Chapter 2

Need for and Purpose of the Project

Table of Contents

List of Figures

List of Tables

2. Need for and Purpose of the Project

2.1 Need for the Project

2.1.1 Introduction and Background

In the late 1990's, the Calgary Airport Authority (the Authority) began to take note of significant air traffic congestion occurring on Calgary International Airport's (YYC) existing airfield system. As a result, an airfield capacity assessment was conducted in 1998. Based on the growth projections in effect at that time, the study suggested that the new runway could be required as early as 2006. However, the report also highlighted the fact that there were many operational enhancements that could be made that would improve the overall efficiency and capacity of the existing airfield system. These improvements fell into various categories, including:

- Additional taxiway infrastructure to improve the flow of air traffic on the ground
- Improved air traffic management on behalf of NAV CANADA
- Implementing new air traffic control technology that would assist air traffic controllers in managing the operation of the airport's existing intersecting runway configuration
- Rationalizing the mix of aircraft operating at YYC, given that small, slow "general aviation" aircraft mixed with larger faster moving aircraft have an adverse effect on airfield capacity (NAPA 1999)

Both the Authority and NAV CANADA acted on the key recommendations coming out of that report. An overall strategy that focused on maximizing the efficiency of the existing airfield system, with the objective of deferring the need to construct the new runway for as long as possible. Various enhancements were made by both the Authority and NAV CANADA during subsequent years, some of which had very dramatic and beneficial impacts with regard to reducing delays and improving the efficiency of the existing airfield. As part of the strategy, the Authority made significant investments in its secondary facility – Springbank Airport – in order for it to perform to its fullest extent as a "general aviation" reliever airport for YYC.

The Authority's most recent Master Plan, which was adopted in 2004, estimated that the current airfield system should adequately meet expected growth in demand for a ten year period – beyond which the parallel runway would be required to supply additional capacity. Thus the 2004 Master Plan suggests that the parallel runway would likely be required sometime in the period 2013 to 2015.

Subsequent to the adoption of the 2004 Master Plan, the Authority undertook further study regarding the parallel runway. In 2005 The Parallel Runway Implementation Study was completed, which acted as "…an overall framework to guide all subsequent studies, planning, regulatory agency involvement and stakeholder participation for the future implementation of Runway 16L-34R at YYC (Acres International 2005)". Based on the research compiled during the study on the implementation timeframes of other new runway projects in North America, it was determined that the overall timeline associated with the delivery of the Parallel Runway Project (PRP) could span 8 to 11 years from the beginning of project planning to in-service operations. The study recognized that the actual timing of the project would be based upon the demands placed on YYC's airfield system. A continuous monitoring of the demand/capacity of the airfield system was recommended.

In 2006, this monitoring of the airfield system commenced, with Landrum and Brown aviation consultants being commissioned to undertake ongoing assessments of airfield demand and capacity at YYC. These updates are identified in Section 2.1.4 of this report. In addition to the Landrum and Brown assessments of airfield capacity, as part of the overall environmental assessment (EA) process an additional and independent assessment of airfield capacity was undertaken by Airbiz Aviation Strategies Ltd. Both sets

of analyses confirm the need for the parallel runway in the timeframe originally suggested in the 2004 Master Plan; that being within the range of 2013 – 2015.

Another important consideration in evaluating the need for the PRP is that in the context of accommodating increasing demand the addition of the parallel runway is a solution that contributes to sustainability. The analysis of this contribution is described in Volume III, Chapter 2 of this Comprehensive Study (CS).

2.1.2 Historical Aircraft Movements

Transport Canada's (TC) (2008) total annual itinerant[1] aircraft movement (1995-2007) summary for YYC is presented in Table 2-1.

Table 2-1 YYC Total Itinerant Aircraft Movement (TC, 2008)

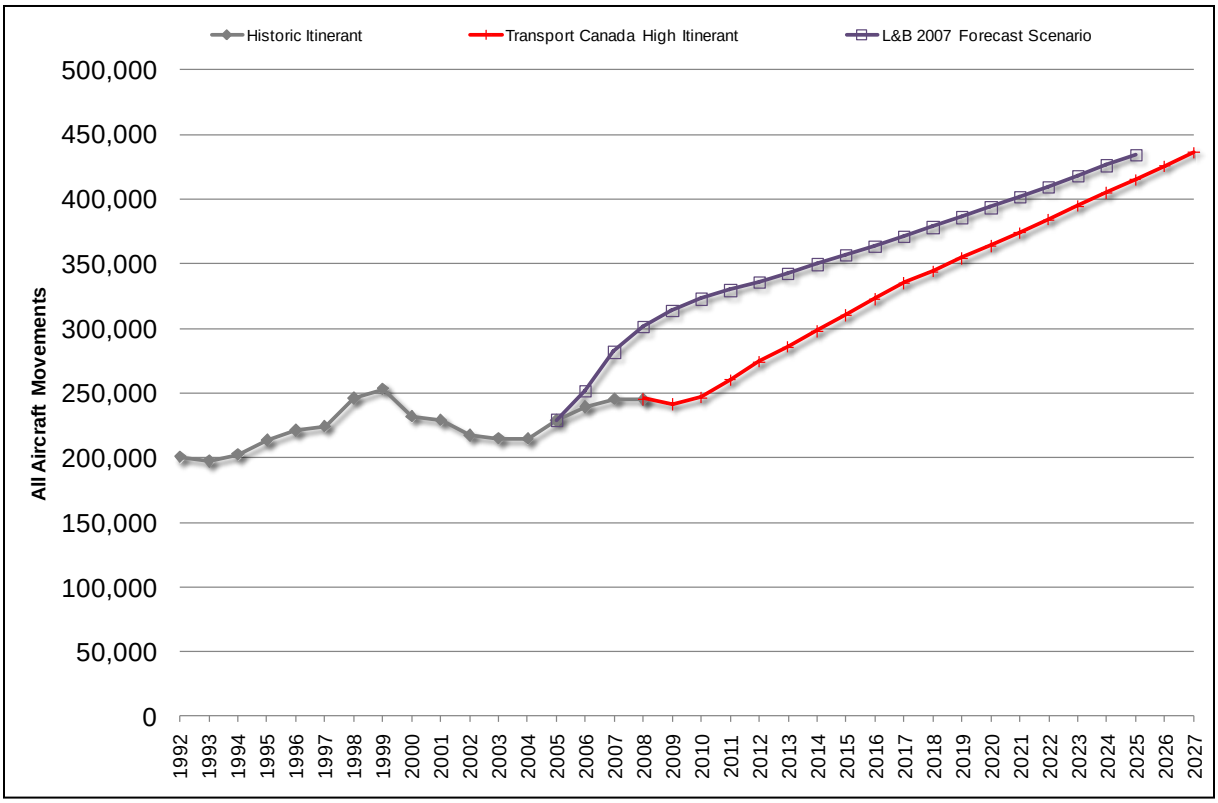
Total Air Carriers					General Aviation		Total Itinerant	
Year	Reporting	Non-Reporting	Grand Total					
1995	119,613	32,824	152,437	9.2%	61,206	-3.1%	213,643	5.4%
1996	132,734	42,605	175,339	15.0%	45,990	-24.9%	221,329	3.6%
1997	136,386	43,509	179,895	2.6%	44,666	-2.9%	224,561	1.5%
1998	155,078	40,300	195,378	8.6%	50,607	13.3%	245,985	9.5%
1999	163,738	35,382	199,120	1.9%	54,451	7.6%	253,571	3.1%
2000	147,754	36,572	184,326	-7.4%	47,587	-12.6%	231,913	-8.5%
2001	133,360	56,755	190,115	3.1%	39,063	-17.9%	229,178	-1.2%
2002	126,900	52,127	179,057	-5.8%	38,449	-1.6%	217,506	-5.1%
2003	127,700	52,268	179,968	0.5%	35,112	-8.7%	215,080	-1.1%
2004	130,200	54,391	184,591	2.6%	30,366	-13.5%	214,957	-0.1%
2005	143,100	54,940	198,040	7.3%	30,875	1.7%	228,915	6.5%
2006	152,400	56,688	209,088	5.6%	30,382	-1.6%	239,470	4.6%
2007	163,100	54,128	217,228	3.9%	28,331	-6.8%	245,559	2.5%

As can be seen in Table 2-1 and Figure 2-1, the period between 1995 and 1999 saw steady growth as annual aircraft movements at YYC grew from 213,643 to 253,571. This was followed by a period of decline between the years 2000 and 2004 as annual aircraft movements fell from 231,913 to 214,957. During 2005 and 2007 a strong recovery occurred, with annual movements growing from 228,915 to 245,559. This period saw growth in all three air carrier segments (domestic, transborder and other international). Growth in the other international sector was particularly strong as it registered a growth rate of 14%.

General aviation movements have been declining on a historic basis, from 61,206 movements in 1995 to 28,331 movements in 2007. In part this decline can be contributed to the Authority's strategy related to migrating lighter and slower aircraft to its reliever facility – Springbank Airport.

[1] *Transport Canada define itinerant aircraft movements as the total of arriving and departing flights, whether entering or leaving the traffic control circuit of an airport.*

Figure 2-1 YYC Total Itinerant Aircraft Movement (forecast and historic)



2.1.3 Airfield Capacity at YYC

Capacity is a measure of processing capability of a system – in this case the runway system as a whole, or specific elements. Capacity is measured as the number of aircraft operations that can be processed during a specific unit of time, such as an hour, a day, or a year. Delay refers to the difference between the scheduled time of arrival or departure and the actual arrival or departure. This can be measured at an airport for a sample hour or day or can be calculated in simulation models. It can be averaged as minutes of delay per aircraft arrival and/or departure over a specified sample period, and will depend on a wide range of factors. These include the airspace allocation and routes close to the airport, the runway configurations and combinations of runways in use, the type of aircraft operating at the airfield, and the operational rules (including those related to the weather conditions).

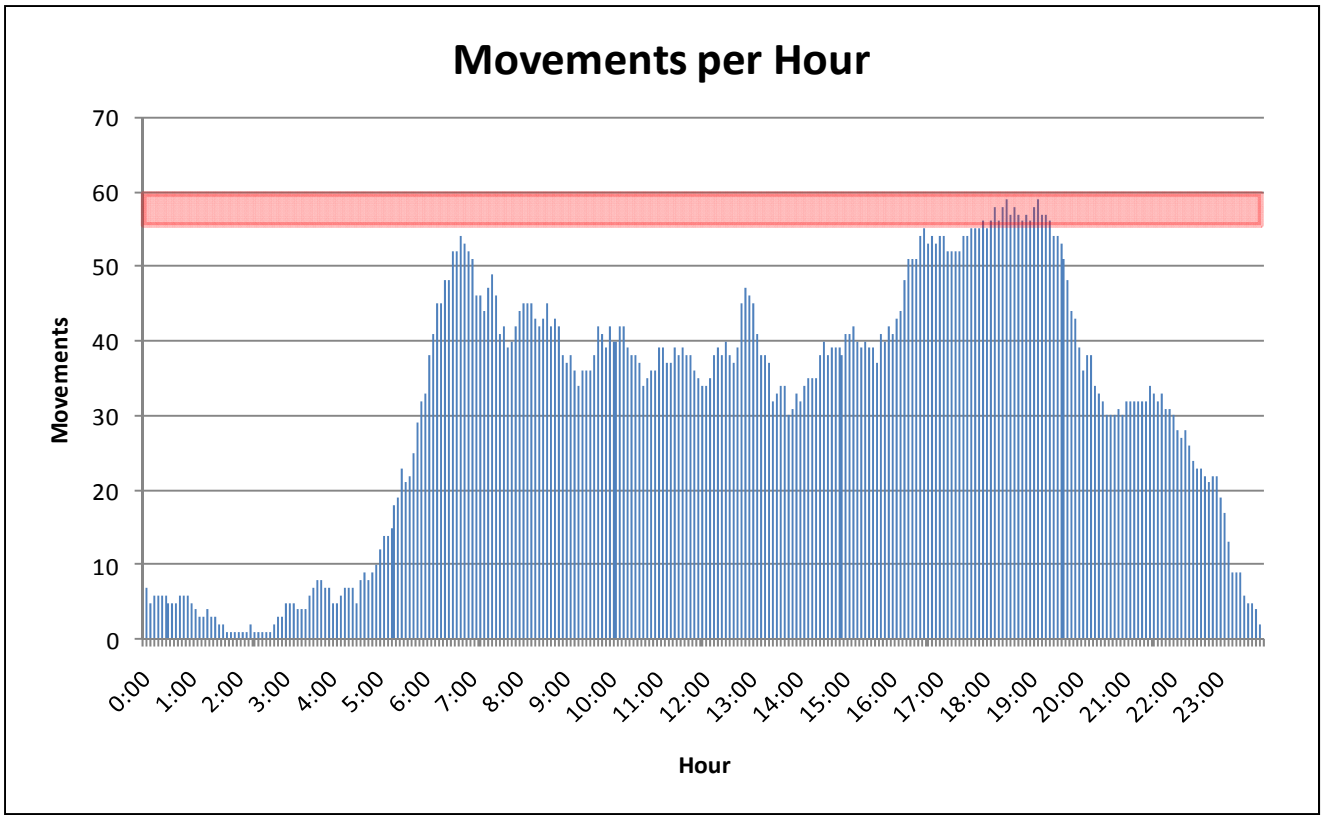
The 2004 Master Plan provided an overview of the capacity of the existing airfield. For operations under Visual Meteorological Conditions (VMC) with the highest capacity crossing runway combinations (Runways 10 and 16 and Runways 28 and 34) the report quoted maximum runway capacities of between 72 and 85 operations per hour. For operations under Instrument Meteorological Conditions (IMC) the quoted capacities were reduced to between 54 and 69 hourly operations. When weather conditions force the use of a single runway then capacities under IMC drop even further to between 47 and 52 hourly operations (Calgary Airport Authority 2004).

More recent analysis indicates that these runway capacity estimates may have been optimistic. A review of actual hourly runway aircraft movement during 2008 showed that for the 100th ranked busy hour (top 1%) the throughput was 55 movements. The 90th percentile day had its busiest clock hour traffic at this level, and is considered close to the sustainable runway capacity of the existing airfield. Figure 2-2 plots

hourly runway movements for the 90th percentile day. It shows an afternoon sustained peak of between 55 and 60 hourly movement on a moving hour basis[2].

The nominal runway capacity for the existing YYC airfield, as indicated by NAV CANADA and supported by anecdotal benchmarking at other airports with crossing dependent runway operations for aircraft operating under Instrument Flight Rules (IFR) is between 55 and 60 total hourly runway movements (Airbiz 2009).

Figure 2-2 90th Percentile Day – Movements per Hour (running hour)



As previously noted, the capacity of an airport's airfield system is often determined with reference to the number of aircraft movements which can be processed without reaching unacceptable levels of delay. Delays cause disruption to the traveling public, impose extra costs on the airlines and the airport, increase total engine emissions due to on-ground queuing and "holds" in the air and if too onerous ultimately act as a disincentive to travel for business or leisure (for local residents or visitors to the region) with consequent economic losses to commerce, industry and tourism in the airport hinterland.

In their work for a number of major airports in Canada, Landrum and Brown have found that on average, aircraft movement delays of between 6 and 10 minutes indicate the need for additional facilities. Anything

[2] *The number of hourly movements is often measured by counting the number of movements by "clock" hour (one that starts at the o'clock and ends at 59 minutes past). In determining the maximum movements in a 60 minute period on any given day, a more precise measure is to use a "moving" hour, also referred to as "running" or "rolling" hour. This counts the movements in **any** 60 minute increment. In practice the movements are summed for the 60 minutes forward at specific increments, for example every 5 minutes or every 15 minutes. By mathematical definition the rolling hour will always be equal to or greater than the "clock hour" peak, as it does not rely on the coincidence of the maximum 60 minute demand or throughput to coincide with an increment starting at the very beginning of the hour (the clock hour).*

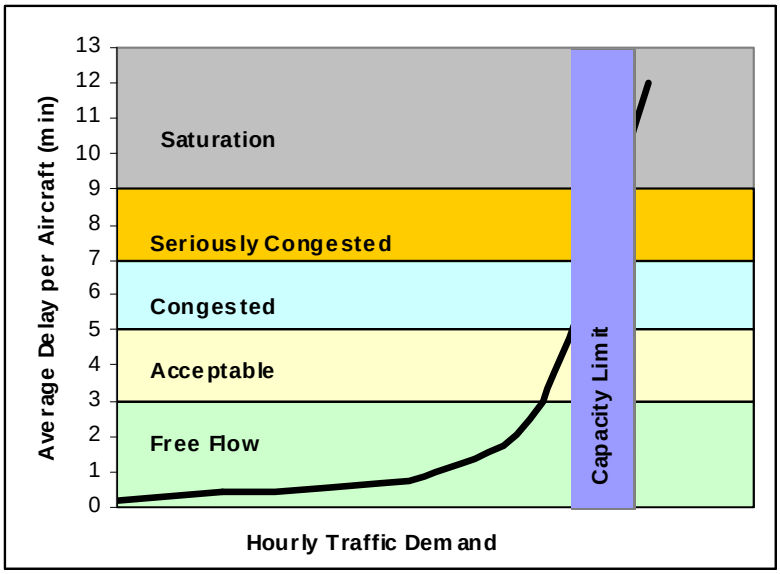
above 10 minutes is deemed unacceptable (Landrum & Brown 2007). Delays increased the amount of fuel burnt by aircraft and therefore increase greenhouse gas (GHG) emissions and impair air quality. Reducing delays contributes to sustainability.

In the United States, the Federal Aviation Authority (FAA) uses a delay threshold of 4 minutes average delay as a signal that new airfield capacity improvement projects should be identified and planned. This same threshold has also been employed in Australia. Furthermore, the FAA highlights the fact that the relationship between demand, capacity and delay is exponential in nature. A 1999 FAA report states the following:

> "*Experience shows that delay increases gradually with rising levels of traffic until the practical capacity of an airport is reached, at which point the average delay per aircraft operation is in the range of 3 to 5 minutes. Delays increase rapidly once traffic demand increases beyond this level. An airport is considered to be congested when average delay exceeds 5 minutes per operations. Beyond this point delays are extremely volatile, and a small increase in traffic, adverse weather conditions, or other disruptions can result in lengthy delays that upset flight schedules and impose a heavy workload on the air traffic control system.*" (FAA 1999)

Figure 2-3 shows a typical delay curve – which illustrates the relationship between airfield delay and demand; as hourly demand increases, delay will eventually begin to increase at an exponential rate (Airbiz 2009).

Figure 2-3 Typical Delay Curve (Airbiz 2009)



While, as discussed above, airport delay criteria are often measured against the average hourly delay over a period (aggregate measures), other criteria include maximum delay to an individual aircraft (distributive measures - for example for the threshold of 15 minutes).

The 2007 Landrum and Brown report forecasted that in 2008 the average delays for YYC's airfield would be in the range of 3.6 minutes, approaching the 4 minute trigger identified by the FAA which suggested that new airfield enhancements should be identified and planned (Landrum & Brown 2007).

2.1.4 Demand and Capacity Analysis

2.1.4.1 Landrum and Brown Analysis

In 2006 the Authority acted upon the recommendations coming out of the Parallel Runway Implementation Study and initiated an on-going program to monitor the demand/capacity (D/C) of the existing airfield. Landrum and Brown were hired to undertake these assessments on an annual basis, the first being completed in 2006. As can be seen in Table 2-2, the 2006 D/C assessment suggested that average delays would exceed 4 minutes in 2013, and would be approaching the 10 minute mark by 2018 (Landrum & Brown 2007).

Table 2-2 2006 Demand / Capacity

Minutes of Delay Per Operation			
Demand Level	**Arrivals**	**Departures**	**Average**
2005	0.8	1.3	1.1
2008	2.6	2.3	2.5
2013	5.9	5	5.5
2018	9.5	9.9	9.7
2023	24.4	33.6	29.0

The D/C assessment was undertaken again in 2007 using the latest data. This assessment concluded that by the year 2008, average delays could be reaching the 4 minute mark, and would exceed the 10 minute mark by the year 2013 (Landrum & Brown 2007). Table 2-3 lists the results of the assessment.

Table 2-3 2007 Demand / Capacity

Minutes of Delay Per Operation 2007 D/C Analysis			
Demand Level	**Arrivals**	**Departures**	**Average**
2006	0.8	1.5	1.2
2008	2.6	4.6	3.6
2013	13.6	8.9	11.3
2018	33.3	29.3	31.3
2023	57.6	83.5	70.6

In their 2007 report, and again in 2008, Landrum and Brown was asked to undertake additional analyses that would focus on operational and infrastructure improvements that might have the result of deferring runway development. A variety of options were considered, including the removal of all aircraft at the airport that had an approach speed of less than 90 knots. The results of these analyses suggested that some deferral of the parallel runway was still possible. By the end of 2008, the Authority had initiated the Runway Development Program for the parallel runway. Part of this program involved undertaking further D/C analysis. This further analysis is discussed below.

2.1.4.2 Airbiz Analysis

Airbiz Aviation Strategies Ltd. was hired as a specialist sub-consultant as part of the EA team for the PRP. Their task was to undertake an additional assessment of airfield capacity with the primary objective of determining the need for the parallel runway, and to develop a “do nothing” and “do something” scenario. “Do nothing” scenarios are future projections of airport operations if the new runway is not built. “Do something” scenarios assume the new runway is in place and operating.

Airbiz specifically looked at demand levels associated with the years 2015 and 2025, using forecasted passenger and aircraft movement growth rates as provided by TC. Both actual passenger and aircraft annual movement trends were closer to the historical TC “high” than the TC “base” forecasts. On this basis the TC High forecast was adopted for planning for the new parallel runway (see Volume II, Chapter 7 Section 7.12 and Volume IV, Item 2). In contrast to the Landrum and Brown analysis, which utilized an analytical spreadsheet based queue model, Airbiz utilized an airspace / airfield simulation model (Airbiz 2009).

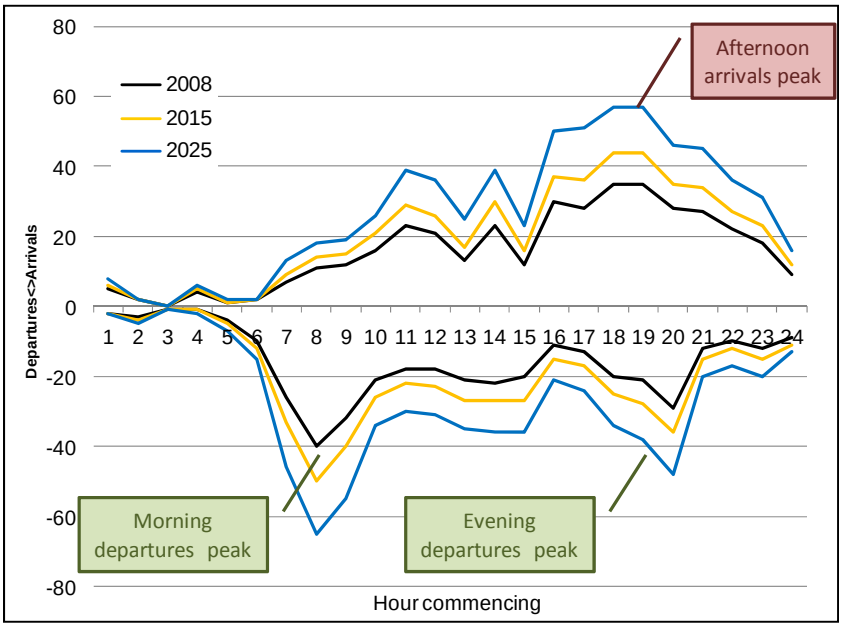
Analytical (static) models account for the mix of aircraft and their separation by Air Traffic Control (ATC) according to process rules. Runway models of this type generally “process” individual aircraft through the runway system according to the rules which ensure safe operations (separation of aircraft by distance and time). The maximum number of arrivals and departures **processed** on a runway based on the mix without violating the ATC rules can be calculated. This will vary depending on the traffic mix (proportion of aircraft in a range of weight and speed categories – which in turn determine separation between successive aircraft) for the period analysed. This model does not calculate delays (time in the queue).

More sophisticated simulation models use the same processing rules and mimic Air Traffic Management (ATM) operating procedures. A project schedule (the air traffic data file with details of each aircraft operation – aircraft type, arrival/departure, origin/destination, estimate time of arrival or departure in the airfield system) is simulated with the traffic flow on the airfield – aprons, taxiways and runways and the arrival and departure tracks in the immediate vicinity of the airport (terminal airspace) over the selected busy period. In addition to measures of throughput on the runway, queuing and delay statistics are accumulated in the model for later analysis and reporting. Criteria for determination of runway capacity can include maximum throughput or various metrics relating to level of service (“acceptable delay”).

A workshop approach was used to develop the key assumptions and inputs for the simulation model. A total of 4 workshops were held with input from the Authority, NAV CANADA, airline representatives (flight operations), the design team and the EA team. For the Airbiz study it was agreed to report on both average delays over the projected representative busy day, and the number of movements above the threshold of “unacceptable delay” at which point there are serious impacts on airline schedules, of 15 minutes. The 15 minute threshold of reporting delays for individual aircraft has also been used by the FAA.

Projected busy day schedules were developed for 2015 and 2025. These busy day schedules were based on the 90th percentile (36th ranked) busy day for YYC, based on 2008 flight records. The daily movements from this day were grown by applying the high growth rate, as identified in TC’s annual aircraft movement forecast for YYC. Using this methodology, Airbiz generated projected busy day schedules associated with the years 2015 and 2025 (Figure 2-4).

Figure 2-4 2015 and 2025 Projections (Airbiz, 2009)



The 2015 “do nothing” scenario involved the prediction of the level of congestion and delay that could occur in the year 2015 should the parallel runway not be constructed. The scenario included the assumption that all planned taxiway improvements to the existing airfield had been implemented. The outcome of the analysis indicated that the existing airfield – complete with all planned taxiway enhancements – would be unable to accommodate the 2015 busy day demand, and that delays would thus be at levels that are unacceptable (15 minutes or more at certain times of the day). The simulation model demonstrated that the level of projected delays is well beyond the accepted criteria (Airbiz 2009). In support of this statement, the simulation model suggested that in 2015, without the parallel runway in place, average delays in the afternoon and evening periods could be over 60 minutes for arriving aircraft and 7 minutes for departing aircraft. The proportion of individual aircraft delayed more than the 15 minute “disruption” threshold was also considerable.

As the modeling showed significant delay at 2015 demand levels, the “do nothing” scenario at 2025 was not modeled. However, delays in the airport system behave as queuing systems, where as demand increases above a threshold, delays will increase at an exponential rate. In practice, airport traffic growth beyond 2015 in the case of “do nothing” would create a constraint to growth. Some services could fit into periods of low demand, but scheduled services generally fit into periods of natural demand or are driven by airline network considerations, such that for a percentage of flights rescheduling because of capacity constraints at YYC will not be possible and increasing number of potential services will be lost.

It is also important to note that all simulation runs for all scenarios and the reported delay statistics were based on “good weather days”. There are, however, “bad weather days”, when operational restrictions will decrease airspace and airfield capacity (e.g., operations reduced to a single runway) and delays may increase (or in practice reduced capacity may be a cause of flight cancellations).

The simulation determined that the parallel runway would be required to meet 2015 projected typical busy day demand. The simulation also indicated that for busy periods during the day both the existing runway 16R-34L and the new parallel runway would be required to operate in “mixed mode” (with both arrivals and departures on each runway) (Airbiz 2009).

2.1.5 Summary

The 2004 Master Plan for YYC suggested that the new parallel runway may be required during the period 2013 – 2015. Subsequent analysis conducted by both Landrum and Brown and Airbiz Aviation Strategies confirm this timing, and suggest that the parallel runway is required by 2015 or sooner in order to avoid unacceptable delays. Given that delays grow in an exponential nature as hourly demand continues to increase, it is prudent for the Authority to commence its planning for the timely construction of a new parallel runway at YYC. Such action is expected to contribute to sustainability and is consistent with TC's Sustainable Development Strategy and the Authority's sustainability policy (see Volume III, Chapter 2).

2.2 Purpose of the Project

The purpose of the proposed expansion is to help the Authority to safely, reliably and efficiently accommodate increasing annual and seasonal demand for air transportation services. To make certain that the airport is capable of servicing the needs of the travelling public, and supporting local businesses through cargo delivery, well beyond the present, the Authority prepared a long-term vision. The vision was elaborated in the 1996 Master Plan, subsequently updated in 2004. One of the key features of the Master Plan is provision of the proposed Runway 16L/34R and associated taxiways to accommodate continued growth in demand.

2.3 Issues Raised During Consultation

As part of the preparation of the CS mounted by the Authority a public and stakeholder consultation program was undertaken and is described in Volume II Chapter 6. The issues raised during consultation relevant to the "need for the project" and the Authority's response are as follows:

Issue: A fourth runway at YYC is not needed.

Response: Section 2.1 of this chapter demonstrates that by 2015 on a typical busy day the capacity of the airport will be exceeded, causing significant delays, especially on arrival.

Issue: How was the capacity of the airport determined?

Response: The capacity of the airport was defined in two ways: by NAV CANADA's determination of the number of aircraft movements that can be handled by the existing airfield and by calculations of the number of aircraft movements that can be handled without unacceptable delays. Detailed explanation is provided in Section 2.1 of this CS.