5.1.1.5 Option 5 Characteristics

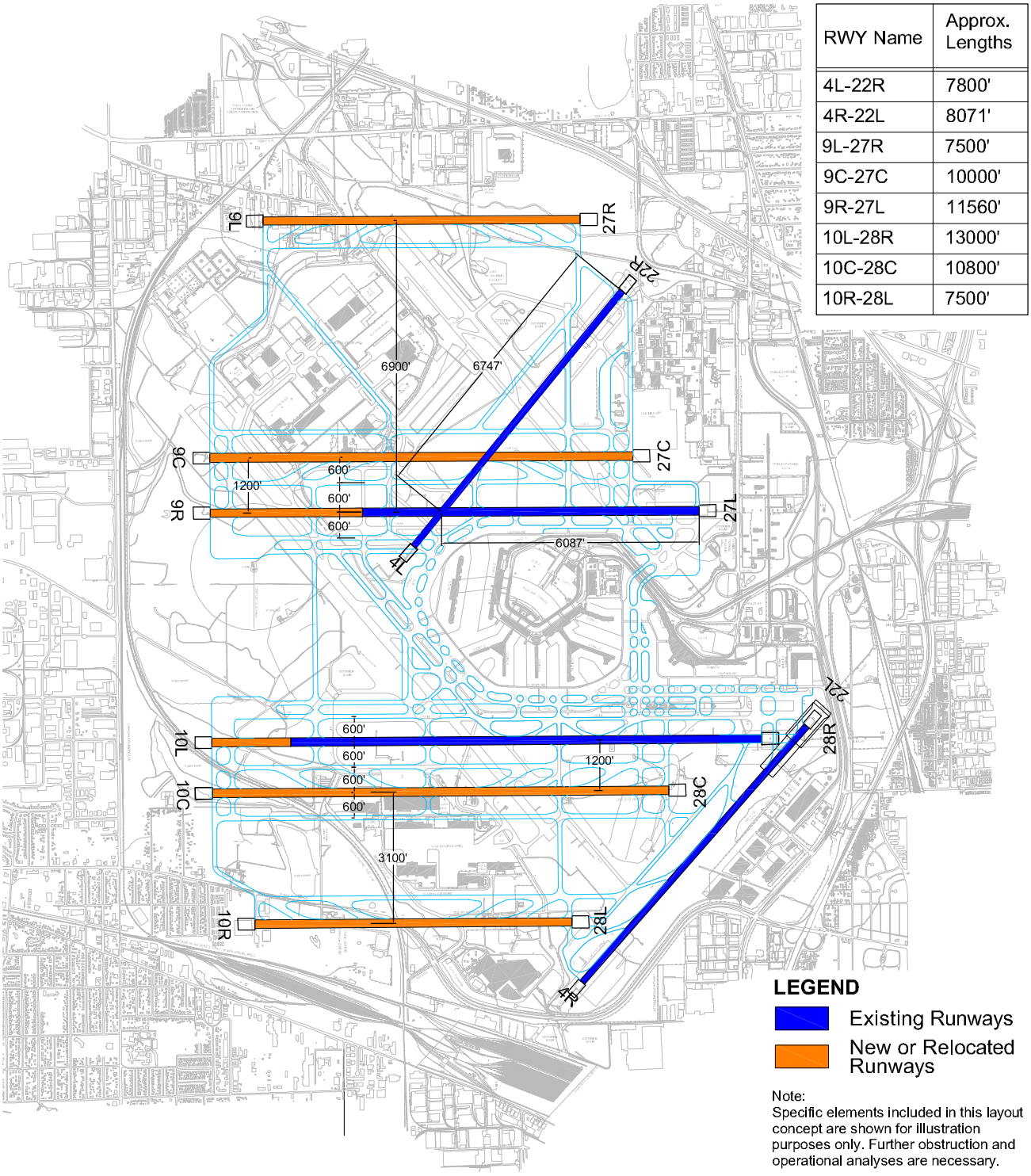
Option 5, depicted in **Exhibit V-13**, is an eight-runway configuration that includes six parallel runways in an east-west direction and two runways in the 4-22 orientation. The primary objectives of the Option 5 airfield layout are to reduce existing IFR delays, increase both IFR and VFR capacity to satisfy future demand, maintain balanced arrival/departure throughput capability, reduce the number of runway intersections, minimize the number of active runway crossings, maximize the flexibility of using runways for either arrivals or departures, and provide accommodations for future ADG VI aircraft.

The characteristics of Option 5 include the addition of four new runways parallel to one of the existing runway pairs oriented to take full advantage of wind coverage in all weather conditions. Based on weather data and existing layout, a 9-27 orientation was determined to meet this criteria. With the addition of these runways, it was necessary to relocate/decommission Runways 14R-32L and 14L-32R, thus eliminating runway intersections. This layout could provide a balanced VFR or IFR arrival/departure capability by utilizing three dedicated arrival runways and three dedicated departure runways during IFR. With FAA approval, this concept could produce a fourth arrival stream during certain conditions.

Characteristics of Option 5 include:

- New Runway 9L-27R, constructed 6,900 feet north of Runway 9R-27L (formerly Runway 9L-27R), is 200 feet wide and 7,500 feet long. A full length, 100-foot wide parallel taxiway is provided at a 600-foot centerline separation. Connecting and high-speed exit taxiways are provided as appropriate for the runway length and expected operating patterns. The runway and associated taxiways meet ADG VI standards.
- Existing Runway 14L-32R is relocated to Future Runway 9C-27C, 1,200 feet north of Runway 9R-27L (formerly Runway 9L-27R). The runway is 200 feet wide and 10,000 feet long and is served by 100-foot wide parallel taxiways to the north and south, both at 600-foot runway-to-taxiway centerline separations. Connecting, bypass, and high-speed exit taxiways are provided as appropriate for the runway length and expected operating patterns. The runway and associated taxiways meet ADG VI standards.
- Existing Runway 9L-27R (future Runway 9R-27L) is extended 3,594 feet to the west to a new length of 11,560 feet. The associated parallel taxiway is also extended and additional connecting, bypass, and high-speed exit taxiways appropriate to the new runway length and expected operational patterns are provided. The runway extension and associated taxiways meet ADG V standards.
- Existing Runway 9R-27L (future Runway 10L-28R) is extended 2,859 feet to a new length of 13,000 feet. The associated parallel taxiway is also extended and additional connecting, bypass, and high-speed exit taxiways appropriate to the new runway length and expected operating patterns are provided. The runway extension and associated extended taxiways meet ADG VI standards.
- Existing Runway 18-36 is relocated to Future Runway 10C-28C, 1,200 feet south of Runway 10L-28R (formerly Runway 9R-27L). The runway is 10,800 feet long and 200 feet wide and is served by a full length, 100-foot wide parallel taxiway at a 600-foot centerline separation. Connecting, bypass, and high-speed exit taxiways are provided as appropriate for the runway

RWY Name	Approx. Lengths
4L-22R	7800'
4R-22L	8071'
9L-27R	7500'
9C-27C	10000'
9R-27L	11560'
10L-28R	13000'
10C-28C	10800'
10R-28L	7500'



Source: Ricondo & Associates, Inc.; Martinez Corp. Aerial Photography (1996); Department of Aviation Airport Management and Records

Prepared by: Ricondo & Associates, Inc.

Exhibit V-13

0 3600 ft.

north

Option 5

length and expected operating patterns. The runway and associated taxiways meet ADG VI standards.

- Existing Runway 14R-32L is relocated to Future Runway 10R-28L, 4,300 feet south of Runway 10L-28R (formerly Runway 9R-27L). The runway is 7,500 feet long and 200 feet wide and is served by a full length, 100-foot wide parallel taxiway to the north at a 600-foot centerline separation. Connecting and high-speed exit taxiways are provided as appropriate for the runway length and expected operating patterns. The runway and associated taxiways meet ADG VI standards.
- Certain combinations of four of the six runways in the 9-27 (10-28) orientation, at runway-to-runway centerline separations ranging from 3,035 feet to 8,223 feet, exceed the recommended separation of 2,500 feet for quadruple simultaneous VFR approaches.
- Certain combinations of three of the six parallel runways in the 9-27 (10-28) orientation, at separations ranging from 4,300 feet to 12,316 feet, meet or exceed the minimum 4,300-foot separation requirement for triple simultaneous IFR approaches.

Exhibit V-14 illustrates estimated typical runway operating configurations and taxi flow patterns associated with Option 5 under both VFR and IFR conditions and east and west operating flow patterns.

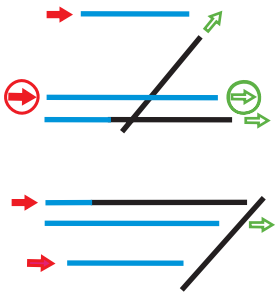
5.1.2 Operational Refinements

The airfield layouts for Options 1, 2, 3, 4, and 5 were presented to the FAA and airline representatives during several advisory sessions. Based on these sessions, it was determined that three of the five options (Options 1, 2, and 5) would undergo additional analyses, including simulation modeling, to identify operational benefits. Because Option 3 is a variation of Option 2 with existing Runway 9L-27R relocated north to provide dual taxiways around the north side of the terminal area, it was decided that Option 3 would be simulated only if taxiway congestion in the area north of the terminal was experienced. Option 4 was dropped from consideration based on FAA guidance regarding taxi movements in RPZs. On March 12, 2002, the FAA Chicago Airports District Office (ADO) indicated that taxi movements on perimeter taxiways that are located inside the RPZ of an active runway would be treated as controlled, dependent crossings. Given that the perimeter taxiway around the future Runway 27L end in Option 4 was already at the expense of Bessie Coleman Drive and the rental car parking area, little opportunity was available for modifications to avoid the RPZ. As such, benefits associated with the perimeter taxiway were limited. Through these advisory sessions, refinements to airfield Options 1, 2, and 5 were developed and are depicted in **Exhibits V-15** through **V-17**.[1] Specific refinements depicted on these exhibits include the following:

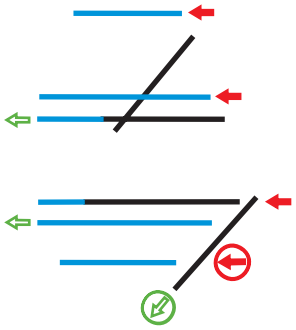
- *ADG VI Runways and Taxiways:* Given the uncertainty surrounding ADG VI levels of aircraft operations, it was decided not to develop all new facilities to accommodate their operation. Runways 10C-28C and 9C–27C under Options 2 and 5 were designated for ADG VI operations and these runways and their associated taxiways were depicted to meet ADG VI requirements. In Option 1, only Runway 10R-28L would meet ADG VI requirements.

[1] Discussion on the various refinements investigated as part of the advisory sessions are included in the *Concept Development/Refinement Report*, February 2003 DRAFT, Ricondo & Associates, Inc., and in advisory session discussion outlines.

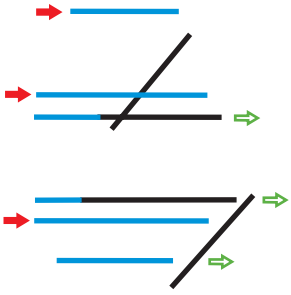
VFR East



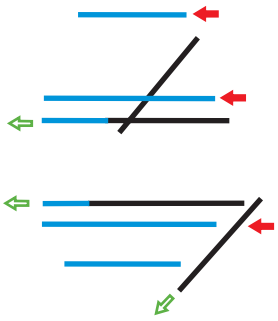
VFR West



IFR East



IFR West



LEGEND

- Existing Runways
- Proposed Runways
- Primary Arrival Runway
- Primary Departure Runway
- Overflow Arrival Runway
- Overflow Departure Runway

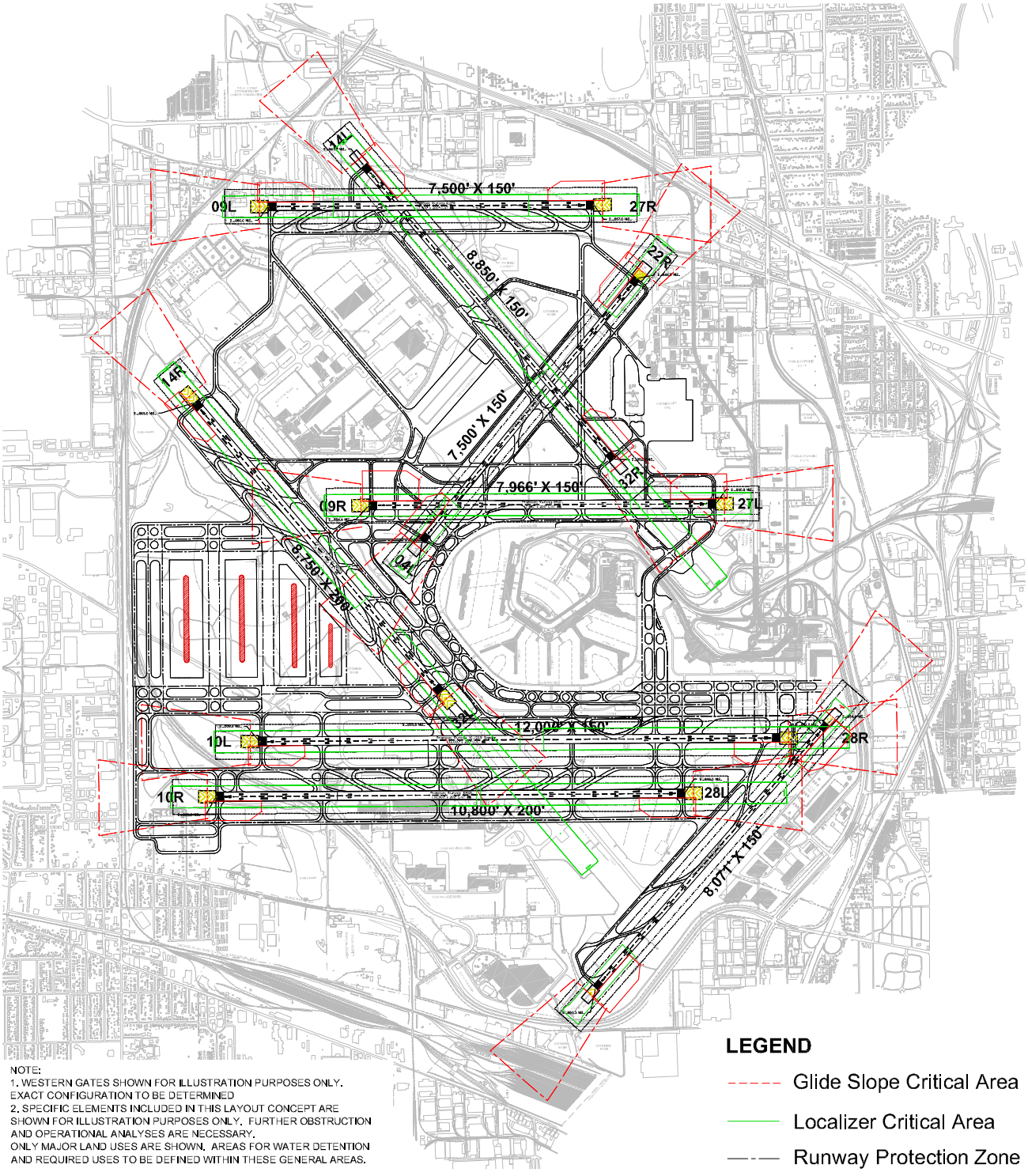
Sources: O'Hare Air Traffic Workgroup
Prepared by: Ricondo & Associates, Inc.

Exhibit V-14

0 N.T.S.

north

Operating Configurations Option 5



NOTE:
1. WESTERN GATES SHOWN FOR ILLUSTRATION PURPOSES ONLY. EXACT CONFIGURATION TO BE DETERMINED
2. SPECIFIC ELEMENTS INCLUDED IN THIS LAYOUT CONCEPT ARE SHOWN FOR ILLUSTRATION PURPOSES ONLY. FURTHER OBSTRUCTION AND OPERATIONAL ANALYSES ARE NECESSARY. ONLY MAJOR LAND USES ARE SHOWN. AREAS FOR WATER DETENTION AND REQUIRED USES TO BE DEFINED WITHIN THESE GENERAL AREAS.

LEGEND

- Glide Slope Critical Area
- Localizer Critical Area
- Runway Protection Zone

Source: Ricondo & Associates, Inc.; Martinez Corp. Aerial Photography (1996); Department of Aviation Airport Management and Records

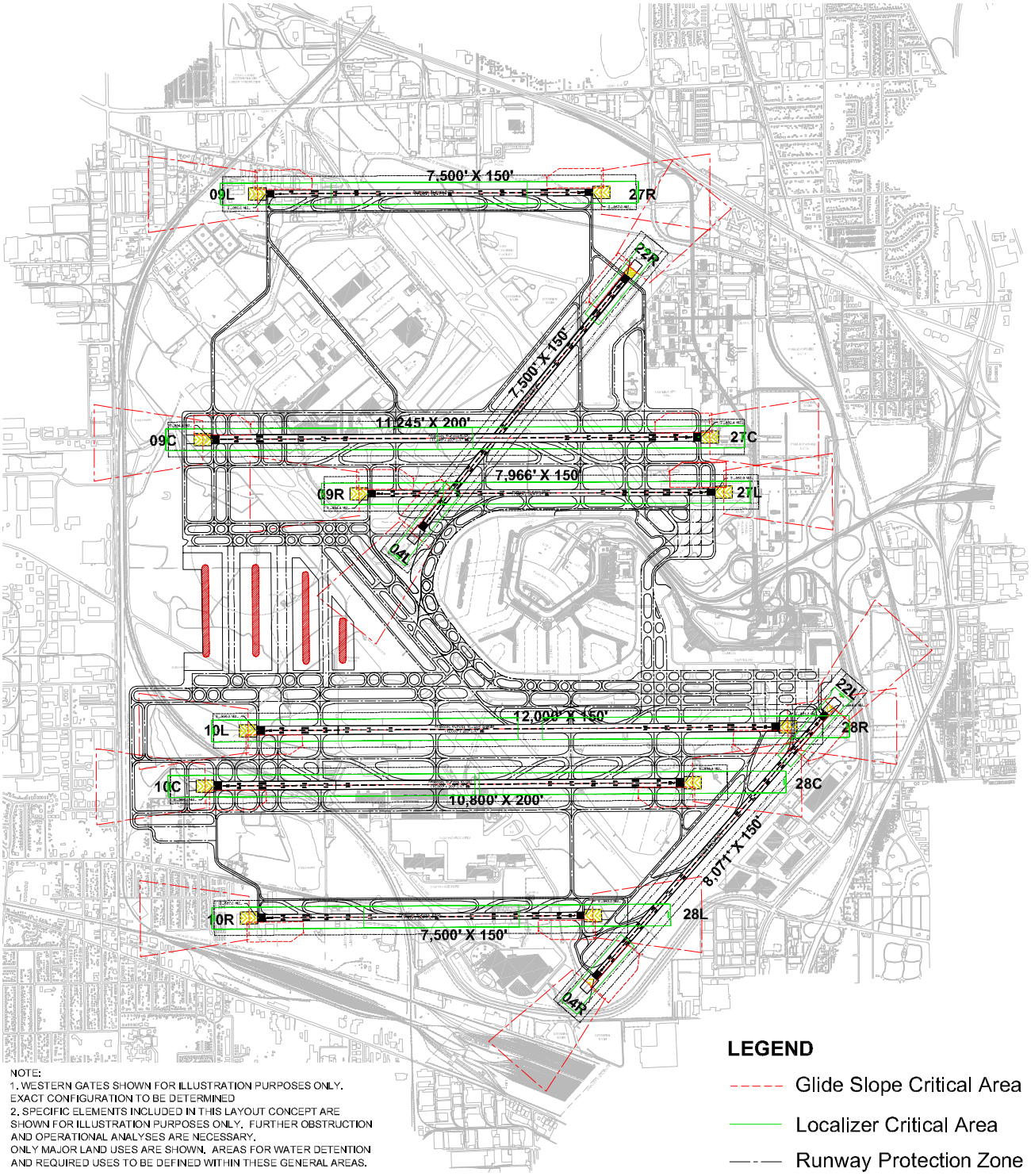
Prepared by: Ricondo & Associates, Inc.

Exhibit V-15

0 3500 ft.

north

Option 1 Refinements



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1. WESTERN GATES SHOWN FOR ILLUSTRATION PURPOSES ONLY. EXACT CONFIGURATION TO BE DETERMINED
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LEGEND

- Glide Slope Critical Area
- Localizer Critical Area
- Runway Protection Zone

Source: Ricondo & Associates, Inc.; Martinez Corp. Aerial Photography (1996); Department of Aviation Airport Management and Records

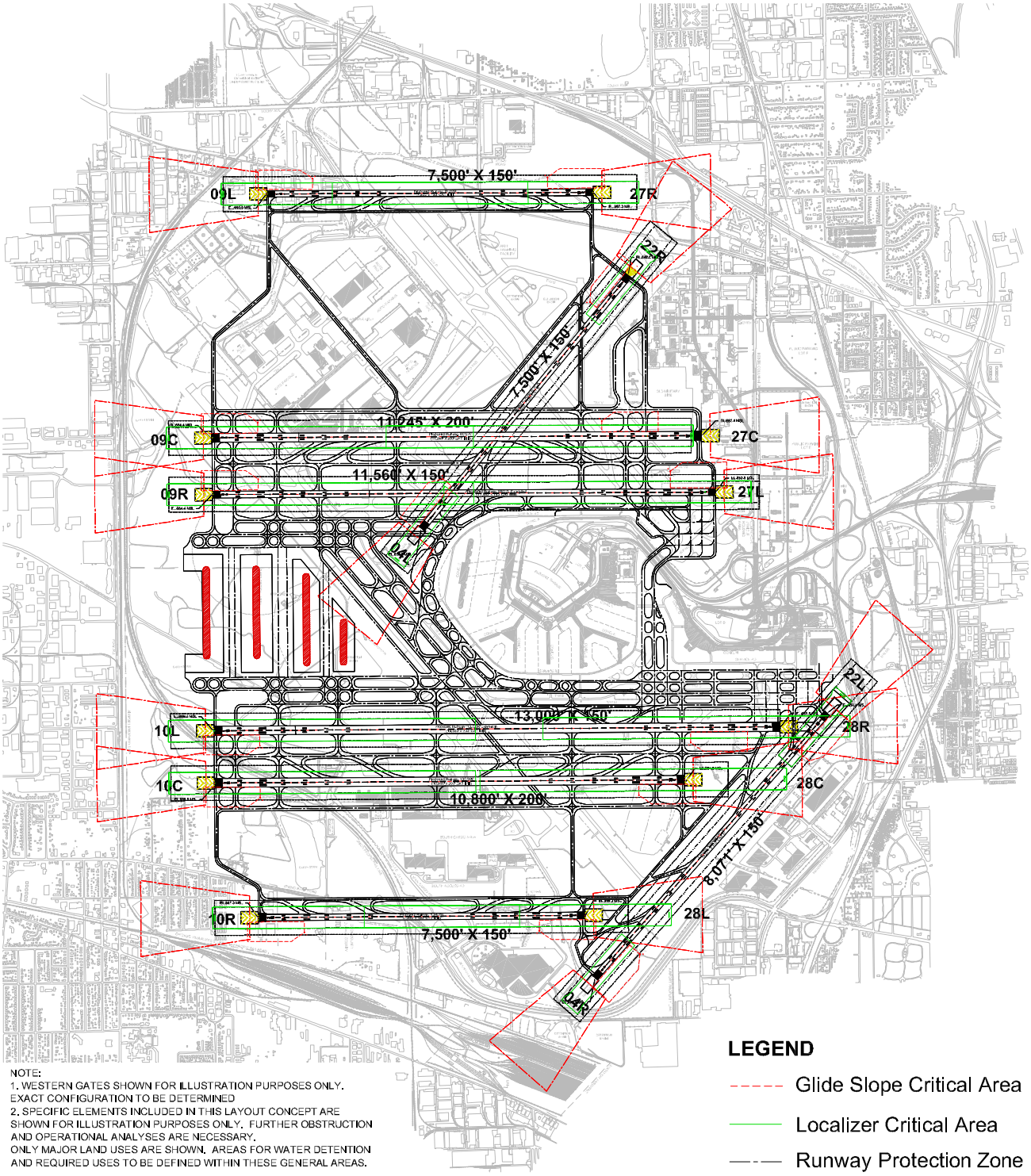
Prepared by: Ricondo & Associates, Inc.

Exhibit V-16

0 3500 ft.

north

Option 2 Refinements



NOTE:
1. WESTERN GATES SHOWN FOR ILLUSTRATION PURPOSES ONLY. EXACT CONFIGURATION TO BE DETERMINED
2. SPECIFIC ELEMENTS INCLUDED IN THIS LAYOUT CONCEPT ARE SHOWN FOR ILLUSTRATION PURPOSES ONLY. FURTHER OBSTRUCTION AND OPERATIONAL ANALYSES ARE NECESSARY. ONLY MAJOR LAND USES ARE SHOWN. AREAS FOR WATER DETENTION AND REQUIRED USES TO BE DEFINED WITHIN THESE GENERAL AREAS.

LEGEND

- Glide Slope Critical Area
- Localizer Critical Area
- Runway Protection Zone

Source: Ricondo & Associates, Inc.; Martinez Corp. Aerial Photography (1996); Department of Aviation Airport Management and Records

Prepared by: Ricondo & Associates, Inc.

Exhibit V-17

0 3500 ft.

north

Option 5 Refinements

- *Option 5, Runway 9C-27C Length:* Runway 9C-27C was initially assumed to be an arrival runway and planned for development at 10,000 feet. Subsequent coordination with FAA ATCT indicated a desire to conduct intersection departures on this runway under certain weather conditions. To facilitate this operation, the runway was extended to the east for an overall length of 11,245 feet.

Prior to the commencement of simulation analysis, the FAA issued a determination relative to a geometric/operational characteristic inherent in Option 2 that significantly impacted its operational benefits. As proposed, Option 2 utilized perimeter taxiways around the runway ends and RPZs to facilitate aircraft movements to and from the outboard runways. In August 2002, FAA Flight Technologies and Procedures Division (FS-400) issued an interpretation of standards that required taxiing aircraft to be positively controlled to cross an extended runway centerline up to 6,000 feet from the runway threshold, which effectively negated the benefits of the perimeter taxiways. Additionally, staggered runway ends resulting from the development of the perimeter taxiways produced wake turbulence dependencies in certain operating configurations reducing runway throughput. These operational constraints were discussed with the FAA and airline representatives during an advisory session and it was determined that Option 2 was no longer an operationally desirable alternative and, thus, was not the subject of further simulation analysis.

5.1.3 Simulation

This section describes findings of the airfield and airspace simulation analysis in terms of operating characteristics of the airfield alternatives, aircraft throughput, and delay and travel times.[2]

The Total Airspace and Airport Modeler (TAAM) Plus model was used in this simulation analysis. TAAM is capable of modeling the entire airspace and airport environment including gates, terminals, pushbacks, taxiways, runways, and terminal and en route airspace. TAAM is capable of, but not limited to, considering and analyzing the following procedural issues:

- Separation standards, such as wake turbulence, runway separation criteria, and in-trail separation;
- Aircraft performance criteria, such as climb rates and approach speeds;
- Airline operations criteria, such as aircraft/airline specific gate assumptions, pushback procedures, and arrival/departure schedule linking; and
- Airfield operation standards such as runway crossing patterns, hold pads, restricted use taxiways, and runway queue balancing.

A post-processing program and template were prepared to facilitate the conversion of data from TAAM into charts and graphs that assessed the phases of operational delay listed in the previous section and throughput.

The objective of the simulation analysis was to evaluate and compare the operational performance of the airfield associated with the Base Case (Existing Airfield) and two alternatives, Options 1 and Option 5. These options were assessed for the following three PALs:

[2] The simulation analysis is detailed in *Airport Layout Plan Update, Airside Simulation Report*, January 2003 DRAFT, Ricondo & Associates, Inc.

- PAL 0 – Representing 2,745 daily operations or approximately 0.9 million annual operations
- PAL 1 – Representing 3,243 daily operations or approximately 1.1 million annual operations
- PAL 2 – Representing 3,864 daily operations or approximately 1.3 million annual operations

These activity levels are based on the FAA's 2001 TAF and extrapolations thereof. **Exhibits V-18** and **V-19** show the passenger enplanements and operations forecasts through 2030 used to define the PALs. **Table V-1** summarizes the aircraft fleet mix used in the simulations associated with each PAL. The aforementioned fleet mix is based on the gross weight of the aircraft, unlike the fleet mix in Section III, which is based on seating capacity.

Table V-1

Planning Activity Level Fleet Mixes – Daily Operations

		PAL 0		PAL 1		PAL 2	
Aircraft Type	Representative Aircraft	Aircraft Count	% of Total	Aircraft Count	% of Total	Aircraft Count	% of Total
New Large Aircraft	A380	0	0.0%	12	0.4%	26	0.7%
Heavy[1/]	A310, A330, A340, B-767, MD-11, B-757	201	7.3%	478	14.7%	690	17.9%
B-757	B-757	193	7.0%	268	8.3%	509	13.2%
Large[2/]	A319, A320, B-737, CD-9, MD-80, MD-90, CRJ, ERJ	2,184	76.6%	2,455	75.7%	2,617	67.7%
Small[3/]	BE-20, BE-40, C560, C650, C750, LJ45	167	6.1%	30	0.9%	22	0.6%
	Total	2,745	100.0%	3,243	100.0%	3,864	100.0%

1/ "Heavy" refers to aircraft greater than 255,000 pounds.

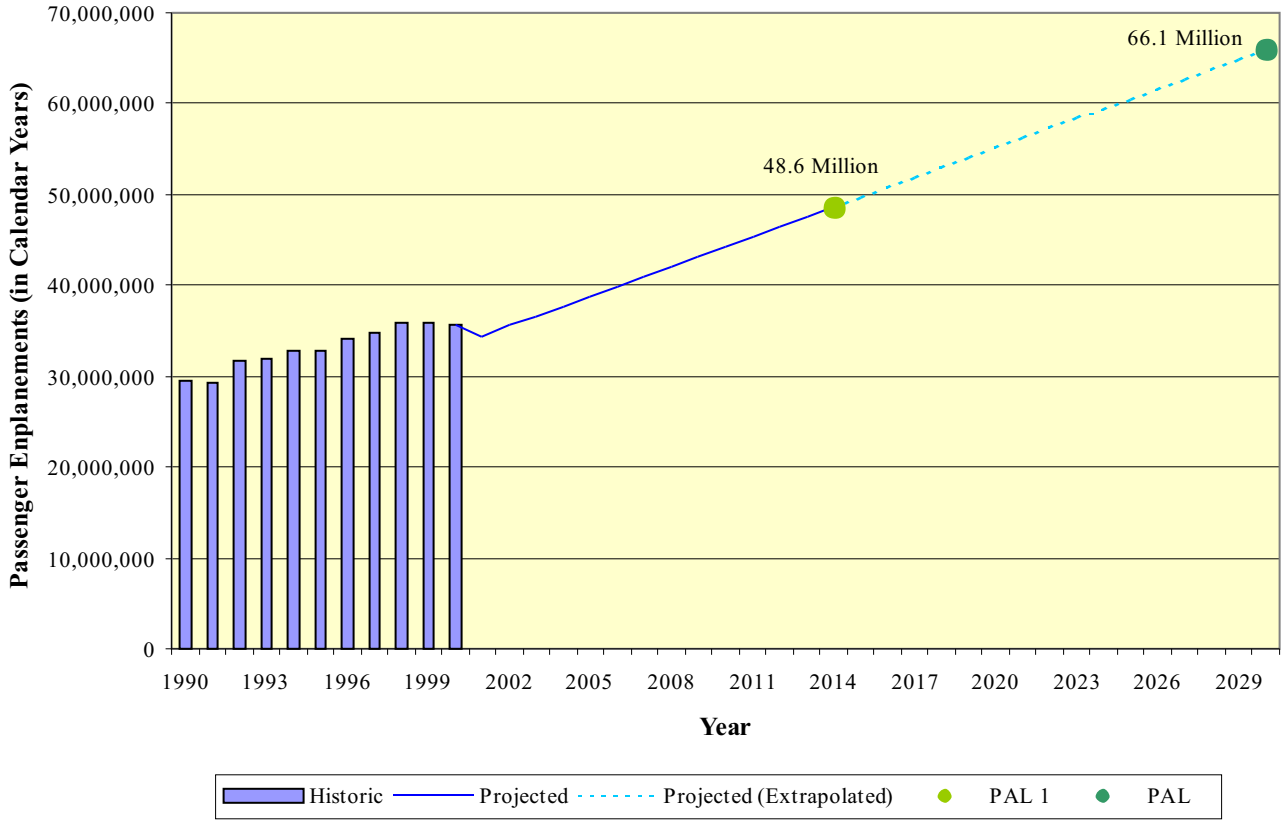
2/ "Large" refers to aircraft between 41,000 pounds and 255,000 pounds.

3/ "Small" refers to aircraft 41,000 pounds or less.

Source: FAA Order 7110.65N, Air Traffic Control, Appendix A.
Prepared by: Ricondo & Associates, Inc.

Airfield capacity can vary significantly due to the weather conditions experienced at the Airport. Wind (direction and speed) dictates which runways can be used for aircraft arrival and departure operations. Other meteorological conditions affecting airfield capacity include cloud ceiling height, visibility, and precipitation. Low cloud ceiling heights and visibility conditions preclude the use of visual separation rules resulting in increased spacing between aircraft in the airspace surrounding the Airport. Wet runways prevent the use of LAHSO runway use procedures. For the purpose of this analysis, two operating conditions, VFR and IFR operations, are assumed based on cloud ceiling height and visibility.

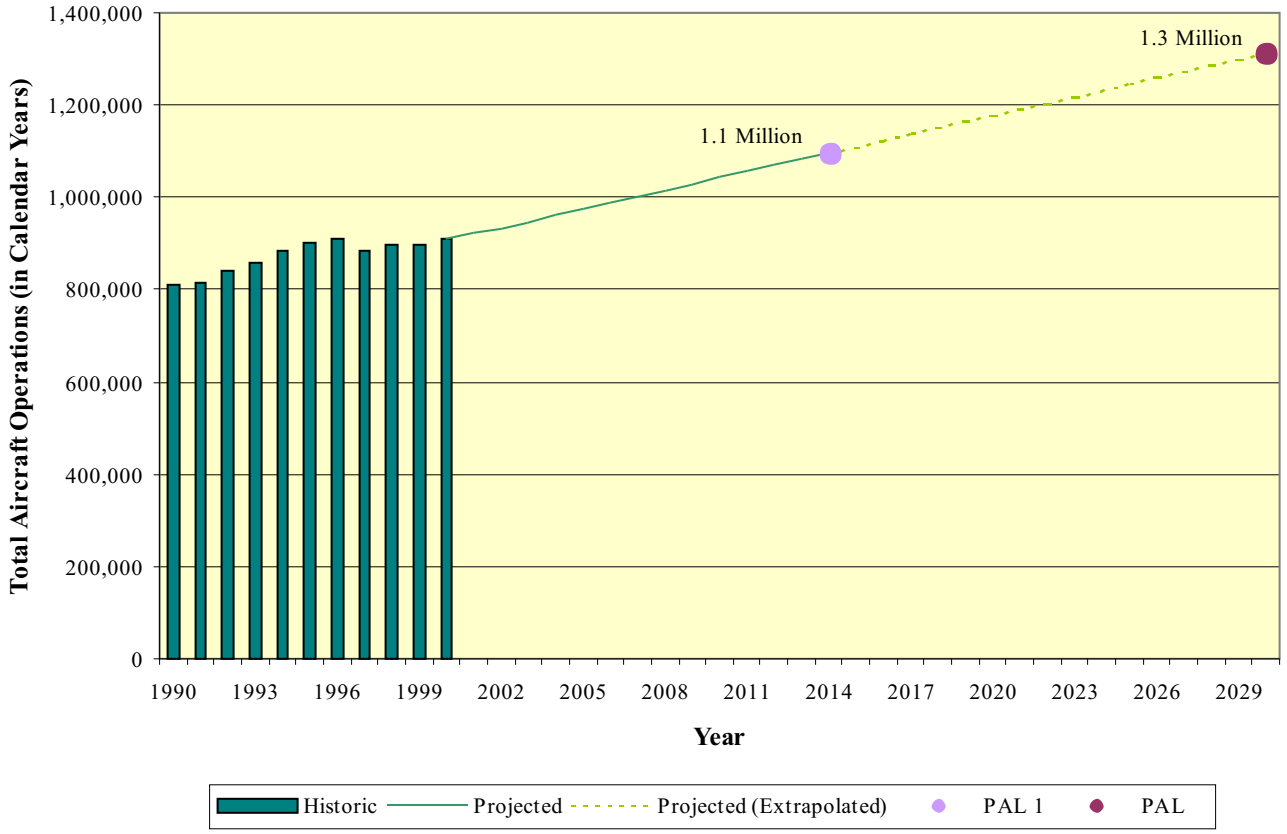
VFR governs the procedures used to conduct flight operations under VMC. IFR governs the procedures used to conduct flight operations under IMC. The criteria for establishing the two operating conditions are summarized in **Table V-2**. Wind and weather data used in the analysis represent 10 years of hourly observations collected by the National Oceanic and Atmospheric



Source: Historical- City of Chicago DOA Management Records; Projected- FAA Terminal Area Forecasts; Projected (Extrapolated)- Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

Exhibit V-18

2001 FAA Terminal Area Forecasts
Passenger Enplanements in Calendar Years



Source: Historical- City of Chicago DOA Management Records; Projected- FAA Terminal Area Forecasts; Projected (Extrapolated)- Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

Exhibit V-19

2001 FAA Terminal Area Forecasts
Total Aircraft Operations in Calendar Years

Administration at the Airport between January 1991 and December 2000. This data was analyzed to determine the nature, frequency, and duration of weather conditions that influence aircraft operations. The analysis focused on the direction and velocity of the wind, cloud ceiling height, and visibility conditions.

Table V-2

Operating Conditions for Airfield Capacity and Aircraft Delay Analysis

Classification	Percent Occurrences	Weather Conditions		
		Visibility		Cloud Ceilings
VMC	90.75%	Greater than or equal to 3 statute miles	and	Greater than or equal to 1,000 feet AGL
IMC	9.25%	Less than 3 statute miles	and/or	Less than 1,000 feet

Source: FAA Advisory Circular 150/5060-5, Aircraft Capacity and Delay; Weather data from the National Oceanic and Atmospheric Administration for period January 1991 and December 2000
Prepared by: Ricondo & Associates, Inc.

5.1.3.1 Operating Characteristics of Simulated Alternatives

The airfield layout concepts, Option 1 and Option 5, share many of the same attributes and utilize the same proposed airspace structure. Arriving aircraft would use airspace procedures similar to the existing procedures (i.e., corner post structure, with some exceptions necessitated by the requirements to route aircraft to the center runways and accommodate additional departure tracks in both the east, west, and south directions).

Aircraft departing the Airport would continue to exit TRACON airspace along broad departure corridors aligned with the four cardinal directions (i.e., north, east, south, and west). Departures would be positioned in departure corridors consistent with their direction of flight and would be cleared to initial altitudes consistent with the current operating environment.

Based on the information provided by the FAA Great Lakes Region Air Traffic Division, the proposed airspace and procedural environment described above is consistent with current planning associated with the National Airspace Redesign (NAR).

Other shared attributes of the alternatives include the development of taxi flows that minimize runway crossings to the maximum extent possible. LAHSO procedures and intersection departures are used to facilitate unimpeded movement on the airfield. Each alternative could accommodate simultaneous triple approaches regardless of weather condition.

5.1.3.2 Simulation Results

This section summarizes the statistics obtained from the simulation runs.

5.1.3.2.1 Throughput

Throughput rates (numbers of arriving and departing aircraft in peak hours) were assessed based on the simulation analysis of the Base Case (Existing Airfield) and Options 1 and 5. The maximum throughput rates observed during simulation are presented in **Table V-3**.

It should be noted that throughput rates may not reflect true airfield capacity as simulation throughput rate is an interaction between airfield capacity and operational demand and subject to the characteristics of scheduled operations. Only if demand were balanced between arrival and departure

operations for the duration of one hour or more would simulation throughput approximate balanced airfield capacity. This is unlikely to occur in everyday operations due to schedule banking that results in distinct periods of high arrival or either high departure demand, but rarely both simultaneously. For this reason, delay is the measure most used to describe airfield performance.

Table V-3

Simulation Throughput Rates for Scheduled Peak Rolling Hour (operations per hour)

Airfield Layout	Operating Configuration	Weather	Peak Arrivals	Peak Departures	Peak Total Operations
Base Case	Plan X	VFR	112	136	216
	Plan W	VFR	118	112	213
	Plan B	VFR	105	123	206
	Plan B Modified	VFR	117	107	213
	Parallel 27s	IFR	83	109	183
	Parallel 14s	IFR	76	92	168
Option 1	East Flow	VFR	116	129	238
	West Flow	IFR	103	120	203
Option 5	East Flow	VFR	142	144	274
	West Flow	VFR	144	150	270
	East Flow	IFR	117	127	234
	West Flow	IFR	117	125	232

Sources: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

5.1.3.2.2 Delay

Delay is the additional operating time attributable to any impediment to the free flow of aircraft through the system. Unimpeded travel time is the time it would take an aircraft to travel from Point A to Point B if it were the only aircraft in the system. Increases in the travel time from Point A to Point B as a result of interactions with other aircraft in the system are considered delays. Thus, total delay for any given aircraft is the difference between the actual time it takes the aircraft to get from Point A to Point B while interacting with other aircraft and the unimpeded time it would theoretically take the aircraft to get from Point A to Point B without other aircraft in the system.

For statistical purposes, this total delay was averaged across all aircraft moving through the system in the simulation day. Total delay is a combination of various key delay components, defined below, including:

- *Departure gate delay:* For departing aircraft, this delay is the extra time incurred after the aircraft is ready to push back from the gate due to other ground traffic preventing the movement. This delay is zero for all arriving aircraft.
- *Departure ground delay:* For departing aircraft, this is the total delay incurred between the time the flight completes its push back from the departure gate until it lifts off. Departure

ground delay includes the sum of taxi-out delay, runway crossing delay, and runway queue delay. This delay is zero for all arriving aircraft.

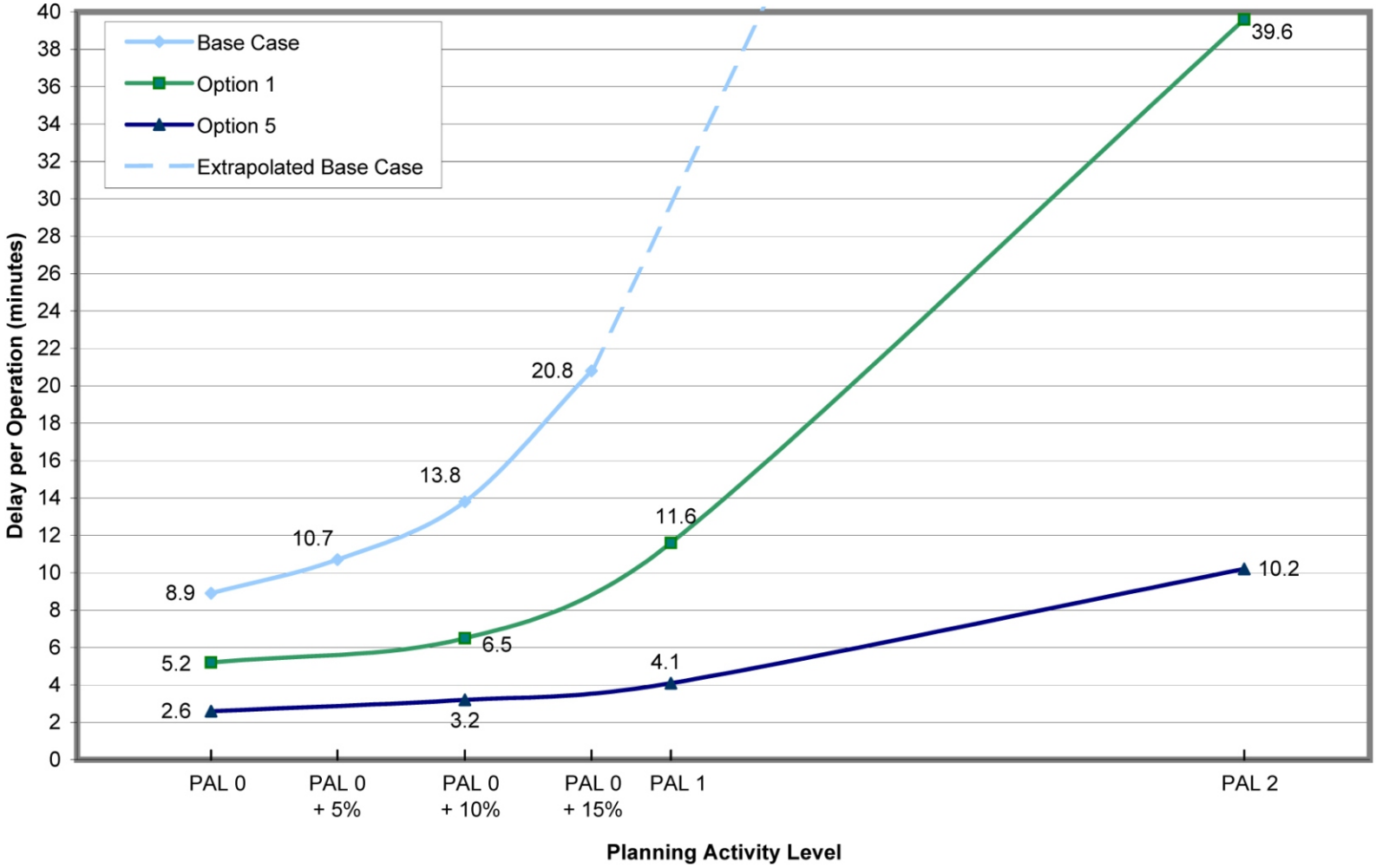
- *Arrival pre-departure ground delay:* For arriving aircraft, this delay is the extra time incurred on the ground at the origin airport, after the scheduled departure time, due to a flow control program at O'Hare. This delay is zero for all departing aircraft.
- *Arrival air delay:* For arriving aircraft, this is the total airborne delay incurred due to holding, vectoring, and speed control within the sequencing boundary in the vicinity of O'Hare. This delay is the result of sequencing actions taken by aircraft to ensure proper spacing on final approach to the arrival runways. This delay is zero for all departing aircraft.
- *Arrival ground delay:* For arriving aircraft, this is the total delay incurred between the time the flight touches down on the runway at O'Hare and the time it reaches the arrival gate. Arrival ground delay includes taxi-in delay, standoff delay, and runway crossing delay. This delay is zero for all departing aircraft.

Once average delays were calculated for every configuration under a given airfield alternative, the numbers were annualized to obtain an overall delay picture for that alternative. Any given option has a number of different runway operating configurations that are used under varying weather conditions. The total delay was averaged across all operations for each configuration. This average was then multiplied by the percent of time each configuration would be used throughout a given year. The sum of these annualized averages across all configurations for a given option yields the annualized average total delay.

Some large delays may occur under certain configurations that are used only a small fraction of the time over a whole year. These high delay values will contribute a relatively small amount to the overall delay value because of the annualization effect. Conversely, smaller delays may occur under certain configurations that are used more frequently and may have more of an impact on overall delay values.

The annualized average delay values for the Base Case, Option 1, and Option 5 were calculated at the three PALs described earlier, as well as at some intermediate demand levels, to provide additional data for use in generating smoother delay curves. These additional demand levels included PAL 0+5 percent or 105 percent of the demand at PAL 0, PAL 0+10 percent or 110 percent of the demand at PAL 0, and PAL 0+15 percent or 115 percent of the demand at PAL 0. Annualized delay values for the Base Case, Option 1, and Option 5 at the indicated demand levels are shown in **Table V-4**. The annualized average delay curves, including all ground and airspace delay components for the Base Case, Option 1, and Option 5 are shown in **Exhibit V-20.**

Delay does not distinguish between or take into account changes in travel time caused by differing physical characteristics of the options or the change in travel patterns because of demand growth. Therefore, total travel time must be included as part of the delay analysis.



Source: TAAM Plus Simulation Runs
Prepared by: Ricondo & Associates, Inc.

Exhibit V-20

Annualized Average Delay
All Airport Operations

Table V-4

Annualized Average Delay

Airfield Option	Activity Level	Daily Simulated Operations	Average Delay per Phase of Operation (minutes per operation)			
			Gate	Taxi-Out/In	Airborne	Total
Base Case	PAL 0	2,745	2.8	3.0	3.1	8.9
	PAL 0 + 5%	2,882	3.5	3.7	3.4	10.7
	PAL 0 + 10%	3,020	4.9	4.8	4.1	13.8
	PAL 0 + 15%	3,157	9.7	5.9	5.2	20.8
Option 1	PAL 0	2,745	2.0	1.8	1.5	5.2
	PAL 0 + 10%	3,020	2.2	2.2	2.2	6.5
	PAL 1	3,243	3.1	4.5	4.0	11.6
	PAL 2	3,864	8.4	12.2	19.0	39.6
Option 5	PAL 0	2,745	0.5	1.1	1.0	2.6
	PAL 0 + 10%	3,020	0.6	1.3	1.3	3.2
	PAL 1	3,243	0.7	1.7	1.7	4.1
	PAL 2	3,864	1.6	4.2	4.5	10.2

Source: TAAM Plus simulation runs.
Prepared by: Ricondo & Associates, Inc.

5.1.3.2.3 Travel Time

The annualized unimpeded travel time is shown in **Table V-5** and **Exhibit V-21**. Two components comprise the total unimpeded travel times. The first being taxi-out/in time and the second being airborne time. Taxi-out/in time increases from the Base Case configurations to the two airfield alternatives, Options 1 and 5, due to longer taxi routes. Unimpeded airborne travel time increases at the higher demand levels due to a change in schedule assumptions (e.g., an increased percentage of international operations resulting in longer routes). To remove the affect of these longer routes in the PAL 1 and 2 schedules, an average unimpeded airborne travel time was calculated for each of the options at PAL 0 and PAL 0+10 percent demand levels. This average unimpeded airborne travel time was then substituted in Option 1 and Option 5 at the PAL 1 and PAL 2 demand levels in place of the actual unimpeded airborne travel times in these options. This allows a direct comparison of total travel times including delays with the Base Case. The adjusted total travel times are shown in **Table V-6** and **Exhibit V-22**.

Table V-5

Annualized Average Unimpeded Travel Time

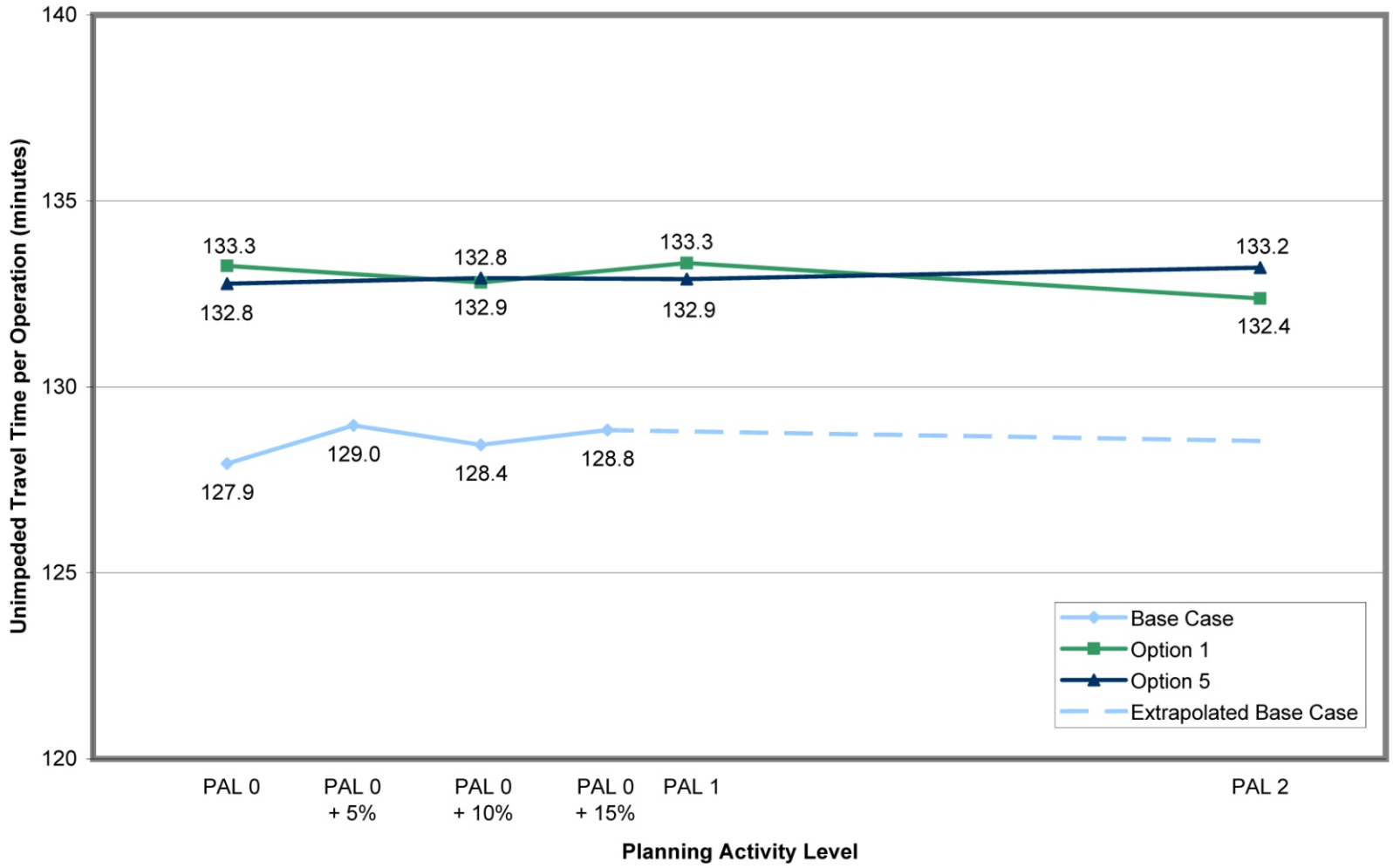
Airfield Option	Activity Level	Taxi-Out/In Time (min./op.)	Taxi-Out/In Delay (min./op.)	Unimpeded Taxi-Out/In Time (min./op.)	Airborne Time (min/op)	Airborne Delay (min/op)	Unimpeded Airborne Time (min/op)	Adjusted Unimpeded Airborne Time (min/op)	Total Adjusted Unimpeded Travel Time (min/op)
Base Case	PAL 0	11.2	3.0	8.1	123.0	3.1	119.8	119.8	127.9
	PAL 0 + 5%	11.9	3.7	8.2	124.2	3.4	120.8	120.8	129.0
	PAL 0 + 10%	12.9	4.8	8.1	124.4	4.1	120.3	120.3	128.4
	PAL 0 + 15%	14.1	5.9	8.2	125.8	5.2	120.6	120.6	128.8
Option 1	PAL 0	14.3	1.8	12.6	122.2	1.5	120.7	120.7	133.3
	PAL 0 + 10%	14.8	2.2	12.6	122.4	2.2	120.2	120.2	132.8
	PAL 1	17.4	4.5	12.9	140.7	4.0	136.7	120.5[1/]	133.3
	PAL 2	24.1	12.2	11.9	163.5	19.0	144.5	120.5[1/]	132.4
Option 5	PAL 0	14.2	1.1	13.1	120.7	1.0	119.7	119.7	132.8
	PAL 0 + 10%	14.4	1.3	13.1	121.1	1.3	119.8	119.8	132.9
	PAL 1	14.8	1.7	13.1	137.2	1.7	135.5	119.8[1/]	132.9
	PAL 2	17.6	4.2	13.5	152.7	4.5	148.2	119.8[1/]	133.2

	Average	Average	Average
Base Case	8.2	120.4	128.5
Option 1	12.5	120.5[2/]	132.9
Option 5	13.2	119.8[2/]	133.0

1/ Average of PAL 0 and PAL 0 + 10% unimpeded airborne travel time substituted to negate effects of longer average routes at PAL 1 and PAL 2

2/ PAL 0 and PAL 0 + 10% only

Source: TAAM Plus simulation runs
Prepared by: Ricondo & Associates, Inc.



Source: TAAM Plus Simulation Runs
Prepared by: Ricondo & Associates, Inc.

Exhibit V-21

Annualized Average Unimpeded Travel Time
All Airport Operations

Table V-6

Adjusted Annualized Average Travel Time (including delays)

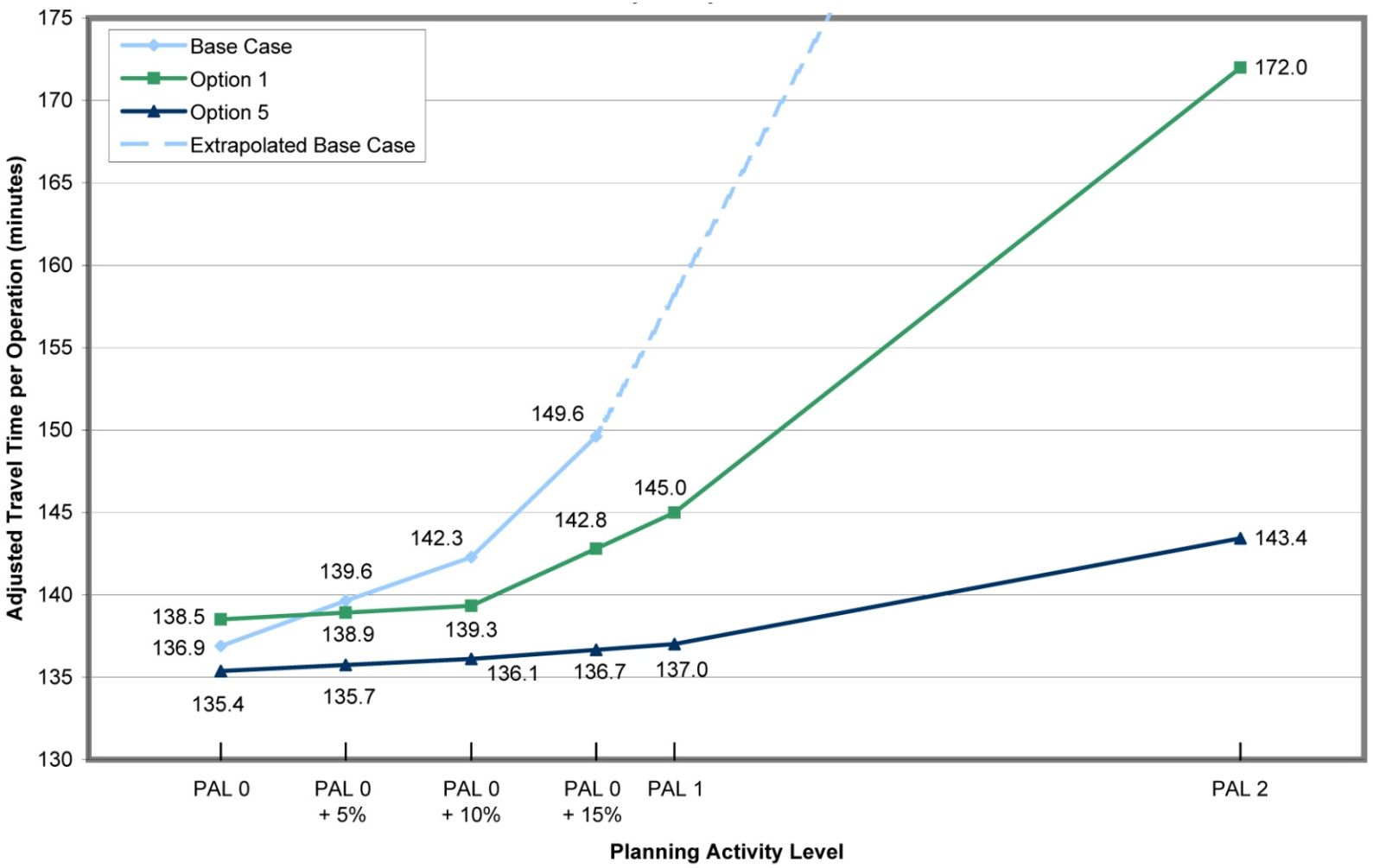
Airfield Option	Activity Level	Daily Simulated Operations	Annual Operations	Average Aircraft Travel Time (minutes per operation)			
				Gate	Taxi-Out/In	Airborne	Total
Base Case	PAL 0	2,745	912,000	2.8	11.2	123.0	136.9
	PAL 0 +5%	2,882	1,003,000	3.5	11.9	124.2	139.6
	PAL 0 +10%	3,020	1,048,000	4.9	12.9	124.4	142.3
	PAL 0 +15%	3,157	1,094,000	9.7	14.1	125.8	149.6
	PAL 1[1/]	3,243	1,123,000	17.0	14.9	126.3	158.2
	PAL 2[1/]	3,864	1,332,000	69.1	20.8	130.2	220.2
Option 1	PAL 0	2,745	912,000	2.0	14.3	122.2	138.5
	PAL 0 +5%[2/]	2,882	1,003,000	2.1	14.6	122.3	138.9
	PAL 0 +10%	3,020	1,048,000	2.2	14.8	122.4	139.3
	PAL 0 +15%[2/]	3,157	1,094,000	2.7	16.4	123.7	142.8
	PAL 1	3,243	1,123,000	3.1	17.4	124.5[3/]	142.0[3/]
	PAL 2	3,864	1,332,000	8.4	24.1	139.8[3/]	172.0[3/]
Option 5	PAL 0	2,745	912,000	0.5	14.2	120.7	135.4
	PAL 0 +5%[2/]	2,882	1,003,000	0.6	14.3	120.9	135.7
	PAL 0 +10%	3,020	1,048,000	0.6	14.4	121.1	136.1
	PAL 0 +15%[2/]	3,157	1,094,000	0.6	14.7	121.3	136.7
	PAL 1	3,243	1,123,000	0.7	14.8	121.5[3/]	137.0[3/]
	PAL 2	3,864	1,332,000	1.6	17.6	124.2[3/]	143.4[3/]

1/ Straight-line extrapolated (discounts probable gridlock for Base Case before reaching PAL 2 operating level).

2/ Interpolated.

3/ Adjusted to allow direct comparison with Base Case.

Source: TAAM Plus simulation runs
Prepared by: Ricondo & Associates, Inc.



Source: TAAM Plus Simulation Runs
Prepared by: Ricondo & Associates, Inc.

Exhibit V-22

Adjusted Annualized Average Travel Time
All Airport Operations

Based on the adjusted average travel times shown in Table V-6, the average time savings for Options 1 and 5 in comparison to the Base Case were calculated. These average aircraft time savings that result from runway modifications are shown in **Table V-7.**

Table V-7

Average Travel Time Savings

Airfield Option	Activity Level	Daily Simulated Operations	Annual Operations	Average Travel Time Savings or (Increases) (minutes per operation)			
				Gate	Taxi-Out/In	Airborne	Total
Option 1	PAL 0	2,745	912,000	0.8	(3.2)	0.7	(1.6)
	PAL 0 +5%	2,882	1,003,000	1.5	(2.7)	1.9	0.7
	PAL 0 +10%	3,020	1,048,000	2.8	(1.8)	2.0	3.0
	PAL 0 +15%	3,157	1,094,000	7.0	(2.2)	2.1	6.8
	PAL 1	3,243	1,123,000	13.9	(2.4)	1.8	13.2
	PAL 2	3,864	1,332,000	60.7	(3.3)	(9.3)	48.2
Option 5	PAL 0	2,745	912,000	2.3	(3.0)	2.3	1.5
	PAL 0 +5%	2,882	1,003,000	3.0	(2.4)	3.3	3.9
	PAL 0 +10%	3,020	1,048,000	4.3	(1.5)	3.3	6.2
	PAL 0 +15%	3,157	1,094,000	9.1	(0.6)	4.4	13.0
	PAL 1	3,243	1,123,000	16.3	0.1	4.8	21.2
	PAL 2	3,864	1,332,000	67.6	3.2	5.9	76.7

Source: TAAM Plus simulation runs
Prepared by: Ricondo & Associates, Inc.

5.1.3.3 Findings

Simulation results presented in this section illustrate that both Options 1 and 5 would result in higher throughput rates, delay reduction, and lower travel times when compared to the Base Case. The simulation results also suggest that the throughput would be higher, the delay reduction greater, and the travel times lower with Option 5 when compared with Option 1. It should also be noted that Option 1 reaches excessive delays in VFR East configuration and gridlock in IFR West configuration between PAL 1 and PAL 2 demand levels, while the base case configurations reach excessive delays and gridlock between PAL 0+10 percent and PAL 0+15 percent demand levels.

5.1.4 Preferred Airfield Concept

Five alternative future airfield configurations, Options 1, 2, 3, 4, and 5 were analyzed. Of the five options, Options 1, 2, and 5 received further analysis and refinement, with Options 1 and 5 ultimately simulated at various activity levels. The following presents an overview of each of the concepts leading to identification of Option 5 as the preferred alternative.

- *Option 1*: The TAAM simulation demonstrated that Option 1 could not provide balanced arrival/departure capability necessary to sustain future demand levels. The airfield configuration provided either three arrivals and two departures simultaneously, or two arrivals and three departures simultaneously. However, the runway configuration could not provide balanced operations for three arrivals and three departures simultaneously

Furthermore, Option 1 reaches excessive delays and gridlocks in certain configurations between PAL 1 and PAL 2 demand levels. As a result, Option 1 was eliminated from further consideration.

- *Option 2, 3, and 4*: Option 2 would result in two major operational deficiencies. The first relates to operational dependencies between Runways 9C and 9R as the result of wake turbulence avoidance procedures. The separation of these runways and their threshold stagger would require the application of certain dependency rules between runway operations greatly reducing their potential operational throughput. The second issue relates to the viability of using perimeter taxiways as a means of maintaining unrestricted ground movements. In August 2002, FAA Flight Technologies and Procedures Division (FS-400) issued an interpretation of standards that clarified FAA operational criteria to be utilized when considering perimeter taxiways. Based on this criteria, the perimeter taxiways proposed under Option 2 would be considered controlled crossings, effectively negating the benefits of the perimeter taxiways. Option 2, and Options 3 and 4, which were variations of Option 2, were dropped from consideration as a result of these limitations.
- *Option 5:* Option 5 not only provides a balanced airfield operation with three simultaneous arrivals and departures, but, by providing longer runway lengths, also provides greater flexibility of runway-use by permitting the runways to be used for either arrivals or departures depending on Air Traffic preference. Additionally, this option provided uncontrolled "inactive" runway crossings through the use of intersection departures and LAHSO not possible with Options 1 or 2. It was demonstrated through TAAM simulation that Option 5 provided significantly fewer delays compared to Option 1 as shown in Exhibit V-20. Option 5 provided the greatest efficiency and flexibility of the alternatives simulated and was chosen as the preferred alternative.

5.1.5 Available Development Areas

Based on the preferred airfield layout, including the ultimate decommissioning of the Runways 14L-32R and 14R-32L, four general areas of the Airport are available for the development of terminal and support/ancillary facilities.

An area in the middle of the Airport between future Runways 9R-27L and 10L-27R and extending from the existing East Terminal, through the Terminal Core Areas to the western boundary of the Airport was identified for terminal expansion. This central area presents the best opportunity to develop a western access point into the Airport as well as provides for the best connectivity to the existing terminal areas. Section 5.2, *Terminal Facilities Alternatives Analysis,* presents terminal expansion concepts within this general area.

Two areas for future development are available in the North Airfield: a reconfigured Northwest Maintenance Area and the former military site. In the preferred airfield concept, the Northwest Maintenance Area is bound by Runways 9L-27R, 9C-27C, and 4L-22R and the western perimeter of the Airport. This area currently supports airline maintenance facilities. While airfield development may result in relocations of several existing facilities, continuation of development of support/ancillary facilities in this area is considered appropriate. Additionally, the general area of the former military site, bound in the preferred airfield concept by Runways 4L-22R and 9C-27C, is also available to support support/ancillary facilities.

Finally, the Southwest Cargo Area in the South Airfield, bound in the preferred airfield concept by Runways 10C-28C and 10R-28L, was identified as an available development area. This area currently supports cargo facilities, and the preferred airfield concept will require the replacement of several existing facilities in this area.