4 DEMAND/CAPACITY ANALYSIS

4.1 INTRODUCTION

The purpose of this chapter is to assess RSW's existing capacity with respect to airfield facilities and compare this with the forecasted demand. The projection of aviation demand was presented through the year 2020 in Chapter Three, "Aviation Activity Forecasts." These forecasts, which included aircraft operations, based aircraft, fleet mix, and peak activity, are part of the basis for determining whether the existing airport facilities at Southwest Florida International Airport can meet the future demands of the users. Basic airport components such as runways, taxiways, airspace and ground access can then be reviewed to determine their capability to accommodate the forecast of aviation demand. Subsequent analysis will identify specific improvements required to address not only the function and capability of the basic facilities to support the projected activity, but also the requirements for improvements to other airport components served by these facilities. Such facilities include the passenger terminal, cargo facilities, associated ramps and aprons, hangars, aviation fuel capacity and storage, the Fixed Base Operator (FBO), and other airport support services.

The objective of this effort is to identify, in general terms, the adequacy or inadequacy of the existing airport facilities and outline what new facilities may be needed based on the level or threshold of activity that generates the need for expansion. Having established these facility requirements, alternatives for providing these facilities are developed and then later assessed to determine the most cost-effective and efficient means for addressing these requirements.

4.2 AIRFIELD CAPACITY FACTORS

Several techniques have been developed for the analysis of airfield capacity. The method recommended by the Federal Aviation Administration (FAA) can be found in Advisory Circular (AC) 150/5060-5, Change 2, "Airport Capacity and Delay." This same methodology is also recommended by the Florida Department of Transportation (FDOT). Because of its wide acceptance in determining airfield capacity and aircraft delay, it was the methodology used in this Master Plan. The following definitions are presented in AC 150/5060-5, Change 2, and will be used throughout this chapter:

- **Hourly Capacity of Runways** – A measure of the maximum number of aircraft operations which can be accommodated on the runway in an hour.
- **Annual Service Volume (ASV)** – A reasonable estimate of an airport's annual capacity. It accounts for differences in runway use, aircraft mix, weather conditions, etc., that would be encountered over a year's time.
- **Annual Aircraft Delay** – Total delay incurred by all aircraft on the airfield in one year.

Airfield capacity is affected by a number of factors, which will be analyzed collectively. The factors will provide the basis for establishing the operational capacity of an airport and include the following:

- Airfield Layout
- Instrument Approaches
- Aircraft Mix Index
- Meteorological Conditions
- Airfield Operational Characteristics

The following sections will evaluate each of these capacity factors with respect to RSW.

4.2.1 Airfield Layout

The airfield layout refers to the location and orientation of the runways, taxiways and apron areas. Runway 6-24 has a northeast to southwest orientation. The total pavement length is 12,000 feet long by 150 feet wide. The Runway is served by a full-length parallel taxiway, Taxiway A, located on the north side of the runway. The runway to taxiway separation adheres to standards set forth in AC 150/5300-13, Change 6, and provides 400 feet of separation for ADG IV (discussed in further detail in the following chapter). Taxiway A also provides access to the Fixed Base Operator (FBO), Cargo area, and the main passenger terminal via a number of taxilanes and taxiway connectors. Runway 6 has a total of seven connector taxiways, three of which are high-speed exit taxiways that are located to provide immediate access to the passenger terminal apron. Runway 24 also has a total of seven connector taxiways, two of which are high-speed exit taxiways.

RSW's straight forward layout limits the Airport to just two primary operating configurations. These consist of landings and departures to/from Runway 6 or landings and departures to/from Runway 24.

4.2.2 Instrument Approaches

The Airport is served by both precision and non-precision instrument approaches. Runway 6 has a Category I instrument landing system (ILS) for precision approaches (both vertical and horizontal guidance) to the runway. This system consists of a glideslope, localizer, Runway Visual Range system (RVR), and Medium Intensity Approach Lighting System (MALSR). Operations can occur on Runway 6 with approach minimums as low as 229 feet (decision height) and ½ statute mile visibility for all aircraft at any approach speed or a runway visual range of 2,400 feet. The localizer component of the ILS provides for a straight-in non-precision approach to Runway 6. This approach can be made with a minimum descent altitude (MDA) of 380 feet and visibility as low as ½ statute mile or a RVR of 2,400 feet for aircraft with approach speeds less than 140 knots (Category A, B, and C). Higher approach speeds require a ¾ statute mile visibility or a RVR of 4,000 feet.

Runway 6 has both Non-Directional Beacon (NDB) and Global Positioning Satellite (GPS) non-precision instrument approaches. The MDA for the straight-in NDB approach is 440 feet with visibility minimums of ¾ of a statute mile or a RVR of 4,000 feet for Category A, B, and C aircraft, and one statute mile a RVR of 5,000 feet for aircraft having approach speeds of between 121 and 141 knots (Category D). The GPS approach for Runway 6 has an MDA of 380 feet and a minimum visibility requirement of ½ statute mile or a RVR of 2,400 feet for Category A, B, and C aircraft. For Category D aircraft, a minimum visibility of one statute mile is required or a RVR of 5,000 feet.

Runway 24 has two non-precision approaches, a Very-high Frequency Omni-directional Range/Distance Measuring Equipment (VOR/DME) approach and a GPS approach. The MDA for the VOR/DME non-precision instrument approach for all aircraft approach classifications is 360 feet with a visibility minimum of one statute mile. The GPS approach for Runway 24 has an MDA of 400 feet with a minimum visibility requirement of one statute mile for approach Category A, B, and C. For Category D aircraft the minimum visibility requirement increases to 1¼ statute mile.

RSW also has an airport surveillance radar (ASR) that provides non-precision approaches to both Runway 6 and Runway 24. These approaches have a MDA of 380 feet for both runways. The visibility minimums for the ASR on Runway 6 are ½ statute mile or a RVR of 2,400 feet for Category A, B, and C. Category D visibility minimums are one statute mile or a RVR of 5,000 feet. The Runway 24 ASR approach cannot utilize the RVR system and visibility minimums therefore increase to one statute mile for Category A, B, and C, and 1¼ statute miles for Category D aircraft.

4.2.3 Aircraft Mix Index

In reviewing the operational fleet mix data from the forecasts presented in the Aviation Activity Forecasts Chapter, it is possible to establish the index value required to compute an airfield's capacity. This index value, known as the aircraft mix index, is calculated based on the type or class of aircraft expected to serve the Airport. The formula for finding the mix index is %(C + 3D) where C is the percentage of aircraft over 12,500 pounds, but less than 300,000 pounds and D is the percentage of aircraft over 300,000 pounds. Since RSW is an air carrier airport, the majority of the current aircraft mix includes Class C and D aircraft.

The mix index calculations indicate that during visual flight conditions approximately 82 percent of the aircraft operations at RSW are currently conducted by Class C aircraft with five (5) percent conducted by larger Class D aircraft. The smaller Class A and B aircraft account for the remaining 13 percent with Class B having the majority with 10 percent. During instrument meteorological conditions at peak periods, it is estimated that the percentage of Class C and Class D aircraft will increase to approximately 90 percent and 6 percent respectively with both Class A and Class B aircraft percentages decreasing significantly. During these conditions Class A and B aircraft account for a reduced percentage of the overall airport mix. This increase in the larger class aircraft and decrease in smaller class aircraft is due to the fact that under instrument meteorological conditions, the larger class aircraft associated with commercial airline operations are often better equipped and trained to make precision instrument approaches and landings into the Airport when weather conditions are poor.

The fleet mix is projected to decrease slightly in terms of Class C aircraft throughout the planning period with the percentage Class C dropping from 82 to 77 percent by 2020. This decrease is a result of an increasing trend towards the use of larger aircraft in both the international and domestic markets. The larger aircraft are used during peak hour instead of an increase in frequency because of delay constraints. The percentage of Class D aircraft is therefore expected to increase throughout the planning period from 5 percent in 2000 to 11 percent by the Year 2020. Class A and B percentages are expected to remain fairly constant throughout the planning period due to the optimistic outlook and expected stabilization in the general aviation and smaller aircraft market. **Table 4-1** presents the aircraft mix analysis relative to VFR conditions.

TABLE 4-1
AIRCRAFT OPERATIONAL MIX (VFR)

Year	Percent Class				
	A	B	C	D	Mix Index (C+3D)
2000-Base Year	3%	10%	82%	5%	97
2005	3%	9%	81%	7%	102
2010	3%	9%	80%	8%	106
2020	3%	9%	77%	11%	111

Percentages may vary due to rounding
Source: Birk Hillman Consultants, Inc., 2001.
Ricondo & Associates, Inc.

The aircraft mix index under VFR conditions is expected to increase from 97 in 2000 to 111 in 2020 based on the projected changes in the fleet. **Table 4-2** presents the aircraft mix analysis relative to IFR conditions.

TABLE 4-2
AIRCRAFT OPERATIONAL MIX (IFR)

Year	Percent Class				
	A	B	C	D	Mix Index (C+3D)
2000-Base Year	1%	3%	90%	6%	108
2005	2%	3%	87%	8%	111
2010	2%	3%	85%	10%	115
2020	2%	3%	83%	12%	118

Percentages may vary due to rounding
Source: Birk Hillman Consultants, Inc., 2001.

The IFR aircraft mix index is expected to increase from 108 in 2000 to 118 by 2020. Again, this is due to the projected changes in the aircraft fleet mix.

4.2.4 Meteorological Conditions

Weather conditions can significantly affect utilization of the runways, and subsequently, affect the capacity of the airside facilities at an airport. Runway utilization is affected by wind conditions, cloud ceilings, and visibility, all of which factor into the direction in which take-offs and landings at an airport generally occur. The majority of the time runway use is solely determined by the prevailing winds at the airport. However, the type of instrumentation and the adequacy of the associated instrument approaches for the runway system will influence which runway is active during inclement weather conditions.

As the ceiling and horizontal visibility diminishes the required spacing between aircraft departing or arriving at an airport increases to provide increased margins of operational safety. However, aircraft operations may cease entirely when conditions have deteriorated below the lowest available approach minimums. As the distance between aircraft increases, the number of aircraft that can operate at the airport during a given time period is reduced, thereby adversely affecting the capacity of the airfield. There are four primary measures of cloud ceiling and visibility conditions recognized by the FAA (AC 150/5060-5) in calculating airfield capacity. These include:

- Visual Flight Rules (VFR) – Cloud ceiling is greater than 1,000 feet above ground level (AGL) and the visibility is greater than three statute miles.

- Instrument Flight Rules (IFR) – Cloud ceiling is at least 500 feet AGL but less than 1,000 feet AGL and/or the visibility is at least one statute mile but less than three statute miles.

- Poor Visibility and Ceiling (PVC) – Cloud ceiling is less than 500 feet AGL and/or the visibility is less than one statute mile.

- Below Minimums- Cloud ceiling and visibility is below stated minimums for the airport. The airport is closed.

Based on weather data received from the National Oceanic and Atmospheric Administration (NOAA), the National Climatic Data Center (NCDC), and per conversations with Air Traffic Control staff, a meteorological analysis was prepared for RSW. Hourly observations from NOAA's weather station located at Page Field for the ten year period ending in 2000 and information provided by ATC staff was used to determine the percentage of time the airport is operated under VFR, IFR, and PVC conditions. At RSW, VFR conditions were found to occur approximately 95 percent of the time, while IFR conditions occur approximately 4 percent of the time. PVC conditions and weather conditions below the published approach minimums were found to account for a combined total of 1 percent over the ten-year period. The percentage of IFR and below minimum conditions can have a considerable negative impact on the overall capacity of the airport from an annual service volume perspective. However, RSW has a very low percentage of time under IFR or below minimums conditions when compared to other airports throughout the country.

4.2.5 Airfield Operational Characteristics

A number of operational characteristics will also affect an airfield's overall capacity. These include the percentage of aircraft arrivals, the sequencing of aircraft departures, and the percentage of touch and go operations at an airport.

Percentage of Aircraft Arrivals

The percentage of aircraft arrivals is the ratio of landing operations to the total operations at the airport. In most cases, the higher the percentage of arrivals during the peak period, the lower the service volume. RSW utilizes a single runway operation and, for purposes of calculating capacity figures, the percentage of arrivals at RSW was assumed to be 50 percent.

Runway Utilization

Based on wind rose analysis and a review of the runway operating configurations outlined in the previous Master Plan, it was determined that the runway utilization had not changed significantly at RSW. In both VFR and IFR conditions, Runway 6 is the most utilized runway accounting for approximately 80 percent utilization during VFR conditions and 85 percent during IFR conditions. Runway 24 is utilized approximately 20 percent of the time during VFR and only 15 percent during IFR weather. The Airport was assumed to be closed one (1) percent of the time due to weather conditions. These percentages are important in computing the weighted hourly capacity and annual service volume for the airport.

Percentage of Touch and Go's

A touch and go is defined as the operation of an aircraft, which lands and then makes an immediate take-off without coming to a full stop or exiting the runway. These operations are usually associated with flight training. Very little flight training exists at RSW, thus touch and go operations occur infrequently. For purposes of calculating the hourly capacity of the runway, a touch and go factor (T) of 1.00 was used reflecting less than one (1) percent touch and go operations at the Airport.

Taxiway Exits

Besides the importance of the runway configuration in the airside capacity model, the type and number of exit taxiways also play a very important role in the calculations. The location of exit taxiways can have a significant effect on the occupancy time of a landing aircraft on the runway. The longer an aircraft remains on the runway, the lower the capacity of the runway becomes.

At RSW, there are a total of nine (9) exits connecting the parallel taxiway to Runway 6-24. This includes the taxiway connectors located at each runway end. Based on the FAA's criteria and the fleet mix at RSW, the optimum exit factor relative to capacity is maximized when a runway has two, three, or even four exit taxiways within a range determined by the operations occurring on the runway. At RSW, this operational range is between 5,000 feet to 7,000 feet from the landing threshold. RSW has two taxiway exits for Runway 6 and two taxiway exits for Runway 24 located within this range. This corresponds to a taxiway exit factor (E) of 0.94 under VFR conditions and 0.92 under IFR conditions.

4.3 AIRFIELD CAPACITY

The characteristics of RSW's capacity as determined in the preceding section were used in conjunction with the methodology developed by the FAA to determine airfield capacity. FAA methodology generates three different values for measuring airfield capacity. These include:

- Hourly Runway Capacity
- Annual Service Volume
- Annual Aircraft Delay

4.3.1 Hourly Capacity of Runway System

The hourly capacity of the runway system measures the maximum number of aircraft operations that can be accommodated by the Airport's runway configuration in one hour. Based on FAA methodology, hourly capacity for runways is calculated by analyzing the appropriate VFR and IFR figures in Advisory Circular AC150-5060-5 for the airport's runway configuration. For both VFR and IFR conditions, the hourly capacity for runways is calculated by multiplying the hourly capacity base, exit factor, and touch and go factor as follows:

Hourly Capacity = C* x T x E

The hourly capacity base (C*) is calculated by applying the aircraft mix index and percent of aircraft arrivals. The calculations from the AC 150-5060-5 figures are delineated in **Table 4-3**.

TABLE 4-3
HOURLY CAPACITY OF RUNWAY SYSTEM (2000)

	VFR	IFR
Hourly Capacity Base (C*)	57	53
Touch and Go Factor (T)	1.00	1.00
Exit Factor (E)	0.94	0.92
Hourly Capacity	**54**	**49**

Source: Birk Hillman Consultants, Inc., 2001.

When analyzing the runway system with an aircraft mix of 82 percent Class C operations in VFR conditions and 90 percent in IFR conditions, no touch and go operations in VFR conditions, and a taxiway exit rating of two, existing hourly runway capacity is estimated to be 54 operations per hour under VFR conditions and 49 operations per hour under IFR conditions.

4.3.2 Annual Service Volume (ASV)

ASV is the approximate measure of an airport's capability in terms of annual throughput capacity. In other words, the ASV represents a reasonable theoretical limit of operations that the Airport can accommodate safely given its operating characteristics. A demand that approaches or exceeds the ASV will typically result in increasingly significant delays. No matter how substantial an airport's capacity may appear, delays may occur even before an airport reaches its stated capacity. Capacity, in fact, is a measure of activity that does not exceed an acceptable level of delay. A number of projects that would increase the capacity at an airport are eligible for funding from the Federal Aviation Administration (FAA). According to FAA Order 5090.3B, "Field Formulation of the National Plan of Integrated Airport Systems (NPIAS)," this eligibility is achieved once the airfield has reached 60 percent of its current capacity. This allows improvements to be made before demand levels exceed capacity in order to avoid lengthy delays normally associated with larger scale construction projects. Future capacity levels for the airport have been calculated based on the forecasted annual operations and the respective ASV for each year.

In order to gain an understanding of the overall capacity at RSW, the calculation of the Airport's Annual Service Volume (ASV) is necessary. RSW's ASV was calculated for each planning period (2000, 2005, 2010, and 2020). By referring to the FAA's methodology to estimate ASV, the ratio of annual demand to average daily demand during the peak month is determined, along with the ratio of average daily demand to average peak hour demand during the peak month. These values are then combined with the weighted hourly capacity according to the following formula:

Annual Service Volume = Cw x D x H

Where: Cw = weighted hourly capacity
D = ratio of annual demand to average daily demand, during the peak month
H = ratio of daily demand to average peak hour demand, during the peak month

For the calculation of annual capacity, a single weighted hourly capacity (Cw) is determined which incorporates VFR and IFR hourly capacities as well as periods of airport closure into a single number that better represents an "average" condition. The weighted hourly capacities calculated for the base year and for each of the three planning periods are included in **Table 4-4**.

TABLE 4-4
WEIGHTED HOURLY CAPACITY OF RUNWAY SYSTEM(Cw)

Year	Operations per Hour
Base Year	
2000	44
Forecast	
2005	42
2010	41
2020	40

Source: Birk Hillman Consultants, Inc., 2001.

ASV – Actual Demand Profiles

Airport capacity as a whole is expressed as the maximum number of operations (takeoffs and landings) that can occur within a given period of time using standard air traffic management practices. The National Airspace System (NAS) capacity would be much greater if traffic were evenly distributed throughout the day (and night) and among all airports. In practice and at RSW, however, traffic demand has peak and off-peak periods. The extent of this peaking can have considerable impact on the ability of an airport to adequately serve demand.

RSW's ASV based on the actual or projected ratio of annual demand to actual or projected average daily demand in the peak month (D) and peak hour (H) for each of the planning periods at RSW is shown in **Table 4-5** below.

TABLE 4-5 ANNUAL SERVICE VOLUME ACTUAL PROFILES				
Year	**Cw**	**(D)**	**(H)**	**ASV**
Base Year				
2000	44	283.2	7.6	94,716
Forecast				
2005	42	282.2	7.5	88,906
2010	41	282.6	7.6	88,058
2020	40	281.7	7.6	85,637

Source: Birk Hillman Consultants, Inc., 2000.

Table 4-7 depicts very low ASV numbers in a decreasing trend towards the long-term planning period. These low numbers are not typical for a single runway airport but reflect the impact of the extreme seasonal and hourly peaking characteristics associated with operations at the Airport.

ASV – Theoretical Profiles

Theoretically, a single-runway Airport should have much higher ASV numbers then those calculated based on the actual demand ratios. This is due to the tendency of operational activity profiles to shift slightly with time to minimize potential for delays, thereby increasing capacity. Ranges of typical ASV (D) and (H) numbers have been identified by the FAA in AC 150/5060-5 as depicted in **Table 4-6** below.

TABLE 4-6 TYPICAL DEMAND RATIOS		
Mix Index	**Daily (D)**	**Hourly (H)**
0-20	280-310	7-11
21-50	300-320	10-13
51-180	310-350	11-15

Source: FAA AC 150/5060-5

To determine the theoretical annual service volume for RSW, a recalculation of the ASV was conducted with the FAA typical demand ratios presented in **Table 4-6** for each planning period. These numbers were used in conjunction with weighted hourly capacity numbers calculated previously for RSW. The demand ratios in the table depict a range to gain an understanding of low, medium, and high ASV scenarios that may be possible with a single runway configuration. The calculated mix indexes at RSW fall in the 51-180 range, thus values representing the low, medium, and high ranges of 310, 330, and 350 for (D) and 11, 13, and 15 for (H), were used. **Table 4-7** presents the resulting ASV numbers:

TABLE 4-7 THEORETICAL (FAA BASED) ANNUAL SERVICE VOLUME					
(D)	**(H)**	**2000 (Base)**	**2005**	**2010**	**2020**
310 (low)	11	150,040	143,220	139,810	136,400
330 (medium)	13	188,760	180,180	175,890	171,600
350 (high)	15	231,000	220,500	215,250	210,000

Source: Birk Hillman Consultants, Inc., 2001.

As depicted in **Table 4-7**, the ASV numbers are significantly higher than those calculated based on actual operational profiles. For the base year, 2000, the low range ASV is estimated at 150,040 while the high range ASV is estimated at 231,000. The high range is an estimate of the maximum possible demand that the Airport would be able to handle at the maximum FAA designated (D) and (H) values. This would assume virtually no monthly or hourly peaks, but rather flat and steady activity levels throughout the year. The low estimate of 136,400 would be representative of a more realistic number of ASV at RSW as the (D) and (H) values are representative of a facility with high seasonal and hourly peaking characteristics.

4.4 AIRFIELD DEMAND VS. CAPACITY

The comparison between demand and capacity provides a measurement for determining when capacity related enhancements should be considered. According to accepted industry standards as demand reaches 60 percent of capacity, planning for improvements should begin and when demand reaches 80 percent of capacity construction of these enhancements should commence. Two different methodologies developed by the FAA were considered in comparing the current and future demand at the Airport to the existing capacity. These include:

- Hourly Demand vs. Capacity
- Annual Demand vs. Annual Capacity

4.4.1 Hourly Demand Vs. Hourly Capacity

This section represents a detailed analysis of the projected hourly demand versus the hourly capacity of the runway system at RSW. As depicted in **Table 4-8**, the base year (2000) peak hour demand is 67 percent of the hourly capacity during VFR conditions and 78 percent during IFR conditions. In 2005, these percentages increase to 83 (VFR) percent and 94 percent (IFR) and continue to increase significantly throughout the planning period, exceeding 100 percent in 2010 under IFR conditions and before 2020 under VFR conditions. When the peak hour demand approaches 80 percent of the hourly capacity the peaking will begin to flatten and spread over a longer period unless additional capacity becomes available. This flattening will increase impacts during the surrounding hours as demand approaches or exceeds 100 percent of capacity.

Although hourly departure and arrival rates (hourly capacity) may appear to be less than the hourly capacity, concentration of flights within the peak hour will likely result in delays prior to reaching capacity levels. The more evenly the traffic is spread throughout peak hour, the better the Airport will be able to serve hourly demands approaching 100 percent of capacity.

TABLE 4-8 RATIO OF PEAK HOUR DEMAND TO HOURLY RUNWAY CAPACITY			
VFR			
Year	**Peak Hour Demand**	**Hourly Capacity**	**% of Capacity**
2000 (base year)	36	54	67%
2005	43	52	83%
2010	49	51	96%
2020	65	50	130%
IFR			
Year	**Peak Hour Demand**	**Hourly Capacity**	**% of Capacity**
2000 (base year)	36	47	78%
2005	43	46	94%
2010	49	46	107%
2020	65	46	141%

Source: Birk Hillman Consultant Inc., 2001.

4.4.2 Annual Demand vs. Annual Capacity

This section presents an analysis of projected annual demand versus the calculated annual service volume based on the FAA's theoretical demand profiles for airports similar to RSW. **Table 4-9** presents the airfield's estimated annual capacity levels.

TABLE 4-9 AIRFIELD CAPACITY LEVELS			
Year	**Annual Operations**	**Annual Service Volume (2000)** ①	**Capacity Level**
2000	77,042	150,040	51%
2005	90,600	143,220	63%
2010	105,700	139,810	76%
2020	139,700	136,400	102%

Source: Birk Hillman Consultants, Inc., 2001.
① ASV calculated using typical FAA demand ratios.

The capacity level in 2005 is expected to exceed 60 percent of the ASV increasing to nearly 80 percent by 2010. Based on this, it is recommended that planning for capacity enhancements at RSW be initiated as soon as practical to avoid future capacity deficiencies.

4.5 ANNUAL AIRCRAFT DELAY

As demand approaches capacity, delays increase at an exponential rate. For a given capacity, there is a tradeoff between demand and delay, with increases in demand accommodated only at the cost of longer and more frequent delays. Even when demand is quite low with respect to capacity, a change in an airport's operating conditions may reduce capacity and thereby increase the delay associated with a given level of demand. One of the major causes for delay besides the influence of weather is flight scheduling and peaking characteristics. Certain arrival and departure times are preferred by travelers, and as a result, airlines schedule their operations accordingly. This peaking of demand produces overloads, traffic queues, and other forms of congestion that translate into delay not only at the point of incidence but elsewhere in the connecting nodes of the airport and airspace network. The relationship between delay and demand/capacity is very sensitive. Ideally, during a given hour, if aircraft using an airport sought service at a continuous rate equal to that at which aircraft operations could be processed, and if operating conditions at the airport were constant throughout the hour, then operations could reach the airport's highest capacity without significant delays. However, it must be realized that the actual rate of which aircraft arrive and depart is never continuous. As demand approaches airport capacity, delays related to congestion will no doubt occur. If demand begins to exceed airport capacity, delays will become more significant and occur at an increasing rate and it may take hours for an airport to fully recover from compounding delays that occur over a relatively short period.

The FAA methodology allows for the determination of average delay per operation as well as total hours of aircraft delay on an annual basis. The estimate of annual delay includes arriving and departing aircraft operations under both VFR and IFR conditions. Essentially, the ratio of projected demand to ASV is utilized in the FAA's charts in AC 150/5060-5, Change 2 to determine a conservative estimate of the average delay per aircraft. This value is then applied back to the annual demand levels to estimate the total amount of annual aircraft delay. The ASV figures from the FAA based ASV calculations were used. The FAA outlines a range of delay values based on the ratio of demand to capacity. **Table 4-10** outlines both the low and high ends of this range, and outlines the costs associated with the delay.

TABLE 4-10
ANNUAL AIRCRAFT DELAY

Year	Average Delay per Aircraft Operation, Low Ratio (minutes)	Average Delay per Aircraft Operation, High Ratio (minutes)	Average Total Annual Delay (hours)	Estimated Cost of Delay (annual)
Base Year				
2000	0.3	0.5	642	$768,900
Forecast				
2005	0.5	0.7	1,057	$1,323,000
2010	0.7	1.3	2,290	$2,798,800
2020	2.5	3.8	8,814	$11,623,900

Source: Birk Hillman Consultants, Inc., 2001.

As presented in **Table 4-10**, the estimated delay per aircraft operation in the base year for FAA low and high ratios of aircraft delay ranges from 18 seconds (0.3) to 30 seconds (0.5) respectively. These delays are expected to increase slightly by 2005 and nearly double by 2010. For planning purposes, the high ratio was used to estimate total annual delay. As noted, in the base year, 2000, the average delay per aircraft operation for the high average was estimated at 30 seconds (0.5 minutes), which equates to approximately 642 total annual hours of delay. This, in turn, equates to an estimated cost of approximately $768,900 annually. By 2020, the average delay per operation for the high average is projected to increase to 228 seconds (3.8 minutes) or 8,814 total annual hours of delay assuming no capacity improvements are done to the Airfield. The average delay per aircraft by 2020 is 3.8 minutes, which may have an impact on airport capacity. In addition, the annual cost of delay is estimated to approach $11,623,900 within this period.

4.5.1 Annual Delay Cost Basis

The estimated annual costs of delay throughout the planning period were calculated using typical costs by aircraft class, in dollars per minute, described in FAA AC 150/5060-5, Change 2. The same four aircraft classifications, A, B, C, and D, used to determine fleet mix were also used to calculate costs associated with aircraft delay. For the purposes of estimating delay costs, the aircraft classifications are broken down further into the type of aircraft based on the number of seats, and the type of operation, General Aviation, Air Taxi, or Air Carrier. Typical costs associated with each classification include the following ranges in dollars per minute:

- $0.60 to $1.80 for Class A (12,500 pounds or less, single engine) including aircraft from 1-3 seat GA aircraft to 4+ seat air taxi aircraft. Examples: Cessna 1152/172/182/210, Piper Warrior, Beechcraft Bonanza.

- $2.50 to $6.80 for Class B (12,500 pounds or less, multi engine) including aircraft from piston twin GA aircraft to twin turbine jet air taxi aircraft. Examples: Beechcraft Baron, Piper Seminole, Cessna Citation I, Cessna 310, Beech King Air 90/100/200/350.

- $2.80 to $35.50 for Class C (12,500 pounds to 300,000 pounds) including aircraft from piston engine GA, four turbine air carrier aircraft, and two engine air carrier jets to four engine air carrier jets. Examples: Cessna Citation II, Lear 35/55, Gulfstream II/III/IV, Boeing 727/737, Douglas DC9/MD-80.

- $39.00 to $79.30 for Class D (over 300,000 pounds) including all air carrier aircraft from two engine jets to four engine jets. Examples: Airbus A300/A310, Boeing 767, Lockheed L1011, MD-11, Airbus A340, Boeing 747.

The estimated costs of annual delay at RSW were derived based on the previously mentioned criteria and a percentage breakdown of the fleet mix for each aircraft typically operating at RSW in each classification. In this manner, delay costs were estimated for each aircraft within each classification based on their percentage of operations. This method was used to obtain the most accurate estimate possible to determine total delay costs. In addition, this method allowed for the compensation of the percentage changes forecast for the fleet mix, thus avoiding a generic dollar per minute figure based on the base year.

4.6 AIRSPACE CAPACITY

Airspace capacity is an essential element of any airport, especially with respect to maintaining the existing and proposed operational characteristics. As discussed in Chapter 2, “Inventory”, RSW has an FAA controlled Air Traffic Control Tower (ATCT) and the airspace surrounding the airport is designated as Class C airspace. Class C airspace consists of two columns of space. The Class C airspace at RSW contains no modifications to the standard airspace configuration. The inner column of airspace encompasses an area that has a 5 nautical mile radius from the Airport and extends from the surface up to 4,000 feet above the airport elevation. The outer column of airspace encompasses an area that has a 10 nautical mile radius, but begins at 1,200 feet MSL and extends up to 4,000 feet MSL. Above 4,000 feet MSL, Class E airspace begins and continues up to 17,999 feet MSL where it intersects the overlying Class A airspace. **Table 4-11** delineates the features of each airspace classification and outlines what requirements, services, and equipment is necessary for use in the different airspaces.

TABLE 4-11
FEDERAL AVIATION REGULATION AIRSPACE CLASSIFICATIONS

Airspace Features	Class A	Class B	Class C	Class D	Class E	Class G
Operations Permitted	IFR	IFR and VFR	IFR and VFR	IFR and VFR	IFR and VFR	IFR and VFR
Entry Requirements	ATC Clearance	ATC Clearance	ATC Clearance for IFR	ATC Clearance for IFR	ATC Clearance for IFR	None
Minimum Pilot Rating	Instrument	Private / Student	Student	Student	Student	Student
Two-way Radio Communication	Yes	Yes	Yes	Yes	Yes for IFR	No
VFR Visibility Minimums	N/A	3 Statute Miles	3 Statute Miles	3 Statute Miles	3 Statute Miles	1 Statute Mile
Aircraft Separation	All	All	IFR, SVFR and Runway Ops	IFR, SVFR and Runway Ops	IFR and SVFR	None
Conflict Resolution	N/A	N/A	Between IFR and VFR Ops	No	No	No
Traffic Advisories	N/A	N/A	Yes	Workload Permitting	Workload Permitting	Workload Permitting
Safety Advisories	Yes	Yes	Yes	Yes	Yes	Yes
Special Equipment	N/A	Mode C Transponder	Mode C Transponder	N/A	N/A	N/A

Source: Birk Hillman Consultants, Inc., 2001.
Abbreviations: SVFR = Special VFR.

The airspace surrounding RSW is controlled by three types of FAA designated air traffic control. These include the Air Route Traffic Control Center (ARTCC), Fort Myers approach/control, also known as Terminal Radar Approach Control (TRACON), and the air traffic control tower (ATCT). Due to the Airport's close proximity to other airports in the area, the navigation corridors for over flying traffic, the Gulf of Mexico, and the increasing aviation activity in the southwest Florida region it is important to maintain efficient traffic flow and coordination through the use of the abovementioned facilities. Based on discussions with the air traffic controllers no upgrades to these facilities are necessary in the near term, but as demand increases in the future, these facilities should be upgraded as necessary based on FAA requirements.

The airspace overlying RSW and the Fort Myers area is controlled by the ARTCC, also known as Miami Center. The center has delegated airspace in the area at 10,000 feet MSL and below to the Fort Myers approach/control. Fort Myers approach control is operational from 6am till 12pm seven days a week, 365 days a year. When not operational, Miami Center provides approach control service for the Airport. Fort Myers approach/control also provides control for the following airports: Naples, Page Field, Punta Gorda, Marco Island, and Immokalee.

The air traffic control tower (ATCT) at RSW controls airspace within the five nautical mile radius up to 4,000 feet MSL. This area of control is bordered by the Page Field control zone to the northwest of the Airport. The fact that RSW and Page Field are located only 7 nautical miles apart, could provide some potential airspace conflicts in the future as the demand at both of these airports increases. The close proximity of RSW to Page Field has resulted in the establishment of ATC procedures to resolve potential airspace and aircraft conflicts. These procedures will also minimize the coordination necessary between the two facilities, thus providing controllers more focus on traffic specific to RSW. Traffic patterns at RSW have been designed and amended to keep traffic on the southeast side of the Airport to maintain separation from Page Field. Furthermore, departures on Runway 13 at Page Field require prior release from the RSW tower to avoid traffic conflicts with potential traffic departing or arriving at RSW. Departures from Page Field from Runway 13 are required to head straight out crossing directly over the RSW airfield. In addition, aircraft tracks are coordinated to comply with noise concerns for the surrounding area.

The alignment of the primary instrument runways at both airports are almost identical, thus minimizing the potential for conflicts. The primary runway at RSW is oriented at 6-24 and Page Field's runway is oriented in a 05-23 direction. Therefore, arriving and departing traffic can follow similar procedures when entering or leaving either airport environment. IFR traffic on arrival to both RSW and Page Field can utilize the Sarasota Three Arrival procedure, which is a general use Standard Terminal Arrival (STAR) procedure for the area. The Sarasota Three STAR also serves Marco Island Airport, and Naples Municipal Airport.

Radar coverage of the airspace surrounding RSW and the Fort Myers area is provided via the Southwest Florida International Airport Surveillance Radar (ASR). Radar control beyond the airport control areas for sequencing and separation is available from Fort Myers approach control for the area within the designated Airport Radar Service Area (ARSA). The ARSA allows for radar sequencing and separation procedures within 10 nautical miles of RSW, thus providing a more efficient traffic system to enhance airspace capacity. The ARSA provides positive control up to 4,000 feet MSL. The ASR is currently scheduled for upgrade to an ASR 11 and will be discussed further in the following chapter.

As previously mentioned, air navigation routes play an important role in the air traffic system. RSW has a large number of over-flights compared to other airports in the region. This is in part due to the fact that many of these navigational corridors (also known as Victor Airways) utilize the RSW VORTAC as a main navigation waypoint. The RSW VORTAC appears to be a congregation point for many low-enroute navigational corridors in the area. This influx of over flights is another factor contributing to the complexity of the air traffic control facilities. These transient flights normally operate in a north to south direction and vice versa. These flights must be coordinated with the east to west traffic flow created by aircraft arriving and departing at RSW. With the increase in air traffic expected at RSW and the Fort Myers area airports in general, in addition to the fact that this type of coordination is becoming more operationally intense, expansion of services and facilities may be required. Plans are being made to expand the current TRACON facility at RSW with additional building space and the upgrading of equipment. In addition, programs are planned to maximize the efficiency and coordination with other major TRACON/approach control facilities in the State of Florida. These include facilities at airports such as Orlando International Airport, Tampa International Airport, and Miami International Airport. This coordination on a larger scale will enable controllers to plan routes for aircraft coming into the airspace earlier, thus allowing additional control of the air traffic system. This coordination is expected to be provided by a new digital radar network.

As demand increases in this area for air traffic control services, so does the potential for capacity related conflicts. As several plans have already been initiated to cope with expected air traffic demand, additional plans should be considered as alternatives to those increases in demand.