3.1.3 Delay Parameters

Delay is the result of demand exceeding capacity. In order to discuss delay it is necessary to talk about how delay is measured using advanced simulation tools like SIMMOD. SIMMOD counts delay as any time that is added to the "normal" time for an aircraft to pass through the route the aircraft wants to take. Examples include: stopping until it is safe to cross a runway, waiting in line to take off, slowing down to follow another aircraft (below the normal speed an aircraft would use for the particular phase of flight), and flying a longer route to follow another aircraft (ATC vector). Therefore it is normal for some level of delay to occur at an airport whenever multiple aircraft want to use an airport at the same approximate time.

SIMMOD segregates the delay measurement reports between arrival delay and departure delay. The arrival delay is counted as any delay that occurs from the point the aircraft enters the simulation (according to the time in the gated flight schedule) until the aircraft arrives at its parking position. The departure delay is counted as any delay that occurs from the time the aircraft is "released" from its parking position until it reaches the point along its route that is the end of the simulation.

The time the aircraft is "released" from its parking point can vary. The first action SIMMOD will take is to "release" a departure according to the time in the gated flight schedule. However, SIMMOD looks at the "minimum turn time" that is set for the aircraft. A typical minimum turn time for an integrated cargo carrier is 90 minutes in order to unload, fuel, and reload the aircraft. If the aircraft incurred arrival delay such that it is less than 90 minutes to its departure time, SIMMOD will hold the aircraft at its parking position until the 90 minutes has transpired. However, SIMMOD only counts departure delay as any delay that happens after the aircraft is released. In this example, the "true departure delay" is the total of the arrival delay measured by SIMMOD plus the SIMMOD measured departure delay. The point is that the SIMMOD data needs to be analyzed closely on a case by case basis since, for many of the aircraft, the gated flight schedule contains several hours between scheduled arrival and departure time, and any arrival delay that occurs is easily absorbed within that time. In other cases the arrival delay cannot be absorbed. This is discussed further later on in this report in the Section 3.2 Capacity and Delay Results.

There is not a "one size fits all" standard for unacceptable delay. The amount of delay that is tolerable depends on many factors. Some of the most important factors involve the demand for air travel to the region served by an airport, and the alternatives that are available to satisfy that demand. The FAA does not normally consider delay to be significant unless it exceeds an average delay of fifteen minutes per aircraft. Consequently, that measure is used as one level of analysis for this study. However, the AIAS is unique in that it has a high preponderance of international air cargo flights that are time-critical. These flights are judged critical because they contain time-critical cargo, and they also need to connect with other time-critical flights in other parts of the country and world and deal with curfews in Asia. Since 15 minutes may or may not be significant for the cargo carriers, other metrics need to be examined.

3.1.4 Integrated Cargo Carriers

Integrated cargo carriers operate time-critical cargo flights often heading to a cargo hub airport where the cargo in one aircraft needs to be removed and transferred to other aircraft within a certain period of the day. Therefore each international cargo aircraft that is delayed in ANC or FAI has the potential to delay aircraft at the next hub airport. This amplifies the impact of the delay and suggests delays need to be kept within a manageable range.

The airlines that routinely use ANC and FAI have been queried regarding what they consider to be unacceptable delay. The airlines have been hesitant to produce any kind of parameter for that. However, during the last master plan the carriers indicated that aircraft which leave ANC eastbound are normally the last aircraft to reach the major cargo hub airports in the Lower 48. This makes these aircraft very time-dependent. All the other aircraft at the cargo hub that will receive cargo from the ANC flight therefore presumably need to wait until the ANC flight has arrived and its cargo transferred before those aircraft depart. Therefore a late arrival from ANC could cause dozens of other aircraft to be delayed in the Lower 48. Generally ANC eastbound flights must leave ANC before 4:30 p.m. to make the sort. The degree of time-dependency is sensitive to headwinds. These aircraft normally have a lot of cross loading at ANC which makes 1.5 hours the minimum time to unload and reload an aircraft, fuel it and have it ready for departure (turn time). This is the block time which starts when the aircraft arrives at the apron and ends when the aircraft can leave the apron. The taxi-in and taxi-out times would be added to the 1.5 hours. Delay then gets added on top of that. The average taxi-in plus taxi-out times for the express cargo carriers (without any delay) is 19 minutes.

Because of this, and lacking any better airline input, 30 minutes is taken as the threshold for when delay becomes unacceptable for these carriers when it occurs on a regular basis. 30 minutes of delay increases the carriers' already critical "turn time" by 33% and increases their total time on the ground at ANC by 28%. This makes it very likely that the carriers have to change their sort windows in the Lower 48, which will increase delivery times and significantly increase delivery costs.

3.1.5 Tech-Stop Carriers

Tech-stop carriers are those that refuel and often change flight crews at ANC, but do not exchange cargo between aircraft. They have stated that one hour is the minimum turn time. Their connection times are not as critical as for the express carriers. However, curfews in Asia are still a consideration for this group. For these carriers, acceptable delay would likely be based on the trade-off between the cost of burning fuel and crew hours while waiting on the taxiway or circling for landing versus the cost of incurring a payload penalty to overfly. While this answer would be different for each aircraft type and market pair, a 30 minute delay which adds 50% to their minimum turn time would likely be deemed to be very significant. In addition, all aircraft are delayed equally during a given period of time. Since 30 minutes is considered significant for a large portion of the AIAS fleet, any willingness of the tech-stop carriers to accept more delay will not solve the problem unless they are willing to be delayed for multiple hours to outside the peak hours. That option is not considered feasible, so 30 minutes delay is considered significant for tech stop carriers as well.

3.1.6 Passenger Carriers and General Aviation

Besides the FAA standard of 15 minutes, the FAA has for many years also used a benefit-cost analysis standard of 20 minutes of daily average annual delay. The focus of this study has been on peak period delays, as opposed to average delays across a year. Therefore that parameter is not evaluated for this study since the focus has been on peak hour delays due to the unique air cargo situation that the AIAS operates under.

3.2 Capacity and Delay Results

3.2.1 ANC Capacity and Delay Results

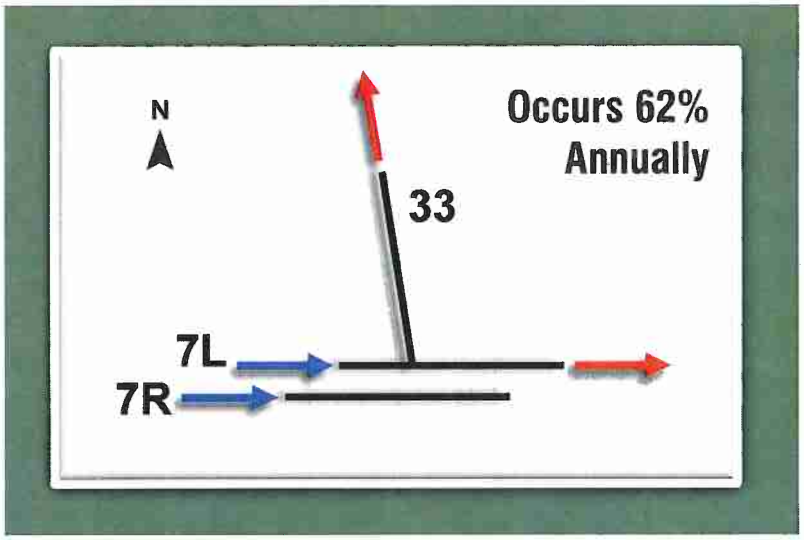
The capacities and delays for each of the four operating modes chosen for ANC are shown in Exhibits 3.15 through 3.22. The exhibits show some of the critical information for the operating modes. The demand is the scheduled number of operations for each hour and is taken from the gated flight schedule. The throughput is the actual number of operations that were accomplished during a given hour and is generated during the SIMMOD run. In some cases the throughput will be more than the demand, since the airfield/airspace is "catching up" after not meeting all the demand in an earlier hour. The maximum throughput that can be sustained when the demand exceeds the throughput becomes the practical capacity for the airfield/airspace. A horizontal bar has been placed on each demand versus capacity chart to indicate the practical hourly capacity that was achieved during that operating mode under the given demand. ANC has an hourly capacity of 70 operations per hour in its most efficient operating mode (Exhibit 3.20) and 44 operations per hour in the mode that is least efficient (Exhibits 3.21 and 3.22).

As shown in the exhibits, the capacity of the airfield was exceeded for at least one or two hours in all of the operating modes for ANC. However, it did not greatly exceed the capacity for significant periods with the exception of Configuration 4 VFR (Exhibits 3.21 and 3.22) and Configuration 1 IFR for the projected Future 2 traffic level (Exhibit 3.18). Exhibits 3.26 (Configuration 4 VFR) and Exhibit 3.27 (Configuration 1 IFR) show the demand/capacity relationship for these two operating modes for departures, along with the "running total" of aircraft departures that were not accommodated. As shown in Exhibit 3.27, the "running total" deficit for Configuration 4 VFR departures reached 27 by 4 p.m. This means that 27 fewer aircraft departed Anchorage by 4 p.m. than were scheduled to depart by that time of the day. The maximum "running total" deficit for Configuration 1 IFR for Future 2 traffic levels is 17, as shown in Exhibit 3.27. Exhibits 3.26 and 3.27 illustrate what can happen when demand exceeds capacity for several hours. The best measure of the impact that this has on airport operations is the delay that is created.

The practical capacity varies somewhat as the demand changes. The highest practical capacity achieved with a demand level of 860 daily operations was 59 operations per hour (Exhibit 3.19), while it rose to 70 operations per hour at a demand level of 1,000 daily operations (Exhibit 3.20).

Figure 3.15

Capacity and Delay Future 1
Anchorage International Airport
Configuration 1
VFR



242,000 Annual Operations Data

Hourly Capacity

Peak Combined	56
Peak Arrival	35
Peak Departure	28

Peak Average Hourly Delay
(Average Day Peak Month)

Arrivals	1.8 min. (1-2 pm)
Departures	16.3 min. (4-5 pm)
	860 Daily Operations

Percent of Heavy Aircraft	28%
Percent of Large Aircraft	46%
Percent of Small Aircraft	26%

Source: SIMMOD analysis

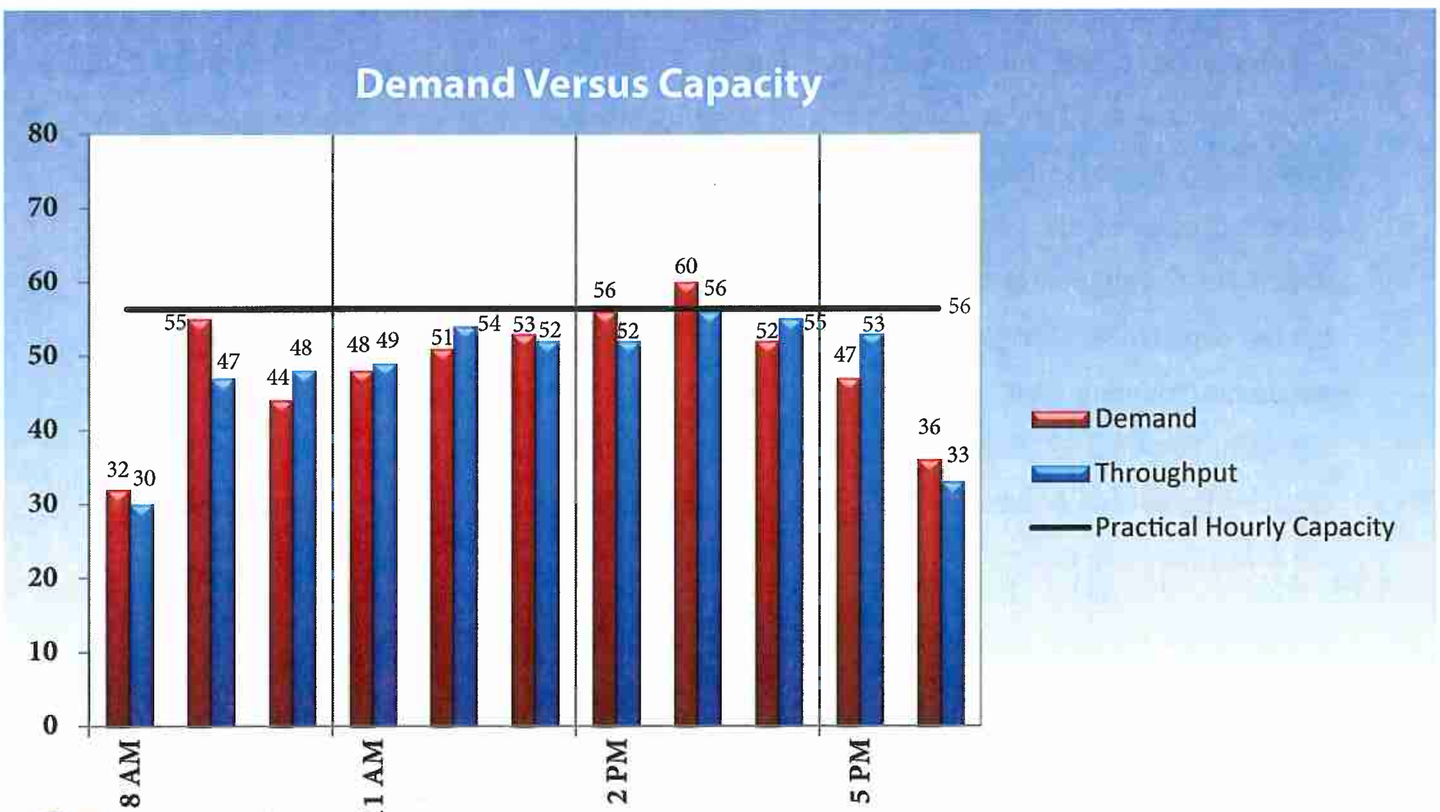
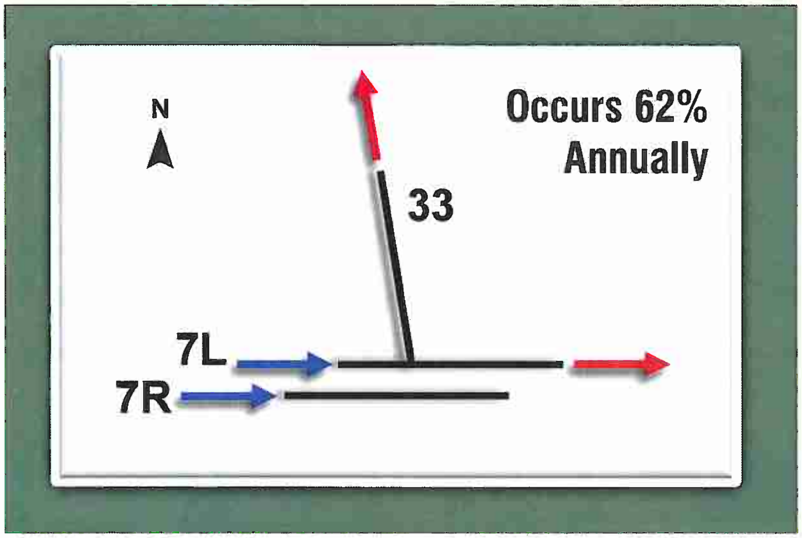


Figure 3.16

Capacity and Delay Future 2
Anchorage International Airport
Configuration 1
VFR



282,000 Annual Operations Data

Peak Hourly Capacity

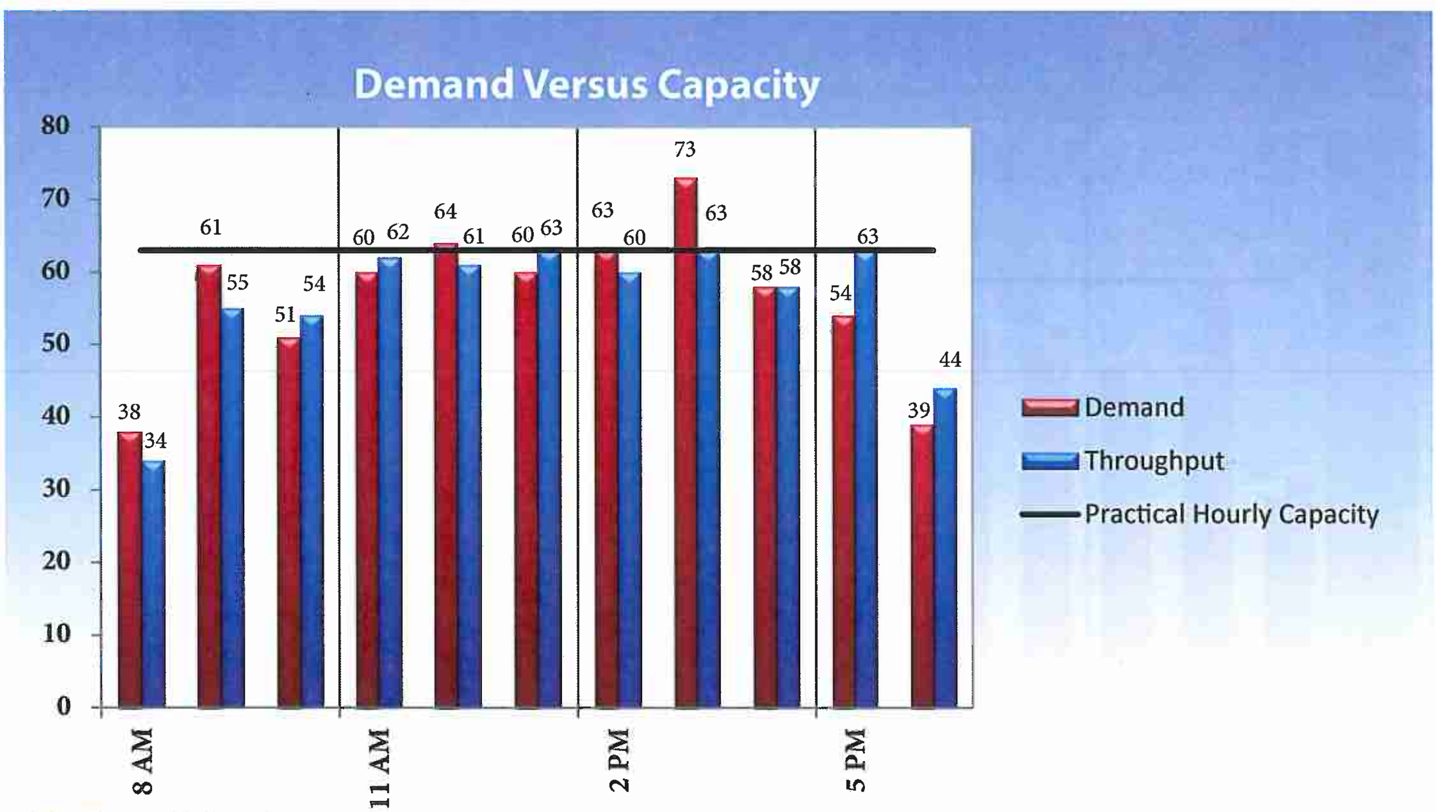
Peak Combined	63
Peak Arrival	43
Peak Departure	32

Peak Average Hourly Delay
(Average Day Peak Month)

Arrivals	3.5 min. (1-2 pm)
Departures	38.6 min. (5-6 pm)
	1,000 Daily Operations

Percent of Heavy Aircraft	30%
Percent of Large Aircraft	45%
Percent of Small Aircraft	25%

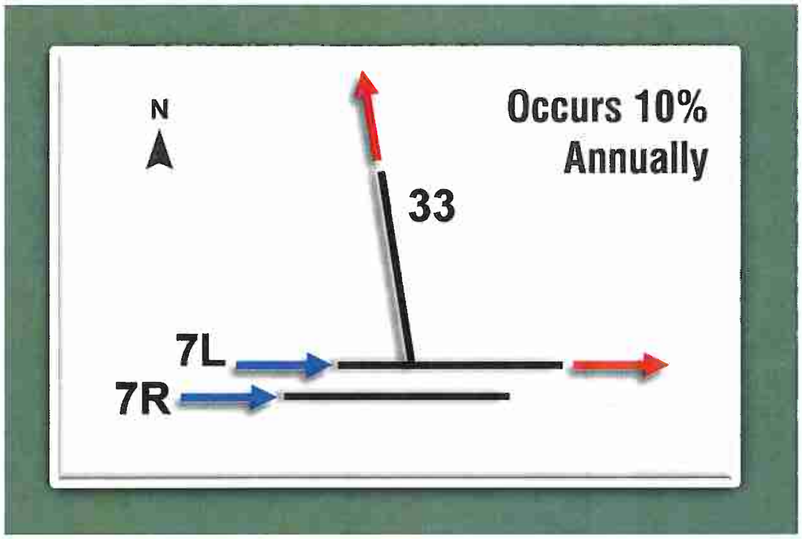
Source: SIMMOD analysis



Alaska International Airport System "AeroNexus"

Figure 3.17

Capacity and Delay Future 1
Anchorage International Airport
Configuration 1
IFR



242,000 Annual Operations Data

Hourly Capacity

Peak Combined	58
Peak Arrival	30
Peak Departure	29

Peak Average Hourly Delay
(Average Day Peak Month)

Arrivals	7.0 min. (2-3 pm)
Departures	14.8 min. (4-5 pm)
	860 Daily Operations

Percent of Heavy Aircraft	28%
Percent of Large Aircraft	46%
Percent of Small Aircraft	26%

Source: SIMMOD analysis

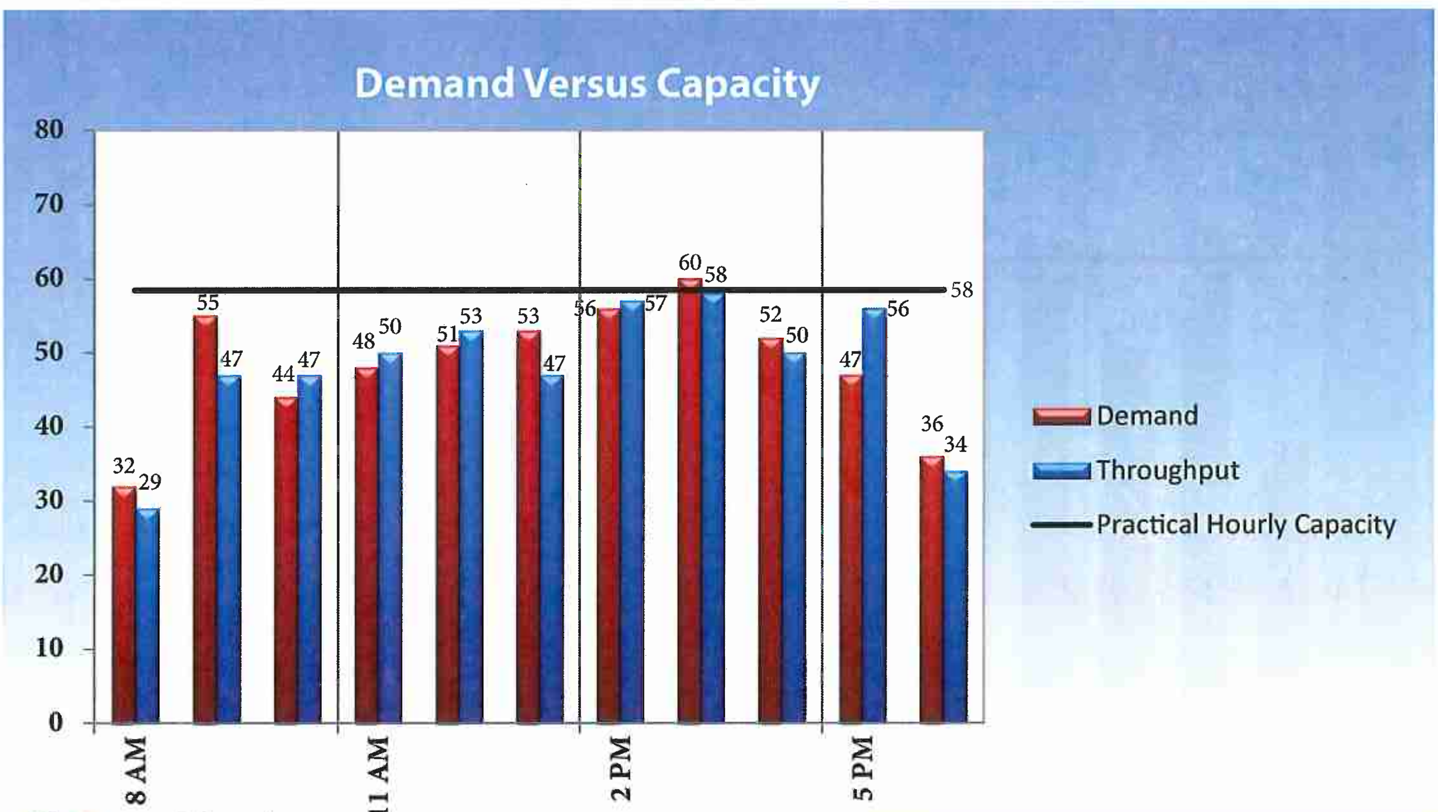
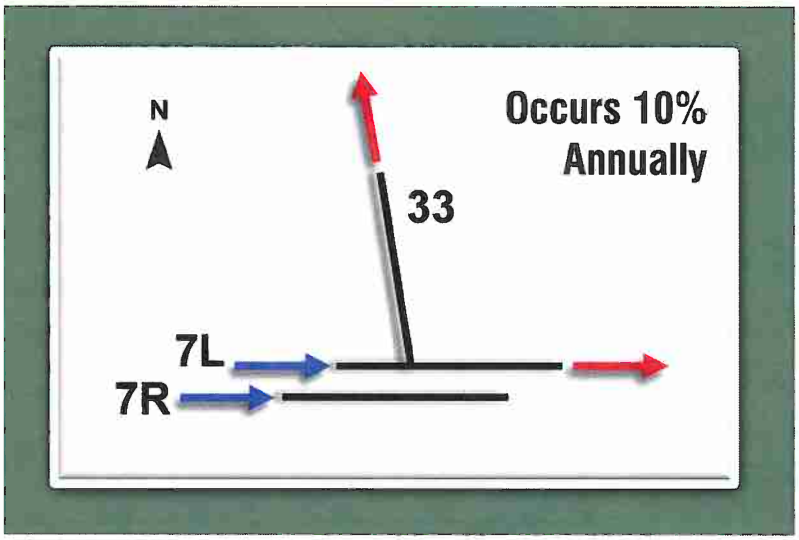


Figure 3.18

Capacity and Delay Future 2
Anchorage International Airport
Configuration 1
IFR



282,000 Annual Operations Data

Hourly Capacity

Peak Combined	65
Peak Arrival	35
Peak Departure	33

Peak Average Hourly Delay
(Average Day Peak Month)

Arrivals	20.3 min. (2-3 pm)
Departures	37.4 min. (5-6 pm)
	1,000 Daily Operations

Percent of Heavy Aircraft	30%
Percent of Large Aircraft	45%
Percent of Small Aircraft	25%

Source: SIMMOD analysis

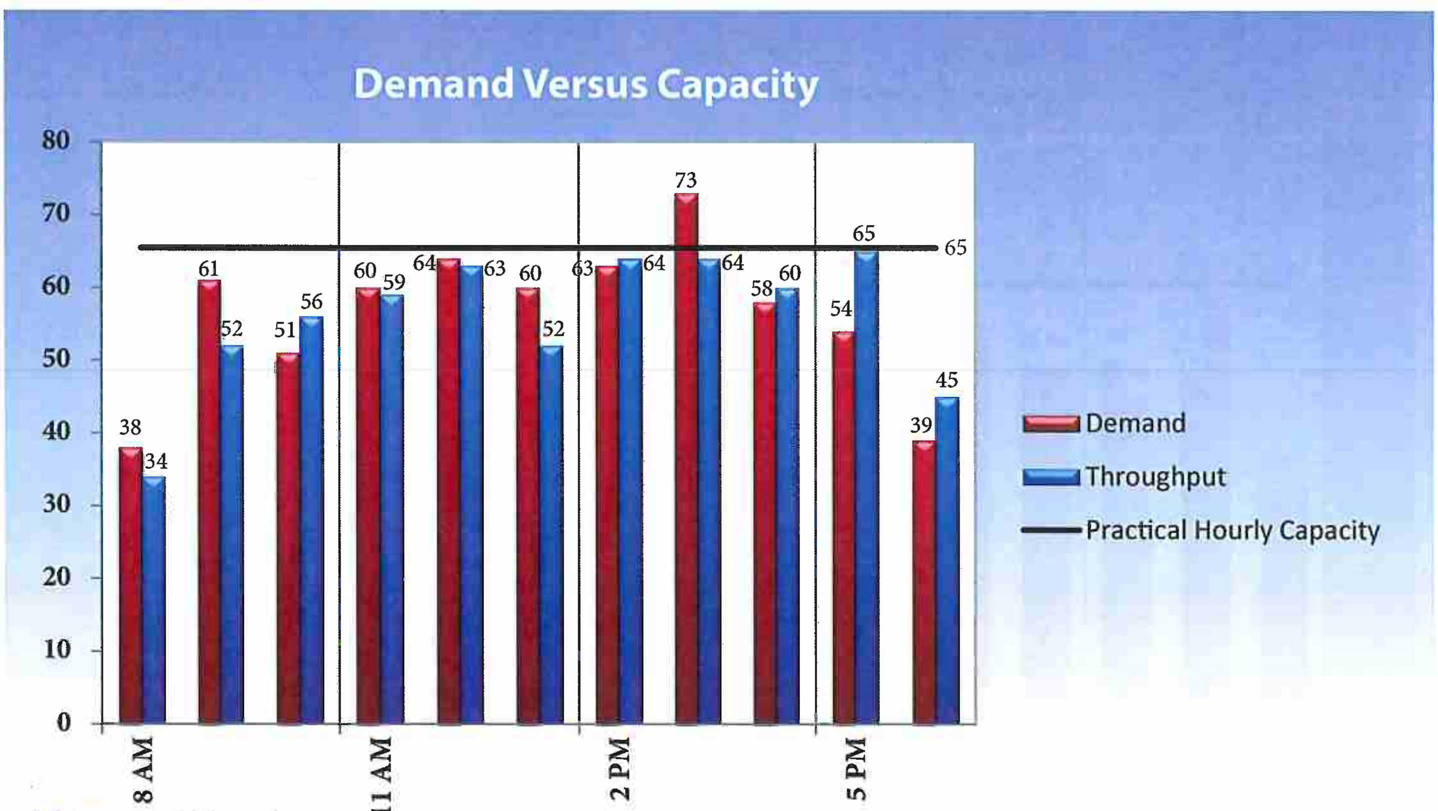
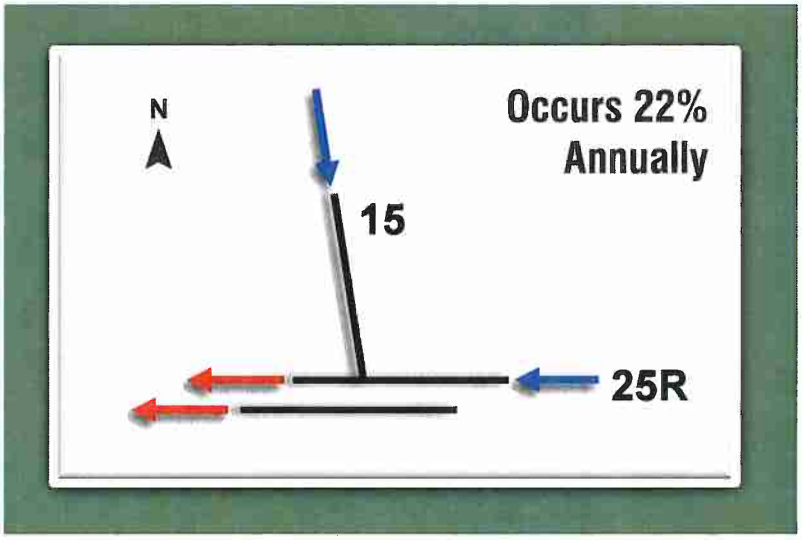


Figure 3.19

Capacity and Delay Future 1
Anchorage International Airport
Configuration 2
VFR



242,000 Annual Operations Data

Hourly Capacity

Peak Combined	59
Peak Arrival	32
Peak Departure	32

Peak Average Hourly Delay
(Average Day Peak Month)

Arrivals	3.8 min. (1-2 pm)
Departures	3.3 min. (5-6 pm)
	860 Daily Operations

Percent of Heavy Aircraft	28%
Percent of Large Aircraft	46%
Percent of Small Aircraft	26%

Source: SIMMOD analysis

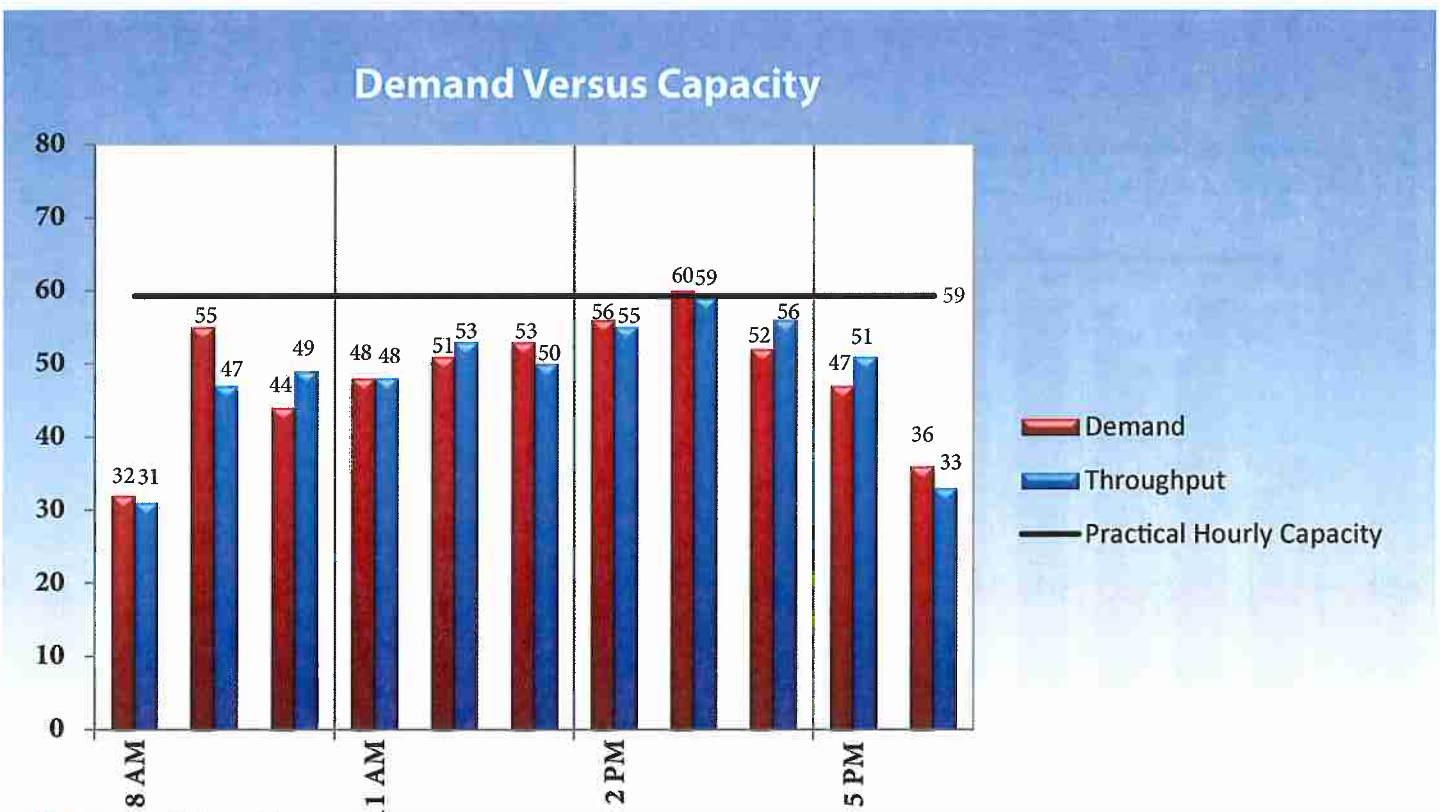
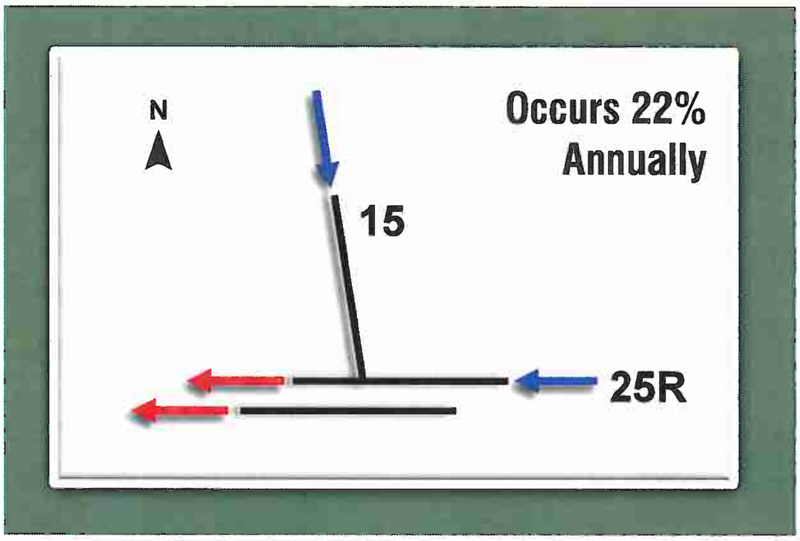


Figure 3.20

Capacity and Delay Future 2
Anchorage International Airport
Configuration 2
VFR



282,000 Annual Operations Data

Hourly Capacity

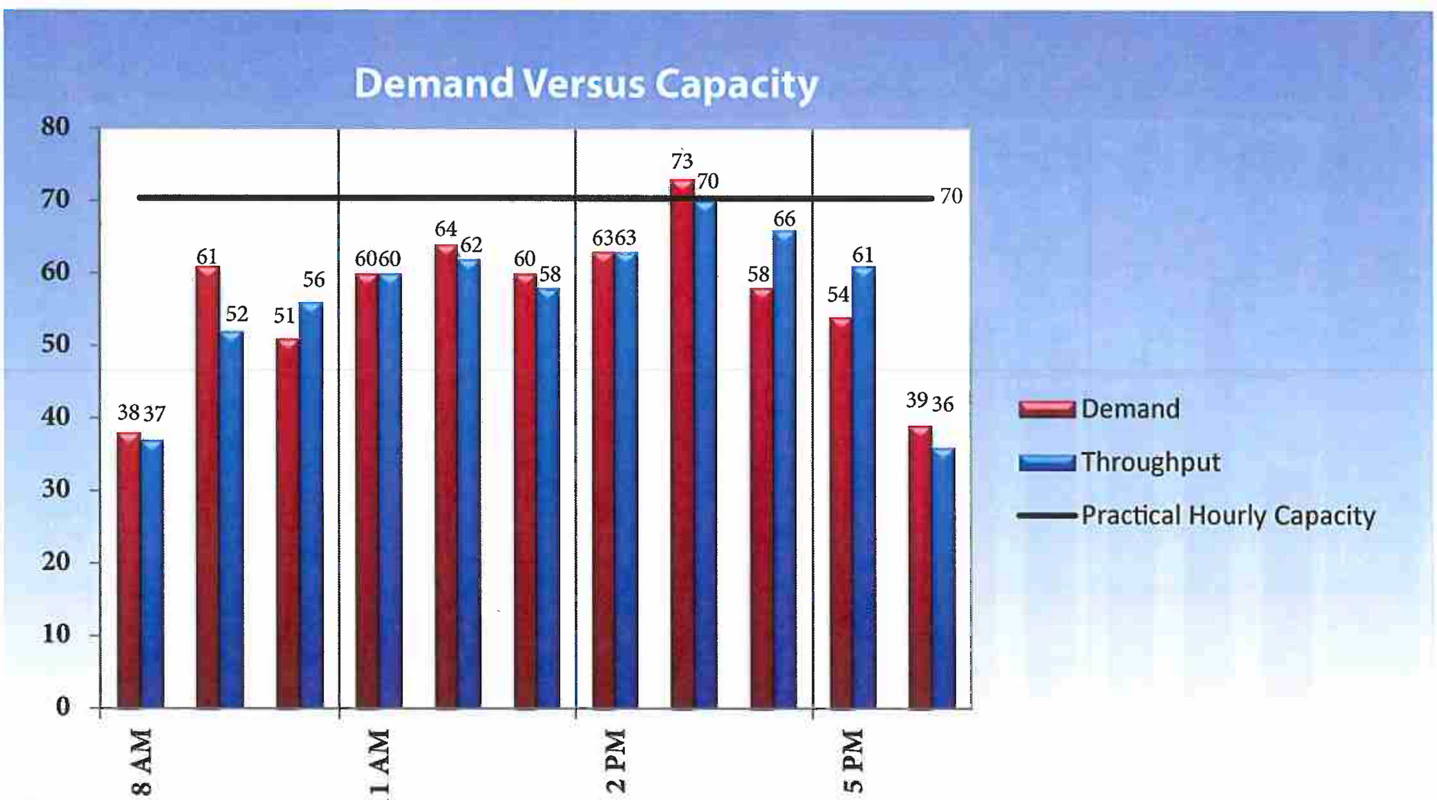
Peak Combined	70
Peak Arrival	38
Peak Departure	37

Peak Average Hourly Delay
(Average Day Peak Month)

Arrivals	10.7 min. (2-3 pm)
Departures	9.6 min. (4-5 pm)
	1,000 Daily Operations

Percent of Heavy Aircraft	30%
Percent of Large Aircraft	45%
Percent of Small Aircraft	25%

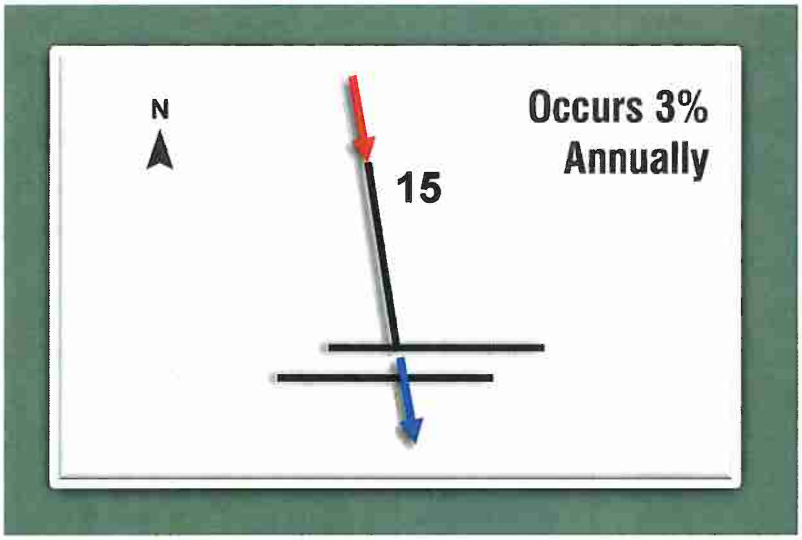
Source: SIMMOD analysis



Alaska International Airport System "AeroNexus"

Figure 3.21

Capacity and Delay Future 1
Anchorage International Airport
Configuration 4
VFR



242,000 Annual Operations Data

Hourly Capacity

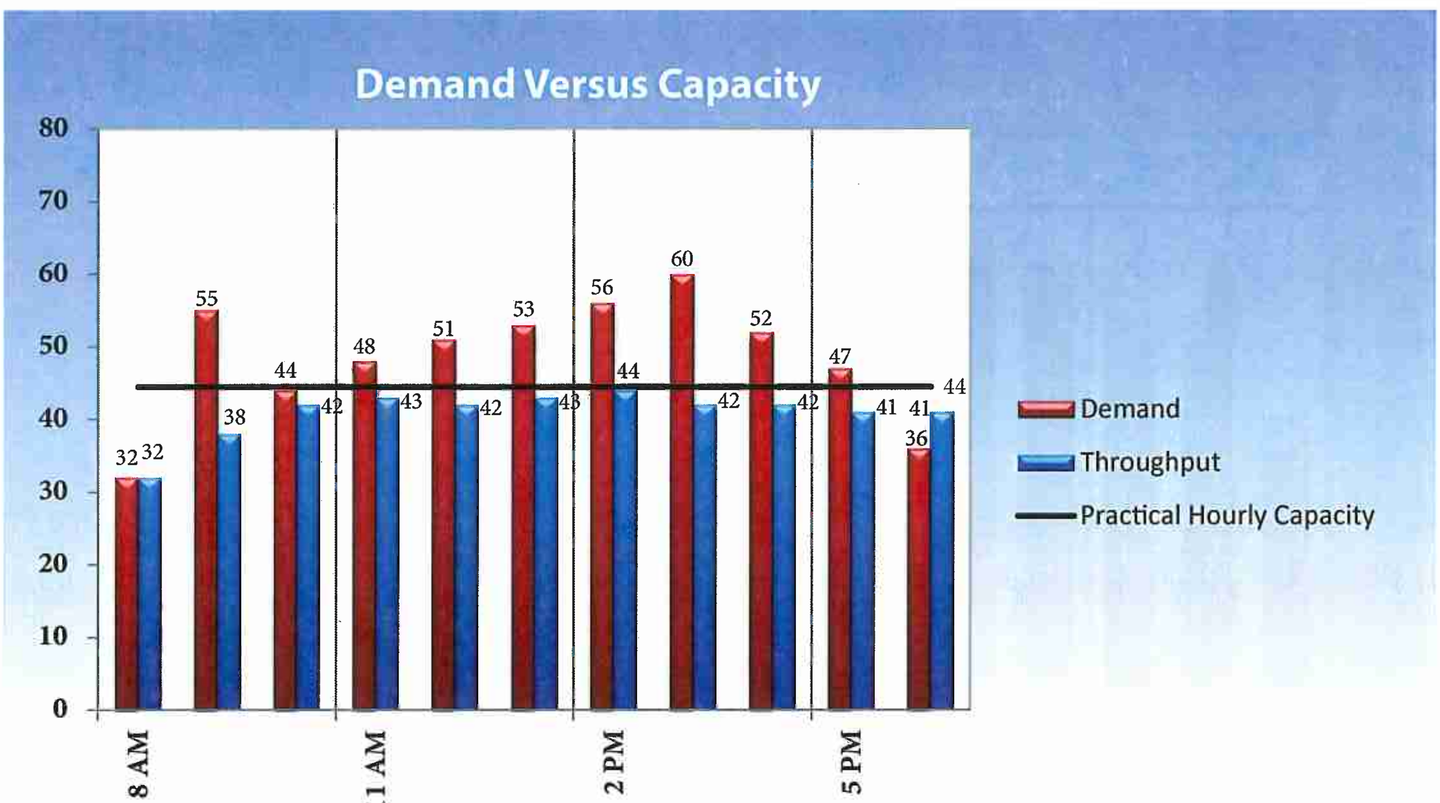
Peak Combined	44
Peak Arrival Capacity	24
Peak Departure Capacity	22

Peak Average Hourly Delay
(Average Day Peak Month)

Arrivals	151.0 min. (10-11pm)
Departures	64.3 min. (5-6 pm)
	860 Daily Operations

Percent of Heavy Aircraft	28%
Percent of Large Aircraft	46%
Percent of Small Aircraft	26%

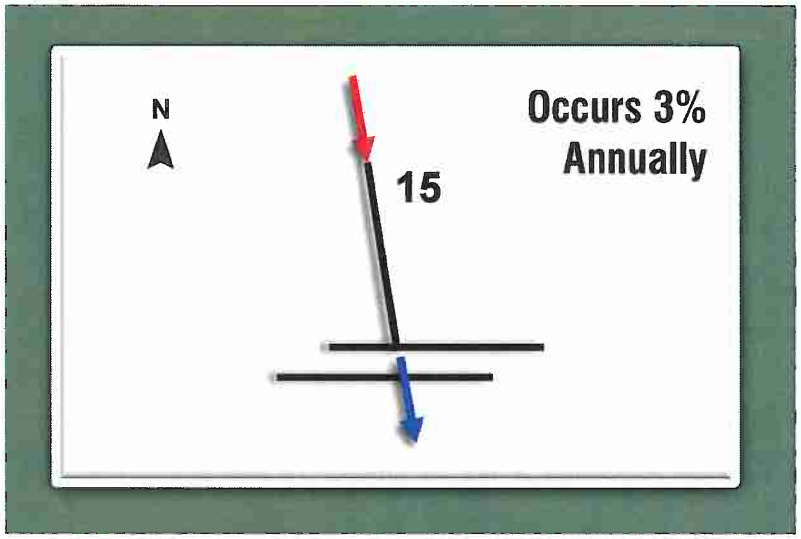
Source: SIMMOD analysis



Alaska International Airport System "AeroNexus"

Figure 3.22

Capacity and Delay Future 2
Anchorage International Airport
Configuration 4
VFR



282,000 Annual Operations Data

Hourly Capacity

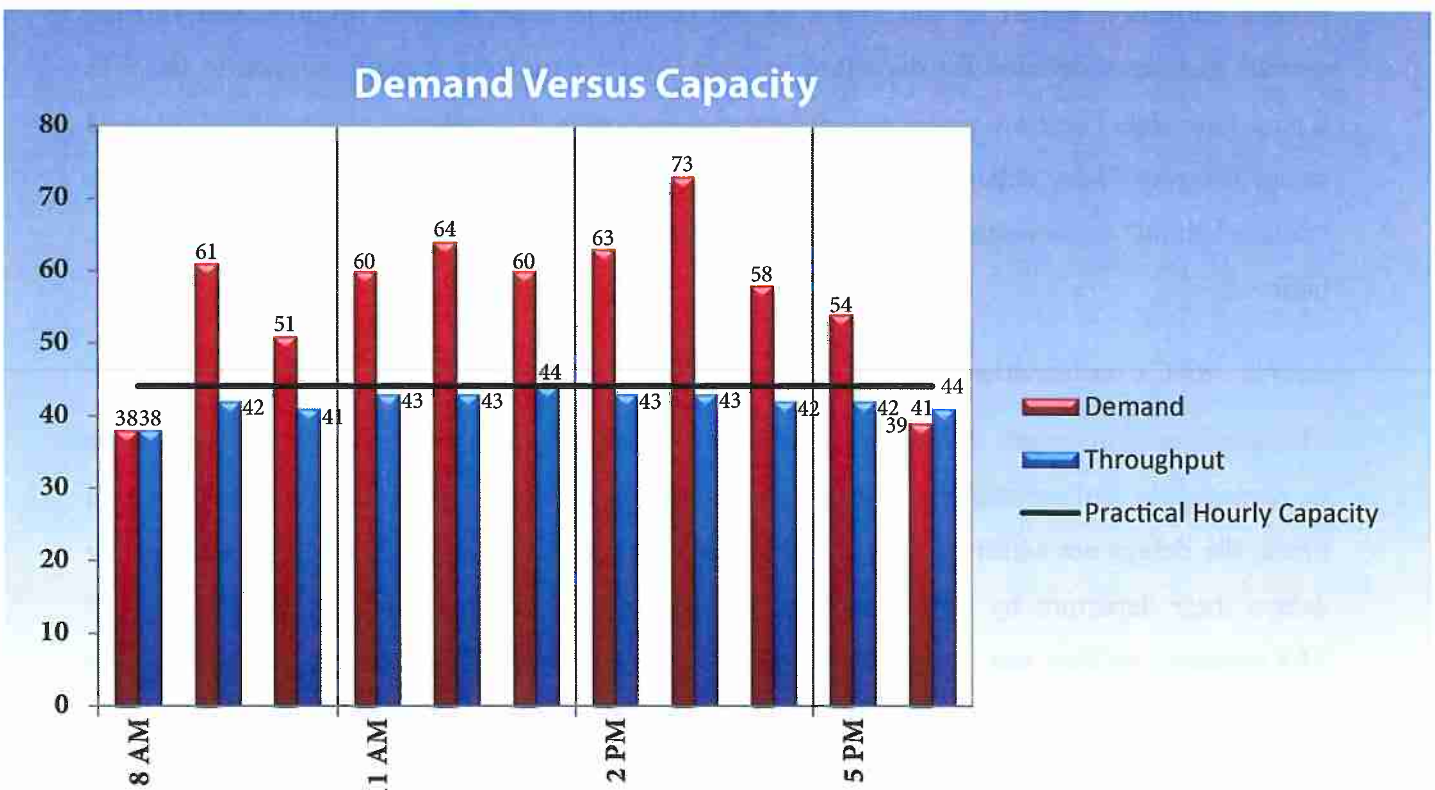
Peak Combined	44
Peak Arrival	25
Peak Departure	28

Peak Average Hourly Delay
(Average Day Peak Month)

Arrivals	196.2 min. (10-11 pm)
Departures	69.2 min. (5-6 pm)
	1,000 Daily Operations

Percent of Heavy Aircraft	30%
Percent of Large Aircraft	45%
Percent of Small Aircraft	25%

Source: SIMMOD analysis



As delays rise, the practical capacity approaches the theoretical capacity of the airport. This is illustrated for Configuration 4-VFR where the peak capacity stays at 44 operations per hour from the Future 1 to Future 2 traffic levels. However, the delays are already excessive at 860 operations (for Future 1), which is discussed later in this section. In essence, as delays rise it is more likely there will always be an aircraft waiting to take an "opening" in the airspace or airfield as soon as that "opening" becomes available and therefore the practical capacity is high. When delays (and likely operations) are less there may not always be an aircraft immediately available to take the "opening" and the practical capacity is less. Some specific observations on the delays for each mode follow.

3.2.1.1 ANC Configuration 1-VFR

This configuration occurs most often at the airport at 62% of the time. At the Future 1 operations level (approximately 242,000 annual operations), the delays are manageable, with the average peak hour delays reaching 16.3 minutes for departures.

At the Future 2 operations level (approximately 282,000 annual operations), the delays appear to be significant during the peak hour, at an average departure delay of almost 39 minutes. This delay occurs during the hours of 5 to 6 p.m., which is just after the critical hour for eastbound express carriers to depart for the Lower 48 and be able to make the sort window. Many of the aircraft that are scheduled for departure between 4 to 5 p.m. have actually slipped to the 5 to 6 p.m. time slot. There are significant departure delays since the majority of aircraft (89%) need to use Runway 33 for departure due to operational requirements. The airport starts significantly "falling behind" on departure capacity at 2 p.m. and falls 17 aircraft behind during the 4 to 5 p.m. hour.

3.2.1.2 ANC Configuration 1-IFR

This configuration occurs 10% of the time. At the Future 1 operations level, the delays appear to be manageable, but are starting to approach significant levels. For aircraft with minimum turn times, the delays are additive. That is, the 6.9 minutes of arrival delay in the 2 to 3 p.m. hour delays their departure by that amount and they are then delayed an additional average of 14.8 minutes, so they are essentially delayed by 21.7 minutes. This has not yet reached the significant or "unacceptable" delay of 30 minutes, but is approaching that number.

By the Future 2 activity level the average peak departure delays have reached 36.2 minutes (similar to the delays for VFR) and the arrival delays are much higher at 20.3 minutes. Note that departure delays are slightly less than for the Future 1 levels. This is likely due to the fact that arrival delays have become much higher which means fewer aircraft are trying to depart during the peak departure hour since their delay inbound has pushed their departure (following their minimum turn time to fuel and perform other functions) into a different hour. Similar to Configuration 1 VFR, the airport falls 17 aircraft behind for departures during the 4 to 5 p.m. hour.

3.2.1.3 ANC Configuration 2-VFR

This configuration occurs 22% of the time. It is the most efficient configuration for the airport. Delays are manageable during both the Future 1 and 2 operations levels.

3.2.1.4 ANC Configuration 4-VFR

This configuration occurs 3% of the time. It is the least efficient configuration for the airport. At Future 1 levels the delays are already extreme, with peak hour average delays of 151 minutes for arrivals and 64 minutes for departures. The numbers for Future 2 levels are much worse. The airport falls over 100 aircraft behind in arrivals and 27 aircraft in departures.

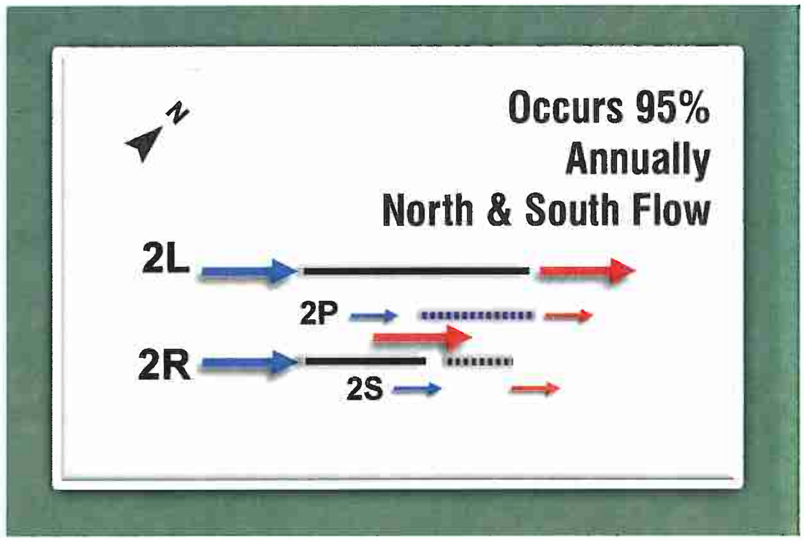
3.2.2 FAI Capacity and Delay Results

The capacity and peak average hourly delay for the VFR operating mode chosen for FAI is shown on Exhibit 3.23. The capacity of the airfield (+100 peak hour operations) was never reached in VFR conditions. Consequently, the VFR capacity has been estimated using an airfield capacity spreadsheet model along with engineering/planning judgment.

The IFR hourly capacity is 42 operations per hour. The capacity and peak average hourly delay for the IFR operating mode chosen for FAI is shown on Exhibit 3.24. This capacity has been tested using the schedule for the average-day peak-month. In the case of Fairbanks, much of the schedule is comprised of small single engine aircraft. Most of these aircraft do not normally fly in IFR weather conditions. However, they can fly in these conditions by either getting an IFR clearance if the aircraft and pilot is equipped (not the case for many of the aircraft) or by getting a special VFR clearance. The demand for IFR should be considered an unlikely, but possible

Figure 3.23

Capacity and Delay
Fairbanks International Airport
Configuration 1
VFR



Future 1

136,000 Annual Operations Data

Hourly Capacity

Peak Combined	100+
Peak Arrival	105
Peak Departure	212

*Capacity has been estimated using an airfield capacity spreadsheet model.

Peak Average Hourly Delay
(Average Day Peak Month)

Arrivals	0.9 min. (3-4pm)
Departures	0.9 min. (11am-12pm)
	602 Daily Operations (includes GA & military)
Percent of Heavy Aircraft	1%
Percent of Large Aircraft	15%
Percent of Small Aircraft	84%

Source: SIMMOD analysis

Future 2

156,000 Annual Operations Data

Hourly Capacity

Peak Combined	100+
Peak Arrival	105
Peak Departure	212

*Capacity has been estimated using an airfield capacity spreadsheet model.

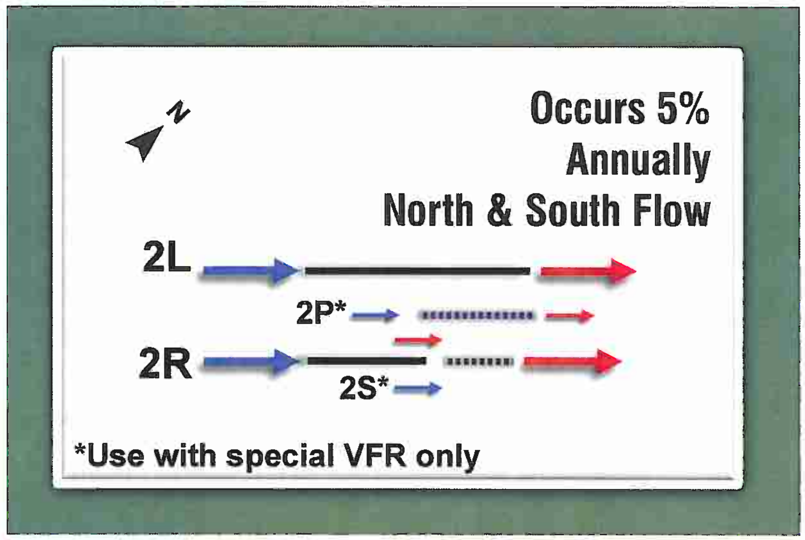
Peak Average Hourly Delay
(Average Day Peak Month)

Arrivals	1.2 min. (3-4pm)
Departures	1.7 min. (3-4pm)
	690 Daily Operations (includes GA & military)
Percent of Heavy Aircraft	1%
Percent of Large Aircraft	7%
Percent of Small Aircraft	92%

Source: SIMMOD analysis

Figure 3.24

Demand and Capacity
Fairbanks International Airport
Configuration 1
IFR



Future 1
136,000 Annual Operations Data

Hourly Capacity

Peak Combined	46
Peak Arrival	28
Peak Departure	30

Peak Average Hourly Delay
(Average Day Peak Month)

Arrivals	3.4 min. (2-3pm)
Departures	13.2 min. (1-2pm)
	602 Daily Operations
	(includes GA & military)
Percent of Heavy Aircraft	1%
Percent of Large Aircraft	15%
Percent of Small Aircraft	84%

Source: SIMMOD analysis

Future 2
156,000 Annual Operations Data

Hourly Capacity

Peak Combined	49
Peak Arrival	29
Peak Departure	33

Peak Average Hourly Delay
(Average Day Peak Month)

Arrivals	4.7 min. (3-4pm)
Departures	32.9 min. (3-4pm)
	690 Daily Operations
	(includes GA & military)
Percent of Heavy Aircraft	1%
Percent of Large Aircraft	20%
Percent of Small Aircraft	79%

Source: SIMMOD analysis