground Support Equipment (GSE) Maintenance Area	12,912 ft ²	Hangar C-1
Urban Air Mobility (UAM)	Up to 132,680 ft ²	Alternative 1 – Westside of Corporate Aviation Alternative 2 – Rooftop of Parking Garage Alternative 3 – East Parcel

Note: Not all sites are needed to meet the forecast requirements, however PAE should reserve all sites to allow for flexibility in future development.

Source: Landrum & Brown

Exhibit 5.5-16 Recommended Support Facilities



Source: Landrum & Brown