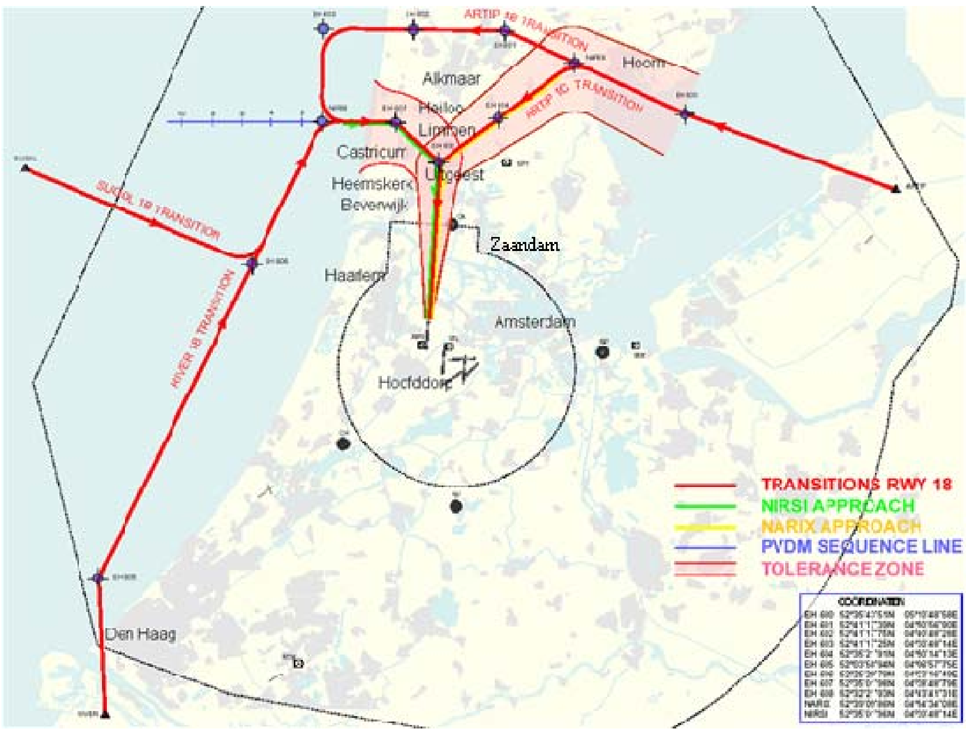
Decision document

CROS pilot 5: Night arrivals for runway 18R



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Abstract

This document describes the changes to the ATM System at Schiphol concerning the night transitions towards runway 18R (Polderbaan). The ATM system changes are intended to allow CROS to experiment and positively influence the nuisance of aircraft noise in the communities north of Schiphol starting November 1, 2006.

Suggested changes in this first version of the document focus only on the vertical profile along the existing routes and conditions for using night transitions. Changing the lateral route is considered outside the scope of this version due to the absence of the required legal framework (experiment article in aviation law) and an agreed map of the communities and building plan.

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Not classified

REVIEWREPORT

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CHANGE OF LOG

Version	Version date	Section	Remarks
0.1	01 April 2006	All	Initial version
0.11	08 May 2006	All	Findings project team meetings included
0.12	23 May 2006	All	Findings project team meeting included
0.2	11 July 2006	Section 3	…
0.3	31 July 2006	All	Document aligned with project status up to CROS update session #1 on July 20, 2006
0.4	22 August 2006	All	Document aligned with project status up to CROS update session #2 on August 22, 2006
0.9	31 August 2006	All	Final draft for release version 1.0 (without lateral route options)
0.95	5 September 2006	All	Pre-release for CROS PT
1.0	6 September 2006	All	Final version

Contents

Abbreviations

AAA	Amsterdam Advanced ATC
AAS	Amsterdam Airport Schiphol
AIP	Aeronautical Information Publication
ATC	Air Traffic Control
CB	Cumulonimbus (thunder cloud)
CDA	Continuous Descent Approach
CROS	Commissie Regionaal Overleg Schiphol
FL	Flight Level
FMS	Flight Management System
FPA	Flight Path Angle
GND	Ground
GP	Glide Path
hPa	hecto Pascal
IAF	Initial approach fix
ILS	Instrument Landing System
IVW	Inspectie Verkeer & Waterstaat / Department for Inspection of Transport and Water Management
KT	Knot (Nautical mile per hour)
KDC	Knowledge and Development Centre
KLM	Koninklijke Luchtvaart Maatschappij / Royal Dutch Airlines
LVNL	Luchtverkeersleiding Nederland / Air Traffic Control The Netherlands
LT	Local Time
nm	nautical mile
P-RNAV	Precision Area Navigation
QNH	Air pressure at sea level (in hPa)
RNAV	Area Navigation
RVR	Runway Visual Range
TL	Transition Level
U/S	Unserviceable
VEM	Veiligheid Efficiency & Milieu

1 Introduction

1.1 Background

With the opening of a new runway at Schiphol in November 2002 (*Polderbaan*, designated as runway 18R), new aviation legislation ("Wet Luchtvaart") has been introduced. One aspect of this legislation is that the aviation sector and the surrounding communities around Schiphol should together discuss the usage of Schiphol airport such that the interests of all stakeholders are best suited. This aspect of the legislation is tasked to a platform that includes representatives of the aviation sector, local government and representatives of community groups by the name "*Commissie Regionaal Overleg Schiphol*" (CROS). More information on CROS can be found on the website http://www.crosnet.nl (in Dutch).

To alleviate the nuisance of aircraft operations around Schiphol CROS launched the idea to do pilot projects and investigate the effectiveness of operational changes before these changes are covered in the aviation law. The CROS assignment to KDC [*assignment CROS*] indicates that the pilots have the following goals (cit.):

1. *Strengthening of the communication between aviation sector and surrounding communities.*
2. *Explore possibilities for experiments where surrounding communities initiate changes to departure and arrival routes and/or procedures to reduce the noise nuisance around Schiphol.*"
3. "*Focus on initiatives that alleviate nuisance from aircraft operations rather than to steer runway usage to prevent overload of limit values at noise control points around the airport.*

CROS will determine whether the pilot projects have been successful. To ensure successful completion a pilot project team has been established that is led by a CROS project manager. The operational preparation and execution of the trial projects, however, has been tasked to the Knowledge and Development Centre (KDC), an initiative by LVNL, KLM and AAS. At this moment two assignments for projects have been received [*Assignment CROS*] by the KDC:

Pilot 1: Runway usage: changing runway preference north/south
Pilot 5: Route usage: night approaches runway 18R

1.2 Objective of this document

This document is the output of the definition phase as described in the project plan [ref. Project Plan]. It documents the problem definition, alternative solutions, evaluation results and a suggestion for the most suitable alternatives to be implemented on trial basis. It has been agreed with CROS, that version 1.0 of this document will NOT contain changes to the lateral route, to ensure that an operational trial can start at November 1, 2006. Changes to the lateral route will be worked out in further detail in a second version of this document in a later stage due to:

1. The experimentation article in the aviation law (Wet Luchtvaart) has not passed into law yet, which prohibits route changes outside the current transition routes. This article is a pre-requisite to allow deviations from the rules for runway and route usage laid down in the aviation law;
2. It is currently not (yet) agreed which areas of the Schiphol surroundings are designated as future populated areas and are not available for new lateral route alternatives;
3. Development of a lateral route is a complex and time consuming process due to possible conflicting interests; and
4. Publication of route changes requires a 19 week period after completion of the design to allow approval with the CAA.

1.3 Document outline

Chapter 2 discusses the problem analysis in order to define concrete problem areas that can be solved. Chapter 3 then describes the alternative solutions of these problem areas. Chapter 4 evaluates these with respect to effects on safety, efficiency and environment (VEM), legal issues, acceptance and costs. Finally in chapter 5, the implementation decision is presented. At this moment the document status is draft, indicating that the decision section must be considered as an advice to the KDC-MT and “CROS plenair” for decision making.

2 Problem analysis

In this chapter the present night arrivals to runway 18R are analysed in order to define the problem statement for the project. This problem statement will be used as the starting point for the solution alternatives presented in the next chapter. The problem statement will be derived by looking at the (perceived and actual) shortcomings in the present situation.

2.1 Present situation

Rules for runway and route usage at and around Schiphol between 23:00 and 06:00 hours local time (LT) is by law considered as night time operation[1]. For this operation special rules have been developed to alleviate the environmental impact on the communities around Schiphol.

Rules for runway usage during night operations comprise amongst others that only one landing runway (06 or 18R) can be used for landing and one for departure (24 or 36L). Arrival routes are designed such that flights are to be above FL70 when flying over land, with the exception of defined tolerance areas or corridors towards the landing runways. This resulted in the design of so called night transition routes that provide a connection between the point where flights enter the Schiphol airspace (i.e. Initial Approach Fix or IAF) and the landing runway.

The lateral RNAV routings for these transitions for runway 18R are shown in Figure 1 below.

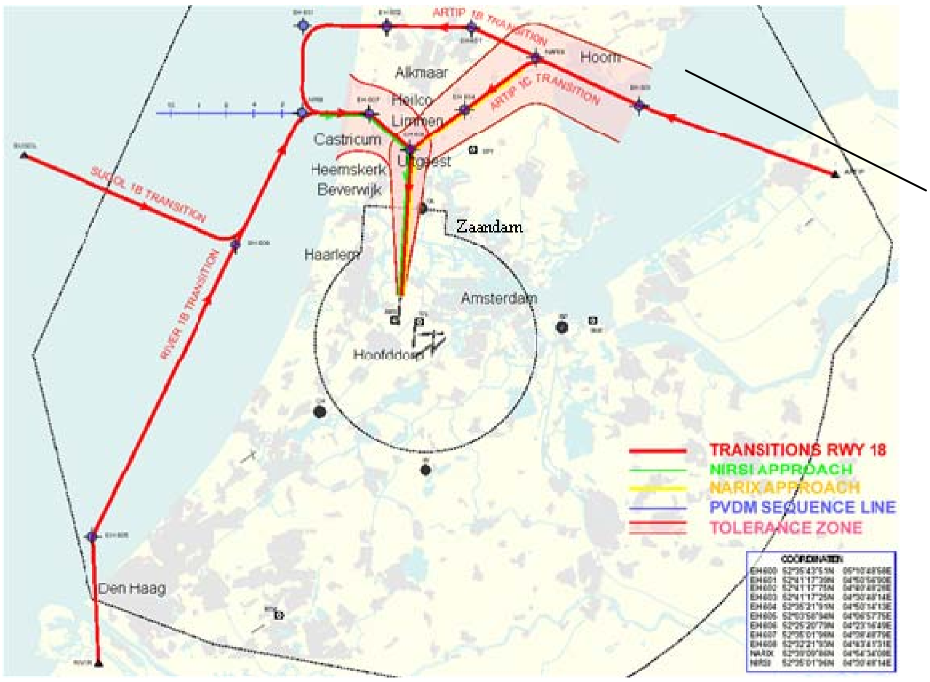

Figure 1: Lateral routing transitions runway 18R

Descent instructions along the route to NIRSI and NARIX are provided by the controller. After these points a Continuous Descent Approach should be flown by the pilot. Speed and altitude constraints have been defined in the procedure to ensure that flights do not fly too low and with too large a variation in speed. At NIRSI flights will have to be at or above 4000 feet at and flying 220kt.

[1] Note that the Dutch Aviation Law makes a different distinction between night and day for the limiting noise limits for total yearly noise (TVG) and its distribution (HHP). In these cases the night is defined to begin at 23:00 LT and ends at 07:00 LT. The noise impact of a single event during night operations are counted ten times that of a single event during daytime.

An alternative approach (ARTIP2C) is defined via NARIX for traffic from ARTIP (constraint at or above FL60 and speed 250kt). After the transition, the flights intercept the glide slope of the Instrument Landing System (ILS) at the Final Approach Point (FAP) at 2000 feet and 6,2 NM from the runway threshold.

Note that night transitions will not be flown:

1. By flights departing from Rotterdam, Valkenburg or Lelystad;
2. By flights with cruising speeds below 250 knots (usually propeller aircraft);
3. By flights that do not have RNAV capability;
4. When the Instrument Landing System (ILS) of the runway in use is not operational;
5. During periods of low visibility (RVR < 550 m and cloudbase below 200 feet);
6. When thunderclouds (CB's) are reported in the vicinity of the airport or along the transition route;
7. When the Amsterdam Advanced ATC (AAA) system is in degraded mode (e.g. during testing of new software).

In these cases the controller will provide radar vectors for a line-up for the ILS 18R (in level flight) at 3000 feet. While vectoring, the controller will try to follow the lateral route of the transitions. Propeller aircraft are allowed to intercept the ILS glide slope at 2000 feet instead of 3000 feet.

2.2 Shortcomings

The night operations for runway 18R described above have been in progress since February 2003. Since this period several shortcomings have been identified. On the one hand operational shortcomings have been identified by ATC and airlines and on the other by the communities near the flight path. This section aims to identify the shortcomings and quantify their effects.

2.2.1 Experience of communities

Since the introduction of runway 18R (*Polderbaan*), many complaints have been received from night time flight operations towards this new runway. In particular the communities of Castricum and Limmen, lying directly near the flight path, have been contributing to a significant portion of the complaints (see Figure 2).

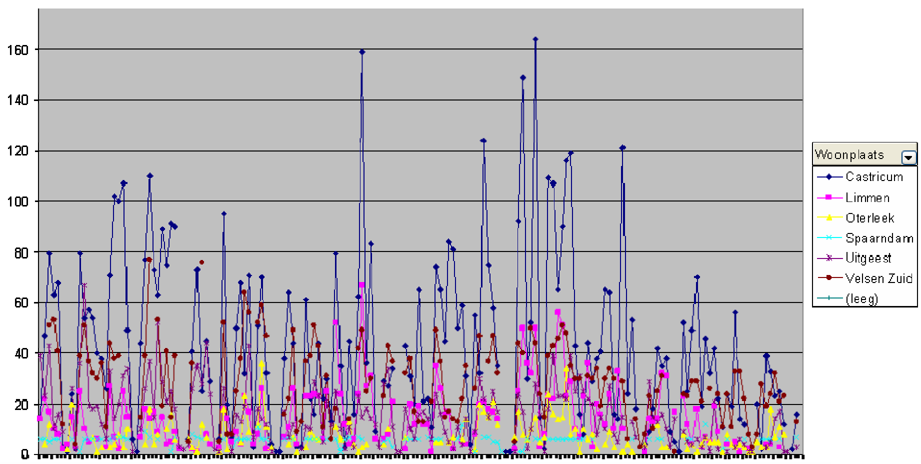

Figure 2: Complaint statistics on night arrivals runway 18R between June 1 and December 31, 2005

In addition, the general feeling amongst the citizens is that non-RNAV flights contribute significantly to the noise nuisance during night time and that the published route (which in itself appears to be an optimum route) is actually flown 1,5 NM (2,8 km) more south [*Assignment CROS*].

2.2.2 Performance analysis

To fully understand the cause of the nuisance experience by the communities and identify the factors that contribute to it, a detailed analysis has been done on different aspects of the night operation; both qualitative and quantitative. The questions that will be answered in this analysis are related to:

A. General statistics:

1. How many flights fly to Schiphol at night and what are the characteristics (aircraft type, company, arrival times, etc.)?
2. What percentage of these flights lands on runway 18R?
3. What percentage of these flights fly a transition?
4. What is the distribution of traffic, flying the transition via NIRSI and NARIX?

B. Characteristics:

5. How accurate are transitions being flown?
6. How is the vertical performance of flights flying the transition?
7. Is there a correlation between the flight paths to runway 18R and the complaints? In other words can we identify specific events that repeatedly trigger complaints? And which flight paths and profiles are flown when transitions are not used?

These analyses are complemented by the discussion on the general relation between noise on the ground and the flight path during the approach in annex A.

General statistics

The KDC project team has tasked NLR to analyse all night flights towards runway 18R in the period between May 1, 2003 and April 30, 2006 [ref. NLR accuracy study] as a follow up activity of a previous study over the period February 22 through April 30, 2003. The data collected involved 18703 flights that were analysed in three parts to accommodate a yearly trend analysis, as shown in Table 1. The selection criteria for the present study were identical to those in the 2003 study to accommodate direct comparison of results.

Table 1: Yearly statistics of number of night approaches towards runway 18R

	Period	Number of approaches
2003-2004	May 1st, 2003- April 30th, 2004	5064
2004-2005	May 1st, 2004- April 30th, 2005	6730
2005-2006	May 1st, 2005- April 30th, 2006	6909
Total		**18703**

These 18703 flights comprise 50% of all night traffic in these three years (see Figure 3). The Figure also shows that 41% of the night traffic landed on the other night landing runway, i.e. runway 06. Other runways were used to accommodate for unforeseen operational situations, such as high winds.

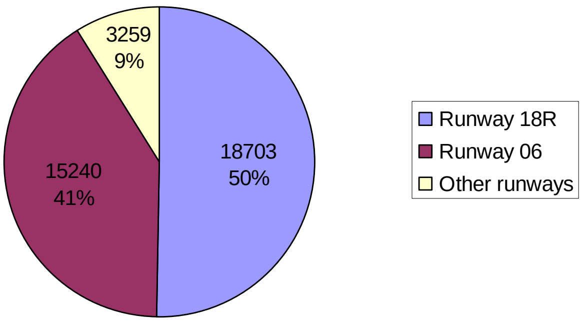

Figure 3: Total night landings on Schiphol in the period May 1, 2003 and April 30, 2006

To provide a better insight into the characteristics of the night traffic to runway 18R, the total number of flights have been plotted against actual arrival (i.e. landing) time at Schiphol and airline (see Figure 4 and 5). The data shows that the majority of night flights lands at runway 18R in the last hour of the night regime, followed by a smaller peak in the late evening.

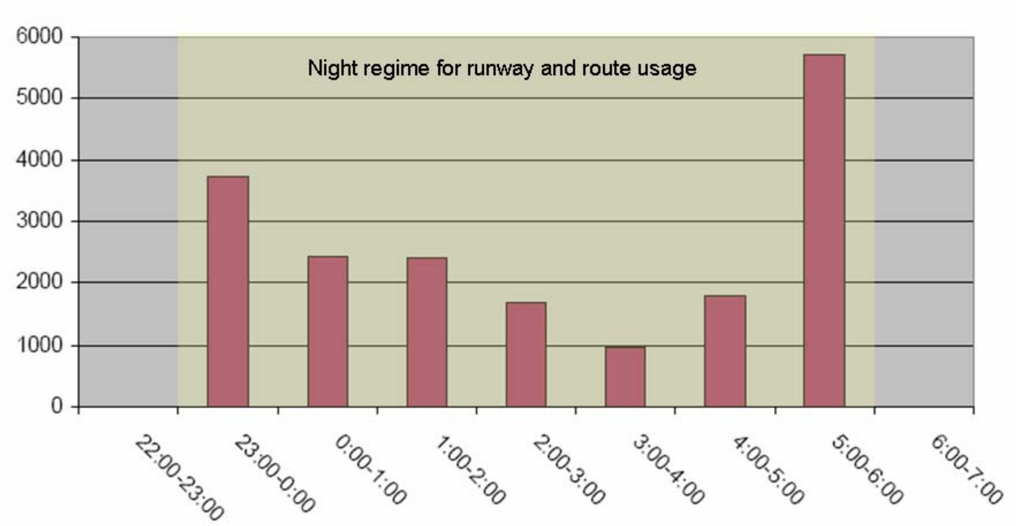

Figure 4: Total night landings on runway 18R per 1 hour intervals in the period May 1, 2003 and April 30, 2006

Dominant aircraft types in the night are modern jet airliners, such as Boeing 737-700 and -800 (see, Figure 5) operated by Transavia and KLM. Other dominant aircraft types such as the heavy Boeing 747-400, MD-11 and Boeing 767-300 are operated by KLM and Martinair, which explains the airlines top 3 operating during night time at Schiphol as shown in Figure 6.

Older aircraft types, such as the B747-200, DC-10 & A300B, are contributing to nuisance due to their noise characteristics and also due to lack of RNAV capability. In total 98% of the night flights are executed by jet aircraft. Turboprop aircraft contribute with only 2% (or 363 flights) to the total amount of 18703 flights. Figure 5 shows all aircraft types with more than 100 approaches in the study period.

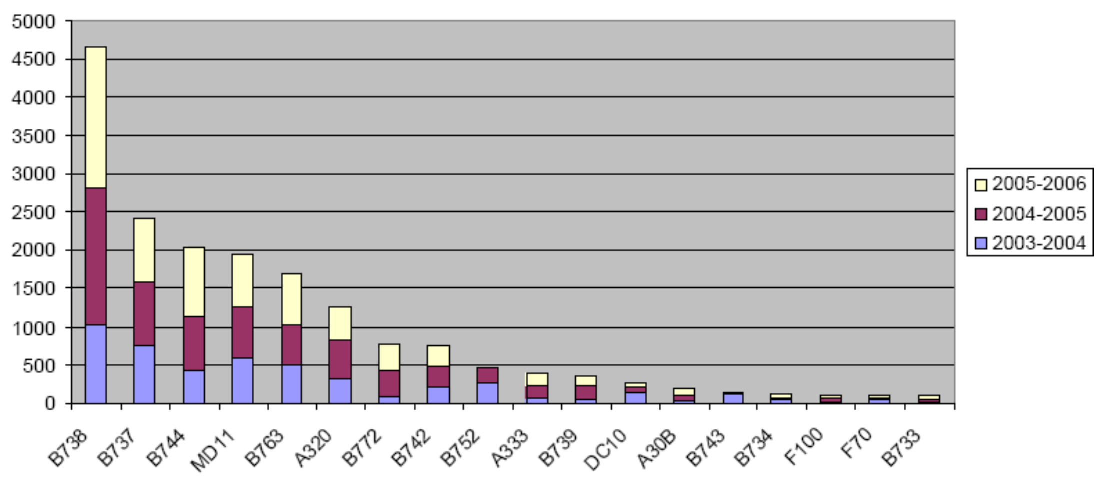

Figure 5: Total night landings on runway 18R per aircraft type in the period May 1, 2003 and April 30, 2006

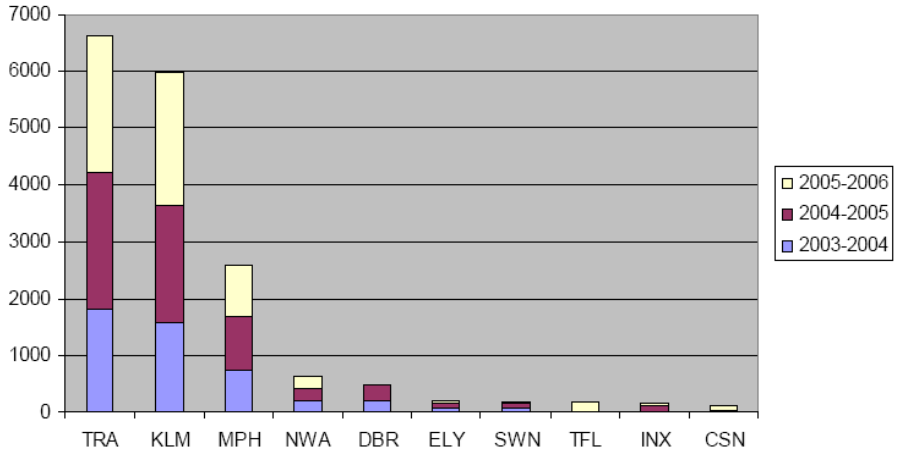

Figure 6: Total night landings on runway 18R per airline in the period May 1, 2003 and April 30, 2006

It is a rather difficult to answer the question of how many flights of the total number of 18703 actually flew a transition. To determine whether a transition was flown from the large data set, use was made of a mechanism involving gates at different locations along the transition route. If a flight passed all gates along the route, it is considered to fly a transition and is taken into account in the accuracy analysis in the next section.

Based on this method, the NLR analysis [NLR accuracy study] has shown that 94,7% of all night approaches to runway 18R are executed in accordance with the transition procedure via either NIRSI or NARIX (see Table 2). Only 997 (5,3%) of all night flights to runway 18R were not flown along a transition.

Table 2: Total number of transitions via NIRSI and NARIX and “other” approaches (i.e. no transitions)

Period	Total	NIRSI	NARIX	OTHER
2003-2004	5064	3340	1431	293
2004-2005	6730	3386	3022	322
2005-2006	6909	3052	3475	382
Total	18703	9778 (52.3%)	7928 (42.4%)	997 (5.3%)

The 5,3% of the flights that did not fly a transition involved situations shown in Figure 7.

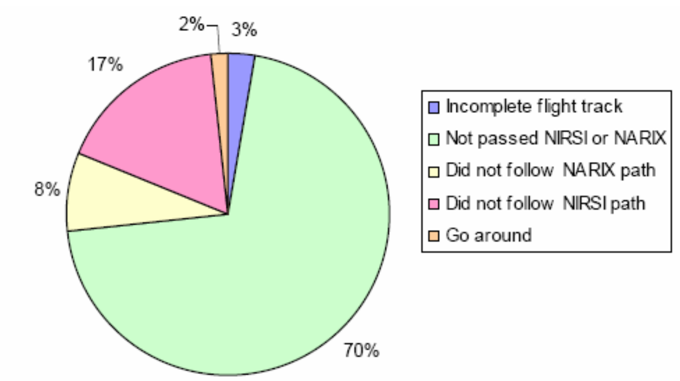

Figure 7: Criteria and occurrence rate for distinguishing non-transition traffic

To influence the nuisance for communities like Castricum it is relevant to know how the traffic flying via NIRSI or NARIX is distributed. The original design of the transition procedures was based on the requirement that all flights had to approach for landing via the North Sea. Later on, an additional shorter route was designed for flights coming from the eastern part of the Schiphol airspace (i.e. via ARTIP) as (see Figure 1, ARTIP 1C transition). Because of this addition to the basic design not all flights to runway 18R pass noise sensitive areas, such as Castricum and Limmen. The distribution of traffic coming in via the North Sea route (NIRSI) and the IJsselmeer-route (NARIX) has developed over the years to the present situation shown in Figure 8. The distribution is only defined by the amount of traffic that comes from the east and west side from Schiphol. East side traffic is only rerouted to the west side, if necessary for merging of both flows at point EH608.

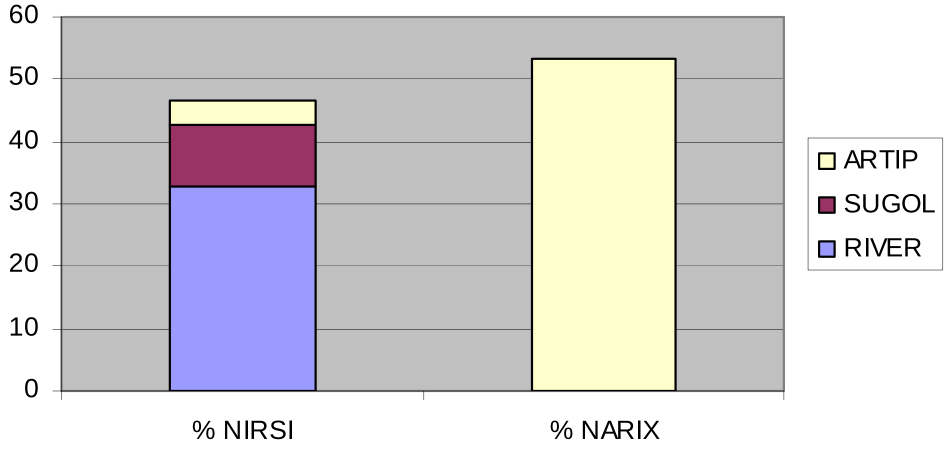

Figure 8: Distribution of traffic flying to runway 18R via NIRSI and NARIX (May 1, 2005 – April 30, 2006)

The figure shows that in the current night operation most of the traffic from ARTIP (e.g. coming from Italy, Greece and Turkey) is already flying the route via NARIX, while a small portion is flying via NIRSI. The remaining traffic via NIRSI is coming from RIVER (e.g. from Spain and Portugal) and – to a lesser extent - from SUGOL. As seen in Figure 8 the traffic distribution via NARIX and NIRSI is about 50/50.

The ARTIP2B transition via NIRSI is mostly used during periods when the controller has doubts about the separation of ARTIP traffic with the merging traffic flow from NIRSI. This merging point is located at the position where the two traffic streams are joining at the ILS (i.e. EH608). This can happen when traffic is arriving in bunches at the same time. In general, traffic density is low during the night hours and merging is usually not a problem. This effect is shown by the low percentage of approximately 9% of ARTIP traffic in the NIRSI column of figure 8, whereas the actual number for 2005 is down to 6%.

Characteristics

Lateral accuracy

The NLR study [ref. NLR accuracy study] analysed the accuracy of how the approach routes from NIRSI and NARIX to runway 18R have been flown. For this purpose the routes and gates (a line perpendicular to the route, which can check whether or not a flight passed that position on the route) were numerically defined and checked against the actual flight tracks (see figure 9). The entrance gate just after NIRSI and NARIX, which is used to check which transition is used, is 6 nm wide and route checkpoints on/before EH608 (merging point) are 4 nm wide. All checkpoints on the ILS-localiser are 2 nm wide. The presented gate-width were taken sufficiently wide and slightly below the official route (see figure 1) width, to avoid unnecessary exclusion of flights. It does result in:

- only 1.3% or 249 flights to be excluded from the list of all flights. They are therefore part of the 5.3% of all flights, that do not fly a transition.
- 174 of the mentioned 249 flights are excluded, while they did not pass the initial entrance gate near NIRSI/NARIX and not because they deviated to much from the route between NIRSI/NARIX and the runway.
- 165 of all 363 turboprops (45%) following the transition route, although they are not required to do so by the rules of section 2.1

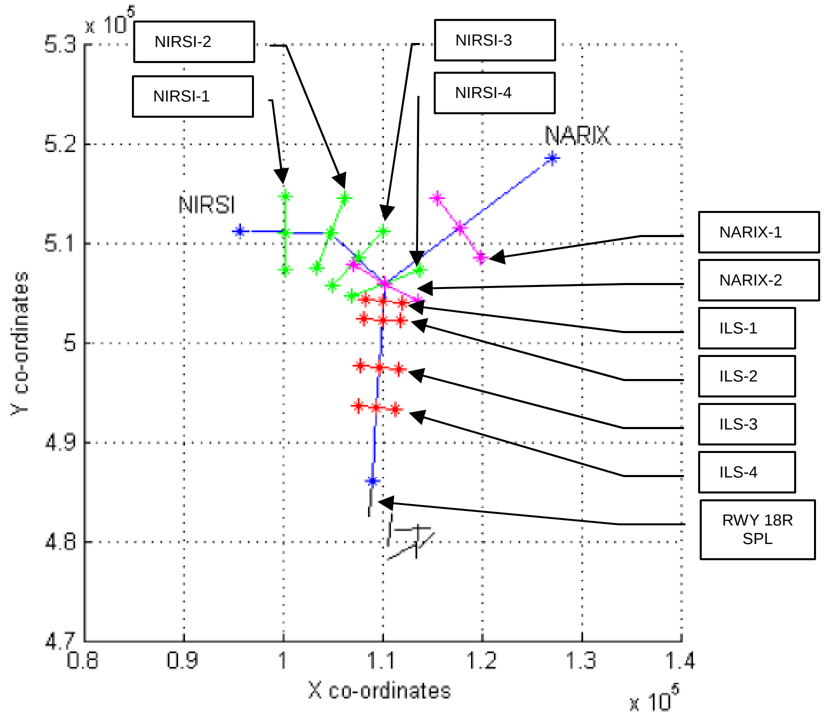

Figure 9: NIRSI and NARIX approach routes to runway 18R and gate definitions

The outcome of the accuracy study is shown in figure 10 (NIRSI approach route, 8 gates) and figure 11 (NARIX approach route, 6 gates) for 3 separate years and for their respective gates along the route. Because the accuracy results do not correspond to the normal (Gaussian) distribution, the results are given in the form of containment areas (figure a) and a semi-width (figure b). The containment areas indicate where 95% of the actual flight tracks were found. This presentation shows where the average flight track is compared to the published route and shows the deviation from this average.

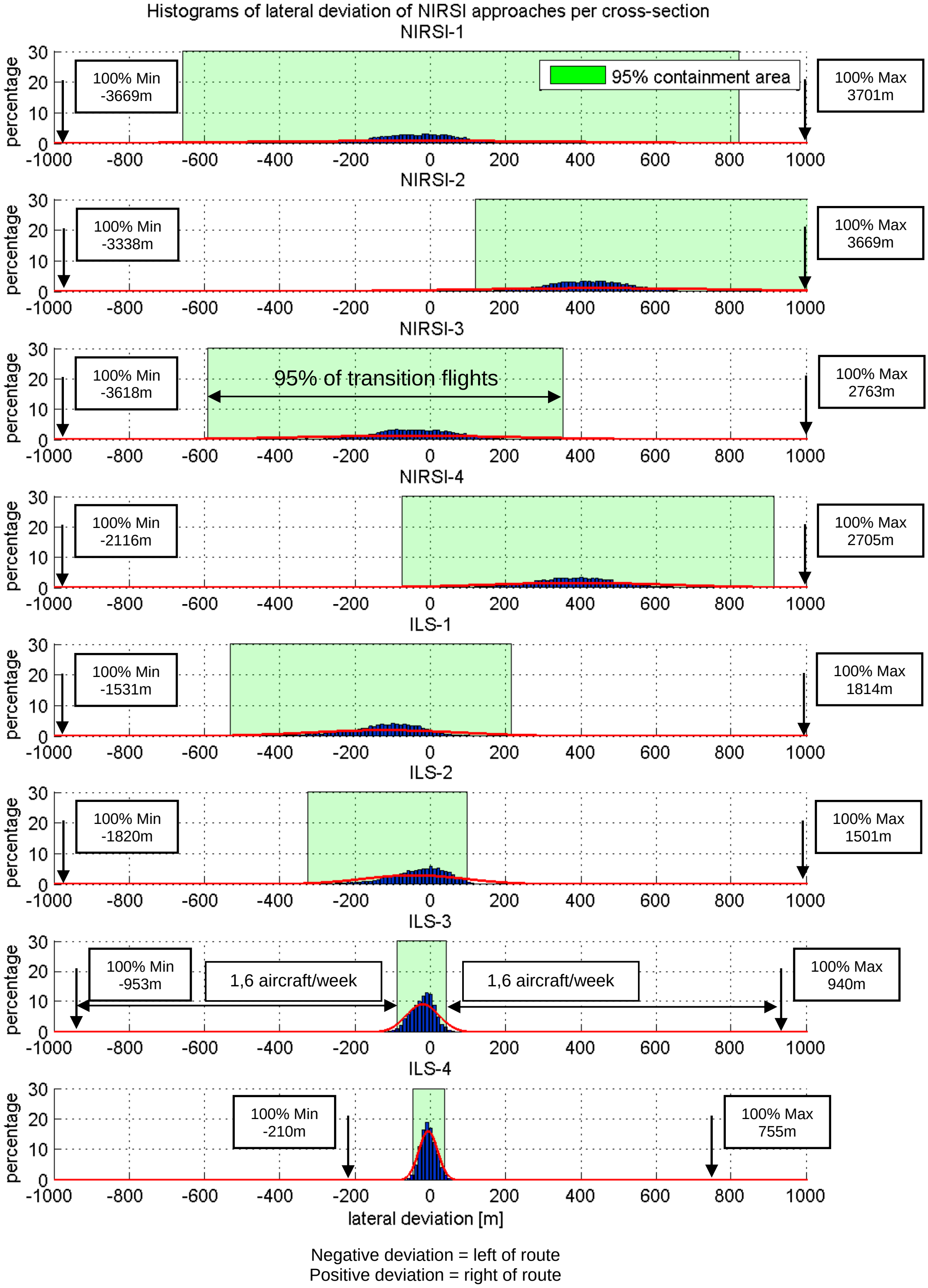

Figure 10a: Accuracy (95% containment area) along the NIRSI approach route

The semi-width representation provides an overview of the width of the 95% containment areas along the gates, but does no longer show the location of the average flight track.

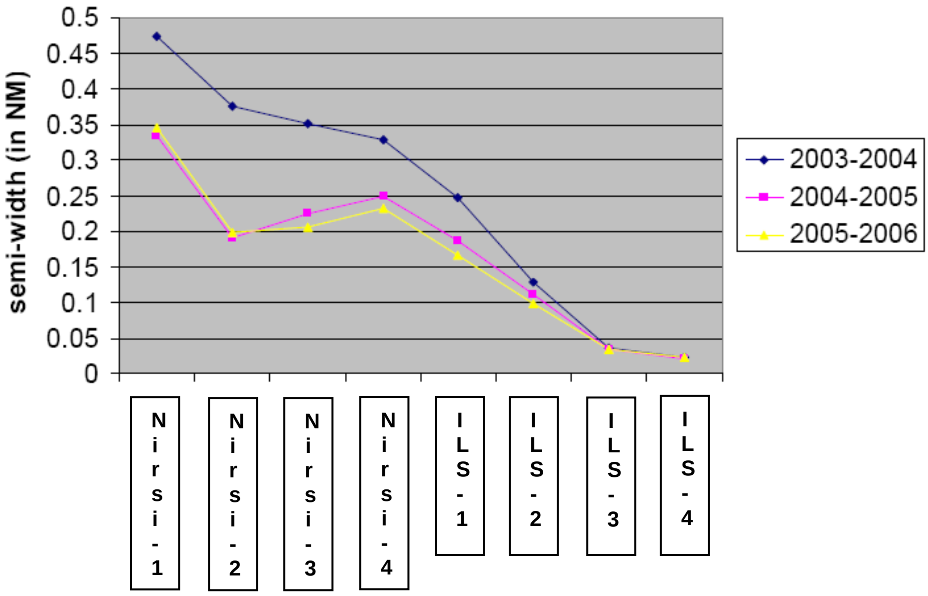

Figure 10b: Accuracy (semi-width) and trend over 3 years for the gates on the NIRSI approach

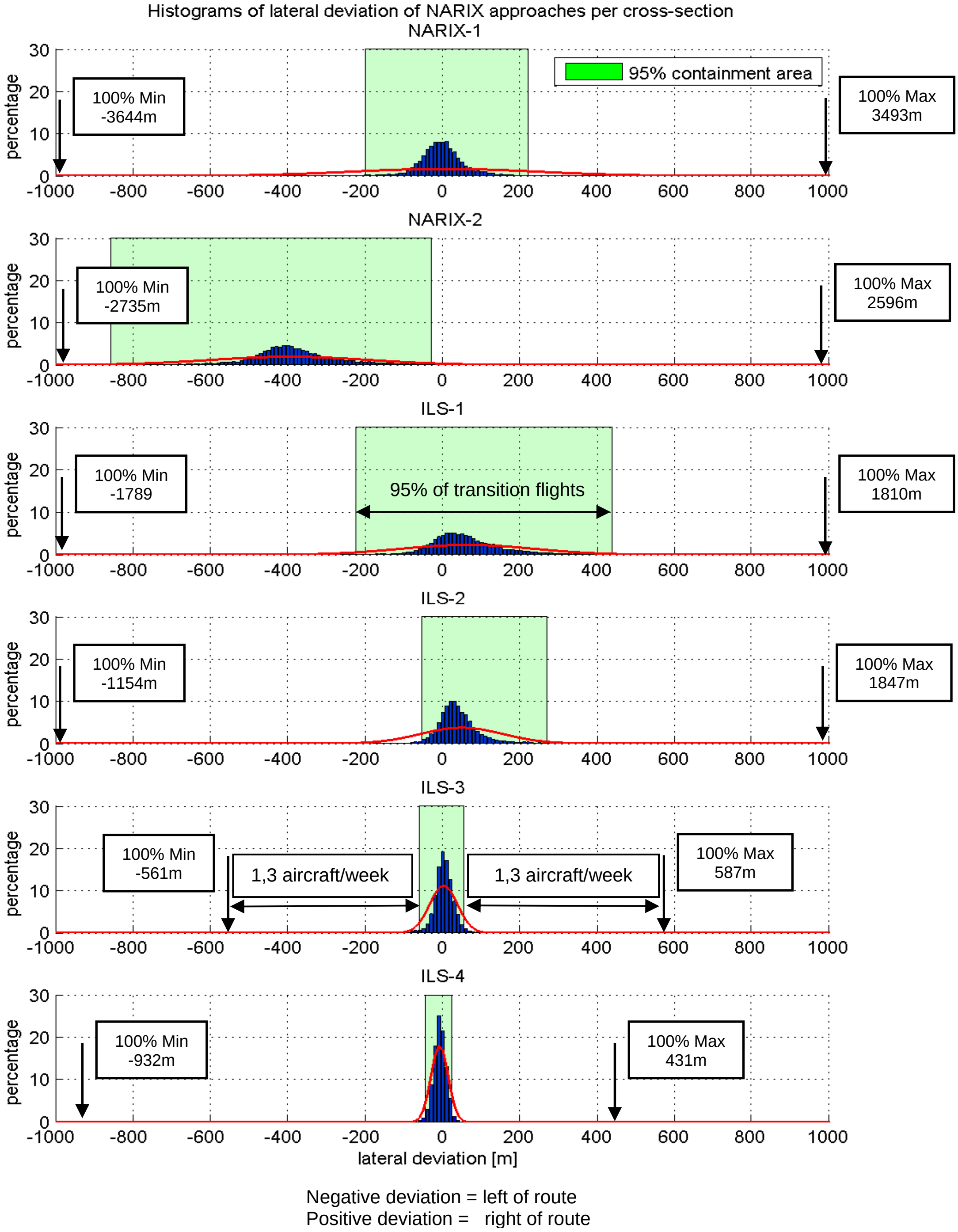

Figure 11a: Accuracy (95% containment area) along the NARIX approach route

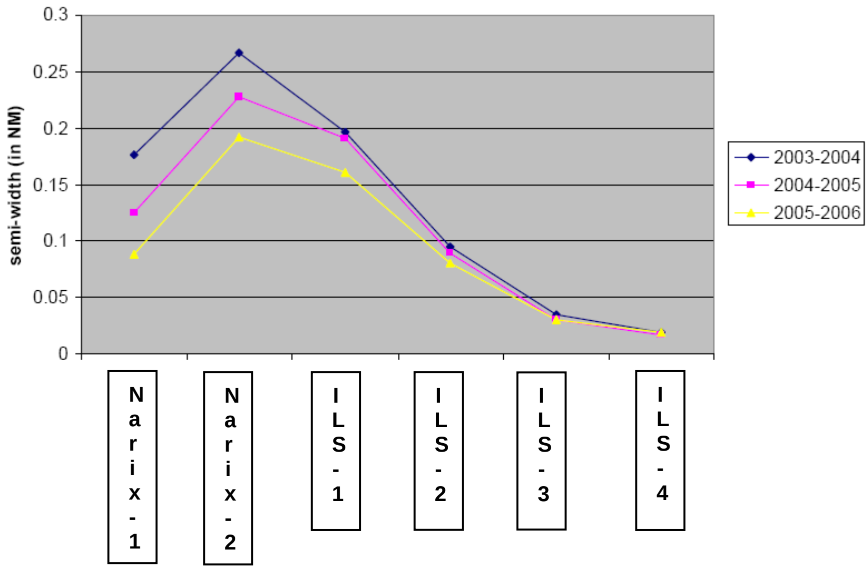

Figure 11b: Accuracy (semi-width) and trend over 3 years for the gates on the NARIX approach

A visual representation of the previous data (see figure 12) shows the route which is followed by 95% of the flights in relation to the geographical location of communities in the vicinity of Schiphol. In this figure, the final approach section from the North Sea Channel down to the north end of runway 18R is not shown, because:

1. The path with flight tracks is so narrow, that it would form a straight line.
2. The accuracy of the FMS-flown approach is higher than that of the estimated calculation error in the analysis, which is approximately 50 meters. The analysis results are therefore not representative for the accuracy of this approach segment.

The shown red (NIRSI) and purple (NARIX) approach segments are depicted in relation to the nominal, dashed, approach route. Observations are that:

1. Both routes show an increase in accuracy (lower semi-width) as:
   - The route is flown for a longer period of time (a later year)
   - And as the aircraft approaches the runway (right half of both graphs).
2. The NIRSI approach route is flown less accurate than the NARIX route, with a maximum observed semi-width of approximately 0.4 nm.

Turns in the approach route decrease the accuracy, as can be observed for gate 4 in figure 10 and gate 2 in figure 11, which correspond to the turn on the ILS-localiser. One should realise however, how the Flight Management System steers the aircraft along the approach route:

- Straight flight path sections are in general no problem and FMS accuracy is very good. Mean deviations from the flight path are approximately within 50 meters from the nominal, published route.
- An aircraft can not turn instantly at waypoints in the approach route. Therefore the FMS (or a pilot, when the flight is executed manually) anticipates a turn by flying a circular route segment on the inside of the nominal route, towards the new leg. This unavoidable behaviour brings the mean route deviation on the NIRSI approach to the right (positive value, gates 2 & 4) of the nominal approach path. The sign reverses on the NARIX approach for the left turn (negative value, gate 2), while it is flown in the opposite direction.

The 5% of the transition flights that fall outside the 95% containment area are of course less accurate. Relative to the nominal NIRSI transition route the following maximum deviations were found (i.e. no flights were found with larger deviations than the numbers below) at the most unfavourable locations (during the turns along the NIRSI route):

- Nirsi-2, -1.80nm left (or north) & 1.98 nm right (or south) of the nominal transition route
- Nirsi-3, -1.95nm left (or north) & 1.49 nm right (or south) of the nominal transition route

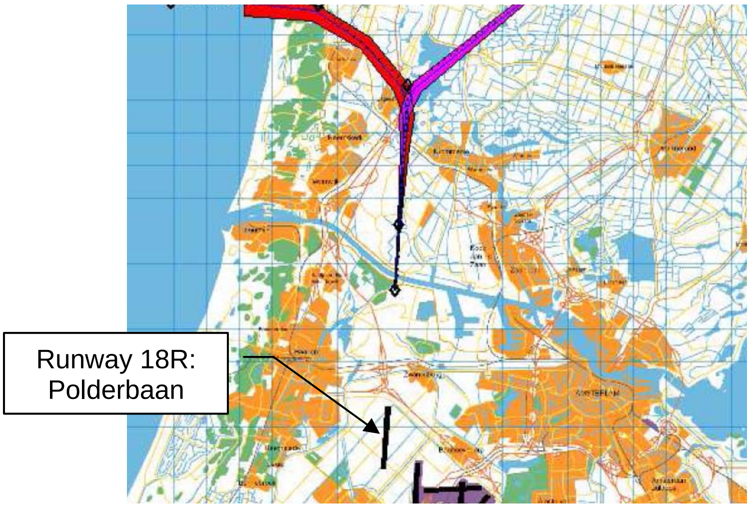

Figure 12: Flown transition routes, followed by 95% of the flights

Vertical accuracy

The vertical profile along the night transitions is supposed to be a continuously descending flight path to the Final Approach Point (FAP). The procedure prescribes a continuous descent approach between NIRSI/NARIX and the point where both routes merge on the ILS localiser (point EH608, aircraft should pass at 3400 feet altitude or higher). To verify the accuracy of the continuous descent approach, a search criterion was introduced that looked for horizontal path segments (i.e. rate of descent of less than 200 feet per minute) of at least 2.5nm or 5nm.

The numerical data of this analysis is available in table 3 for the NIRSI-EH608 approach segment and in table 4 for the NARIX-EH608 segment. The same data is also shown graphically in figure 13 and it clearly shows the difference between the amount of continuous descent approaches on the different routes. The NIRSI route percentage is stable at approximately 73%, whereas the NARIX route percentage is stable at a much higher value of 91% with almost no horizontal flight segments over 5 nm long. When both routes are combined and averaged for the amount of traffic on each route, then it can be concluded that 18 percent of all traffic is not able or has been instructed to follow a continuous descent approach.

Table 3: Percentage of true continuous descent approaches on the NIRSI-EH608 approach segment

Period	Total	CDA	2.5 NM stepdown	5.0 NM stepdown
2003-2004	3340	2441 (73%)	664 (20%)	235 (7%)
2004-2005	3386	2496 (74%)	683 (20%)	207 (6%)
2005-2006	3052	2223 (73%)	630 (21%)	199 (6%)
Total	**9778**	**7160 (73%)**	**1977 (20%)**	**641 (7%)**

Table 4: Percentage of true continuous descent approaches on the NARIX-EH608 approach segment

Period	Total	CDA	2.5 NM stepdown	5.0 NM stepdown
2003-2004	1431	1273 (89%)	147 (10%)	11 (1%)
2004-2005	3022	2771 (92%)	240 (8%)	11 (0.4%)
2005-2006	3475	3177 (91%)	288 (8%)	10 (0.3%)
Total	**7928**	**7221 (91%)**	**675 (9%)**	**32 (0.4%)**

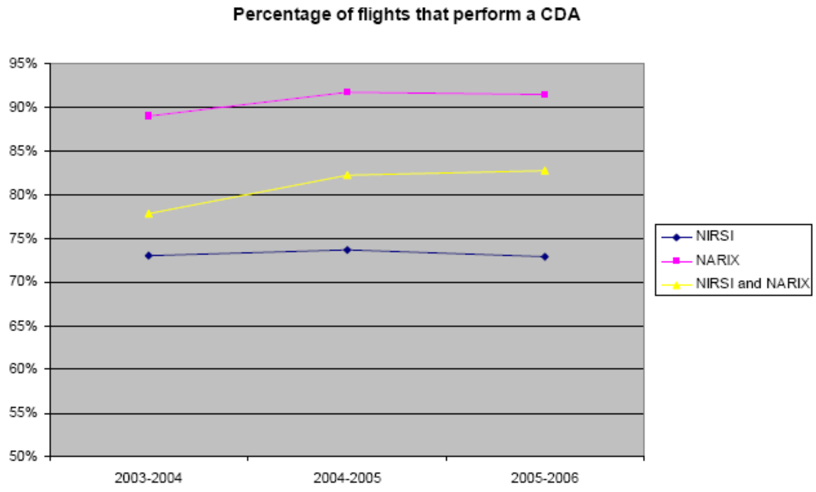

Figure 13: percentage of true continuous descent approaches during night transitions

The remarkable difference between the vertical performance of the NIRSI traffic versus the NARIX traffic is likely caused by different aspects that are not applicable to the NARIX case, i.e.:

- At NIRSI traffic coming from different directions has to be merged tot a single traffic stream. This requires the controller to interfere with the optimum flight path by vectoring or by providing level instructions in order to keep traffic within the required separation;
- Flight techniques and Standard Operating Procedures (SOPs) that differ by airlines operating the same airframes, have been found to cause level segments. The so called “dive and drive” technique is commonly applied by US airlines approaching via the west (NIRSI) instead of the east (NARIX);
- Data analysis and simulator experiments have shown that for specific environmental conditions (air pressure, wind, temperature, etc.) the altitude constraints along the NIRSI route are misinterpreted, causing the flights to fly level segments.

Correlation between operational conditions and complaints

In addition, to the analysis lateral and vertical performance, an attempt has been made to look for a relation between the number of complaints and flight data, to search for specific operational conditions that repeatedly trigger a high number of complaints. It is the intention that when such conditions can be found, they can be solved as well. The analysis is in a first phase focused on the community of Castricum, as this is the community for which the most complaints are filed.

Areas that have been looked for to find probable causes for a high number of complaints are:

- **Horizontal deviations**. Traffic not flying a transition may be directed via different flight paths to the ILS. Conditions will be studied to find indications that these deviations repeatedly cause additional complaints.
- **Vertical deviations**. Aircraft flying anything different than a continuously descending flight path may cause additional noise on the ground that may trigger additional complaints.
- **Operational conditions preventing transitions to be flown**. Specific conditions that prevent that transitions are flown (e.g. low visibility or system maintenance) will cause flight patterns that are different than the published transition routes.

First, a correlation was searched between the number of complaints and the number of flights during the night (see figure 14). For those nights where the number of complaints in Castricum exceed one hundred (see area A in figure 14) a more detailed analysis has been done to compare the timing of the complaints with peculiar flight paths. On the other hand, nights were studied that triggered few complaints, but had a large number of flights (Area B).

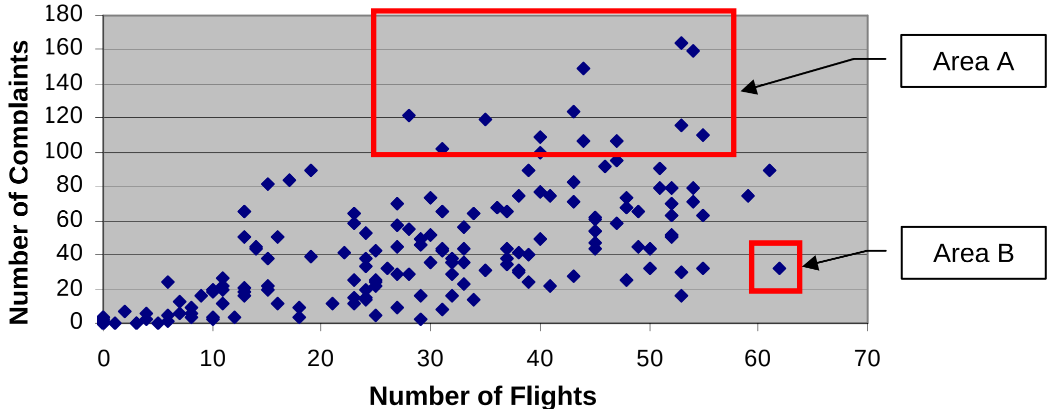

Figure 14: Relationship between the amount of flights per night and the resulting complaints

The analysis was first executed by analysing statistics in complaints as provided by 'CROS Klachtenbureau' over the time period 1 June 2005 – 31 December 2005. In this period a total number of 7127 complaints are filed from the community of Castricum, which is an average of 41 complaints per night period. The complaints are counted for a specific night period, including the periods 00.00-06.00 hours and 2300-2359 hours. The detailed analysis is found in annex B.

Although different operational conditions were found that potentially could have triggered complaints, no clear correlation was found between complaints and specific operational conditions or lateral flight paths. The project team was unable to proper analyse the vertical behaviour due to the lack of data. The large spread in the vertical profiles, already noticed in the statistical analysis may therefore contribute significantly to the nuisance experience, but this could not be positively identified by the complaints analysis.

A correlation between days with low visibility and complaints was also expected, as during conditions with less than 550 m runway visual range, transitions are not flown. No correlation was found here a well. However, this could be clarified by the fact that during low visibility there usually are very light winds, during which runway 06 is the preferred runway. Annex C presents the characteristics of these flights.

2.2.3 Discussion of results

Lateral performance

In general, over the years an increase in traffic for Schiphol airport can be observed during the night time operations. During this period, traffic mainly concentrates in the last hour and less on the first. The traffic that uses this period is approximately shared evenly over two runways (Kaag- and Polderbaan), which are assigned for use during normal operations and operators mostly use a Boeing 737 aircraft.

Section 2.2.2 shows, that the current traffic distribution between the NIRSI and NARIX approach routes is almost equal. If the nuisance at Castricum is to be reduced by redirecting flights via NARIX, this would mean that new lateral routes from SUGOL and RIVER would have to be redefined. The lateral route definition, however, falls outside the scope of this document version.

It has been shown, that 94.7% of all traffic in the night period follows the transition route. 95% of that amount is also capable of navigating these routes with a high accuracy. All tracks are within the transition route definition.

The perceived route deviation of 1.5nm south of the NIRSI route (1st complaint from local communities on current operations) may therefore be caused by less accurate transition traffic in an isolated case. This traffic is still within the limits of the transition route boundaries. A possible improvement for the current route could be to require traffic to follow the route with a higher accuracy compared to the values, which are shown for the current flight tracks. It would also be an improvement if the 94.7% of traffic, which does fly a transition, could be increased. If more aircraft fly within the transition route, that would concentrate the nuisance to a smaller area on the ground.

Another remarkable finding in the accuracy results is the difference between traffic flying the NIRSI and the NARIX route. This is on the one hand caused by the fact that traffic from different directions has to be sequenced around NIRSI by the controller, and on the other by the increased number and angles of the turns in the NIRSI route. Due to the turn anticipation feature in the aircraft, flights flying different speeds will show different a turn radius, causing a spread in the flight tracks on the inside of the turn.

More concentration of traffic is also possible by directing flights, which are not required to fly transitions (as shown in annex B), to fly along the transition route as much as possible. This will increase the predictability of flight operations. Section 2.1 lists conditions when transitions do not have to be flown. Elements 4, 6 & 7 can never be altered, so that unfortunately a 100% level of flights flying a transition can not be reached.

The previous discussion also has a link to the part of the analysis described in annex B (which deviations occurred and how many complaints followed) and section 2.1. On each of the exclusion statements, we can now make the following comments:

1. By flights departing from Rotterdam, Valkenburg or Lelystad; since Valkenburg is now closed, only the flights from Rotterdam and Lelystad remain. These flights have not been investigated separately.
2. By flights with cruising speeds below 250 knots (usually propeller aircraft); Annex B shows that in most cases, propeller aircraft can be allowed to follow the transition route.
3. By flights that do not have RNAV capability; same as for 2.
4. When the Instrument Landing System (ILS) of the runway in use is not operational; Transitions can not end on a runway without ILS-capabilities and are therefore not possible if the ILS is U/S.
5. During periods of low visibility (RVR < 550 m); Annex C shows that this exclusion is outdated and can be removed.
6. When thunderclouds (CB’s) are reported in the vicinity of the airport or along the transition route; transitions have to be aborted for safety reasons, when the transition route crosses an area with CB’s
7. When the Amsterdam Advanced ATC (AAA) system is in degraded mode (e.g. during testing of new software); there are currently no possibilities to support transitions during maintenance periods.

The deviating flights, described in the 7 exclusion statements above, are flown correctly according to procedures and legislation and currently form 5.3% of all night traffic. This category of flights however shows wide variations in flight tracks over the area surrounding Schiphol, as is also the case for flights discussed in annex C. This annex discussed that transitions are possible during low visibility operations. Both statements are proof that the current procedures for non-transition flights and the elements of section 2.1, which exclude flights from flying transitions, can be optimised to increase the amount of traffic flying a transition.

Vertical performance

The discussion on the vertical flight profile is more complex:

- Annex A describes the relation between flight altitude and noise, but also the difference between a normal descent and a continuous descent approach. The conclusion here is that there are multiple factors, which affect the altitude in relation to the distance to the runway, such as: starting altitude, power setting, flap setting, wind (direction and speed), ATC instructions (for separation) and required aircraft configuration. Additionally, it was found that the way in which pilots handle air pressure in the FMS do vary across the pilot population and that this has a direct effect on the vertical behaviour of the aircraft.
- Pilots are trained according to different standards with respect to flying vertical profiles. Stepped approaches, where the next assigned altitude is rapidly reached, are still in use and are contradictory to the gradual altitude changes required in a CDA-profile. When this training is combined with airline standard operating procedures that have similar rules for vertical profiles, it is likely that their vertical profile deviates from the intended CDA-profile.
- Annex B has shown that large variances occur between the flight paths of various descents and does not show a comparable bundle of vertical profiles, as is shown for the lateral route. Both annexes therefore indicate that more attention is needed for the description of the descent profile, how it should be followed and for effective control of power changes.
- Aircraft themselves can also be the cause of horizontal segments in the vertical approach profile, as observed in flight tracks and simulator sessions. The transition level (TL) in the FMS has an effect on the vertical flight path. With a TL at FL40, QNH at 1033hPa and start of CDA above FL40, a horizontal segment is produced by the B737-800 (aircraft that forms the largest percentage of aircraft in the night approach population). A higher TL (e.g FL70 or FL90) allows a true CDA without these segments. A higher transition level could therefore improve the accuracy of the vertical profile.

2.3 Conclusions of the analysis

The conclusions have been divided over lateral, vertical and transition usage section and are the result of the study that has been performed so far.

For the lateral performance it is concluded that:

- 5.3% of all traffic in the night does not fly a transition, while navigation equipment and operational limitations (e.g. low visibility, rain and ATC system degradation) do not enable them to follow this route. In these cases, course instructions will be provided at 3000 feet altitude to the final approach (and on 2000 feet for propeller aircraft).
- 94.7% of all traffic in the night period flies a transition. 95% of that traffic achieves a good lateral accuracy and is able to maintain its track within a bandwidth of 0.8 nm. 100% of all traffic within legal boundaries of the transition

For the vertical performance it is concluded that:

- Large variances in the vertical profile (pronounced indications are visible in the approach from NIRSI) are observed. This could add to higher noise levels on the ground then what could be achieved, when all approaches where flown as a CDA. The benefit of flying a CDA versus traditional approaches with a level segment have been shown with figures that show the impact on peak dBa-levels along the NIRSI-route. A high percentage of CDA’s of all approaches is therefore desired. Actual numbers for true continuous descent approaches are 73% for the NIRSI-approach and 91% for the NARIX-approach.

- The observed horizontal segments in the approach profiles could lead to an increase in noise levels around the flight track on the ground. Three types of horizontal segments occur:
  1. An idle power descent needs to decelerate and does so by reducing the flight path angle. The resulting horizontal segment is not likely to result in additional noise.
  2. Horizontal segments at constant speed are required to maintain separation (e.g. ATC instruction) or to stay clear of minimum descent altitudes in the approach procedure. These altitudes would otherwise be crossed, due to changes in atmospheric conditions (e.g. wind and air pressure). Such altitude corrections require extra power relative to that of a descent and consequently produce more noise.
  3. Stepped approaches are part of flight training and in standard operating procedures of some airlines. This affects the way in which pilots fly altitude profiles.

For the conditions for usage of the transitions it is concluded that:

- No repeatable correlation has been found in the (limited) analysis between complaints on the one hand and specific operational conditions on the other hand, such as traffic volume, flight tracks, navigation equipment, ATC system performance and low visibility. It is therefore concluded that the complaints are more complex than previously thought.
- The current distribution of traffic between NIRSI/NARIX is approximately equal.

3 Definition of alternatives

Based on the previous analysis, this chapter describes the alternative solutions for the problem areas. It is not meant to judge these options, but purely to define its intent and impact on the current ATC system. Note that in this first version of the document the lateral route alternatives have intentionally not been considered.

3.1 Directions for change

The conclusion on the problem analysis indicates several areas that can be improved to alleviate the nuisance due to aircraft noise. In particular the following problem areas are to be solved for the lateral part (not considered in this document version):

- Relocation of the current transition routes.
- Increasing the accuracy of the transition tracks, if the current 0.4 nm maximum deviation (by 95% of all transition traffic) is not seen as accurate enough. A VEM-analysis has to show if the extra accuracy requirement does not degrade safety, by making the operation more complex.
- Increasing the percentage of transition traffic (this percentage however will never be 100%)
- Optimising the procedures for non-transition traffic

For the vertical part solutions will have to be sought in:

- Avoiding the use of and changes in power during the approach; i.e. by preventing level segments at constant airspeed by e.g. flight technique or errors in compensation for environmental conditions;
- Prescribing the descent profile to the ILS for as far as possible;
- Following the predetermined descent profile as accurately as possible.

For the conditions for usage of the transitions the problem definition is:

- Fly as many transitions as possible
- Try to match the approach to a transition as closely as possible, when transitions are not mandatory. This type of approach could be performed by all aircraft, when ATC provides distance to the pilot during the transition, based on the distance-to-go to the threshold of the runway and pilots use this information to plan their descent.

The following sections aim to work out these directions for change in further detail. Annex D provides an overview of the options in tabular format.

3.2 Options for changing the approach in the lateral plane

Not considered in this version.

3.3 Options for changing the approach in the vertical plane

To prevent horizontal segments in the vertical profile, four different alternatives are suggested that provide better definition of the vertical profile and allow better execution of the profile; i.e.:

- Prescribe a continuous descent profile;
- Higher CDA start altitude at NIRSI;
- Increase Transition Level (TL);
- CDA performance monitoring programme.

3.3.1 Prescribe a continuous descent profile

To eliminate horizontal segments in the descent profile, a fixed continuous descent profile can be prescribed in the procedure. Initial research however, shows that a descent gradient can only be specified in a procedure during the final approach segment (i.e. by ILS or flight path angle (FPA). For the segment prior to the final approach along the transition route, the continuous descent profile can be emulated by introducing additional ‘at or above’ constraints along the route that correspond to a specified descent profile. In this case, however, a step down flight path would still be possible, although with an intermediate step. In addition, introducing constraints has been found (and is confirmed by aircraft and avionics manufacturers) to introduce irregularities in the Flight Management Systems’ behavior and reduces the performance of aircraft to comply with the prescribed procedure..

A significant drawback of the fixed descent gradient is the fact that the chosen descent angle (e.g. 2,5°) is not optimal for all aircraft types. For those aircraft types that fly at different descent gradient, additional engine thrust or drag (e.g. by speed brakes) will be needed to fly the descent profile with the desired airspeed. In those cases, additional noise will be produced compared to the low power/low drag approach.

If publication in the AIP is required for this alternative, a publication period of 19 weeks will have to be taken in to account.

3.3.2 Higher CDA start altitude

When the CDA is started at a higher altitude than the current 4000 feet at NIRSI, the chance of flights flying below the continuous descent profile or flying level segments is reduced. Obviously, without a prescribed descent profile, flights may still end up below the descent profile.

A suitable CDA start altitude at NIRSI could be 6000 ft. This corresponds to a descent angle of 2,7° in no wind conditions. During strong westerly winds however, the ground speed along the transition will be much higher and excessive rates of descent will be required to follow the descent profile. This increases the chance that flights end up too high on the approach and will have to execute a missed approach. Proper design of the higher CDA altitude has to be done to make sure this chance is reduced to within reasonable limits and verified in simulator experiments. On the other side, Castricum’s benefit would be that the altitude at which the aircraft fly overhead, will increase from the current minimum of approximately 3700 feet to a nominal 4550 feet.

If publication in the AIP is required for this alternative, a publication period of 19 weeks will have to be taken in to account. However, this period could be reduced by either a NOTAM while awaiting AIP change and/or when the controller clears the flight to a higher altitude at NIRSI.

3.3.3 Increase Transition Level (TL)

Data analysis and simulator experiments have indicated that during specific environmental conditions (high sea level air pressure, or QNH) different aircraft types have difficulty in following the correct vertical profile. Although technical in nature, the cause is found in the value of the altitude constraint at NIRSI and the so called Transition Level (TL) in combination with the high air pressure at mean sea level. An increase of the Transition Level (TL) to a higher level (e.g. FL70 or FL90) is likely to prevent this phenomenon and allows aircraft to accurately follow the correct descent profile instead of levelling off at a specific altitude.

The Transition Level is the flight level where the arriving aircraft’s altimeter is changed from the standard pressure setting of 1013 hPa to the local air pressure at mean sea level to allow proper reference to aircraft and obstacles closer to the ground. A departing flight will change over to standard pressure at the so called Transition Altitude (TA is 3000 ft in the Netherlands). The layer between the TA and TL is called the Transition Layer and should be at least 1000 ft thick. To accommodate this, the TL is determined by ATC based on the local air pressure on the ground.

If the TA is to be changed as well, in order to keep the transition layer around the required 1000 ft, this has a lot of far reaching consequences on all flight operations in the Dutch airspace. However, if the TA remains unchanged and ATC (i.e. via ATIS and/or by the controller) reports the higher TL to arriving flights during night time operations, the impact is expected to be limited.

3.3.4 CDA performance monitoring program

All airlines are to be aware of the fact that the vertical profile along the transition route should be flown as a continuously descending path instead of a step down procedure (dive & drive). Some distinct airlines have been found to show this flight technique. When a CDA performance monitoring program is established, airlines will receive monthly reports on their ability to follow the proper vertical profile. A similar program exists for London Heathrow (code of conduct). Note, that although the program is non-punitive it will certainly affect operators not flying a CDA and encourage them to do so.

3.4 Options for non-transition traffic

Another direction for change is found in the conditions when transitions are not used. The following alternatives are suggested to further improve the 5,3% that is not flying transitions and improve the performance when transitions are not flown:

- Deny access for non-RNAV traffic
- Fly transitions during low visibility
- Announce planned maintenance
- Improve flight procedures for non-transition traffic

3.4.1 Discourage non-RNAV traffic

By discouraging non-RNAV equipped traffic to fly to Schiphol during night time, the current 5.3% of traffic that is unable to fly a transition, can be further reduced. The discouragement could be found in denial by the Dutch government or by discouragement in economic sense such as higher landing fees.

Although the department of IVW has indicated in an AIC that all night flights to Schiphol are supposed to be P-RNAV equipped, exemption agreements for night operations without P-RNAV equipped aircraft can still be made. Therefore, this measure is achievable only by the Dutch government. All traffic with a P-RNAV waiver can not be refused access by LVNL and has to be accommodated on the transition route with radar vectors (see section 3.4.4).

3.4.2 Fly transitions during low visibility operations

For historic reasons transitions are not flown during low visibility (RVR less than 550 meters). By allowing transitions during low visibility, the 5,3% non-transition traffic can also be slightly reduced. Research has learned that at present no flight or ATC operational restrictions exist, which would limit transition use to good visibility conditions only. The only requirements during low visibility are for the aircraft to be stabilised at/above 1000ft on the final approach and for ATC to safeguard clearance of the ILS sensitive area. For the latter condition, the standard separation criteria during low visibility operations remain in force.

3.4.3 Announce planned maintenance

Transitions cannot be flown during full scale system maintenance (REA testing). Although, this cannot be changed, it would be beneficial if this planned maintenance would be published on CROSNET.

CROS has also requested to better plan the start time of the maintenance activity. This is not possible however, because the REA test is a major system test of the operational ATC system and requires a full night. Depending on the progress during the test, it may be completed earlier. ATC usually aims the system to be operational again before 4:30 LT.

3.4.4 Improve flight procedures for non-transition traffic

For the remaining non-transition traffic the deviations from standard transition procedures can be limited as much as possible, by trying to fly transition and CDA “look-a-like” flight patterns.

Non transition traffic will vectored by the air traffic controller as much as possible along the lateral transition profile. If the controller additionally provides the pilot with track miles, the pilot should be able to determine its optimum descent profile using the rule of thumb 3NM/1000ft. The controller cannot force the flight to fly a CDA “look-a-like” profile. It is up to the pilot of the non-transition traffic to interpret the distance-to-go information into The success of this measure depends on many operational variables.

4 Evaluation of alternatives

The alternatives, defined in chapter 3, will be detailed in the design phase of the project [ref. Project plan]. An initial evaluation of the alternatives has been started and is described below. It will be completed during the design phase.

4.1 Safety, efficiency & environmental effect analysis

The safety, efficiency & environmental-effect analysis, to be performed on the defined alternatives, will contain the following elements:

- A safety analysis, based on expert judgement of operational experts. In this version of the report the alternatives in chapter 3 have been judged by several operational experts
- Comparison / benchmarking of Schiphol with other airports by the NLR.
- Noise-calculations by To70. The alternatives will be characterised by:
    - Noise indicators
    - Calculation models, with sufficient detail to describe the problem accurately. The evaluation will compare the current situation with that including the alternatives. No relation will be made to actual measurements, since model and measurement always produce a different outcome due to the numerous variations between model and true conditions.

  Unfortunately at the time of publishing this version of the report the noise calculations have not yet been completed. Therefore, there is only a qualitative estimate that when the percentage of level segments of the transition traffic via NIRSI can be reduced, the noise in the Castricum area is reduced as well.

4.2 Legal effect analysis

The following statements are made on legal effects of the suggested options in chapter 3 of this document:

1. Rules for use of runways and routes have been defined in the law 'Wet Luchtvaart'
2. Rules for use of routes during the night contain a restriction to fly the transition within the defined corridors
3. Changing the location of the current lateral route is only possible, when the experimentation article ('experimenteer artikel' in Dutch law) does allow a deviation from statement 2. This article has not been approved or passed into law yet.
4. Furthermore, the Department for Inspection of Transport and Water Management is not willing to accept procedures, which are contradictory to the law 'Wet Luchtvaart'
5. Liability and other juridical aspects have to be investigated before implementation of any of the alternatives

4.3 Acceptance effect analysis

The acceptance-effect analysis is due after completion of the design phase.

4.4 Cost analysis

The cost impact of the various options has not yet been defined.

5 Conclusion

5.1 Considerations

Based on the history of noise nuisance at Schiphol airport, the problem analysis and suggested solutions in the form of alternatives, we are now able to oversee the amount of alternatives to reduce that nuisance. The alternatives fall in three categories: lateral, vertical and general. During the definition phase, the project group was not provided with data on future urban developments in the surrounding of Schiphol airport and the legal opportunity to make lateral route changes possible. These considerations result in the advice of the next section.

5.2 Implementation advice

This section discusses when the various alternatives are likely to be implemented and when they will start to decrease nuisance of flight operations in the night time period. Implementation time of the chosen alternatives is mainly determined by the question of how many alterations are necessary to the AIP and the associated publication time of 19 weeks. The indication of whether an alternative solution is achievable on the set date of November 1st is therefore made as either Yes, maybe or Not per November 1st.

The following estimate assumes authorisation of changes by the Dutch government.

Implementation advice for the vertical route alternatives:

- **Transition Level is achievable per November 1st if by ATC.**
- **Increase CDA start altitude at NIRSI is achievable per November 1st, if by ATC or NOTAM awaiting AIP change.**
- **The CDA performance monitoring and awareness program for airlines is achievable per November 1st and required!**

Implementation advice for the general option alternatives:

- **Discouragement of non-RNAV traffic is not achievable per November 1st, unless a government decision to deny this traffic is available**
- **Transitions during low visibility is achievable per November 1st**
- **Announce maintenance via CROSNET is achievable per November 1st**
- **Non-RNAV route and profile similar to transition traffic may be achievable per November 1st, depending on traffic load.**

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DGTL letter	"*Verbetering van de regels eerst in de praktijk testen*" (in Dutch). Letter DGTL/06.006669 dated February 24, 2006 by M.H. Schultz van Haegen to Voorzitter van de Tweede Kamer der Staten-Generaal.
RNAV accuracy	"*Accuracy analysis of RNAV-based night-time transitions at Amsterdam Airport Schiphol*". Doc. NLR CR-2003-323 dated 8 July, 2003.
NLR accuracy study	"Accuracy analysis of RNAV-based night-time transitions to runway 18R", Doc. NLR CR-2006-521 (draft) version 0.3, dated August 2006.
Project Plan	Project plan 'CROS Pilot 5: Night arrivals for runway 18R' KDC Doc D/R&D 06/011 version 1.0 dated May 3, 2006.

Annex A: Noise levels on the ground during the approach

Figure A.1 shows the relationship between noise levels on the ground and the vertical approach profile. The blue line shows a normal approach with a horizontal flight segment to intercept the ILS (which corresponds to the red line in the peak dBA figure). This type of approach produces up to 8 dB more noise, at a distance of 10nm (18,5 km) to the threshold of the runway, then when a continuous descent approach would be followed.

The other benefit op de continuous descent approach is that it reduces the noise footprint of an approach between approximately 18 and 6 nm to the runway by a considerable amount. This difference is shown in figures A.2 and A.3. From the moment that both types of approaches follow the same 3° descent path to the runway, there is no difference in noise production anymore.

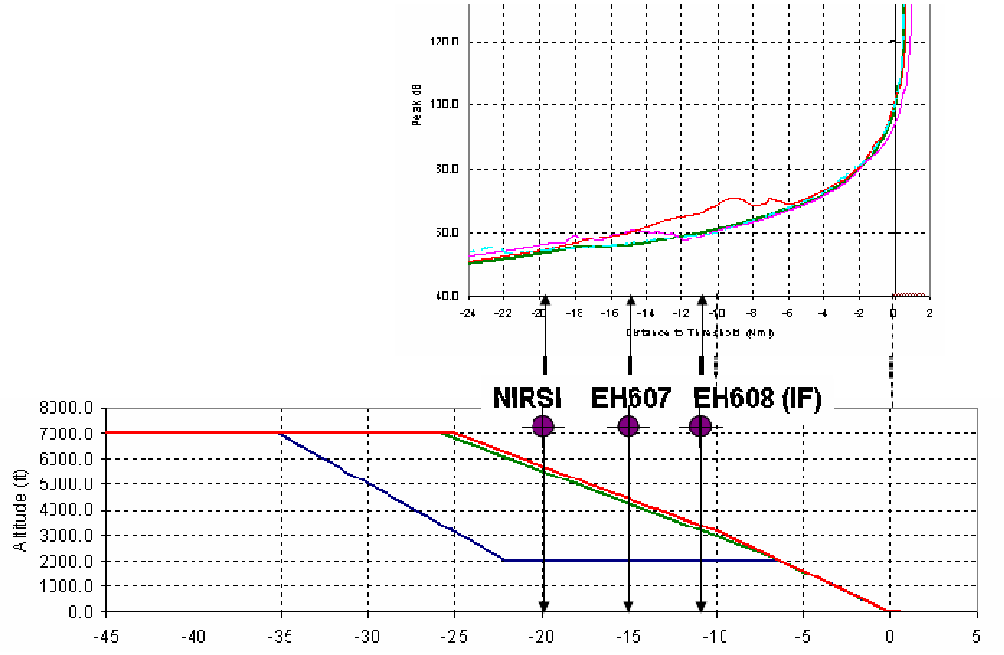


Figure A.1 Impact of approach altitude on sound levels on the ground

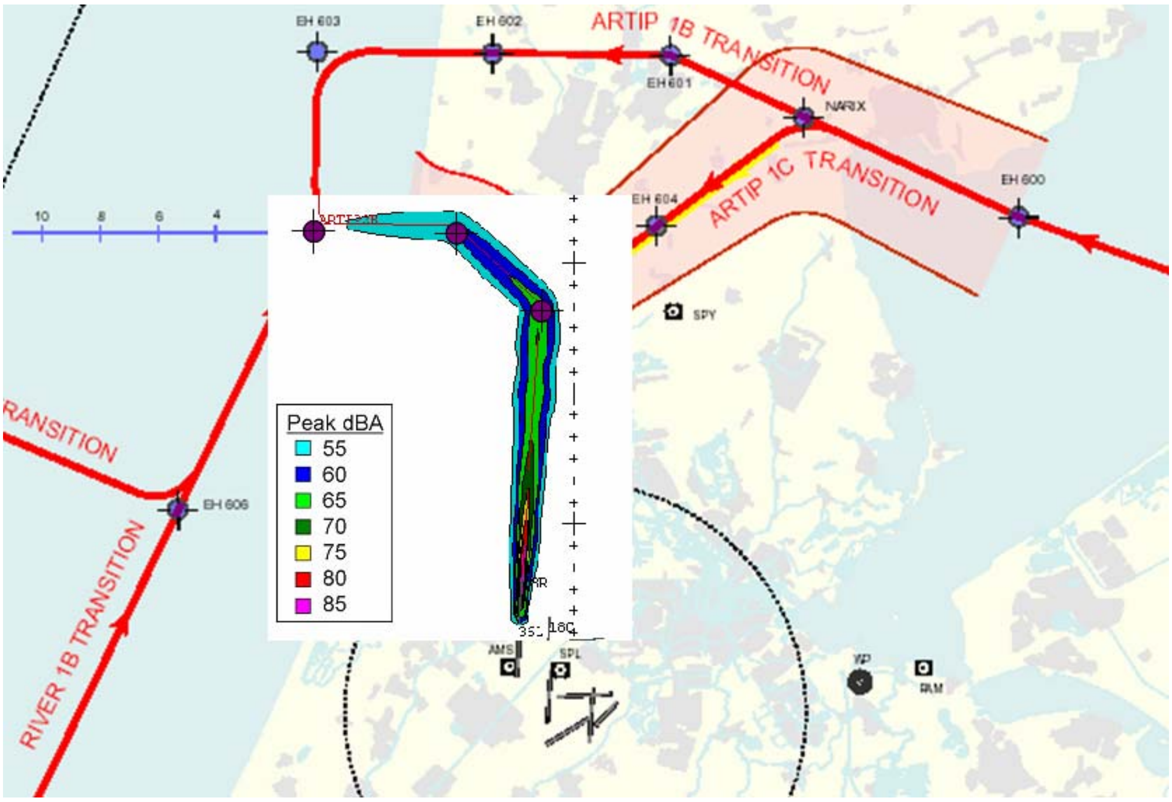


Figure A.2 Sound levels on the ground for a level intercept of the ILS at 2000ft

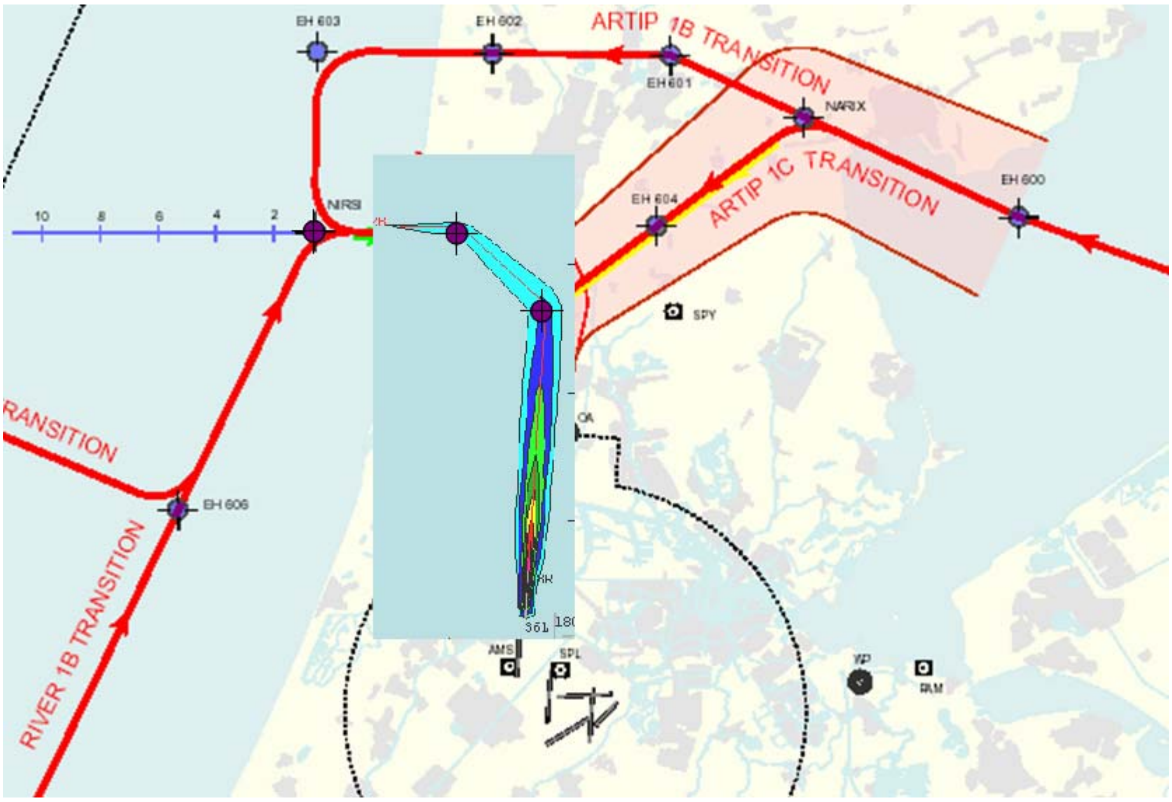


Figure A.3 Sound levels on the ground for a continuous descent approach

Remarks for the continuous descent approaches (CDA).

An optimum CDA (for lowest noise emission) will be flown, when:

1. The aircraft is in a low power and low drag configuration

2. The approach route is fixed and known

3. The aircraft is free to follow the vertical profile along the approach route

Influence of altitude restrictions:

1. Descending to a minimum allowed altitude before passing a control point on the approach route results in a level flight segment. Level segments require engine power to maintain altitude and constant speed.

Influence of speed restrictions:

1. When speed restrictions are active and the aircraft is approaching too fast with a low power setting, then the normal way to decelerate is by pulling up the nose of the aircraft and thereby decrease the angle of the flight path. This new path is higher than the intended path and the aircraft therefore needs additional drag (wing flaps and/or spoilers), which results in additional airframe noise.

2. Aircraft flying at low airspeeds require extended wing flaps to be able to operate safely. Extended flaps produce airframe noise and consequently adds to the total noise production of the aircraft.

Additional notes:

1. ATC will handle high capacity traffic with predetermined fixed speeds and separation distances to optimise the traffic flow (lowest amount of delays) and safety (minimum required separation). These speeds require corrections in power and/or drag and result in additional noise production.

2. Changes of atmospheric conditions relative to planned values, such as wind and air pressure, will lead to deviations in the optimal approach path. These deviations require corrections with additional power or drag and result in additional noise production.

Annex B: Correlation between complaints and flight patterns

In this annex the results of the correlation analysis between complaints and flight patterns is presented. The analysis aims to identify specific events that attribute to an increase in the number of complaints. Listed characteristics of the analysed flights are:

1. The date of the flight operation.
2. The number of arrivals and corresponding complaints on that date.
3. The lateral tracks of the arrivals, plotted on a map of the Schiphol area.
4. The vertical profiles, where the altitude is compared to the track distance to the runway.
5. A figure showing the distribution of the number of flights (in purple), combined with the number of complaints (in blue) per half hour period.
6. And finally a box with remarks on special occurrences on that specific date during night time hours only.

Summarised findings are:

- Propeller aircraft are vectored to runway 18R, as they are excluded from flying transitions. This resulted in large deviations between tracks from propeller aircraft and that of traffic on the transitions on 8 occasions. The exclusion is based on:

    i. The fact that instrumentation of propeller aircraft is in most cases less than that of jets. They are therefore less able to follow the transition route with sufficient accuracy.

    ii. Their cruise speed is much lower than that of the jets. This is usually a problem, when jet and propeller traffic have to follow the same route and maintain a constant separation. However, jets are restricted to a maximum speed of 220kt on the transition route and traffic density is usually low during night time operations. This combination could allow propeller aircraft to follow the transition.

  When these aircraft are provided course and altitude instructions they could follow the transition and the exclusion can be removed, if the amount of traffic is not too high.

- 10 occasions, during which ATC System maintenance took place in 3 nights. Transitions can not be flown under these circumstances and aircraft can only be vectored along the transition route.

- 1 aircraft performed a missed approach and had to make another approach over land. After a go-around, the safety situation of the aircraft will be given priority over other constraints. Flying back to the start of the transition (both lateral and vertical) instead of a short route back to the ILS, requires a lot of time and fuel. The aircraft fuel planning does not take such route extensions into account. This situation coincided with a peak in traffic and complaints on the 15th of November.

- 1 medical emergency, which resulted in an altitude deviation.

- 5 inaccurate executions of the prescribed transition route, of which 2 resulted from vectoring before NIRSI. The lateral flight execution of the transition for the other flights is good.

- The vertical flight profile shows a whole different picture. Variations in altitude are large and do not show a consistent path, although:

    i. All are above the minimum descent profile described in the CDA procedure

    ii. The two approach routes (NIRSI and NARIX) with different track length and minimum altitudes have been combined in one picture. Separate pictures for NIRSI and NARIX are presented in figures B.1 and B.2 respectively for completeness.

- It was not possible to extract data on power changes in turns and it is therefore not possible to link them to complaints and to the suggestion that a lot of complaints come from these power changes.

As is shown in this summary, 25 deviations occurred on 468 flights, which form 5% of all flights in the selected nights (with more than 100 complaints).

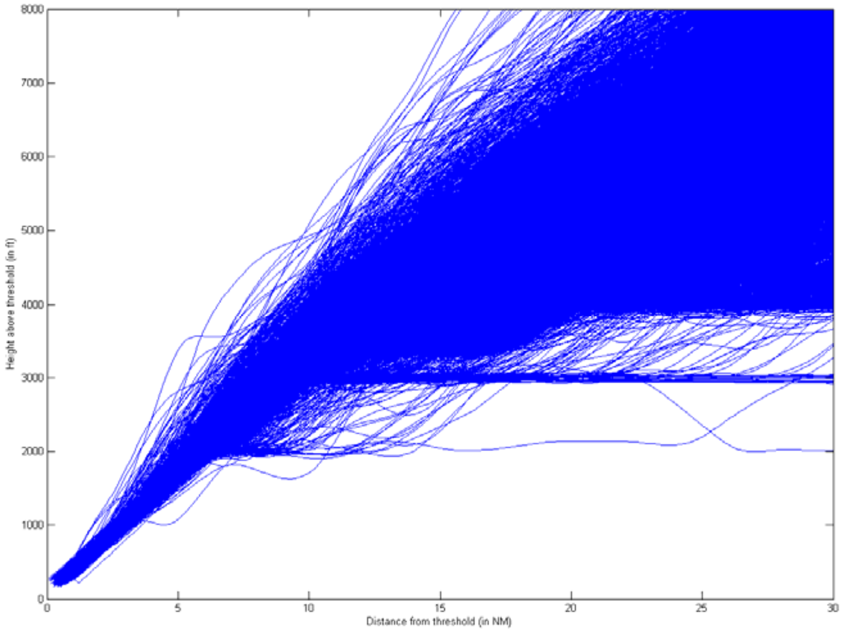


Figure B.1 Vertical profile of all flights on the NIRSI transition

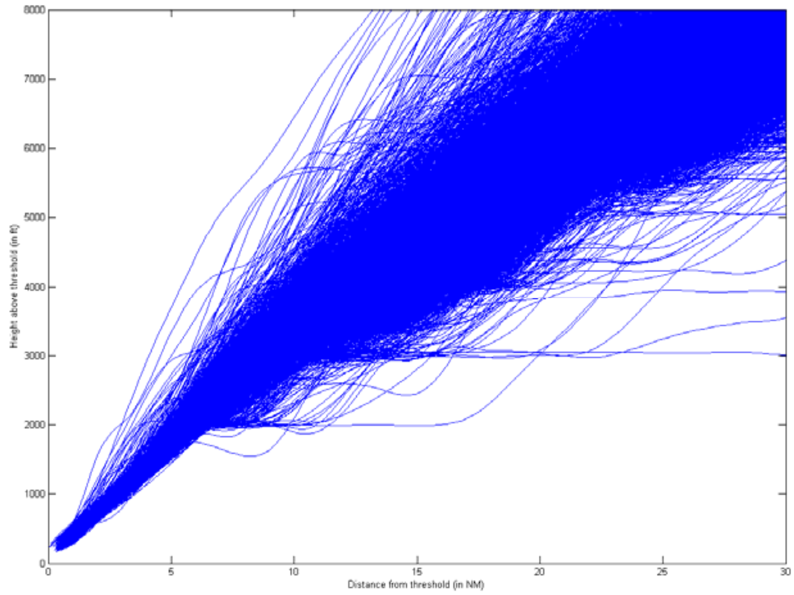


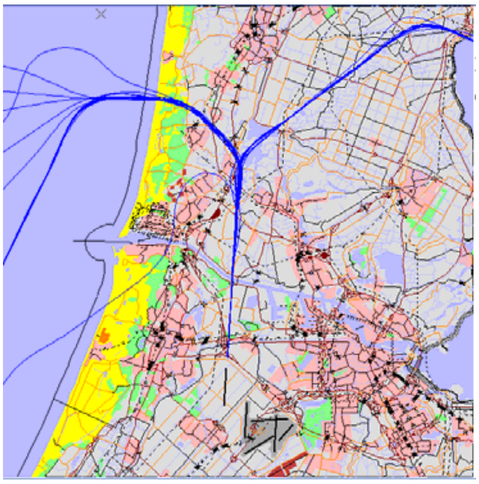
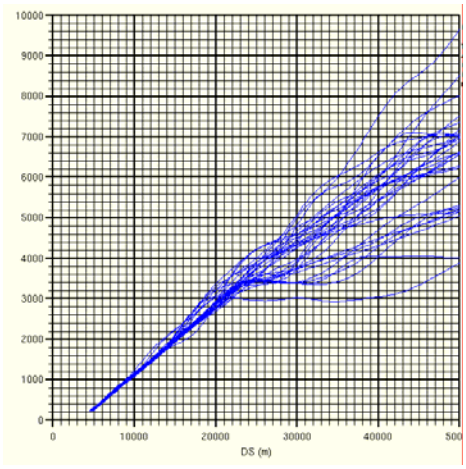
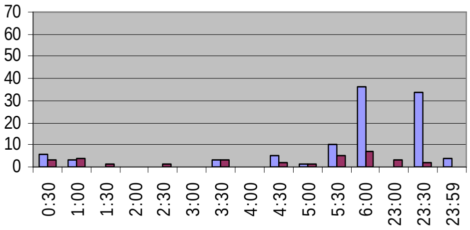
Figure B.2 Vertical profile of all flights on the NARIX transition

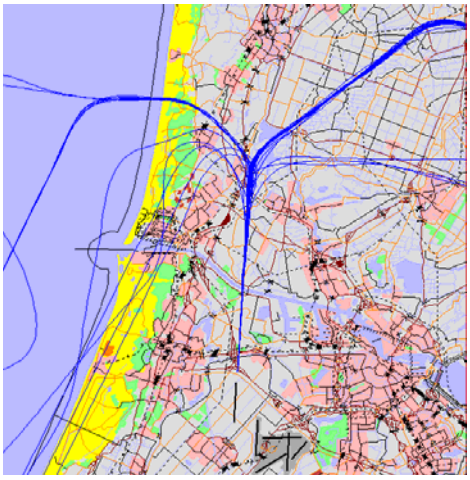
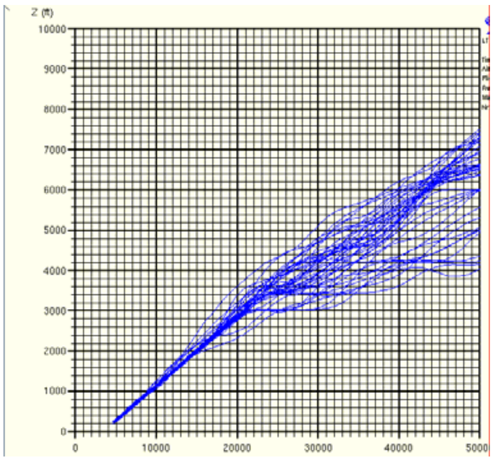
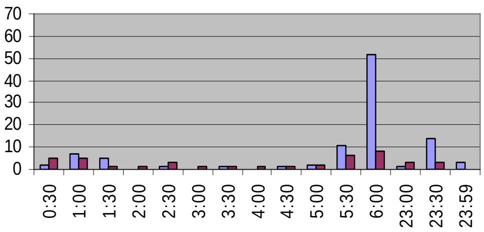
For interpretation of the following results a reference table is presented for conversion of feet to meters.

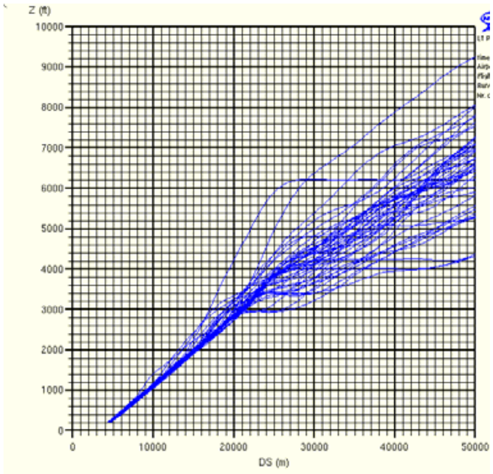
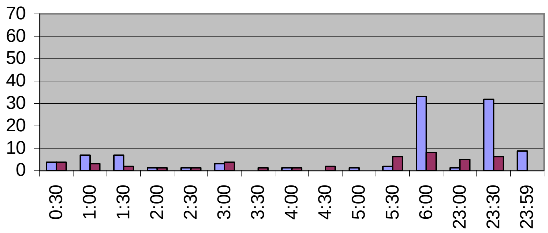
Reference table: distance conversions

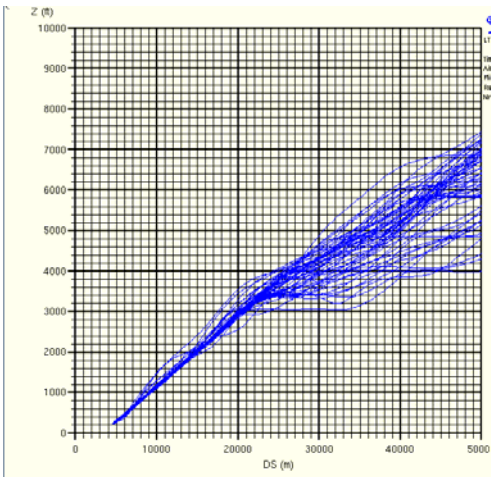
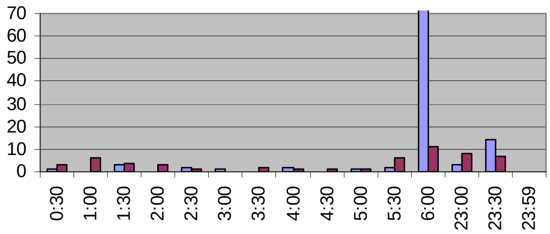
Feet	Meters		nm	Kilometers
500	152		1	1.85
1000	305		2	3.7
1500	457		3	5.6
2000	610		4	7.4
2500	762		5	9.3
3000	914		6	11.1
3400	1036		7	13.0
3500	1067		8	14.8
4000	1219		9	16.7
5000	1524		10	18.5
7000	2134		15	27.8

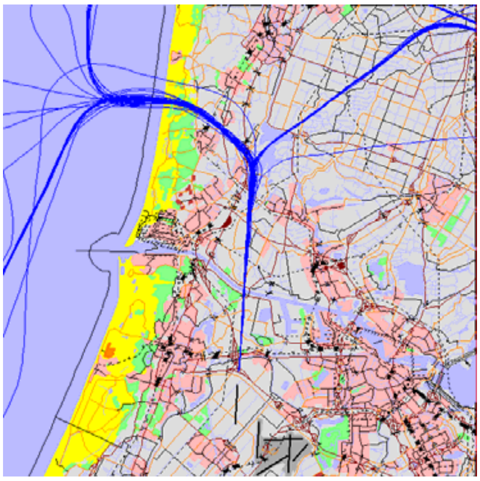
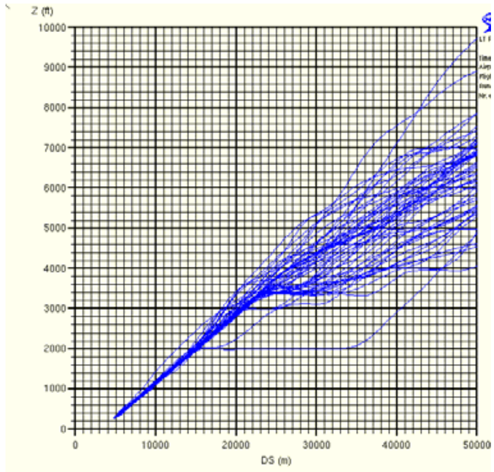
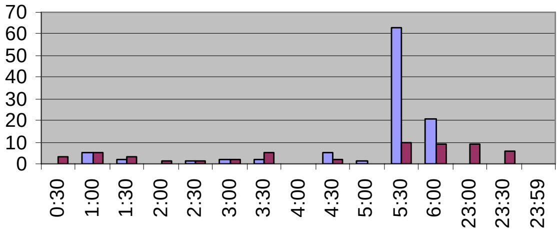
The following sheets show the correlation analysis for the days with more than 100 complaints at Castricum (Area A in figure 14).

<table>
<tr><th>Tuesday 21st June 2005</th><th>102 complaints; 31 arrivals</th></tr>
<tr><td></td><td>
</td></tr>
<tr><td>
</td><td>Deviations from track over Castricum from NW-SE
—05:16; 3034 ft; ATP; Propeller</td></tr>
</table>

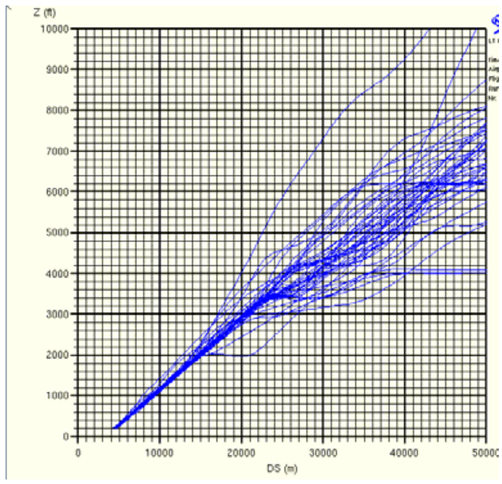
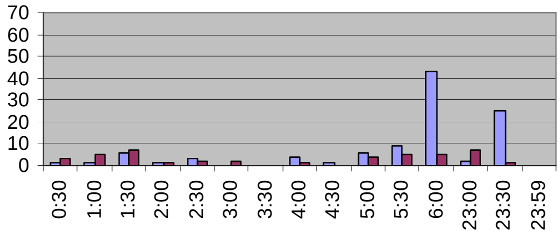
<table>
<tr><th>Wednesday 22 June 2005</th><th>100 complaints; 41 arrivals</th></tr>
<tr><td></td><td>
</td></tr>
<tr><td>
</td><td>Deviations from track over Castricum from NW-SE
—00.52; 3155ft; B744 medical emergency
—05:35; 3031ft; ATP, Propeller
—23:06; 3597 ft; B738; ATC system maintenance
—23:21; 4140 ft; B737; ATC system maintenance
—23:04; 3088 ft;; B737; ATC system maintenance</td></tr>
</table>

Thursday 23 June 2005	107 complaints; 44 arrivals
	
	Deviations from track over Castricum from NW-SE —00.18; 3025ft; TRA790; B737; ATC system maintenance —00:01; 3050 ft; TRA5134; B737; ATC system maintenance

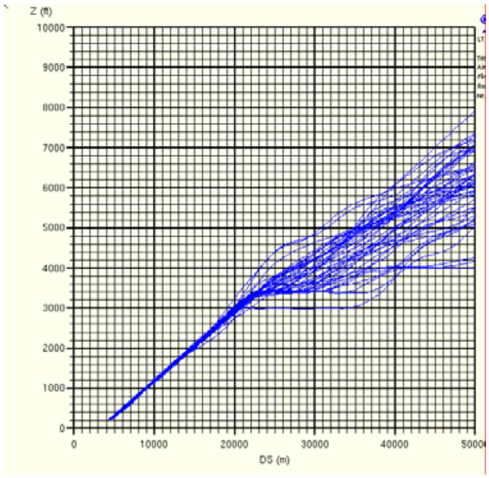
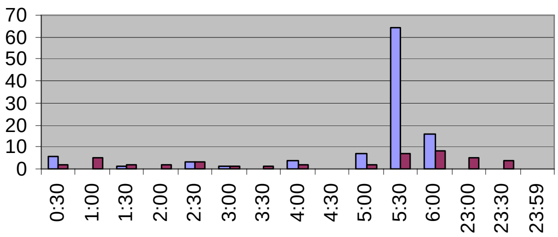
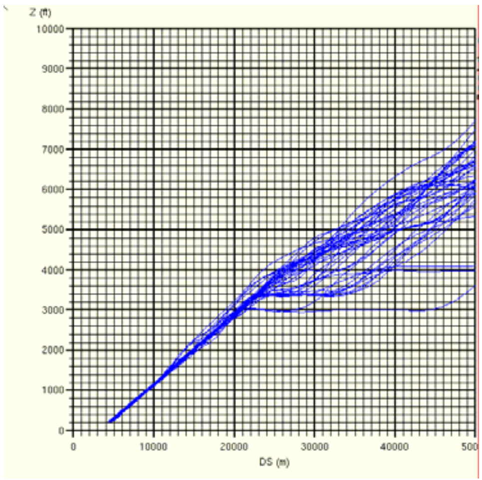
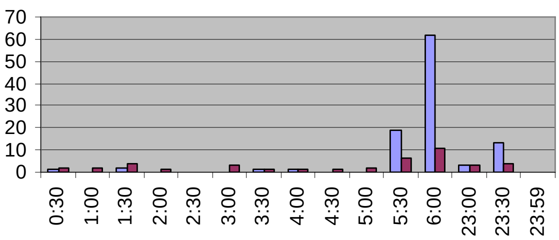
Friday 1 July 2005	110 complaints; 55 arrivals
	
	Deviations from track over Castricum from NW-SE —05.49; 4639ft; KLM410; B763; ATC vectoring before NIRSI —05:52; 4116ft; KLM40; B739; ATC vectoring before NIRSI —05:41; 3380 ft; NWA DC10; inaccurate execution of transition —05:47; 4052 ft; WLX4SM; ATP; propeller —03:51; 3324 ft;; DRT1498; BE20; propeller

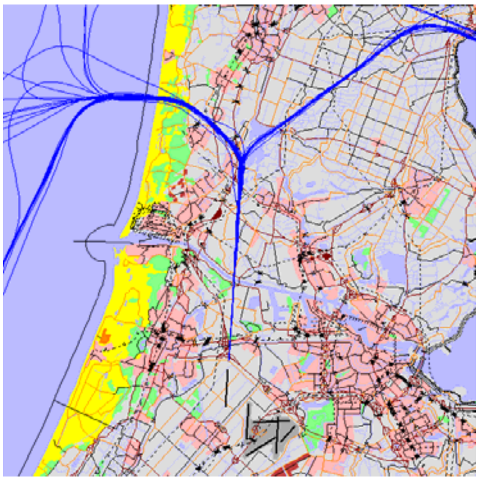
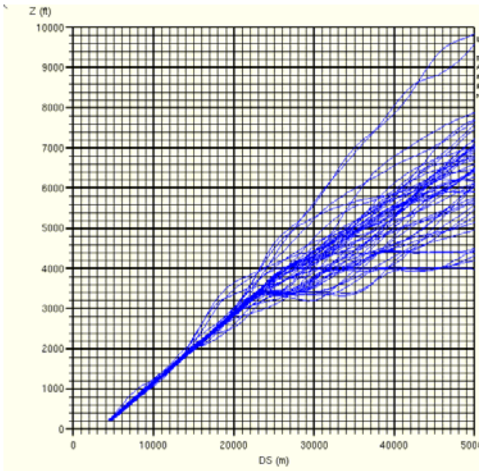
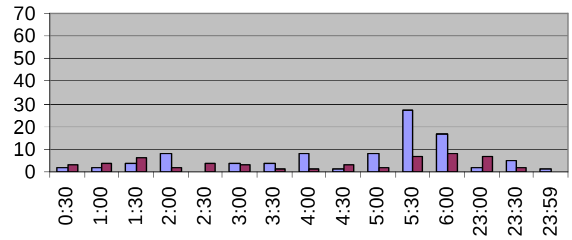
<table>
<tr><th>Thursday 8 September 2005</th><th>159 complaints; 54 arrivals</th></tr>
<tr><td></td><td>
</td></tr>
<tr><td>
</td><td>Deviations from track over Castricum from NW-SE

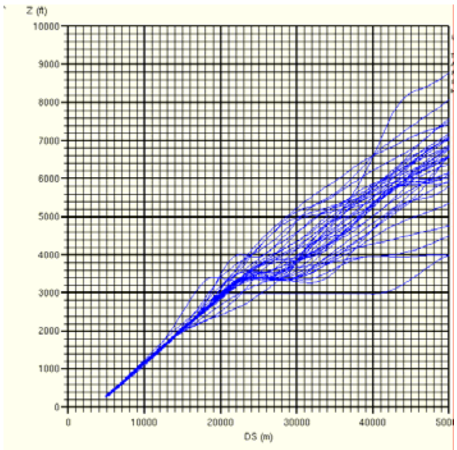
—05.17; 3402ft; WLX4SM; ATP, Propeller (north of route)
—05:43; 3355 ft; NWA42; DC10; inaccurate execution of transition</td></tr>
</table>

<table>
<tr><th>Monday 10 October 2005</th><th>124 complaints; 43 arrivals</th></tr>
<tr><td></td><td>
</td></tr>
<tr><td>
</td><td>Deviations from track over Castricum from NW-SE

—23:16; 3829 ft no flight data avail., ATC system maintenance
—23:19; 3118 ft no flight data avail., ATC system maintenance
—23:37; 3303 ft; no flight data avail., ATC system maintenance
—23:05; 3521 ft no flight data avail., ATC system maintenance
—22:54; 2831 ft no flight data avail., ATC system maintenance</td></tr>
</table>

Friday 21 October 2005	149 complaints; 44 arrivals
	
	Deviations from track over Castricum from NW-SE —04.47; 3004ft; SWN4SM; ATP; Propeller
Thursday 27 October 2005	**109 complaints; 40 arrivals**
	
	Deviations from track over Castricum from NW-SE —05:31 2966ft; SWN4SM; ATP; Propeller

<table>
<tr><th>Monday 31 October 2005</th><th>116 complaints; 53 arrivals</th></tr>
<tr><td></td><td>
</td></tr>
<tr><td>
</td><td>-</td></tr>
</table>

<table>
<tr><th>Tuesday 1 November 2005</th><th>119 complaints; 35 arrivals</th></tr>
<tr><td></td><td>
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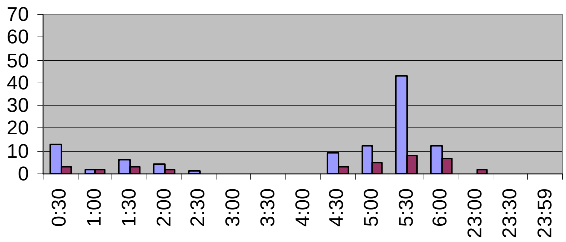
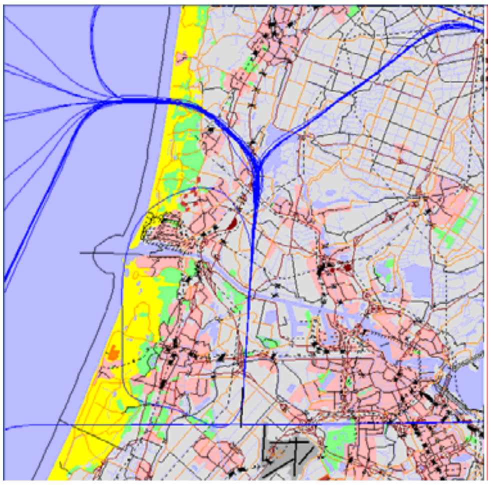
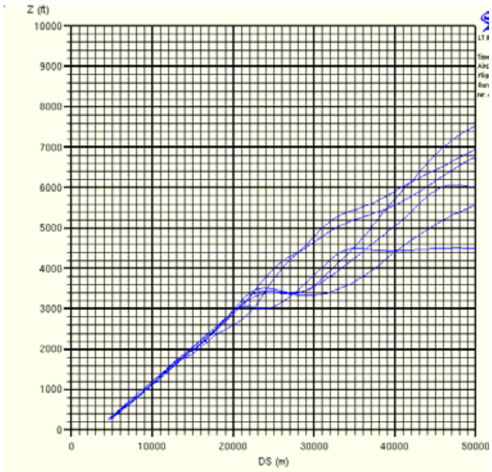
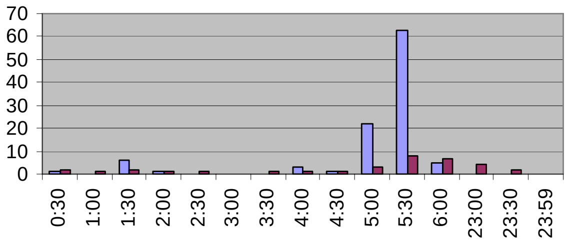
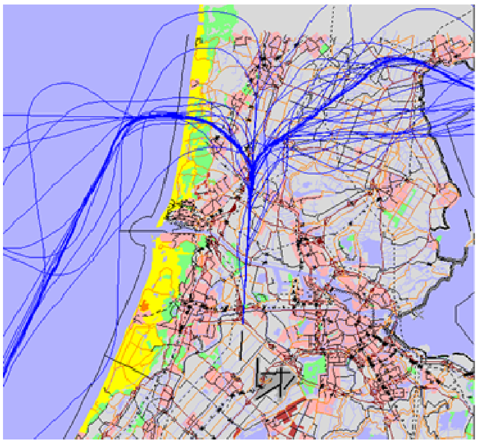
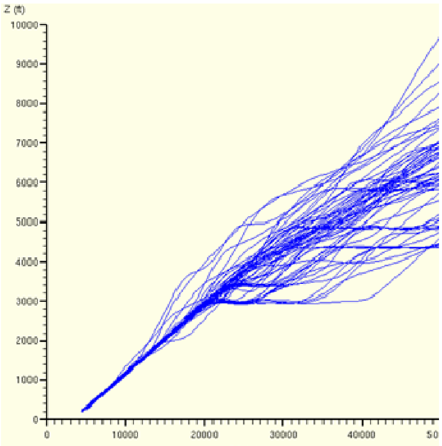
<tr><td>
</td><td>Deviations from track over Castricum from NW-SE
—05:31; 3031ft; ATP, Propeller (north of track)</td></tr>
</table>

Sunday 13 November 2005	121 complaints; 28 arrivals
	
	Deviations from track over Castricum from NW-SE –05:09; 3449ft; KLM428 MD11; inaccurate ILS capture –05:24; 3027 ft; KLM566; B772; landing after go-around

The following sheet presents the complaint analysis for a night with high traffic load and low number of complaints (area B in figure 14).

<table>
<tr><th>31 July 2005</th><th>32 complaints; 62 arrivals</th></tr>
<tr><td></td><td>
</td></tr>
<tr><td>Niet beschikbaar</td><td>Deviations from track over Castricum from NW-SE
–02:15 ; TRA268; B738; reason unknown
–03:18; TRA384; B738; reason unknown
–05:12; KLM408; B739; reason unknown</td></tr>
</table>

Annex C: Low visibility conditions

These days with low visibility in the night time period occurred in 2005:

Days with low visibility 2005 (RVR < 550m)	***Number of complaints***	***Landing RWY in use***
8-9 July	0-0	08-07: RWY 06 09-07: RWY 06
27-28 July	20-7	RWY 06 RWY 18R from 27-7 2300 till 28-07 0030 RWY 06
16-17 August	0-0	RWY 06
21-22 August	0-0	RWY 06
22-23 August	0-0	RWY 06
5-6 September	45-16	RWY 06 RWY 18R from 05-09 0400 till 06-09 0010 RWY 06 RWY 18R from 6-09 2300
5-6 October	0-0	RWY 06
6-7 October	0-4	RWY 06
7-8 October	4-55	RWY 06 RWY 18R 08-10 from 0330
8-9 December	24-19	RWY 18R RWY06 from 08-12 2300 till 09-12 0200 RWY18R from 09-12 0200-0300 RWY 06 from 0912 0200-0600 RWY 18R from 09-12 2300
9-10 December	19-56	RWY 18R

From the data above a few obvious remarks can be made:

1. During low visibility conditions, runway 06 is used for landing most of the time and does result in 4 complaints.

2. As transitions are not mandatory during low visibility conditions, the flight tracks of approaching flights are scattered over a much wider area and results in much more complaints. This is clearly illustrated by figure C.1 below. There is however no operational restriction, which limits the capability to fly transitions under these conditions and improvement under these conditions is therefore possible.

8 October 2005	8-10 december 2005

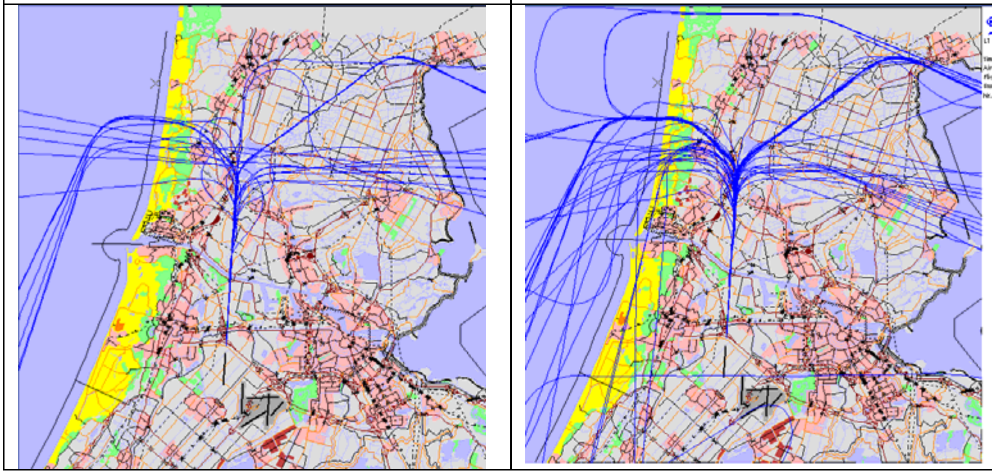


Figure C.1 Tracks of two nights with low visibility

Annex D: Alternative solution sheets

This annex presents a brief overview of the description of alternatives in tabular format.

Lateral options

Not considered in this version of the document.

Vertical options

Identifier & Name	Prescribe the entire continuous descent profile (e.g. from 7000ft)
Intended target	Eliminate horizontal segments in the vertical approach profile
Description	A prescribed descent profile (ILS GP, FPA, etc.) avoids horizontal segments by allowing engine power and drag producing changes. Both options increase noise levels on the ground
Advantage / Disadvantage	• A fixed prescribed profile is not optimal for all aircraft types, which does require most aircraft to adjust power/drag to fly the descent profile with the desired airspeed; therefore the noise on the ground can either decrease, but also increase compared to the present situation • Such a change would require publication in the AIP or agreements with Dutch airlines (for a limited trial, not involving foreign airlines)
Parties involved	Airlines, LVNL, government

Identifier & Name	Increase CDA start altitude at NIRSI
Intended target	Reduce the chance of level segments in the vertical approach profile
Description	An increased start altitude at NIRSI requires a steeper descent angle to the runway. The current altitude leads to a shallow initial angle, which often requires horizontal segments to maintain a sufficiently high altitude.
Advantage / Disadvantage	• Higher start altitude will reduce the chance of level segments during the transition; therefore noise on the ground will be reduced compared to the present situation • Strong westerly winds might necessitate use of additional drag to increase the descent rate for a correct flight path angle with the resulting higher ground speed.
Parties involved	Airlines, LVNL, government

Identifier & Name	Increase the Transition Level (TL)
Intended target	Avoiding horizontal segments in the vertical approach profile
Description	Simulator trials have shown that the CDA procedure will be flown better, when they are performed using one altimeter setting. ATC will report a higher TL (e.g. on ATIS and/or by the controller) without changing the TA.
Advantage / Disadvantage	• The aircraft (or better FMS) is in the best position to determine the most optimum low power/low drag profile for a CDA without horizontal segments. As a consequence, noise is minimised below and along the flight path. • This option has a lot of far reaching consequences on all flight operations below the TL if the TA is to be changed as well.
Parties involved	Airlines, aircraft manufacturers, LVNL, government

Non-transition procedures

Identifier & Name	Discourage non-RNAV traffic
Intended target	Reduce the current 5.3% of all traffic, which is currently unable to fly a transition
Description	The department of V&W (Transport and Water Management) does not grant permission to airlines for night operations without P-RNAV equipped aircraft at Schiphol airport
Advantage / Disadvantage	All traffic with a P-RNAV waiver can not be refused access by LVNL and has to be accommodated on the transition route with radar vectors
Parties involved	Government

Identifier & Name	Fly transitions during low visibility operations (RVR<550m)
Intended target	Reduce the current 5.3% of all traffic, which is currently unable to fly a transition
Description	No flight/ATC operational restrictions (check all airlines: now valid for KLM only) exist, which would limit transition use to good visibility conditions only. The remaining condition is, that the aircraft is stabilised at/above 1000ft on the final approach.
Advantage / Disadvantage	• A higher amount of traffic would be able to fly a transition, including the aircraft arriving during low visibility conditions • Low visibility conditions usually coincide with calm weather and corresponding use of runway 06 (Kaagbaan) for landing, according to the runway preference table. This limits the noise benefit for the area around runway 18R (area north of Schiphol)
Parties involved	Airlines, LVNL, government

Identifier & Name	Announce planned maintenance to AAA and other irregularities (e.g. ILS u/s) on CROSNET
Intended target	Create awareness in the surrounding communities, that transitions can not be flown in combination with higher expected noise levels
Description	Information on planned maintenance will increase the predictability of nuisance
Advantage / Disadvantage	Nuisance could be reduced if it is known when flight operations deviate from normal procedures
Parties involved	LVNL, CROS

Identifier & Name	Vectoring along transition profile
Intended target	Limit deviations from standard transition procedures as much as possible, when transitions are not mandatory.
Description	Non transition traffic (see section 2.1) is vectored by the air traffic controller along the lateral and vertical transition profile with distance-altitude instructions, based on the distance-to-go to the threshold of the runway and the required angle of the flight path. The number of these flights could later be published on the CROSNET, so that surrounding communities are aware of this type of operation.
Advantage / Disadvantage	Nuisance could be reduced if deviations relative to standard flight procedures are kept within limits.
Parties involved	Airlines, LVNL, CROS