ANNEX F: RUNWAY CAPACITIES

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Technical note

Project	RASCO	**Date**	14 August 2001
Note	Runway Capacity Note	**Ref**	1338000/
DRAFT	**11 - FINAL**		

1 Introduction

1.1 The planning of airports rests heavily on the determination of runway capacities. Aircraft stands, terminals and other facilities are sized to support runway capacity.

1.2 For the purposes of this note two types of runway capacity have been defined:

- operational capacity – the runway capacity when capacity constraints begin to be felt; and
- physical capacity – the physical capacity of the runway.

1.3 The physical capacity of a runway will be dependent on the characteristics of the runway in terms of length, provision of taxiways etc. The operational capacity will vary according to traffic characteristics and location[1].

1.4 By definition runway capacity constraints will begin in the peak period. When an airline cannot get a slot in the peak period the airline has three options:

- move to an inter-peak slot;
- travel via an alternative airport; and
- do not travel.

1.5 Consequently capacity constraints will occur even though slots are available in the inter-peak period. The physical capacity of a runway will be the same throughout the day and so will approximate to the flat demand profiles found at Heathrow and Gatwick. Over time the demand for air travel will increase and more inter-peak slots will become viable for airlines and there will be a move from operational to physical capacity, as illustrated in Figure 1.

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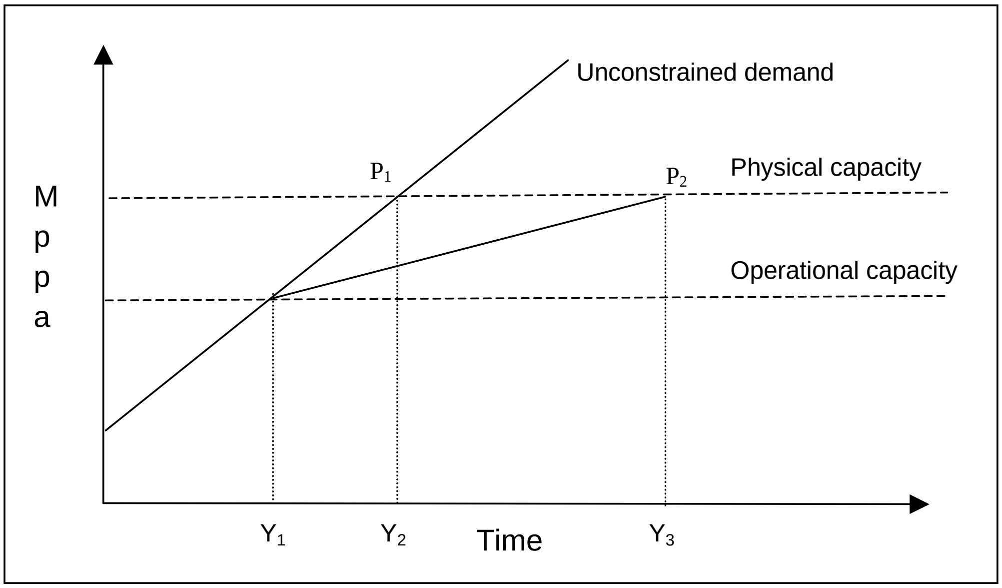
1 To some extent physical capacity will also be dependent on the size and mix of aircraft

Figure 1: Interaction of demand and capacity at regional airports



1.6 The following technical note identifies the operational runway capacity of regional airports. The approach is based on Stan Abraham's work, first in CAP 570 and then in a later note[2], and calculates runway capacity as a function of physical, operational and demand characteristics. The physical capacity of a single runway is likely to be similar to the capacity assumed for Stansted and Gatwick in the SERAS study of around 260,000 ATMs/year.

1.7 This paper sets out that methodology and applies it to main regional airports where runway capacity could become an issue before 2030; Birmingham, East Midlands, Edinburgh, Glasgow and Manchester. A simplified approach has been used to estimate runway capacity at other regional airports to ensure that there is scope for Reference Case traffic forecasts to be accommodated.

2 Approach

2.1 Runway capacity can be calculated from two elements:

- the sustainable runway capacity over a fixed period, usually an hour, and
- the relationship between hourly and annual demand (a function of the type of traffic and the daily, weekly and seasonal pattern).

Sustainable runway capacity

2.2 Sustainable runway capacity is determined by a combination of operational characteristics such as aircraft mix and separation standards, and physical

2 CAP 570 - Traffic Distribution Policy and Airport and Airspace Capacity: The next 15 years (1990), Stan Abrahams – Note on Airport Capacity (2001)

characteristics such as the presence of turn-offs and taxiways. Short term capacity is normally calculated in relation to an acceptable average aircraft delay. Aircraft delay times increase steeply as the aircraft arrival and departure rate approaches the effective capacity of the runway system.

2.3 Short term runway capacity is usually estimated through simulation modelling. Simulation modelling has been carried out for some of the regional airports, including single runways at Birmingham[3] and close parallel runways at Manchester[4]. Further modelling work has been carried out as part of the SERAS study including segregated operations at Heathrow[5].

Demand variation

2.4 The demand for runway slots is not consistent over any period. It will vary from hour to hour and over the week, month and year. An examination of the relationship between annual and hourly demand can be most conveniently considered by looking at demand patterns on a daily, monthly and annual basis.

Sustainable daily capacity

2.5 Short term runway capacity cannot be sustained at high intensity for a period of more than about four hours, as ‘fire breaks’ need to be built into the airport operations to allow for the dissipation of any queues that might have built up. Hence the daily capacity of an airport will be less than the hourly capacity multiplied by the number of opening hours, by a factor representing these fire breaks.

Daily demand variation

2.6 The demand for runway slots will not be sustained throughout the day and a maximum daily utilisation, defined as maximum daily demand divided by theoretical daily operational capacity, will be achieved when no more slots will be taken up by the airlines, even if theoretically on offer. The take-up of slots will be dependent on the type of traffic, the availability of alternative airports and the size of the airport catchment area.

Monthly demand variation

2.7 The utilisation of the runway will vary month by month. In the peak month when demand is strong, the demand throughout the month will be comparatively level. A high peak month to peak day ratio will be expected at airports which have small variations between weekdays and weekends and consistently high demand throughout the peak month.

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3 DORA/NATS – R&D Report 9966 (December 1999)
4 Manchester Airport Second Runway Public inquiry: Second Runway Need and Demand – Appendix 27 Capacity Assessment of the Two Runway Configuration (1994)
5 NATS – SERAS Airport Capacity Modelling – Phase 1 (December, 2000)

Seasonal (annual) demand variation

2.8 The peak month to annual ratio provides a measure of seasonality of demand. In this case, it is to be expected that scheduled traffic has a lower peak month to annual ratio than charter traffic indicating a more even demand throughout the year.

Summary

2.9 Hence, annual traffic may be broken down into meaningful components as follows :

Annual movements
=
[annual movements/peak month movements]
x
[peak month movements/peak day movements]
x
[peak day movements/peak day capacity]
x
[peak day capacity/peak hour capacity]
x
peak hour capacity

2.10 Of the components, only the last is solely operational; the rest also depend on demand considerations. Both operational and demand factors need to be taken into account in calculating annual capacity.

3 Evidence on runway capacity

3.1 To calculate annual runway capacity, estimates are required of the hourly and daily operational capacities and the daily, monthly and annual traffic patterns. The following section provides details of the runway capacity parameters at three airports that are at or near capacity, Heathrow, Gatwick (and Manchester before the opening of the second runway).

Declared maximum hourly capacity*.*

3.2 As previously stated, both Gatwick and Heathrow are operated to the maximum of operational sophistication and provide an indication of the maximum annual capacities of modern one- and two-runway airports. In 1999, the maximum declared hourly capacities of Heathrow and Gatwick, based on a 10 minute average delay, were 84 and 48 ATM/hour respectively.

3.3 The maximum declared hourly capacity of regional airports (at their current general state of development) is likely to be markedly lower than that of Gatwick and Heathrow, due to differences in aircraft mixes and technical configuration. At the time of the second runway inquiry (1994), Manchester airport had a declared maximum capacity of 42 ATM/hour, based on a five-minute average delay. However, for economic reasons, regional airports with a different mix of aircraft, airside layout and operating procedures, could have even lower runway capacities.

3.4 In 1999, the average hourly capacities over the whole day for Heathrow and Gatwick were 77.7 and 44.4 ATM/hour, giving a ratio between average and maximum hourly capacities of 0.925. The approach to fire breaks and dissipation of delays is likely to be similar at regional airports and so the same factor has been used.

Daily Usage

3.5 Table F1 sets out the daily utilisation of Heathrow and Gatwick in 1999:

Table F1: Daily Utilisation of Heathrow and Gatwick - 1999

Airport	Peak Day Movements	Daily capacity	Peak day/ daily capacity
Heathrow	1,315	1,360	97%
Gatwick	831	755	110%

Note: Daily capacity is the sustainable hourly capacity times the number of operating hours. The sustainable hourly capacity is the maximum declared capacity times an operational factor of 0.925.

3.6 Peak daily movements include night movements[6], accounting for the high percentage at Heathrow and the above 100% figure at Gatwick. These figures reflect that both airports were at or close to capacity on the peak day.

3.7 Information on peak day movements was not available from Manchester. An indication of peak day movements was taken from a typical July busy day figure of 596 ATM/day (including night movements). This gives a daily utilisation of 82% with an operational capacity of 723 ATM[7]. This reflects the dinodal (double peaked) profile of traffic at Manchester.

Monthly Usage

3.8 The peak month utilisation of all three airports was similar, indicating a flat demand profile across the peak month for airports near maximum capacity. For those at lower levels of capacity utilisation, Peak Month utilisation is expected to be lower as some services will not operate every day during the week (eg charter and long haul) and there will be less weekend scheduled services. For such airports a factor of 90% is assumed, rising to 95 % as they approach capacity.

6 Separate night movement information was not available.
7 Assuming a peak capacity of 46 ATM/hour based on an acceptable average delay of 10 minutes, and an operational factor of 0.925.

Table F2: Monthly Peak Utilisation of Heathrow and Gatwick - 1999

Airport	Peak month	Peak month/peak day	Peak month utilisation
Heathrow (99)	39,499	30.0	97%
Gatwick (99)	23,879	28.7	93%
Manchester (00)	17,731	29.8	96%

Note: peak month utilisation is (peak month) / (peak day x 31)

Seasonality (Annual) Usage

3.9 The annual utilisation of Gatwick and Manchester is much lower than Heathrow reflecting the higher proportion of seasonal charter traffic at these airports.

Table F3: Annual Utilisation of Heathrow and Gatwick - 1999

Airport	Annual	Annual/peak month	Annual utilisation
Heathrow (99)	449,400	11.4	97%
Gatwick (99)	246,500	11.0	88%
Manchester (00)	178,500	10.7	85%

Note: annual utilisation is (annual) / (peak month x 365/31)

Overall

3.10 The overall slot utilisation of the three airports ranges from 93% at Heathrow and 90% at Gatwick to 67% at Manchester. These utilisation rates reflect differences in the types of traffic, catchment areas and the strategic objectives of the airport concerned.

4 Runway Capacity Parameters

4.1 Operationally, there is no reason why most single runway airports should not approach the same runway capacity as Gatwick, given the same demand profile and aircraft mix and the expenditure of some capital. Over time it might be expected that the demand profile and aircraft mix at regional airports will change to become more like those at Gatwick. For economic reasons regional airports may not feel it is reasonable to constrain demand at peak times, and there may not be a commercial case for airlines to accept off-peak slots. The runway capacity at regional airports may therefore be much lower than at Gatwick.

4.2 It is not possible to determine the true economic capacity of an airport without a complex cost benefit analysis including a consideration of delays, diversions to other airports and the cost of rescheduling. Deriving accurately the commercial capacity of a particular airport requires detailed knowledge and analysis of negotiations with airlines and slot times they will and won’t accept for different routes at the airport concerned. This is not feasible within the scope of this study and some surrogates are therefore required. The following analysis draws on the experience of Heathrow, Gatwick and

Manchester to provide an indication of the likely runway capacity parameters across the regional airports.

Peak hour capacity

4.3 The declared hourly runway capacities described earlier for Heathrow and Gatwick were based on a 10 minute average delay. The SERAS study has shown that the use of a 5 minute instead of a 10 minute average delay leads to significant producer and consumer benefits. At both Heathrow and Gatwick airlines are more willing to accept higher delays as these are offset by high yields. Regional airlines services are less profitable and the airlines will not accept the same delays. A maximum average hourly delay of 5 minutes has therefore been used for the assessment of runway capacity.

4.4 Airport capacity modelling carried out for the SERAS study indicated that a 50% reduction in average delay could reduce capacity by between 5 and 10%. A conservative approach has been followed and a 10% reduction has been assumed to apply across all airports. It should be emphasised that simulation modelling is airport specific and this capacity reduction is only indicative.

4.5 The peak hour runway capacity at Gatwick was 48 ATM/hour in 2000, based on a 10-minute average delay. A maximum peak hour capacity of 44 ATM/hour has been assumed for a high capacity airport with a five-minute average delay. For a low capacity airport the peak hour capacity has been assumed to be 40 ATM/ hour based on a worst case aircraft mix[8]. Over the last decade runway capacity at Gatwick has increased by approximately 1 ATM per year. Whilst it would not be prudent to extrapolate these trends into the future, it is expected that technological change will lead to further improvements in capacity. The 'Study into the potential impact of changes in technology on the development of air transport in the UK' identified a future runway capacity gain of between 5 and 20%. A mid point technology gain of 10% has been applied to the peak hour capacity for the purposes of this analysis[9].

4.6 It is important to emphasise that the future technology gain assumed could well prove to be over-optimistic because no account has been made of the enhanced safety standards that are likely to be required by SRG to keep accident rates at or below current levels as traffic grows. Nor have human factors such as the ability of pilots to perform perfectly in all weather conditions, day in day out, for every landing been considered; SRG are examining this issue. An average of 66 seconds runway occupancy for a sustainable rate of 50 ATM/hr would implicitly assume some aircraft occupy the runway for much shorter than 66 seconds, and others longer. This represents an exceptionally high level of performance to expect all airlines

8 worst case aircraft mix is assumed to be one third turbo-props, one third narrow body and one third widebody aircraft. Capacity figure based on analysis carried out by SAL (ERM – The Scottish Regional Air Services Study).
9 This is consistent with BAA forecasts.

and pilots to attain. This has therefore been factored to slightly lower sustainable hourly rates for regional airports than at Gatwick.

4.7 The maximum hourly capacity for a single runway airport with all facilitating infrastructure (parallel taxiways, RETs/RATs) will therefore range from 48 ATM/hour (high) to 44 ATM/hour (low). Performance of a particular airport within this range will depend on the mix of aircraft types, the balance of arriving and departing traffic, airport specific physical and operational considerations, the performance of local air traffic controllers and the technology available to them and the aircraft that use it.

Table F4: Aircraft Mix & Peak Hourly Capacity

Aircraft mix	Peak hourly capacity (ATM/hour)
Good	48
Average	46
Poor	44

Daily utilisation

4.8 Daily runway utilisation will be dependent on an airport's willingness and ability to spread traffic throughout the day. For strategic economic or commercial reasons an airport may wish to minimise the number of slot applications that it rejects. This will require it to invest in runway capacity ahead of when it is fully used. Evidence provided to the Manchester Second Runway Inquiry suggested that as a regional airport nears 70% annual utilisation of its runway capacity it begins to turn away traffic. The figure implies some measure of peak spreading below 70% that may not be economically, as opposed to commercially optimal.

4.9 Alternatively, where an airport is physically or environmentally constrained, it may need to maximise the use of existing capacity because it is difficult in planning or commercial terms to add capacity beyond the current single or two runway configuration and operating mode. In these circumstances, an airport's ability to increase daily utilisation, that is attract airlines to use slots that are operationally or commercially sub-optimal, will depend on the level of unsatisfied demand and the airlines ability to generate an acceptable yield from off-peak services. This in turn will depend on the size and characteristics of the airport's catchment area and the availability of alternative airports and routings for passengers to make their journeys.

4.10 For example, lower levels of daily utilisation might be expected for airports with nearby alternatives which are in competition rather than common ownership because there will be an incentive to invest to ensure attractive slot times can be offered, particularly to new entrants. Where real choices are not available to passengers (and these will be route, frequency, price and surface access dependent), it is less likely that timely capacity investments will be made, even if the planning system so allows. This is because it is commercially more attractive for an airport, in the absence of competition or a regulatory framework tailored to investment rather than reducing charges, to intensify the utilisation of (and therefore the rate of return on), its capital assets across the day. They will do this, even if it is not commercially or operationally efficient for their customers the airlines, or economically optimal for passengers and the wider regional economy, because their first obligation is to their shareholders.

4.11 Consequently, unless their ownership structure encourages them to make investment decisions that are commercially sub-optimal, but recognise their wider public interest obligations (eg in relation to the regional economy), maximising return on capital invested rather than maximising route development and traffic throughput will dominate capacity investment decisions.

4.12 Interestingly, lower levels of daily utilisation have been a feature at Manchester airport. Manchester is owned by ten local authorities in the North West and is seen as a key driver of the regional economy. It also has increasing levels of competition in some market sectors from Liverpool, Leeds Bradford, Birmingham and East Midlands. By comparison, high daily utilisation at Gatwick, which is not dissimilar to Manchester in terms of traffic mix, is a function of high suppressed demand associated with planning led capacity constraints and the absence of real alternatives, particularly for charter passengers, south of London[10]. It is also a privately owned airport operating under a regulatory framework that to date has put pressure on keeping charges to airlines and passengers down.

4.13 The daily utilisation will also be higher for airports where a significant number of night flights for passenger or freight (typically above 5 to 10%) are possible and viable (eg East Midlands). On the basis of this discussion, four broad categories of airport are identified with different levels of daily utilisation:

Table F5: Daily Utilisation & Peak Daily Capacity

Daily utilisation	**Peak day movements/ peak day capacity**
Very High	more than 95%
High	90 to 95 %
Medium	85 to 90 %
Low	less than 85%

Monthly utilisation

4.14 From the limited amount of information available there does not appear to be a pattern for peak month utilisation across the three airports on which we have evidence. An average monthly utilisation of 95% has therefore been assumed for busier capacity constrained airports and 90% for those that are less constrained.

10 The economic capacity will differ from the physical/operational capacity described above, in that it will be lower for airports with no alternatives

Annual utilisation

4.15 The annual utilisation factor provides a measure of the seasonality of demand. Annual utilisation will be highest for airports that predominantly handle scheduled traffic that has fewer seasonal peaks. There will however be some differences where that scheduled traffic has a significant leisure component. These factors for current traffic patterns are illustrated in the Table F6:

Table F6: Annual utilisation across large UK airports (2000)

Airport	Annual utilisation %	Charter pax ATM %	Charter pax ATM
Gatwick	88%	21%	High
Heathrow	97%	0%	Low
London City	93%	2%	Low
Luton	89%	16%	Medium
Stansted	88%	6%	Low
Aberdeen	93%	45%	High
Belfast City	93%	1%	Low
Belfast International	90%	12%	Medium
Birmingham	89%	14%	Medium
Bristol	91%	17%	Medium
East Midlands	87%	17%	Medium
Edinburgh	96%	4%	Low
Glasgow	89%	14%	Medium
Leeds/Bradford	89%	14%	Medium
Liverpool	96%	5%	Low
Manchester	85%	25%	High
Newcastle	89%	20%	High

Note: Includes all airports over 30,000 ATM/year

4.16 Although the data provided above does not show a direct inverse correlation between the proportion of charter passenger flights and annual utilisation there is a definite pattern across the airports. This becomes more apparent if the airports are grouped.

Table F7: Charter pax ATM and annual utilisation

Charter pax ATM	Charter pax ATM %	Annual utilisation %	Airports
High	20+%	85-89%	NWL, LGW, MAN
Medium	10-20%	87-91%	LTN, BFS, BHX, BRS, EMA, LBA
Low	0-10%	93-97%	LHR, LDC, BHD

4.17 There are two exceptions to this pattern. Stansted behaves more like a medium seasonality airport due to the high proportion of more seasonal low cost scheduled flights. Aberdeen behaves like a low seasonality airport as most charter flights are associated with the energy industry and therefore do not exhibit seasonal characteristics.

4.18 The above table is based on the existing traffic mix and does not necessarily represent future seasonality at these airports. The charter and leisure component of scheduled traffic of some airports will change significantly over time. This will happen where charter is growing rapidly from a small base or where low cost services with a strong leisure focus are introduced. The changing nature of the aviation leisure market suggests that low cost operators are growing at the expense of charter services. Tour operators, despite their vertical structure, are also making greater use themselves of schedule services by block-booking seats on city-break and long-haul leisure routes. Therefore, even where there are strong scheduled networks from regional airports, traffic and service frequency may become more seasonal, with significant changes between winter and summer schedules.

4.19 This will create exceptions to the overall pattern, like Stansted Airport. These trends may become significant in the next ten years.

Table F8: Capacity as a function of Utilisation and Seasonality

Annual utilisation/ charter pax ATM	**Seasonality**	**Annual movements/ peak month capacity**
High	Low	94 to 97 %
Medium	Medium	88 to 93 %
Low	High	85 to 87 %

Single runway capacity

4.20 The capacity for a single runway is shown in Table F9. The low single runway capacity in is around the usage at Manchester airport in 2000, the year before the second runway opened. The high runway capacity is close to IATA forecasts for Gatwick airport, if the differences in assumed delays are taken into consideration. Whilst the capacity of most regional airports will lie between these two boundaries, and many are likely to be closer to the lower end, for some it may be even lower. This reflects the higher proportion of charter flights, resulting seasonality, and poorer aircraft mix that is common at most regional airports.

Table F9: Single runway capacity (ATM/year)

	High	**Low**
Hourly capacity	48	44
Daily capacity	755	692
Peak day utilisation	97%	85%
Peak month utilisation	95%	95%
Annual utilisation	95%	85%
Overall utilisation	88%	68%
Annual capacity	241,000	173,000

Note: Night movements included in peak day utilisation factor, where limits are explicitly set these can be separately identified and added to annual capacity.

4.21 The utilisation factor for the low capacity forecast is similar to the commercial capacity limits indicated by the Association of European Airlines (AEA) in the 1987 report, Capacity of Aviation Systems in Europe – Scenario on Airport Congestion. This report reinforces Manchester’s evidence to its Second Runway Inquiry. This stated that it would not be possible to meet the commercial demand of airlines if more than 70% of available slots were used. For airports with strong seasonal fluctuations even 60% utilisation would represent a saturated situation in peak periods. Manchester started experiencing slot allocation problems in the early 1990s when slot utilisation was around 50%, reflecting its high level of seasonality. By 2000 utilisation had reached 67% and slot allocation problems were severe. In the same year utilisation rates for Heathrow and Gatwick were around 90%, commensurable with high utilisation forecasts.

Twin runway capacity

4.22 The only regional airport with twin runways is Manchester, which opened its second runway April 2001. Demand variations are predicted to be lower at a twin runway airport reflecting the flatter demand patterns associated with higher demand and the greater scope for complementary timing of scheduled and charter aircraft from the broader mix of aircraft. Table F10 shows high and low capacity forecasts for a two independent runway system.

4.23 For an airport with two completely independent runways the annual capacity is expected to be higher than the parallel runways operating at Heathrow. IATA have indicated that hourly capacities are likely to be between 93 to 96 ATM/hour based on a 10 minute average delay. With an increase in utilisation to 95% (high) and 85% (low) this gives a forecast capacity of between 410,000 and 520,000 ATM (these numbers are comparable with IATA forecasts after allowances are made for lower average delays).

Table F10: Two independent runways – airport capacity (ATM/year)

	High	Low
Hourly capacity	96	84
Daily capacity	1,510	1,320
Overall utilisation	97.5%	85%
Annual capacity	530,000	410,000

Note: High hourly capacity based on 10 minute average delay, low hourly capacity based on 5 minute average delay. Night movements included as part of peak day utilisation factor.

5 Airport Specific Runway Capacity Forecasts

5.1 In RASCO airport-specific capacity analysis is carried out for airports that could exceed runway capacity during the Government's 30-year planning horizon. The following analysis provides consistent capacity forecasts for single runways at Birmingham, East Midlands, Edinburgh and Glasgow and twin runways at Manchester. Where feasible these capacity forecasts are compared to those prepared in the individual airport capacity studies and by alternative methods. Runway capacity at other airports has been based on general analysis using typical airport characteristics.

6 Birmingham

6.1 The capacity of the single runway at Birmingham was assessed as part of the BIA capacity study (Scott Wilson, September 2000). On the basis of previous work carried out by the Department of Operational Research and Analysis (DORA) of the National Air Traffic Service (NATS) and consultants Burks Green and Partners existing sustainable peak hour capacity was estimated at 40ATM/hour. With the provision of rapid exit taxiways this was forecast to increase to 46 ATM/hour. These forecasts were based on a maximum average delay of 10 minutes. This appears reasonable compared to the declared capacity of Gatwick of 48 ATM/hour. An hourly capacity of 46 ATM/year was therefore used in the annual capacity assessment (the reduction in average delay and technological improvements cancel out).

6.2 Scott Wilson forecast maximum runway capacity of 190,000 ATM/year. This has been re-estimated on the basis of the runway capacity parameters defined above. The following utilisation factors were applied:

Table F11: Birmingham single runway capacity (ATM/year)

	Forecast	Comments
Hourly capacity	46	Simulation modelling by DORA and Bucks Green
Daily capacity	723	17 hour day, 0.925 operational factor
Peak day utilisation	85%	Peak day utilisation 63% in 2000 – Night movements 5%. Scope for peak spreading limited as EMA nearby
Peak month utilisation	95%	Assumed average across all airports.
Annual utilisation	90%	Over last 10 years annual utilisation has been between 87 and 92%. Charter pax ATM was 14% indicating medium seasonality of around 90%.
Overall utilisation	73%	Slightly above AEA utilisation limits, similar to SW utilisation of 72%.
Annual capacity	190,000	

Note: Night movements included in the daily utilisation factor

6.3 A cross check on the capacity forecast has been made by examining timetabled slot utilisation for the peak day in Summer 2000. On this basis airport capacity will be between 180 and 200,000 ATM/year, approximately the same as the capacity forecast above.

6.4 Under RASCO and Unconstrained forecasts Birmingham airport will exceed capacity by 2025. Under Birmingham airports own forecasts and SERAS forecasts capacity will be exceeded by 2020.

6.5 The forecasts provided above assume that Birmingham International Airport (BIA) has limited scope for peak spreading. If, for strategic reasons, BIA manages to spread the peaks then capacity could increase to 215,000 ATM/year. This will still be exceeded by 2025, under all forecast scenarios.

7 East Midlands

7.1 No detailed capacity studies have been carried out for East Midlands Airport. It is estimated that with runway and parallel taxiway extensions and the construction of fast RETs/RATs, peak hour capacity should reach 44 ATM/hour.

7.2 Unlike the airports listed above freighter aircraft make up a significant proportion of movements at EMA, particularly at night. Night movements have therefore been dealt with separately in the capacity forecasts. In 2000, 28% of movements and 70% of freighter movements occurred at night. To allow for this daily capacity has been increased by a third.

Table F12: East Midlands single runway capacity (ATM/year)

	Forecast	Comments
Hourly capacity	44	Peak hour capacity below BHX as aircraft mix poor.
Daily capacity	692	17 hour day and 0.925 fire break factor
Peak day utilisation	80%	Daily utilisation likely to remain low as alternatives available. Night movements removed.
Peak month utilisation	95%	Assumed average
Annual utilisation	90%	Medium seasonality
Overall utilisation	68%	
Annual daily capacity	173,000	
Night movements	57,000	
Total capacity	230,000	

Note: Night movements not included in daily utilisation figure

7.3 The forecast runway capacity will be sufficient for the RASCO Reference Case forecasts. Under the SERAS forecasts, with high South East spill and no further capacity elsewhere in the Midlands, capacity is exceeded by 2020, with night time capacity becoming an issue from 2015.

8 Edinburgh

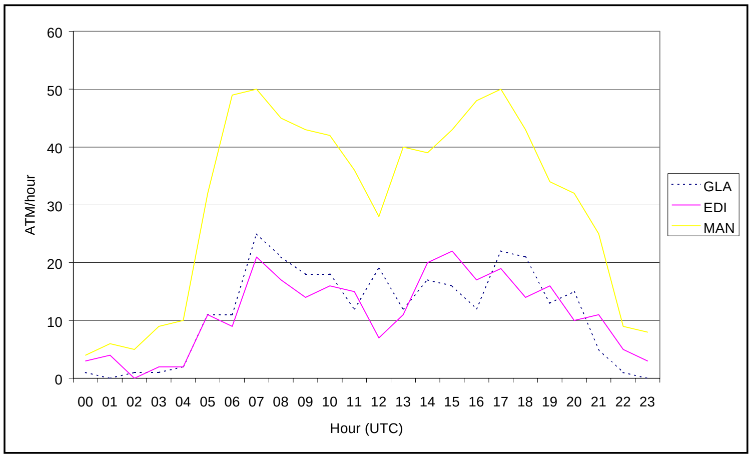
8.1 The capacity of Edinburgh airport was assessed as part of the Scottish Regional Air Services Study (Environmental Resource Management, June 2000). Scottish Airports Limited (SAL) estimated peak hour capacity to be 19 ATM/hour, based on a 'worst case' aircraft mix[11]. But Edinburgh regularly achieves 27 ATM/hour during busy periods. This reflects the fact that there are less widebody jets than in the theoretical than in the 'worst case' and that some aircraft do not use the whole length of the runway for take-off and landing.

8.2 Edinburgh airport appears to have been subject to peak spreading in recent years. The comparison of the daily profiles for Manchester, Edinburgh and Glasgow shows that both Scottish airports have flat movement profiles.

8.3 The ERM report estimated that the future hourly capacity (with the development of a full length taxiway and fast RETA/RATA) was between 40-42 ATM/year (based on a 'worst case' scenario of aircraft mix). The report goes on to argue that peak hour capacity could be as high as 50 ATM/hour with changes in the aircraft mix and utilisation of the Turnhouse runway.

11 The worst case scenario as previously defined is one-third wide body, one third narrow body and one third turbo prop.

Figure F2: Daily profiles at Edinburgh, Glasgow and Manchester (July 28, 2000)



8.4 Neither estimate is based on simulation modelling or delay assumptions. It is believed the maximum capacity increment from the Turnhouse runway would be 5 ATM/hr, but that would require airside frontage of the terminal to be pushed back to accommodate taxiway requirements. Failure to make these improvements would reduce the capacity of the main runway of the Turnhouse runway were being used.

8.5 It is doubtful whether fully integrated use of the Turnhouse runway will be feasible. It only has a visual approach over the city (which imposes severe limitations for scheduling purposes), cannot be equipped with ILS, substantially increases noise nuisance and raises important safety issues for key development sites. Even if it were to prove possible it is unlikely that the capacity of both Edinburgh runways could exceed 50ATM/hr in total. Given the anticipated aircraft mix we think the capacity of the main runway on its own will be between 44 and 46 ATM/hr.

8.6 Edinburgh's aircraft mix today is similar to Birmingham (see Table F12). Given the introduction of parallel taxiways, fast RETs/RATs and a 5 minute delay standard capacity of Edinburgh's runway would be 46 ATM/hour given the same aircraft mix in the future. However it is believed that Edinburgh will have increasing numbers of charter and long haul flights, increasing the number of wide bodied aircraft. It is also forecast that links to the Highlands will be improved and possibly concentrated at Edinburgh because of its role as Scotland's national capital. This will increase the proportion of turbo-prop aircraft In combination this would mean that the mix at Edinburgh would more closely resemble that at Glasgow today. This would imply 44 ATM/hour, but to avoid being overly conservative a figure of 45 ATM/hour has been adopted. Simulation modelling will be required to confirm this figure.

Table F14: Aircraft Mix at Edinburgh and Birmingham Airports (peak day, Summer 2000)

	Edinburgh	Birmingham	Glasgow
Turbo prop/light	40%	36%	44%
Narrow body	44%	47%	26%
Widebody	17%	16%	30%

8.7 Based on this assumption and a 16.5 hour operating day (6.30 am to 11.00 pm) for passenger aircraft, total potential capacity having been taken into account operational factors is 250,000 ATM/pa. Factors affecting the extent to which this potential capacity is utilised at Edinburgh are set out in Table F15.

Table F15: Edinburgh single runway capacity (ATM/year)

	Forecast	Comments
Hourly capacity	45	Similar to Glasgow
Daily capacity	687	16.5 hour day, 0.925 operational factor
Peak day utilisation	85%	To minimise peak spreading
Peak month utilisation	90%	Less congested than LGW and MAN but more charter and long haul with less than daily frequency.
Annual utilisation	90%	Medium seasonality as charter and low cost grows.
Overall utilisation	69%	High due to large proportion of scheduled traffic
Annual capacity	172,500	

Note: Night movements included in daily utilisation figure

8.8 The demand profile and service mix is likely to change over time from those seen today. As shown in Figure F2, significant peak spreading currently occurs at both Edinburgh and Glasgow airports. As there are no alternative airports for the much of the population of Scotland, flights have either been suppressed or pushed into off peak periods[12]. Although this may be in the commercial interests of the airport, it may not be in the commercial interests of the airlines or in the economic interests of Scotland as a whole. Travellers, in particular business travellers, will incur large economic disbenefits. It has been assumed that this situation will not continue as new routes come on stream. Many of these will require peak slots if they are to be attracted.

8.9 For the purposes of this analysis, it has been assumed that either current voluntary regulatory agreement is changed to incentivise BAA to invest in significant new capacity (in line with CAA proposals in the south East), or that a more competitive airport environment is created in the Scottish Lowlands. In either case, the underlying purpose will be to secure the investment in capacity that will attract and accommodate new services. With this in mind, the daily utilisation factor has been reduced to 85%, comparable with

12 Prestwick airport is in the wrong location and does not have the connecting services to take much of this demand.

Manchester, reflecting more limited peak spreading and demand suppression than hitherto experienced.

8.10 Under these revised assumptions Edinburgh airport will have a runway capacity of 172,500 ATM/hour. This capacity will be exceeded by 2020 under Alternative RASCO Reference Case forecasts. Even if the runway capacity forecasts are viewed as pessimistic is seen as beneficial, additional runway capacity will still be required by 2030. It is therefore important that these issues are given further consideration in part 3 of this study.

9 Glasgow

9.1 Capacity forecasts for Glasgow airport were prepared as part of the Scottish Regional Air Services Study (ERM, 2000). Again detailed simulation modelling was not carried out and a maximum peak hour capacity of 45 ATM/hour was simply estimated. The aircraft mix at Glasgow is worse than at Edinburgh and Birmingham and so capacity is likely to be lower. Peak hour capacity has therefore been assumed to be 44 ATM/hour.

Table F16: Aircraft Mix at Glasgow Airport (peak day, Summer 2000)

	Glasgow
Turbo prop/light	44%
Narrow body	26%
Widebody	30%

9.2 Demand utilisation factors are shown in Table F17. The forecast capacity of Glasgow airport is 168,500 ATM/year. This is below the ERM forecasts of 205,000 ATM/year. Daily utilisation is forecast to be 85%, similar to Manchester, and in line with our assumptions for Edinburgh, and overall utilisation of 69%. This will provide sufficient runway capacity until 2030 under RASCO Reference Case and Alternative Reference Case forecasts, however RASCO High and Unconstrained forecasts will be surpassed in 2025.

Table F17: Glasgow single runway capacity (ATM/year)

	Forecast	**Comments**
Hourly capacity	44	Peak hour capacity below BHX as aircraft mix poor.
Daily capacity	672	16.5 hour day assumed
Peak day utilisation	85%	Similar to Manchester as same type of traffic. Peak spreading stopped.
Peak month utilisation	90%	Monthly utilisation of 84% in 2000 expected to increase slightly but remain below LGW and MAN.
Annual utilisation	90%	Medium seasonality
Overall utilisation	69%	
Annual capacity	168,500	

Note: Night movements included in daily utilisation figure

10 Manchester

10.1 Manchester's twin runway system became operational in Spring 2001. The two runways are parallel and allow for operation in 'independent segregated mode', where one runway handles arrival traffic and one departure traffic, maximising available capacity.

10.2 Manchester airport has assessed the capacity of the twin runway system in the paper 'Manchester airport: Assessment of Capacity at 2030' (draft report - June 2000). Detailed simulation modelling indicated that the existing twin runway system at Manchester has a sustainable capacity of 65 ATM/hour, with a five-minute average delay. Manchester airport argues that with full simultaneous mode operation, facilitating infrastructure and improvements to ATC procedures and routings, it will be possible to increase the sustainable capacity to 78 ATM/hour. This is consistent with a peak hour capacity of 84 ATM/hour, at the lower end of future expectations. Manchester airport argues that the sustainable capacity could increase to over 90 ATM/hour with a new terminal at Clough Bank Farm and a relaxation of the delay criteria to 10 minutes. This is towards the upper end of IATA forecasts for a twin runway system[13].

10.3 Manchester airport had an utilisation rate of 68% in 2000. The airport argues that this could increase to 90% by 2030, the same as Gatwick, with a flatter demand profile and better scheduling. Total runway capacity is forecast to be 440,000 ATM in 2030, sufficient for the airports own traffic forecasts.

11 Other Airports

11.1 Runway capacity at other regional airports has been estimated on the basis of typical demand profiles. The airports have been divided into three groups based on their seasonality and proportion of charter traffic. Regional airport runway capacities are shown in Table 11. It should be noted that these figures are only indicative and different daily utilisation or aircraft mix assumptions can lead to +/- 10,000 ATM change in capacity. Comparing the forecast capacities to the traffic forecasts provided elsewhere in this report, indicates that no other regional airports are likely to exceed. Bristol airport is the closest to capacity with a forecast of 180,000 ATM in 2030 under SERAS forecasts, however there should be sufficient capacity elsewhere in the South West (Cardiff, Plymouth, Bournemouth, Newquay) to cope with any additional demand.

13 IATA SERAS: Demand Forecast and Runway Capacity Assessment (July 2000)

Table F18: Indicative runway capacities

Seasonality	Capacity (ATM/year)	Airport
Low	210 - 220,000	Liverpool, Aberdeen, Belfast City
Medium	200 – 210,000	Bristol, Belfast International, Leeds Bradford
High	190 – 200,000	Newcastle

Assumptions: Average aircraft mix, Peak hour capacity 46 ATM/hour, Daily utilisation – 90%, monthly utilisation 95%

12 Summary

12.1 This paper sets out the methodology for identifying operational runway capacity at regional airports. This suggests that the capacity of single runways at regional airports will be lower than in the South East as the scope for peak spreading and maximising utilisation will not be possible to the same degree. This suggests that new runways will be required in both the Midlands and Scotland before 2030. This will need to be investigated further in Part 3 of the Regional Airport Services Study. Any specific investment decisions will need to be assessed on a financial and/or economic basis before being implemented.