Appendix D

Orange County/John Wayne Airport (JWA) General Aviation Improvement Program (GAIP) Based Aircraft Parking—Capacity Analysis and General Aviation Constrained Forecasts

Technical Memorandum

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Date: April 3, 2018 (Revised)

Subject: Orange County/John Wayne Airport (JWA) General Aviation Improvement Program (GAIP) Based Aircraft Parking—Capacity Analysis and General Aviation Constrained Forecasts

Synopsis

This Technical Memorandum evaluates the aircraft storage capacity of the existing general aviation (GA) facilities and for the GAIP alternatives to determine if and/or when limited facility capacity could potentially constrain the forecast for based aircraft.

Currently, there are 482 aircraft based at JWA.[1] They range in size from small single-engine airplanes with as few as two seats to large transcontinental business/private jets capable of seating up to 19 passengers plus crew. Assuming no restrictions or limitations, the "unconstrained" forecast indicates that the number of aircraft based at JWA will increase to 540 by 2026—an increase of 58 aircraft over the 10-year period. However, the estimated capacity of the GAIP alternatives indicates that there may not be enough space available to accommodate current and/or projected demands. If so, the based aircraft forecast would eventually become "constrained" by the storage capacity of the GA facilities associated with each development scenario. The findings of the analysis are:

- Under Existing Conditions, the current facilities accommodate approximately 596 based aircraft, ±10 percent depending on the mix of different aircraft types and sizes at any given time.
- The Proposed Project, and Alternatives 1 and 2, provide fewer aircraft parking spaces than the Existing Conditions. Therefore, under these three scenarios, the based aircraft forecast would be limited to the design capacity of the selected alternative on or about opening day in 2024. This is due mostly to the increase in aircraft storage hangars, which are in greater demand than tie-downs but are a less efficient use of space.
- Alternative 3 utilizes the capacity available in the existing facilities and is the only option that provides an allowance for future growth. Approximately 72 spaces would be available to accommodate the baseline forecast through 2026 and beyond. Assuming all the hangars are filled to capacity, the remaining spaces are associated with tie-down ramps and apron areas for aircraft that cannot be accommodated in hangars or under shaded structures elsewhere on the airport.

[1] As of October 2016 (baseline year for analysis).

1. Historical Perspective and Trends

Time-lapse aerial photography indicates that the overall size and layout of the GA facilities have remained mostly unchanged for more than 20 years. It is estimated that there were as many as 750 parking spaces in 1994 (see **Figure 1**). Since then, no parking areas have been added while a few areas have been reduced or replaced by buildings and development, effectively decreasing the total number of parking spaces available at the airport when compared to previous years (see **Figure 2**).

The same aerial photography also indicates that there are fewer small single-engine and light twin-engine airplanes and more turboprops and business/private jets parked at JWA than ever before. Because one large business/private jet requires the same parking space as four small airplanes, it can be concluded that changes in the aircraft fleet mix have also had a reducing effect on the overall storage capacity of the airport.

Figure 1: Google Earth Photo (1994)

Figure 2: Google Earth Photo (2016)

2. Capacity Analysis

Section 2 estimates the aircraft storage capacity of the existing GA facilities and for the GAIP alternatives. The alternatives are generally defined by the nature and extent of the improvements to be undertaken and they are differentiated by the number and location of full-service Fixed Base Operators (FBOs) included with each alternative. The scenarios for analysis are:

- Existing Conditions. This is the baseline or "No Project" alternative used to determine the effects of the Proposed Project and Alternatives 1, 2 and 3. No improvements or changes are proposed.
- Proposed Project. This is a GAIP redevelopment option that is based on having one (1) Full-Service Northwest FBO and one (1) Full-Service Northeast FBO.
- Alternative 1. This is a GAIP redevelopment option that is based on having one (1) Full-Service Northwest FBO, one (1) Full-Service Northeast FBO, and one (1) Full-Service Southeast FBO.
- Alternative 2. This is a GAIP redevelopment option that is based on having one (1) Full-Service Northeast FBO, and one (1) Full-Service Southeast FBO.
- Alternative 3. Under this scenario, no improvements are proposed except for three projects that are needed to comply with FAA standards for airport design (i.e., projects needed to correct existing non-standard conditions).

2.1. Methodology and Assumptions

For the purpose of estimating the storage capacity of the different types of facilities, the following assumptions apply to the Proposed Project and Alternatives 1 and 2:

- The Full-Service FBO community hangars are assumed to have capacity for five (5) aircraft each. Actual storage capacity will vary depending on the type and size of aircraft stored in the hangar at any given time. Typically, priority is given to the largest aircraft that fits within the space available until the hanger is full.
- The Limited Service Southwest FBO community hangars are assumed to have capacity for approximately 17 aircraft because the access taxilane would be limited to aircraft with wingspans up to 66 feet (e.g., Embraer Legacy 500).
- T-hangars provide capacity for one (1) single-engine or one (1) light twin-engine aircraft per unit.
- Box hangars provide capacity for one (1) aircraft per unit. It is assumed that a box hangar would be used to store the largest turboprop or business/private jet that fits inside the hangar, even though some hangars may be used to store two or more smaller aircraft, including helicopters.
- FBO Aprons provide additional capacity for storing based aircraft. It is assumed that 50 percent of each FBO's apron space is allocated for based aircraft parking and the remaining 50 percent is allocated for transient aircraft parking. Actual storage capacity will vary depending on the type and size of aircraft parked on the apron at any given time.

- Tie-Downs provide capacity for one (1) single-engine or one (1) light twin-engine aircraft per unit.
- No Shade Structures are provided (except for Alternative 3).

Auto parking is depicted in the illustrations for preliminary information. The capacity of each parking lot is subject to change based on the detailed layout and design of each alternative.

In addition, there is a wide range of types and sizes of business/private jets at JWA. For the purpose of this analysis, these aircraft are categorized by Airplane Design Group (ADG) as follows:

- Small (ADG I). These are very light jets, and light jets, with 4 to 6 seats and a range up to 2,400 nautical miles. Current examples include: Eclipse 550, HondaJet, and Cirrus Vision Jet.
- Medium (ADG II). These are mid-size to super mid-size jets suitable for longer range travel such as transcontinental flights. They typically accommodate 8 to 19 passengers and have ranges up to 5,700 nautical miles. Most business/private jets occur in this category. Current examples include Bombardier Challenger 604, Cessna Sovereign, Dassault Falcon 900, Embraer Phenom 300, and the Gulfstream 450.
- Large (ADG III). These are ultra long-range jets designed for intercontinental travel. These aircraft typically accommodate 13 to 19 passengers and have ranges up to 7,900 nautical miles. Current examples include: Gulfstream 550/650 and the Bombardier Global 7000/8000. Although private airliners such as the Boeing Business Jet and Airbus Corporate Jet may occur, no private airliners are based at JWA and none are planned for.

2.2. Existing Conditions (No Project Alternative)

Table 1 summarizes the location and type of parking facilities available at JWA as shown in **Figure 3.** The estimated capacity of the existing GA facilities is ±596 based aircraft.

As of October 2016, there were 482 based aircraft parked at JWA, indicating there are ±114 spaces available. Reportedly, no hangar spaces or other sheltered spaces are currently available; however, there are ±80 County tie-downs available for single-engine and light twin-engine airplanes. Therefore, it can be concluded that the remaining ±34 spaces occur within the apron areas associated with the two existing FBO facilities.

The following **Table 2** indicates the aircraft fleet mix for the Existing Conditions shown in **Figure 3.**

Table 1: Based Aircraft Storage Capacity (Existing)

Existing Conditions	ACI Jet	Atlantic Aviation	Ltd Svc FBO (Jay's)*	Ltd Svc FBO (Martin)**	Executive T-Hangars	SouthCoast Hangars	Orange County	Total
Tie-Down Ramp	0	0	0	0	0	0	302	**302**
T-Hangars	14	0	0	0	97	0	0	**111**
Box Hangars	34	0	0	0	0	11	0	**45**
FBO Community Hangars	5	18	0	0	0	0	0	**23**
Shade Structures	0	0	0	0	0	0	66	**66**
FBO Apron	20	21	0	8	0	0	0	**49**
Total	**73**	**39**	**0**	**8**	**97**	**11**	**368**	**596**

*Note: * Assumes 0 based aircraft are associated with the existing facility (aircraft maintenance only).*

*** There are no proposed changes to Martin Aviation & Lyon Air Museum (not included in this study).*

Table 2: Based Aircraft Fleet Mix (Existing)

Existing Conditions	Single-Engine*	Multi-Engine	Turboprop	Business/Private Jet			Helicopter	Total
				Small	Medium	Large		
Oct 2016	339	35	26	19	44	2	17	**482**

** The based aircraft count for single engine airplanes includes one motor glider.*

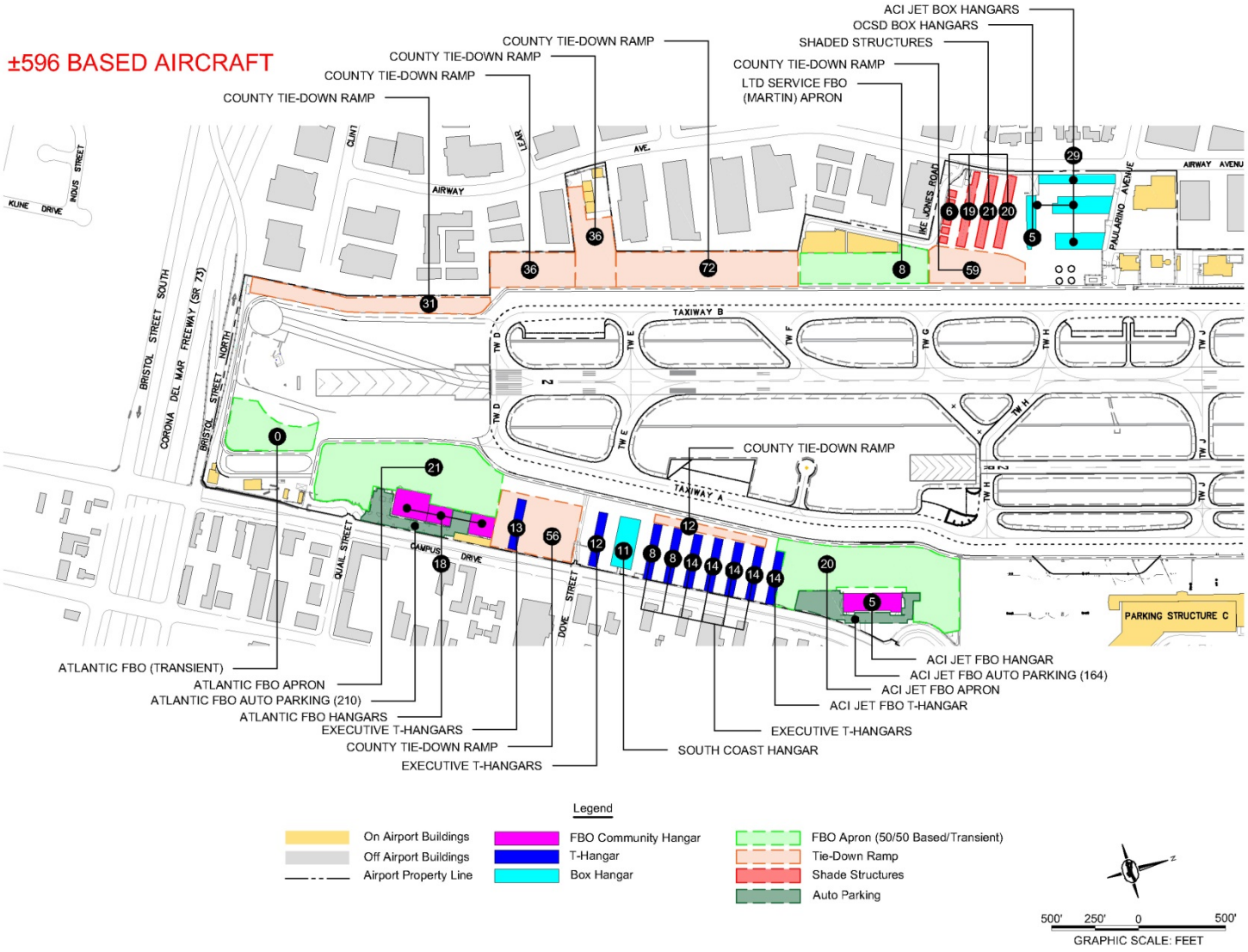

Figure 3: Existing Conditions

2.3. Proposed Project

The Proposed Project is a GAIP redevelopment option that is based on the following FBO arrangement:

- (1) Full-Service West FBO
- (1) Full-Service East FBO

As shown in **Figure 4**, the total aircraft storage capacity for the all of the GA facilities included in this alternative is ±354 based aircraft.

When compared to Existing Conditions, the Proposed Project reduces aircraft storage capacity by ±242 spaces (see **Table 3**). Given 482 based aircraft in 2016, the Proposed Project would not provide sufficient capacity to accommodate current (or forecast) demand—the deficiency is ±128 spaces.

Table 3: Proposed Project—Demand/Capacity Analysis

Facility	Capacity (Aircraft Parking Spaces)		Change (+/-)
	Existing Conditions	Proposed Project	
Tie-Down Ramp	302	135	-167
T-Hangars	111	96	-15
Box Hangars	45	35	-10
FBO/Community Hangars	23	47	24
Shade Structures	66	0	-66
FBO Apron Spaces	49	41	-8
Total	**596**	**354**	**-242**

Aircraft Parking Spaces	Demand (2016)	Capacity	+/-
	482	354	-128

Note: Numbers in red indicate a loss or deficiency.

The following **Table 4** indicates the aircraft fleet mix for the Proposed Project as shown in **Figure 4.**

It is noted that the Proposed Project includes 30 box hangars (60x60) for turboprop airplanes and small business/private jets (mid-size and large business/private jets would be stored in the FBO hangars). By comparison, Alternative 2, presented later in this report, includes a range of box hangar sizes to accommodate all types and sizes of GA aircraft including large business/private jets.

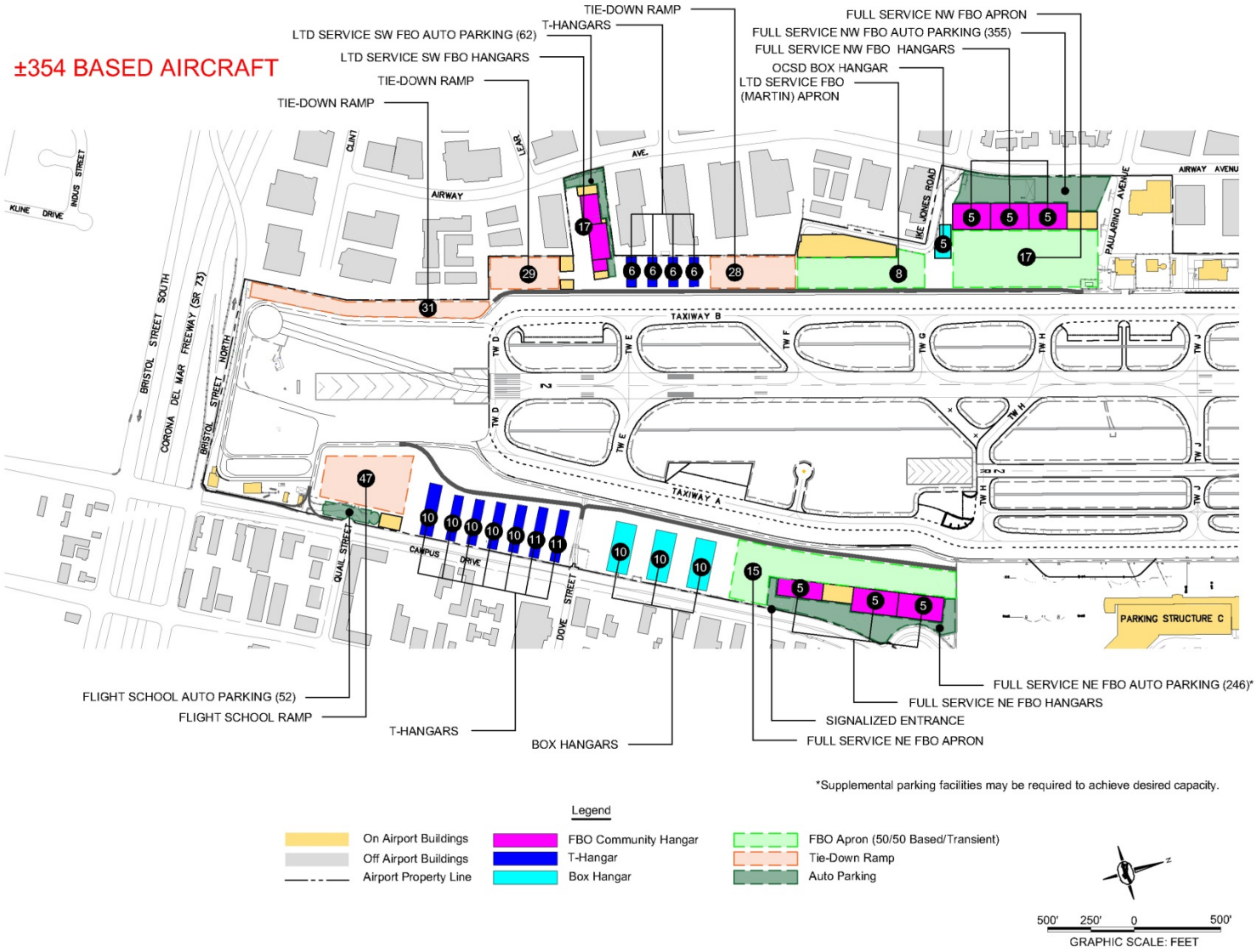

Figure 4: Proposed Project

Table 4: Aircraft Fleet Mix (Proposed Project)

Existing Conditions	Single-Engine	Multi-Engine	Turboprop	Business/Private Jet			Helicopter	Total
				Small (I)	Medium (II)	Large (III)		
Tie-Down Ramp	101	31					3	**135**
T-Hangars	86	10						**96**
Box Hangars			8	10	10		7	**35**
FBO Community Hangars	5		12		21	9		**47**
Shade Structures								**0**
FBO Apron	2		10	9	12	2	7	**41**
Total	**194**	**41**	**30**	**19**	**43**	**11**	**17**	**354**

Note: The fleet mix distributions may not match the sum totals due to rounding.

2.4. Alternative 1

Alternative 1 is a GAIP redevelopment option that is based on the following FBO arrangement:

- (1) Full-Service West FBO
- (1) Full-Service Northeast FBO
- (1) Full-Service Southeast FBO

As shown in **Figure 5**, the total aircraft storage capacity for all the facilities included under this alternative is ±356 based aircraft.

When compared to Existing Conditions, Alternative 1 reduces aircraft storage capacity by ±240 spaces (see **Table 5**). Given 482 based aircraft in 2016, Alternative 1 would not provide sufficient capacity to accommodate current (or forecast) demand—the deficiency is ±126 spaces.

Table 5: Alternative 1—Demand/Capacity Analysis

Facility	Capacity (Aircraft Parking Spaces)		Change (+/-)
	Existing Conditions	Alternative 1	
Tie-Down Ramp	302	119	-183
T-Hangars	111	114	3
Box Hangars	45	5	-40
FBO/Community Hangars	23	62	39
Shade Structures	66	0	-66
FBO Apron Spaces	49	56	7
Total	**596**	**356**	**-240**

Aircraft Parking Spaces	Demand (2016)	Capacity	+/-
	482	356	-126

Note: Numbers in red indicate a loss or deficiency.

The following **Table 6** indicates the aircraft fleet mix for Alternative 1 as shown in **Figure 5.**

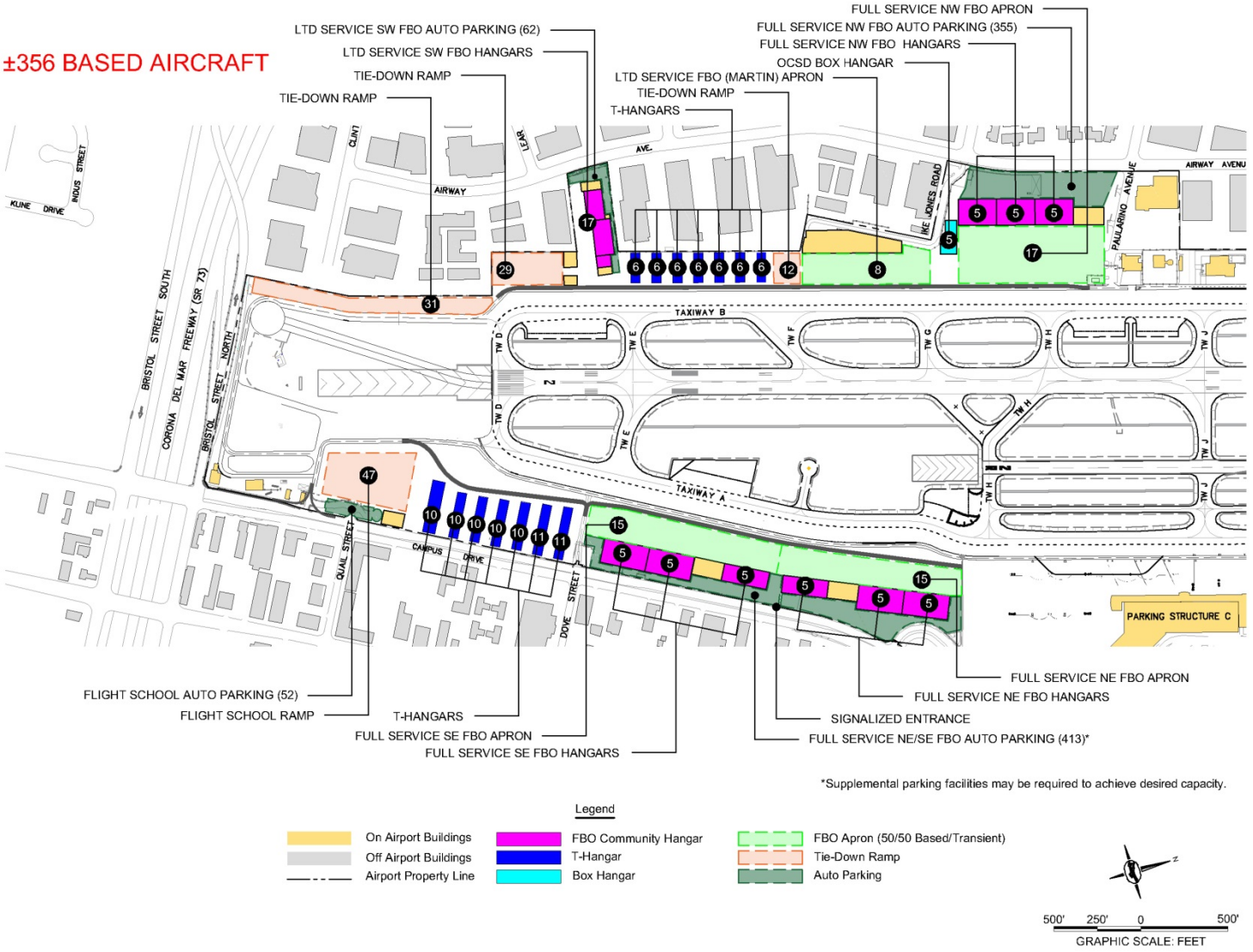

Figure 5: Alternative 1

Table 6: Aircraft Fleet Mix (Alternative 1)

Existing Conditions	Single-Engine	Multi-Engine	Turboprop	Business/Private Jet			Helicopter	Total
				Small (I)	Medium (II)	Large (III)		
Tie-Down Ramp	88	31						**119**
T-Hangars	104	10						**114**
Box Hangars							5	**5**
FBO Community Hangars	2		12		36	9	3	**62**
Shade Structures								**0**
FBO Apron	2		14	12	17	2	9	**56**
Total	**196**	**41**	**26**	**12**	**53**	**11**	**17**	**356**

Note: The fleet mix distributions may not match the sum totals due to rounding.

2.5. Alternative 2

Alternative 2 is a GAIP redevelopment option that is based on the following FBO arrangement:

- (1) Full-Service Northeast FBO
- (1) Full-Service Southeast FBO.

As shown in **Figure 6**, the total aircraft storage capacity for all the facilities included under this alternative is ±361 based aircraft.

When compared to Existing Conditions, Alternative 2 reduces aircraft storage capacity by ±235 spaces (see **Table 7**). Given 482 based aircraft in 2016, Alternative 2 would not provide sufficient capacity to accommodate current (or forecast) demand—the deficiency is ±121 spaces.

Table 7: Alternative 2—Demand/Capacity Analysis

Facility	Capacity (Aircraft Parking Spaces)		Change (+/-)
	Existing Conditions	Alternative 2	
Tie-Down Ramp	302	179	-123
T-Hangars	111	72	-39
Box Hangars	45	24	-21
FBO/Community Hangars	23	47	24
Shade Structures	66	0	-66
FBO Apron Spaces	49	39	-10
Total	**596**	**361**	**-235**

Aircraft Parking Spaces	Demand (2016)	Capacity	+/-
	482	361	-121

Note: Numbers in red indicate a loss or deficiency.

The following **Table 8** indicates the aircraft fleet mix for Alternative 2 as shown in **Figure 6.**

It is noted that Alternative 2 provides 19 box hangars for business/private jets using four (4) different hangar sizes: small (78x68); mid-size (83x83); super mid-size (109x98); and large (131x124). A detailed layout of this area has been prepared and provided under separate cover.

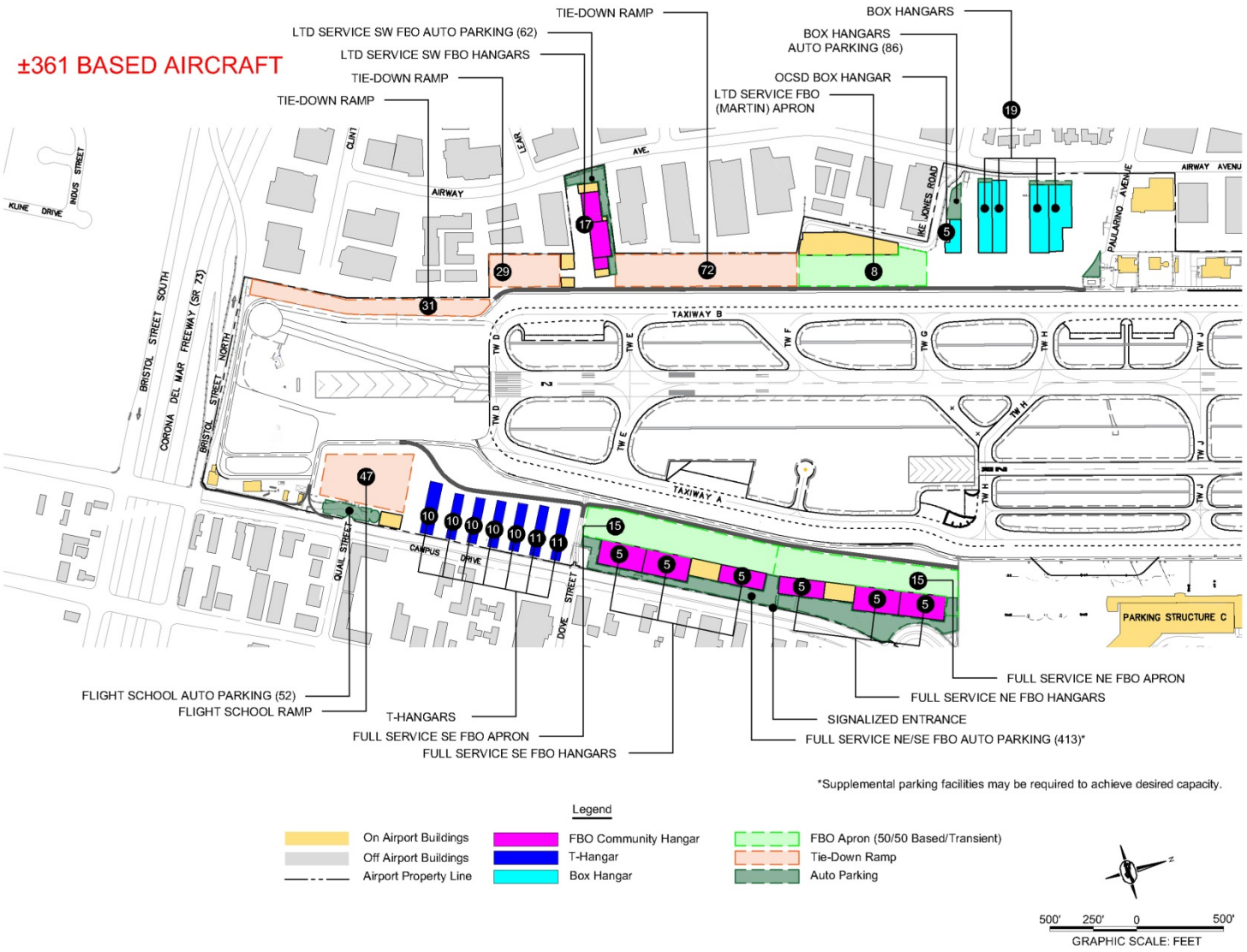

Figure 6: Alternative 2

Table 8: Aircraft Fleet Mix (Alternative 2)

Existing Conditions	Single-Engine	Multi-Engine	Turboprop	Business/Private Jet			Helicopter	Total
				Small (I)	Medium (II)	Large (III)		
Tie-Down Ramp	142	31					6	**179**
T-Hangars	62	10						**72**
Box Hangars				8	9	2	5	**24**
FBO Community Hangars	5		12		30			**47**
Shade Structures								**0**
FBO Apron	2		10	8	12	2	6	**39**
Total	**211**	**41**	**22**	**16**	**51**	**4**	**17**	**361**

Note: The fleet mix distributions may not match the sum totals due to rounding.

2.6. Alternative 3

Under Alternative 3, the following improvements and changes would be undertaken to correct existing nonstandard conditions:

- Relocate the Vehicle Service Road (VSR) along Taxiway A to comply with FAA clearance standard dimensions for Group V aircraft
- Remove obstructions (two community hangars from the Full-Service Southeast FBO) to comply with FAA height restrictions
- Remove 31 transient aircraft apron parking spaces from within the extended object free area (OFA) in the approach to Runway 2L.

But for these improvements, the current facilities would remain essentially unchanged. The total aircraft storage capacity for all the facilities included under this alternative is ±554 based aircraft (see **Table 9** and **Figure 7**).

When compared to Existing Conditions, Alternative 3 reduces aircraft storage capacity by ±42 spaces. Given 482 based aircraft in 2016, there would be a surplus of ±72 spaces, which is sufficient to accommodate forecast demand through approximately 2035.

Table 9: Alternative 3—Demand/Capacity Analysis

Facility	Capacity (Parking Spaces)		Change (+/-)
	Existing Conditions	Alternative 3	
Tie-Down Ramp	302	276	-26
T-Hangars	111	111	0
Box Hangars	45	45	0
FBO/Community Hangars	23	11	-12
Shade Structures	66	66	0
FBO Apron Spaces	49	45	-4
Total	**596**	**554**	**-42**

Aircraft Parking Spaces	Demand (2016)	Capacity	+/-
	482	554	72

Note: Numbers in red indicate a loss or deficiency.

The following **Table 10** indicates the aircraft fleet mix for Alternative 3 as shown in **Figure 7.**

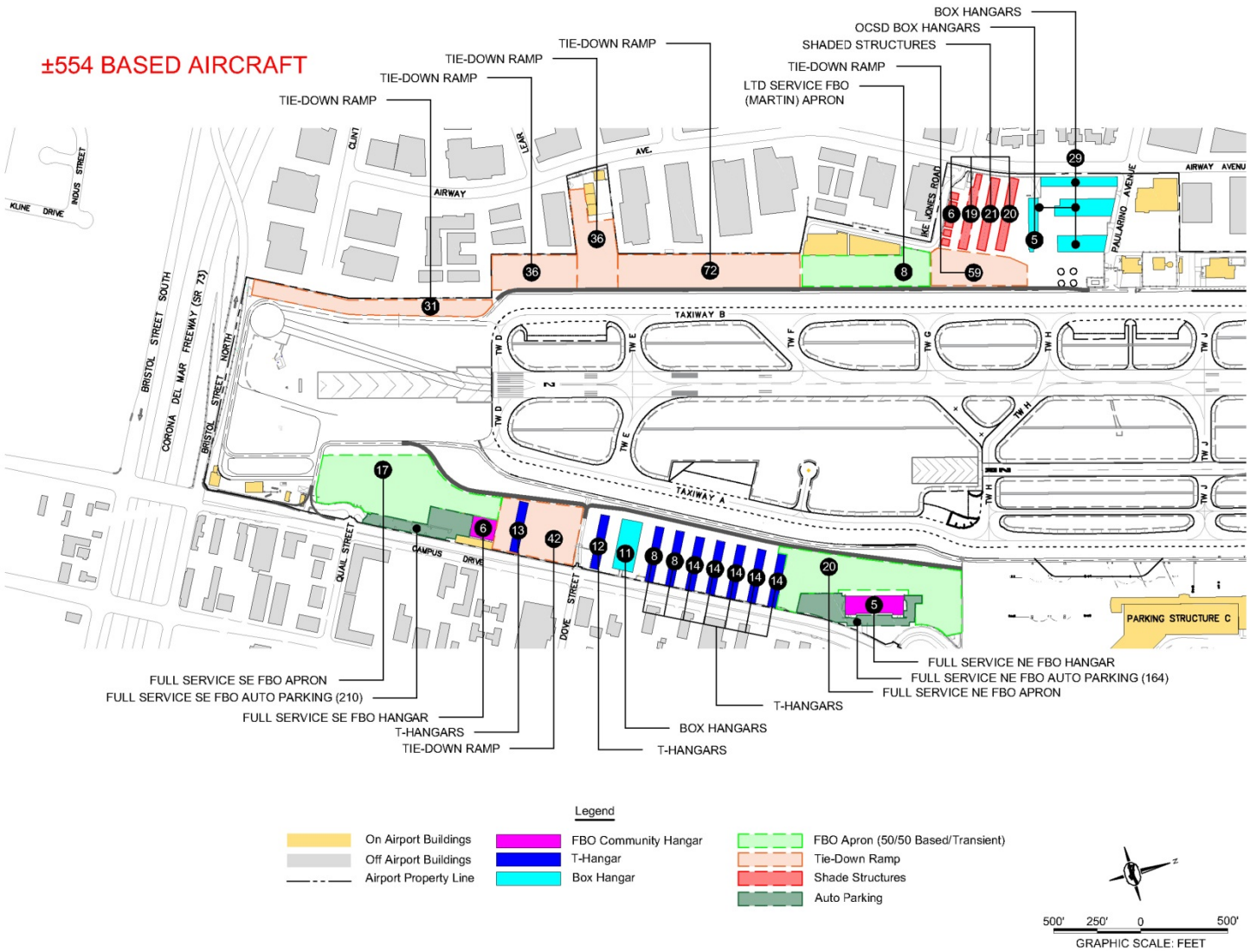

Figure 7: Alternative 3

Table 10: Aircraft Fleet Mix (Alternative 3)

Existing Conditions	Single-Engine	Multi-Engine	Turboprop	Business/Private Jet			Helicopter	Total
				Small (I)	Medium (II)	Large (III)		
Tie-Down Ramp	245	31						**276**
T-Hangars	92	16					3	**111**
Box Hangars	8	1	6	25			5	**45**
FBO Community Hangars			2	2	6		1	**11**
Shade Structures	66							**66**
FBO Apron	2		11	9	13	2	7	**45**
Total	**413**	**48**	**19**	**36**	**19**	**2**	**16**	**554**

Note: The fleet mix distributions may not match the sum totals due to rounding.

2.7. Comparison of Alternatives

Table 11 compares the capacity of the Existing Facilities to the Proposed Project and Alternatives 1, 2 and 3.

Figure 8 illustrates the results of the demand-capacity analysis. As shown, the Proposed Project, and Alternatives 1 and 2, provide fewer aircraft parking spaces than the Existing Conditions. However, these redevelopment options are intended to provide new GA facilities that are needed to accommodate a changing aircraft fleet mix consisting of newer and larger aircraft. Although Alternative 3 has limited capacity for future growth, this option does not provide the new facilities associated with the other alternatives.

Table 12 presents the aircraft fleet mix for each scenario.

Table 11: Based Aircraft Storage Capacity

Summary	Full Svc NW FBO	ACI Jet Full Svc NE FBO	Atlantic Aviation Full Svc SE FBO	Jay's Maint Ltd Svc SW FBO	Martin Aviation Ltd Svc FBO	Executive Hangars T-Hangars	SouthCoast Hangars Box Hangars	Orange County Tie-Downs	Flight School	OCSD	Total
Existing Conditions	-	73	39	0	8	97	11	368	0	-	**596**
Proposed Project	32	30	0	17	8	96	30	88	47	5	**354**
Alternative 1	32	30	30	17	8	114	0	72	47	5	**356**
Alternative 2	0	30	30	17	8	72	19	132	47	5	**361**
Alternative 3	0	73	23	0	8	97	11	342	0	0	**554**

Note: May not sum due to rounding.

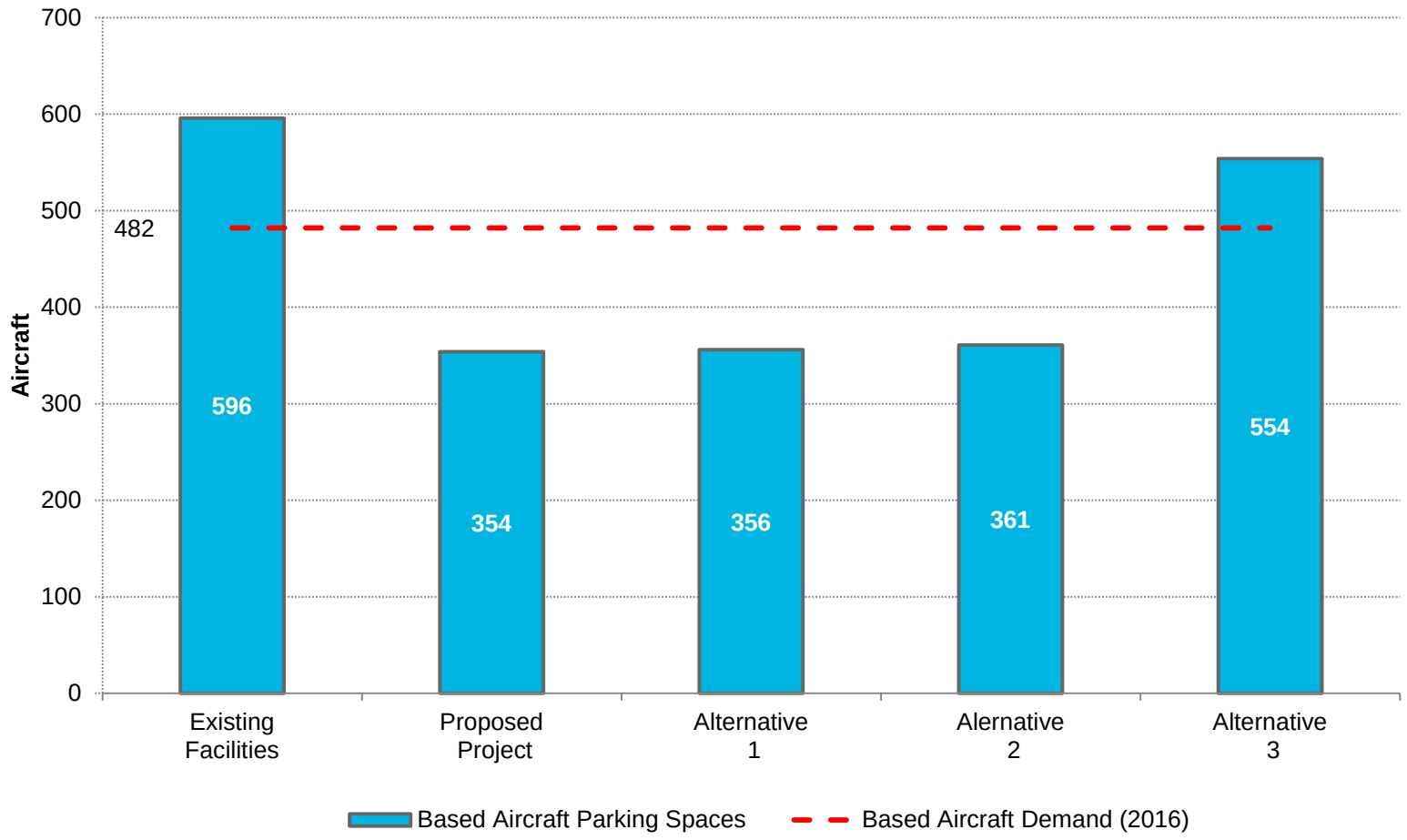

Figure 8: Based Aircraft Parking and Capacity Analysis

Table 12: Demand/Capacity by Aircraft Type

Existing Conditions	Single-Engine	Multi-Engine	Turboprop	Business/Private Jet			Helicopter	Total
				Small (I)	Medium (II)	Large (III)		
2016 Demand	*339*	*35*	*26*	*19*	*44*	*2*	*17*	*482*
Existing Conditions	440	48	26	36	27	2	17	596
Proposed Project	194	41	30	19	43	11	17	354
Alternative 1	196	41	26	12	53	11	17	356
Alternative 2	211	41	22	16	51	4	17	361
Alternative 3	413	48	19	36	19	2	16	554

Note: The fleet mix distributions may not match the sum totals due to rounding.

3. Constrained Forecasts

This section presents the "unconstrained" forecasts developed earlier in the study for comparison to the "constrained" forecasts developed for the Proposed Project and Alternatives 1, 2 and 3.[2]

3.1. Summary of "Unconstrained" Forecasts

Summaries of the baseline "unconstrained" forecasts for GA based aircraft and annual operations are provided in **Tables 13, 14 and 15** for easy reference. Details of the unconstrained forecasts shall refer to the *General Aviation Forecasting and Analysis Technical Report, January, 2018*.

Table 13: SNA Unconstrained Forecast Based Aircraft by Type

Year	Fixed Wing Piston			Fixed Wing Turbine			Helicopter			Other	Total Based Aircraft
	Single Engine	Multi-Engine	Total	Turbo prop	Turbo Jet	Total	Piston	Turbine	Total	(Glider)	
Oct 2016	338	35	**373**	26	65	**91**	6	11	**17**	**1**	**482**
Baseline Scenario											
2021	348	36	**384**	29	76	**105**	7	13	**20**	**1**	**510**
2026	359	37	**396**	32	89	**121**	7	15	**22**	**1**	**540**

Table 14: SNA Unconstrained Forecast General Aviation and Air Taxi Operations

Year	Air Taxi	General Aviation	General Aviation	Total Operations
		Itinerant	Local	
2016*	15,400	90,900	86,500	**192,800**
Baseline Scenario				
2021	17,600	93,100	88,600	**199,300**
2026	20,200	96,100	91,500	**207,800**

*Note: * The 192,800 annual GA operations in 2016 are rounded from the number of operations obtained from L&B and the Airport on 3 November 2017 as given in Table 12 in Section 5.3 of the General Aviation Forecasting and Analysis Technical Report, January, 2018. The number of air taxi, itinerant GA, and local GA operations in 2016 are estimated from FAA ATADS and prorated to match 192,800 annual operations.*

[2] All forecasts are subject to levels of uncertainty. The forecasts provided in this Technical Memorandum are based on the information available at the time of their creation. Various factors, other than those included in the forecast models, can influence future aviation demand. Unexpected events may occur and some underlying forecast assumptions and/or expectations may not materialize. Therefore, actual performance may differ from the forecasts presented in this report and could be significant.

Table 15: SNA Unconstrained Forecast Operations by Aircraft Engine Type

Year	Piston	Turbine	Jet	Helicopter/Other	Total Operations
2016*	147,300	9,800	31,800	3,900	**192,800**
Baseline Scenario					
2021	146,700	10,900	37,200	4,500	**199,300**
2026	147,100	12,000	43,600	5,100	**207,800**

Note: The 192,800 annual GA operations in 2016 are rounded from the number of operations obtained from L&B and the Airport on 3 November 2017.

3.2. Constrained Forecasts for the No Project Alternative (Existing Conditions)

Table 16 and **Figure 9** summarize the constrained forecast based aircraft for the No Project Alternative. The number of based aircraft for each type of aircraft increases following the growth estimated from the unconstrained forecast given in **Table 13** until it reaches the maximum capacity identified under the capacity analysis as explained in the previous Section 2. Once the number of based aircraft demand for each type of aircraft reaches the maximum capacity, the growth for the corresponding type of aircraft is constrained.

As shown in **Table 16** and **Figure 9**, turboprops, jet aircraft, and helicopters based aircraft demands are at capacity at the base year 2016, while single engine and multi-engine piston aircraft will have capacity to grow in the long term under the No Project Alternative.

Table 16: SNA Constrained Forecast Based Aircraft by Type–No Project Alternative (Existing Conditions)

Year	Fixed Wing Piston*		Fixed Wing Turbine		Helicopter	Total Based Aircraft
	Single Engine	Multi-Engine	Turbo prop	Turbo Jet		
Capacity	440	48	26	65	17	**596**
2016	339	35	26	65	17	**482**
2021	349	36	26	65	17	**493**
2026	360	37	26	65	17	**505**

*Note: * The based aircraft count for single engine includes one motor glider.*

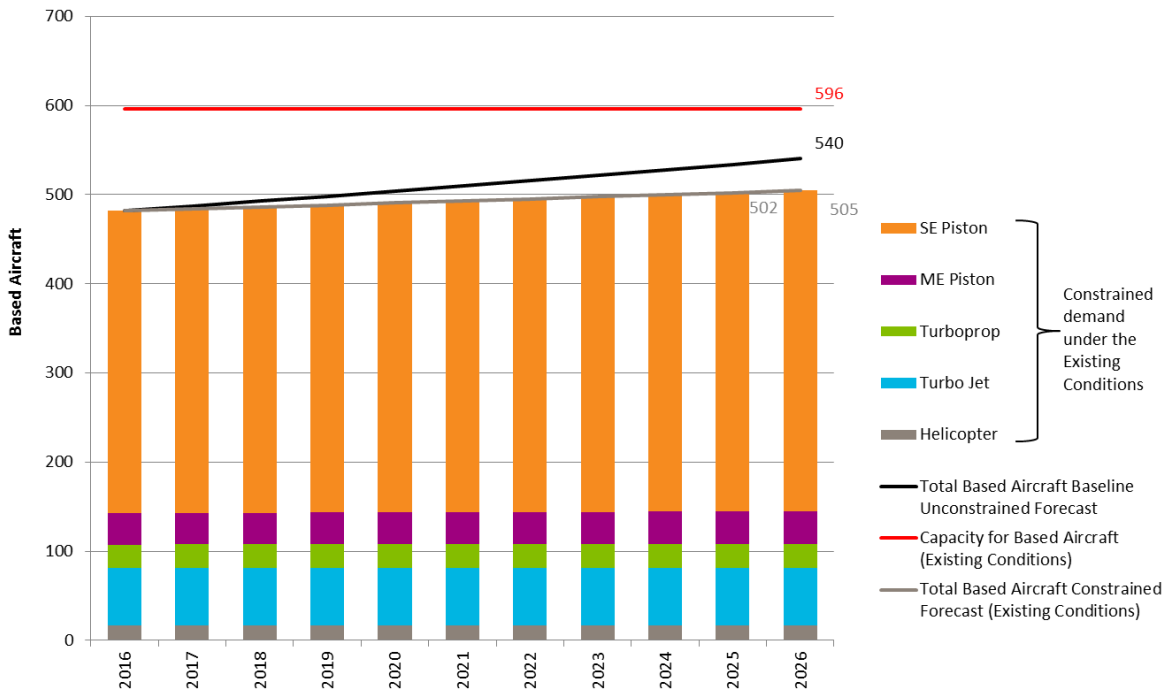

Figure 9: Constrained Forecast Based Aircraft - No Project Alternative (Existing Conditions)

The methodology for estimating the annual operations is based on the estimated number of operations per based aircraft by type of aircraft, ownership, and usage as explained in the *General Aviation Forecasting and Analysis Technical Report, January, 2018*, with the following additional considerations for those aircraft types that will be constrained:

- Inactive based aircraft will leave the airport first
- Based aircraft which are older and with lesser annual activities will leave sooner than the newer and more active aircraft
- Estimated number of landings per based aircraft is increased. For example, the estimated average landings per based jet aircraft range from 190 to 230 landings in the unconstrained forecast model. It is increased to 230 landings per all based jet aircraft for the constrained forecast model

The transient operations estimated from the unconstrained forecast models are included in the total annual operations. The unconstrained forecast models are driven by socio-economic growth, historic data, information gathered from stakeholder interviews and aircraft owner surveys, and industry trends. Both Jay's Aircraft and Martin Aviation have existing ramp space adjacent to their hangars to accommodate visiting aircraft to be serviced. Both existing full service FBOs have maintained transient aprons to accommodate visiting transient aircraft operations. Similar transient ramp spaces will be maintained in the No Project Alternative, and the transient activities will be at the same level as the unconstrained forecast transient operations.

Table 17 and **Figure 10** present the estimated annual operations with breakdowns for local, itinerant general aviation, and air taxi operations for the No Project Alternative. **Table 18** summarizes the annual operations by aircraft engine type.

Table 17: SNA Constrained Forecast General Aviation and Air Taxi Operations–No Project Alternative (Existing Conditions)

Year	Air Taxi	General Aviation	General Aviation	Total Operations
		Itinerant	Local	
2016	15,400	90,900	86,500	**192,800**
2021	16,900	92,600	86,900	**196,400**
2026	18,600	95,000	87,400	**201,000**

Table 18: SNA Constrained Forecast Operations by Aircraft Engine Type–No Project Alternative (Existing Conditions)

Year	Piston	Turbine	Jet	Helicopter/Other	Total Operations
2016	147,300	9,800	31,800	3,900	**192,800**
2021	146,400	10,400	35,400	4,200	**196,400**
2026	147,000	10,900	38,300	4,800	**201,000**

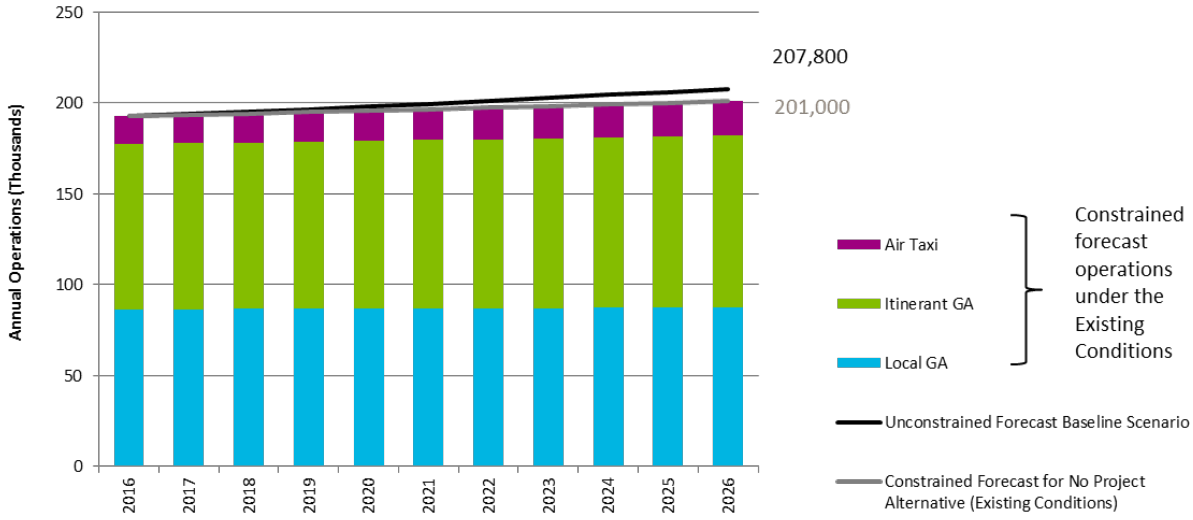

Figure 10: Constrained Forecast Operations - No Project Alternative (Existing Conditions)

Lyon Air Museum, John Wayne Airport

3.3. Constrained Forecasts for the Proposed Project

Table 19 and **Figure 11** summarize the constrained forecast based aircraft for the Proposed Project. The approach is similar to the No Project Alternative except during the 6-year construction period.

Before construction commences in 2019, the number of based aircraft will follow the estimate for the No Project Alternative. By opening day (i.e. 2025), the number of single engine aircraft will be constrained by the estimated capacity. Hence, during the construction period (i.e. from 2019 to 2024), approximately 141 single engine based aircraft will be relocated to other airports due to lack of parking spaces.[3] A steady rate of decline from 2018 to 2025 is assumed during the construction period.

As shown in **Table 19** and **Figure 11**, the growth of turboprops and jet aircraft will reach capacity in the near term, and there will be no growth for helicopters. Although multi-engine piston aircraft will have capacity to grow in the long term under the Proposed Project based on the capacity analysis, the four vacant spaces for multi-engine piston aircraft will likely be occupied by existing single engine based aircraft. It is anticipated that all of the 354 based aircraft parking spaces will be fully occupied by opening day.

Table 19: SNA Constrained Forecast Based Aircraft by Type–Proposed Project

Year	Fixed Wing Piston*		Fixed Wing Turbine		Helicopter	Total Based Aircraft
	Single Engine	Multi-Engine	Turboprop	Turbo Jet		
Capacity	194	41	30	72	17	**354**
2016	339	35	26	65	17	**482**
2021**	271	36	28	68	17	**420**
2026***	198	37	30	72	17	**354**

*Note: The fleet mix distributions may not match the sum totals in previous tables due to rounding. *The based aircraft totals for single engine include one motor glider. ** No. of based aircraft in 2021 (during construction) assumes constant rate of decline from 2018 (year before construction) to 2025 (opening year). *** Assume 4 existing SE Piston aircraft will park at the vacant spaces for ME Piston aircraft and fill up capacity.*

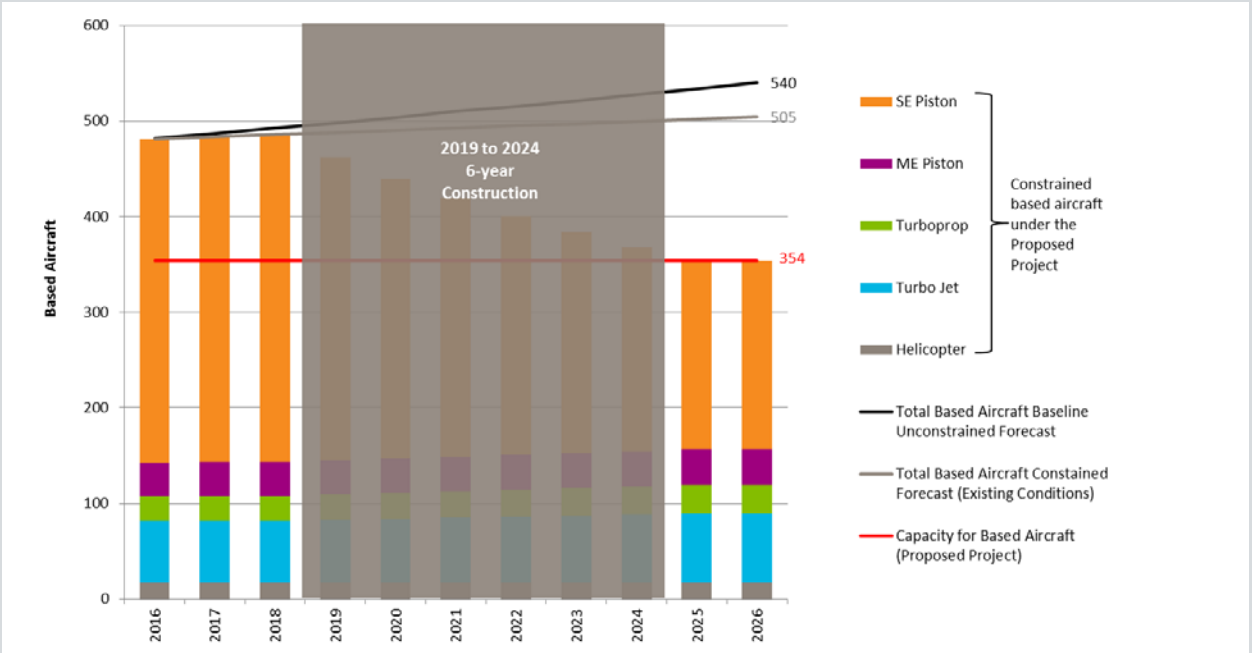

Figure 11. Constrained Forecast Based Aircraft – Proposed Project

[3] The actual number of based aircraft to be relocated during construction will depend on the actual number of based aircraft before construction. The 141 SE piston aircraft to be relocated was estimated based on the difference between 2016 and 2025. For simplicity, it ignores the potential growth between 2016 and the year construction commences.

The methodology for estimating the annual operations is similar to the No Project Alternative.

Table 20 and **Figure 12** present the estimated annual operations with breakdowns for local, itinerant general aviation, and air taxi operations for the Proposed Project. **Table 21** summarizes the annual operations by aircraft engine type.

Table 20: SNA Constrained Forecast General Aviation and Air Taxi Operations–Proposed Project

Year	Air Taxi	General Aviation	General Aviation	Total Operations
		Itinerant	Local	
2016	15,400	90,900	86,500	**192,800**
2021	17,000	90,300	77,100	**184,400**
2026	19,100	87,500	61,300	**167,900**

Table 21: SNA Constrained Forecast Operations by Aircraft Engine Type–Proposed Project

Year	Piston	Turbine	Jet	Helicopter/Other	Total Operations
2016	147,300	9,800	31,800	3,900	**192,800**
2021	133,700	10,600	35,800	4,300	**184,400**
2026	111,000	11,700	40,400	4,800	**167,900**

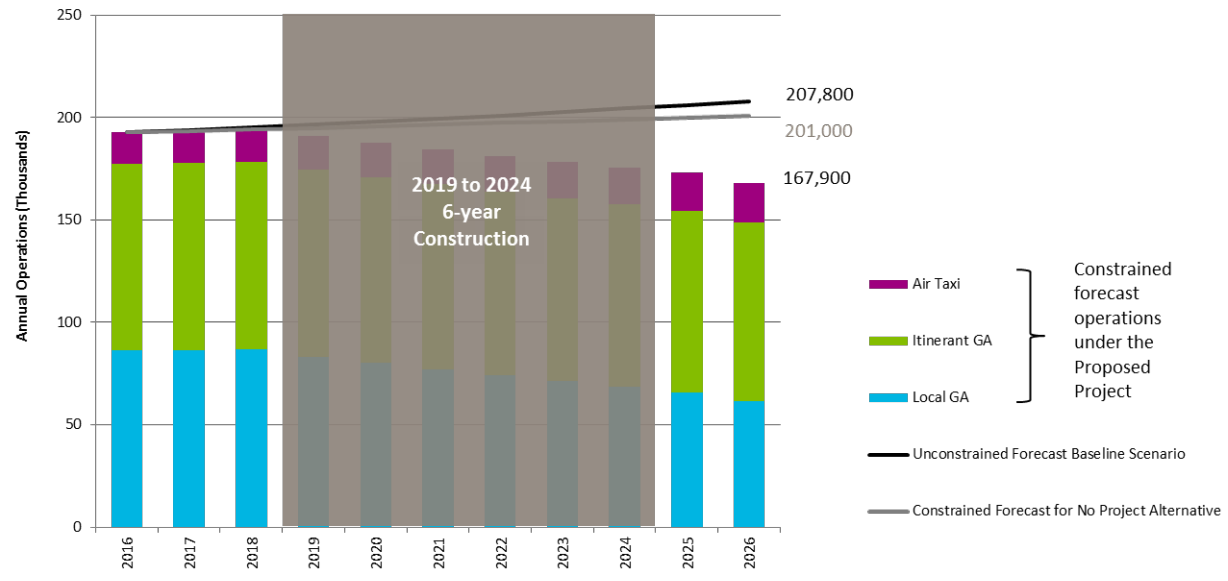

Figure 12. Constrained Forecast Operations – Proposed Project

3.4. Constrained Forecasts for Alternative 1

Table 22 and **Figure 13** summarize the constrained forecast based aircraft for Alternative 1. The approach is similar to the Proposed Project.

Before construction commences in 2019, the number of based aircraft increases following the estimate for the No Project Alternative. By opening day (i.e. 2025), the number of single engine aircraft will be constrained by the estimated capacity. Hence, during the construction period (i.e. from 2019 to 2024), approximately 139 single engine based aircraft will be relocated to other airports due to a lack of parking spaces.[4] A constant rate of decline from 2018 to 2025 is assumed during construction.

As shown in **Table 22** and **Figure 13**, the growth of jet aircraft will reach capacity in the near term, and there will be no growth for turboprops and helicopters. Although multi-engine piston aircraft will have capacity to grow in the long term under Alternative 1 based on the capacity analysis, the four vacant spaces for multi-engine piston aircraft will likely be occupied by existing single engine based aircraft. It is anticipated that all of the 356 based aircraft parking spaces will be fully occupied by opening day.

Table 22: SNA Constrained Forecast Based Aircraft by Type–Alternative 1

Year	Fixed Wing Piston*		Fixed Wing Turbine		Helicopter	Total Based Aircraft
	Single Engine	Multi-Engine	Turboprop	Turbo Jet		
Capacity	196	41	26	76	17	**356**
2016	339	35	26	65	17	**482**
2021**	272	36	26	69	17	**420**
2026***	200	37	26	76	17	**356**

*Note: The fleet mix distributions may not match the sum totals in previous tables due to rounding. * The based aircraft totals for single engine include one motor glider. ** No. of based aircraft in 2021 (during construction) assumes constant rate of decline from 2018 (year before construction) to 2025 (opening year). *** Assume 4 existing SE Piston aircraft will park at the vacant spaces for ME Piston aircraft and fill up the capacity.*

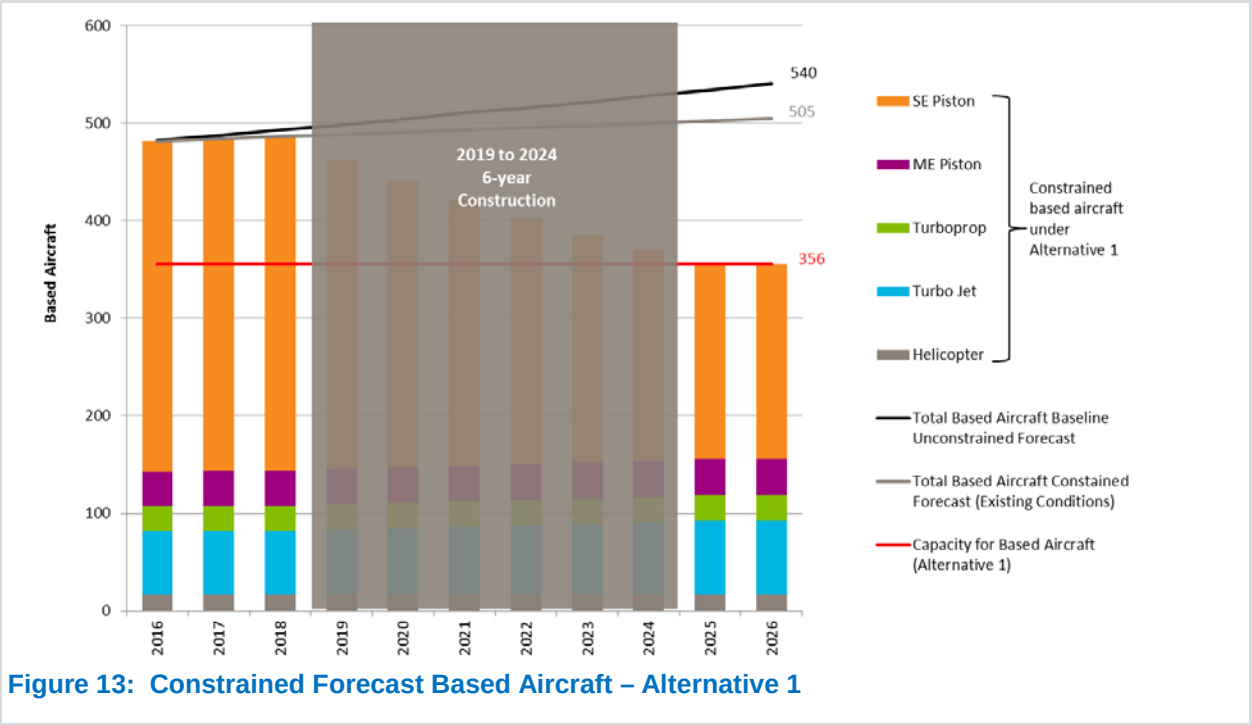

Figure 13: Constrained Forecast Based Aircraft – Alternative 1

[4] The actual number of based aircraft to be relocated during construction will depend on the actual number of based aircraft before construction. The 139 SE piston aircraft to be relocated was estimated based on the difference between 2016 and 2025. For simplicity, it ignores the potential growth between 2016 and before construction commences.

The methodology for estimating the annual operations is similar to the No Project Alternative.

Table 23 and **Figure 14** present the estimated annual operations with breakdowns for local, itinerant general aviation, and air taxi operations for Alternative 1. **Table 24** summarizes the annual operations by aircraft engine type.

Table 23: SNA Constrained Forecast General Aviation and Air Taxi Operations–Alternative 1

Year	Air Taxi	General Aviation	General Aviation	Total Operations
		Itinerant	Local	
2016	15,400	90,900	86,500	**192,800**
2021	17,000	90,300	77,300	**184,600**
2026	19,000	87,700	61,900	**168,600**

Table 24: SNA Constrained Forecast Operations by Aircraft Engine Type–Alternative 1

Year	Piston	Turbine	Jet	Helicopter/Other	Total Operations
2016	147,300	9,800	31,800	3,900	**192,800**
2021	133,900	10,300	36,100	4,300	**184,600**
2026	111,600	10,800	41,400	4,800	**168,600**

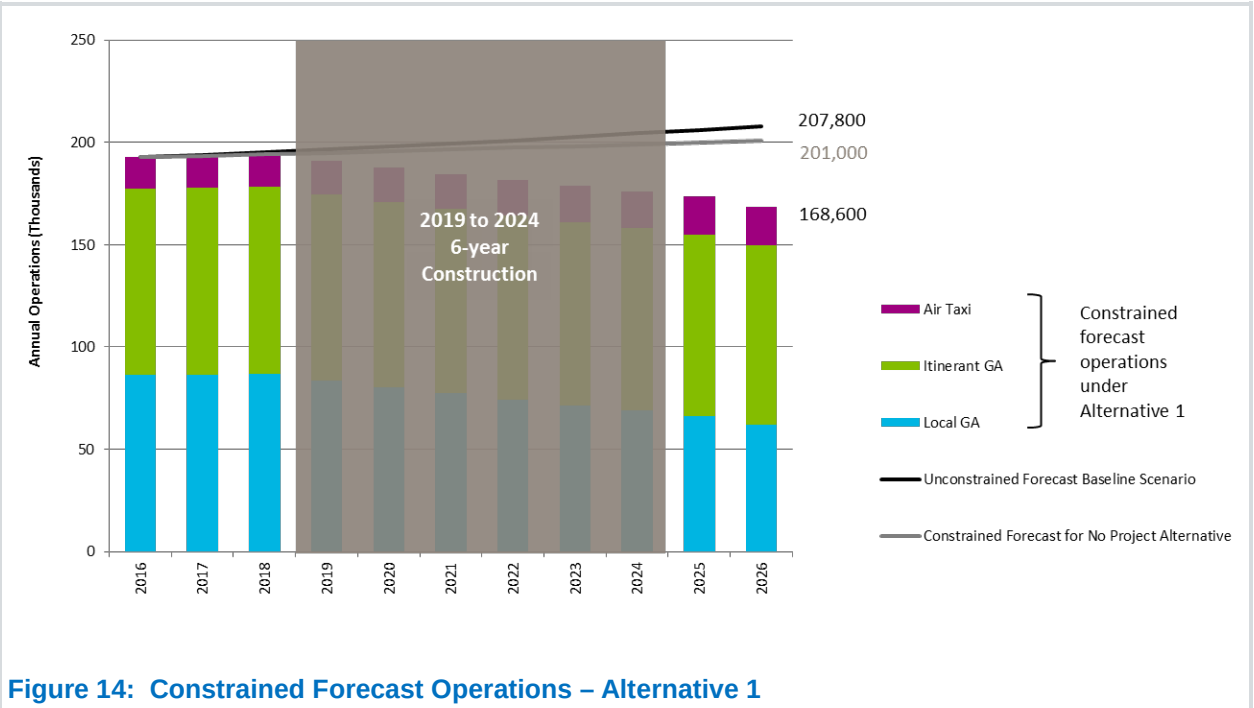

Figure 14: Constrained Forecast Operations – Alternative 1

3.5. Constrained Forecasts for Alternative 2

Table 25 and **Figure 15** summarize the constrained forecast based aircraft for Alternative 2. The approach is similar to the Proposed Project.

Before construction commences in 2019, the number of based aircraft increases following the estimate for the No Project Alternative. By opening day (i.e. 2025), the number of single engine aircraft will be constrained by the estimated capacity. Hence, during the construction period (i.e. from 2019 to 2024), approximately 124 single engine based aircraft and four turboprops will be relocated to other airports due to a lack of parking spaces.[5] A constant rate of decline from 2018 to 2025 is assumed during construction.

As show in **Table 25** and **Figure 15**, the growth of jet aircraft will reach capacity in the near term, and there will be no growth for helicopters. Although multi-engine piston aircraft will have capacity to grow in the long term under Alternative 2 based on the capacity analysis, the four vacant spaces for multi-engine piston aircraft will likely be occupied by existing single engine based aircraft. It is anticipated that all of the 361 based aircraft parking spaces will be fully occupied by opening day.

Table 25: SNA Constrained Forecast Based Aircraft by Type–Alternative 2

Year	Fixed Wing Piston*		Fixed Wing Turbine		Helicopter	Total Based Aircraft
	Single Engine	Multi-Engine	Turboprop	Turbo Jet		
Capacity	211	41	22	70	17	**361**
2016	339	35	26	65	17	**482**
2021**	281	36	24	67	17	**425**
2026***	215	37	22	70	17	**361**

*Note: The fleet mix distributions may not match the sum totals in previous tables due to rounding.. * The based aircraft totals for single engine include one motor glider. ** No. of based aircraft in 2021 (during construction) assumes constant rate of decline from 2018 (year before construction) to 2025 (opening year). *** Assume 4 existing SE Piston aircraft will park at the vacant spaces for ME Piston aircraft and fill up the capacity.*

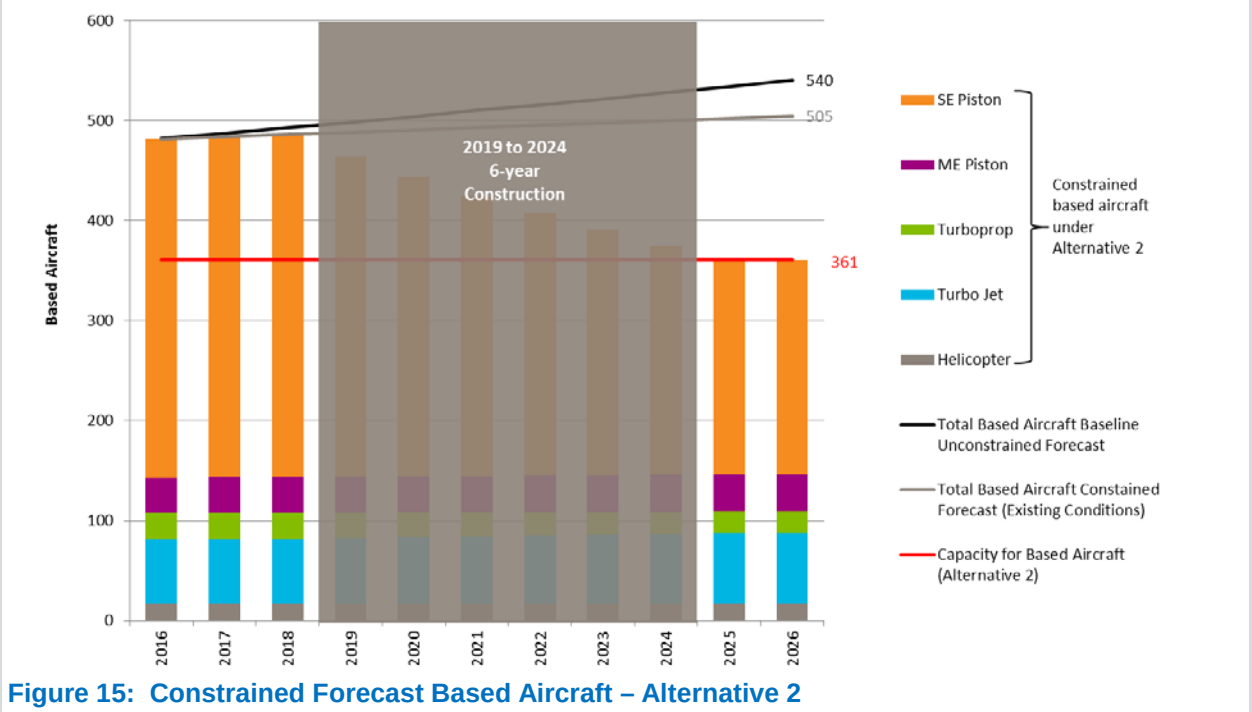

Figure 15: Constrained Forecast Based Aircraft – Alternative 2

[5] The actual number of based aircraft to be relocated during construction will depend on the actual number of based aircraft before construction. The 124 SE piston aircraft and 4 turboprops to be relocated were estimated based on the difference between 2016 and 2025. For simplicity, it ignores the potential growth between 2016 and the year construction commences.

The methodology for estimating the annual operations is similar to the No Project Alternative.

Table 26 and **Figure 16** present the estimated annual operations with breakdowns for local, itinerant general aviation, and air taxi operations for Alternative 2. **Table 27** summarizes the annual operations by aircraft engine type.

Table 26: SNA Constrained Forecast General Aviation and Air Taxi Operations–Alternative 2

Year	Air Taxi	General Aviation	General Aviation	Total Operations
		Itinerant	Local	
2016	15,400	90,900	86,500	**192,800**
2021	16,900	90,400	77,600	**184,900**
2026	18,600	88,000	62,800	**169,400**

Table 27: SNA Constrained Forecast Operations by Aircraft Engine Type–Alternative 2

Year	Piston	Turbine	Jet	Helicopter/Other	Total Operations
2016	147,300	9,800	31,800	3,900	**192,800**
2021	135,000	10,000	35,600	4,300	**184,900**
2026	114,700	10,000	39,900	4,800	**169,400**

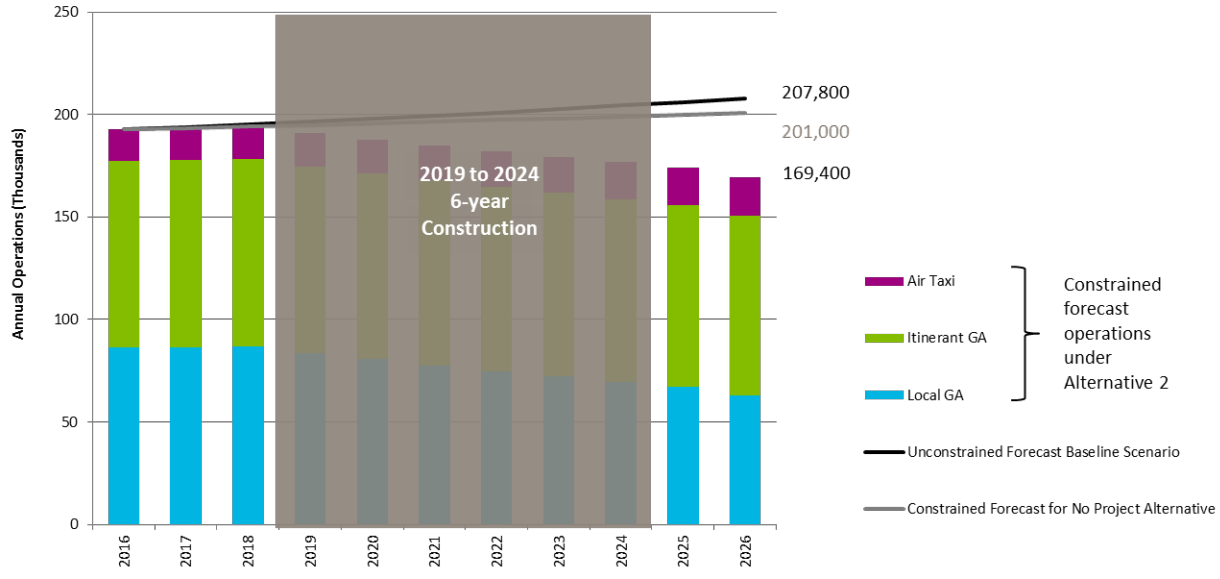

Figure 16: Constrained Forecast Operations – Alternative 2

3.6. Constrained Forecasts for Alternative 3

Table 28 and **Figure 17** summarize the constrained forecast based aircraft for Alternative 3. The approach is similar to the Proposed Project.

Before construction commences in 2019, the number of based aircraft increases following the estimate for the No Project Alternative. By opening day (i.e. 2025), the number of turboprops, jet aircraft, and helicopters will be constrained by the estimated capacity. Hence, during the construction period (i.e. from 2019 to 2024), seven based turboprops, seven jet aircraft, and one helicopter (total 15 based aircraft) will be relocated to other airports due to a lack of parking spaces.[6] A constant rate of decline from 2018 to 2025 is assumed during the construction.

As show in **Table 28** and **Figure 17**, single engine and multi-engine piston aircraft will have capacity to grow in the long term under Alternative 3.

Table 28: SNA Constrained Forecast Based Aircraft by Type–Alternative 3

Year	Fixed Wing Piston*		Fixed Wing Turbine		Helicopter	Total Based Aircraft
	Single Engine	Multi-Engine	Turboprop	Turbo Jet		
Capacity	413	48	19	58	16	**554**
2016	339	35	26	65	17	**482**
2021**	349	36	23	62	17	**487**
2026	360	37	19	58	16	**490**

*Note: The fleet mix distributions may not match the sum totals in previous tables due to rounding. * The based aircraft totals for single engine include one motor glider. ** No. of based aircraft in 2021 (during construction) assumes constant rate of decline from 2018 (year before construction) to 2025 (opening year).*

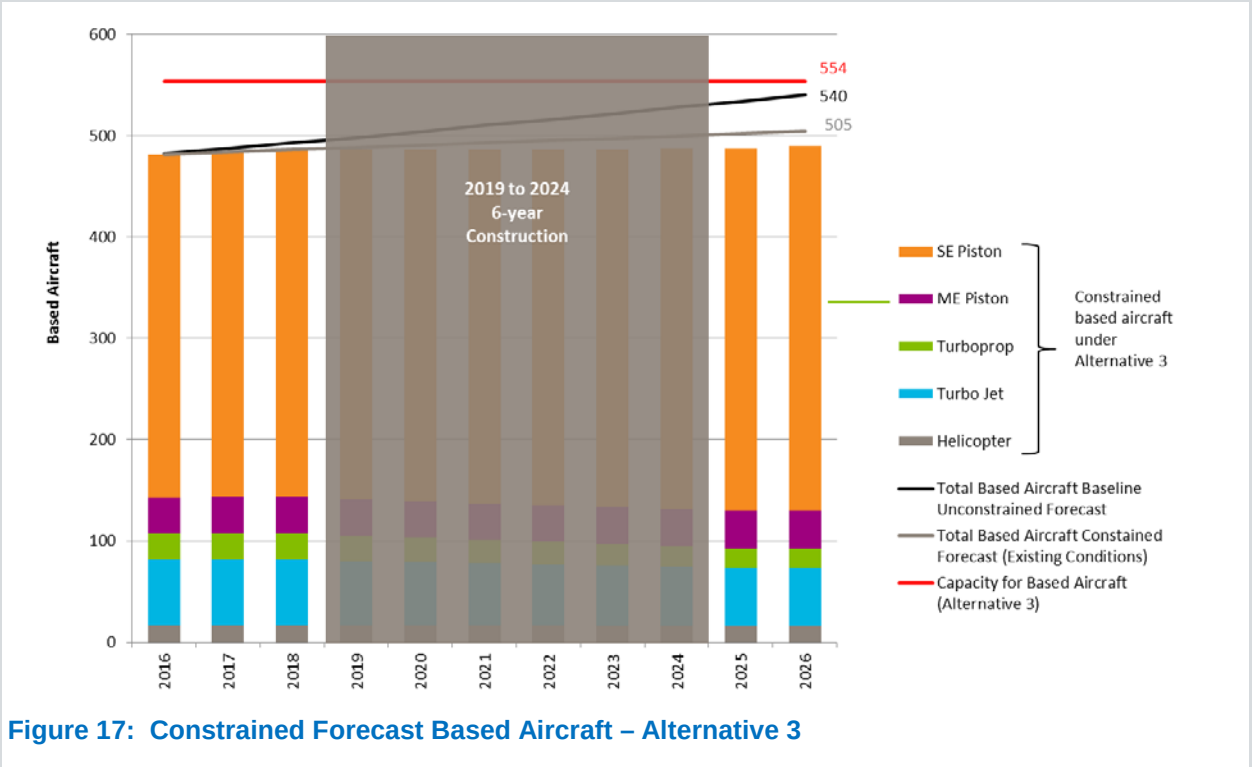

Figure 17: Constrained Forecast Based Aircraft – Alternative 3

[6] The actual number of based aircraft to be relocated during construction will depend on the actual number of based aircraft before construction. The 7 based turboprops, 7 jet aircraft, and 1 helicopter to be relocated were estimated based on the difference between 2016 and 2025. For simplicity, it ignores the potential growth between 2016 and the year construction commences.

The methodology for estimating the annual operations is similar to the No Project Alternative.

Table 29 and **Figure 18** present the estimated annual operations with breakdowns for local, itinerant general aviation, and air taxi operations for Alternative 3. **Table 30** summarizes the annual operations by aircraft engine type.

Table 29: SNA Constrained Forecast General Aviation and Air Taxi Operations–Alternative 3

Year	Air Taxi	General Aviation	General Aviation	Total Operations
		Itinerant	Local	
2016	15,400	90,900	86,500	**192,800**
2021	16,700	92,600	86,100	**195,400**
2026	18,000	94,400	85,200	**197,600**

Table 30: SNA Constrained Forecast Operations by Aircraft Engine Type–Alternative 3

Year	Piston	Turbine	Jet	Helicopter/Other	Total Operations
2016	147,300	9,800	31,800	3,900	**192,800**
2021	147,000	9,800	34,400	4,200	**195,400**
2026	147,000	9,500	36,400	4,700	**197,600**

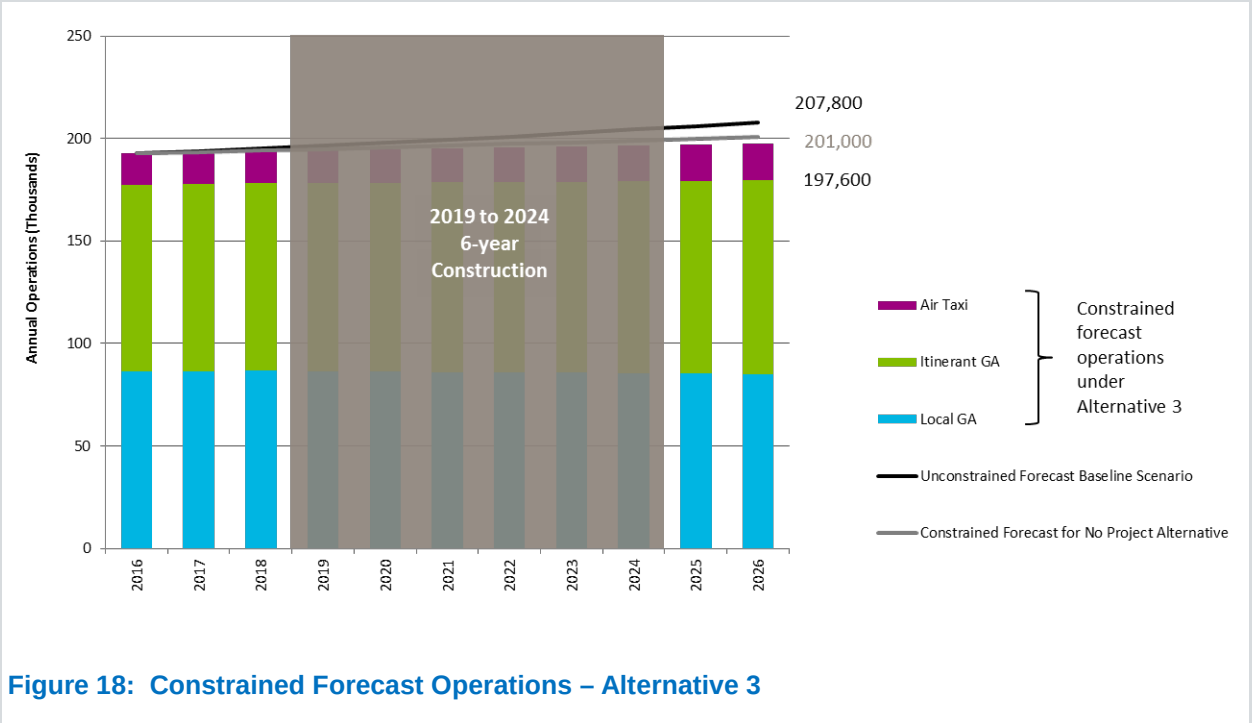

Figure 18: Constrained Forecast Operations – Alternative 3