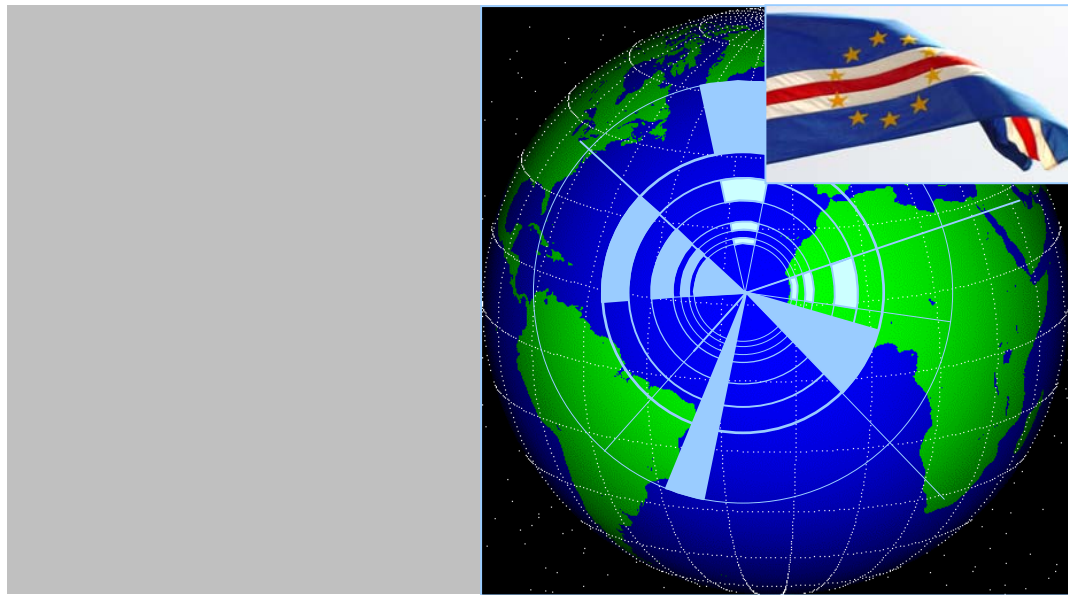




SAFETY, OPERATIONS AND INFRASTRUCTURE

AIRPORT CONSULTANCY SERVICES

FINAL REPORT FOR PROVISION OF CONSULTANCY SERVICES



ENVIRONMENTAL IMPACT ASSESSMENT FOR RABIL AIRPORT BOA VISTA – CAPE VERDE

19 NOVEMBER 2004



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ENVIRONMENTAL IMPACT ANALYSES FOR
RABIL AIRPORT, BOA VISTA – CAPE VERDE

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EXECUTIVE SUMMARY

ASA (Empresa Nacional de Aeroportos e Segurança Aérea) of Cape Verde and the Ministry of Transport are preparing plans for expanding aviation services, diversification of international ports of entry and development of the archipelago for tourism. The mandate of this study is to perform an environmental impact analysis for the expansion of the Rabil Airport on Boa Vista.

Rabil Airport (GVBA) is located near the village of Rabil on the west coast of Boa Vista Island. The study covers the effects of phase 1-3 of the Master Plan development.

The EIA comes to the following conclusions:

- The calculated aircraft emissions for NO_x show that the impact on air quality is negligible.
- The calculations of noise level indicate that the operation of the expanded Rabil Airport will lead to an increase of noise level.
- No densely populated areas are affected by aircraft noise.
- Upon development of a separated solid waste management system or integration into the municipal system, the wastes generated at the New Rabil Airport will not lead to relevant impacts on the environment.
- When the liquid waste management system is established the operation of the expanded airport will not lead to relevant impacts on the environment.
- The operation of the new airport will lead to an increase of energy consumption. The impact on the environment is assessed as not relevant.
- The flora and fauna in the airport zone is sparse and no rare species occurs.
- The impact of the extended Rabil Airport on landscape and biosphere is negligible.

For the entire airport, the analysis concludes that NO significant impact on the environment will result from the operation of the new facilities.

As no significant environmental impact will result, there is no need for significant mitigation measures over the implementation of a liquid waste handling system for aircraft toilet fluids. However, additional measures might be considered for further improvement, especially regarding architectural measures to reduce the need for air conditioning.



1. INTRODUCTION

1.1 STUDY INTRODUCTION

ASA (Empresa Nacional de Aeroportos e Segurança Aérea) of Cape Verde and the Ministry of Transport are preparing plans for expanding aviation services, diversification of international ports of entry and development of the archipelago for tourism. ASA is the state-owned company responsible for the operation and development of the airports of Cape Verde. The company operates under the Ministry of Infrastructure and Transport. To provide the necessary infra-structural prerequisites for the expected (forecasted) air traffic, they have invited IATA's Airport Consultancy Services to assist in the appraisal of a runway extension project and associated ground facility development in Rabil Airport in Boa Vista.

This document provides the environmental impact assessment for the runway extension, the planned realignment of the existing Rabil road as well as for the new passenger and airfield infrastructure facilities.

1.1.1 MANDATE

The mandate of this study is to perform an environmental impact analysis for the future development of the existing Rabil Airport. The mandate encompasses the Phases 1 to 3 described in the Master Plan and Passenger Terminal Development Study (IATA/ACS). Phases 1 to 3 include the following projects:

- Extension, widening and strengthening of the existing runway
- Realignment of the existing Rabil road
- Additional Aircraft Parking Positions
- Provision of new passenger and airfield infrastructure facilities

The methodology of an environmental impact assessment provides a generalised overview. This document provides an overview on the actual situation, trends and environmental sensitivity/vulnerability. No legal compliance assessment was performed.

The aim of our analyses is to identify and to describe the possible impacts due to project realisation and operation on the different environmental compartments at the specific site.



1.2 SOURCES AND BASES

- IATA/ACS: Cape Verde Airports Traffic Forecast – Rabil Airport, Boa Vista. December 2003.
- IATA/ACS: Boa Vista Airport Cape Verde – Integration of the Airport Enhancement Project into the Island Wide Development Strategy. November 2003.
- IATA/ACS: Boa Vista Airport Cape Verde – Master Plan and Passenger Terminal Development Study. September 2003.
- ASA/ACS: Dados Meteorológicos Rabil, Estatística de tráfego 2002, Estatística de tráfego 2003. August 2004.
- Dr. Luis F. López Jurado, Applied Environmental Consultant's Office, Las Palmas, Canary Islands: Cape Verde Airports Master Plan Studies and Environmental Master Plans. September 2004.
- ICAO Engine Exhaust Emissions Data Bank.
- IATA/ACS: Plans and Maps. August 2004.
- INM Integrated Noise Model 6.0.
- European Union, Fundación Universitaria de Las Palmas, Canary Islands: Cabo Verde Natura 2000.



2. LOCATION AND AIRPORT DESCRIPTION

2.1 LOCATION

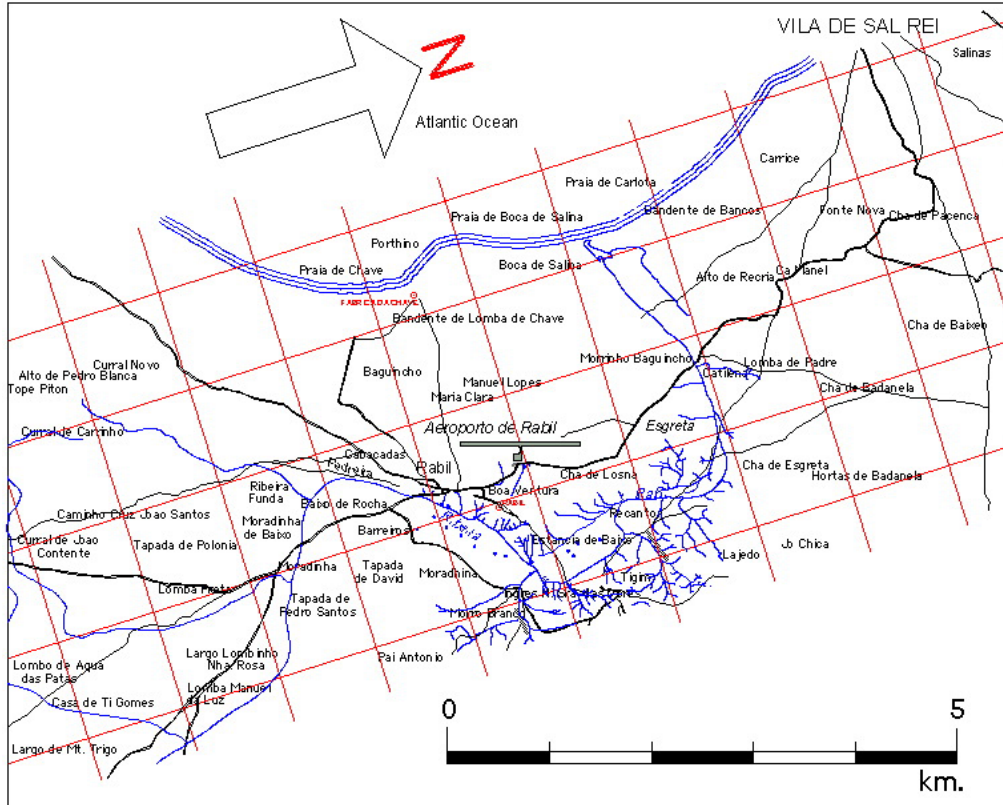
Boa Vista islands belongs to the group of the "Barlavento" (windward) islands of the archipelago of Cape Verde. Having an area of 620 square km Boa Vista is the third largest in the Cape Verde islands located most eastern of the archipelago. Boa Vista's population however is not in keeping with its size. With 4,193 inhabitants in the year 2000, Boa Vista has the smallest population of all the islands with seven persons per square km. The principal town is Sal-Rei. The village of Rabil, lying adjacent the airport, is the second settlement of the island. Furthermore, in the immediate coastline to the west of the airport boundary, tourism orientated development has already taken place.

Economically, Boa Vista had a history of salt extraction industry until salt production ceased in 1979. Apart, there is subsistence fishing and farming. However, Boa Vista is dependent on the other islands with most of the goods being imported. It should be noted that Boa Vista receives one of the highest rates of foreign investment per head in the country. Tourism became important on the commercial agenda in Cape Verde since the early 1990s.

2.2 RABIL AIRPORT

The Rabil Airport (GVBA) is located near the village of Rabil on the west coast of Boa Vista island (see figure 2.1).

Figure 2.1:
Location of Rabil Airport and its surroundings



FACILITIES

Rabil airport is a small airport with facilities being relatively rudimentary. The facilities comprise of a small, single storey passenger terminal, separate VIP building, Fire Station and generator housing (see figure 2.2). Access to the airport is via the main Rabil coast road. Parking provision at the site is limited.

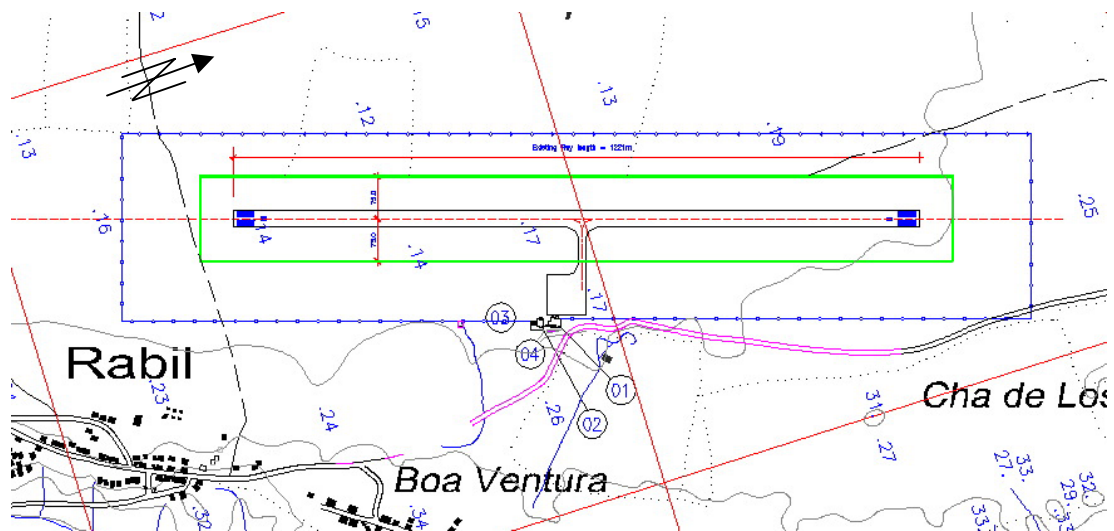
Figure 2.2:
Existing passenger terminal and VIP building; Rabil road



AIRFIELD

The airport elevation is about 21 m. The single runway directions are 03/21 (16° 07' 52.48" // 022° 53' 25.91"). The relatively small runway has a dimension of 1221*30 m. The single apron is accessed by a single taxiway. For an overview on the existing Rabil airport see figure 2.3.

Figure 2.3:
Existing Rabil Airport



- 1: Existing Passenger terminal, 2: Existing VIP facility, 3: Rescue and Fire Fighting,
- 4: Principal Landside Access

Due to the predominant meteorological conditions, the preferential operating direction is on heading 03, with the take off path to the north and approach from the southerly

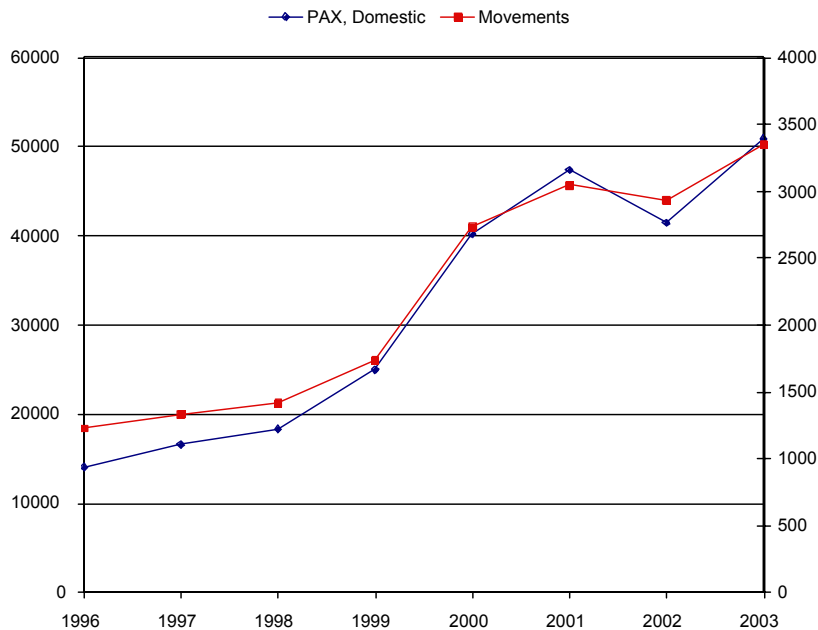


direction. The steady wind direction is mainly from the north/northeast to east. Strong easterly sand storm situation can occur. An obstacle in approach to the south east of the existing airfield restricts operations to daylight hours only under VFR conditions.

PASSENGERS AND MOVEMENTS

The airfield is serviced only by ICAO 'Code (B)' traffic, which means it can only be used by aircraft types similar to those currently used by TACV (Cape Verde Airlines) and Cape Verde Express. Therefore, Rabil airport handles only domestic flights. Compared with the eight operational commercial airports of Cape Verde, Rabil airport handles about 5% of the domestic passengers of the whole archipelago. For Boa Vista, TACV are the only carrier to operate a scheduled service to the island. There is a daily connection from and to Sal as well as twice a week from and to Praia. The following figure 2.4 shows the development the passenger numbers and movements in the last eight years.

Figure 2.4:
Growth in Passengers and movements at GVBA





3. PROJECT DESCRIPTION

3.1 MASTER PLAN OBJECTIVES

Boa Vista's beaches are probably the best to be found in Cape Verde. This has been recognised as having a major potential in an expanding tourism industry in the archipelago. Tourism development on Boa Vista has been hampered by limited air transportation. Accordingly, plans have been made to extend the runway at Rabil airport and improve the ground facilities, to enable aircraft to fly to and from Europe to Boa Vista.

The development for Rabil airport has been divided in four discrete phases (see report "Master Plan and Passenger Terminal Development Study").

Our mandate encompasses the Phases 1-3. Phase 4, which in effect illustrates a site saturation scenario for the airport with either a rotation of the runway or the introduction of a new runway to the immediate west of the existing runway is not part of this environmental impact analyses.

The **Phase 1** encompasses the following development works:

- Strengthening of existing runway pavement
- Extension of the existing runway
- Widening of the existing runway
- Provision of shoulders and turning pads to the existing runway
- Provision of graded RESA at both thresholds
- Provision of new apron with dedicated taxiway
- Provision of new passenger and airfield infrastructure facilities (new western apron, new terminal building)
- Adaptation of the existing terminal to RFF / ATC Facilities
- Realignment of the existing Rabil road

The **Phase 2** development works at Boa Vista Airport are focused on the following provisions:

- Additional Aircraft Parking Positions
- Runway/taxiway lights
- Enhanced nav aids provisions
- Enhanced Air Traffic Control provisions

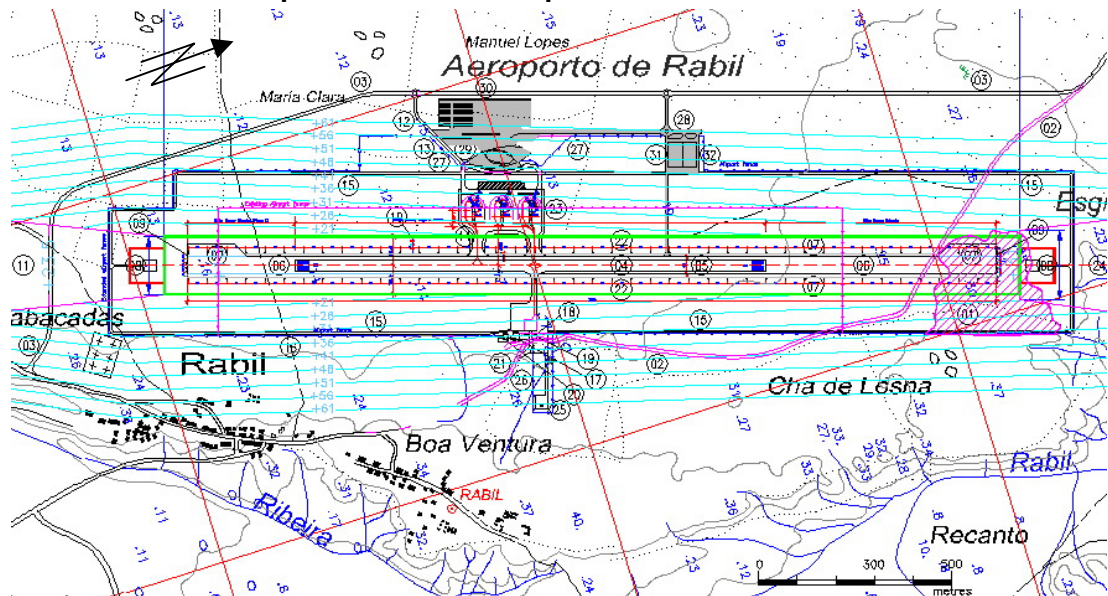
The **Phase 3** development scenario is predicated on:

- On site fuel storage and distribution facility
- Airfield maintenance provisions
- Enhanced air terminal and landside parking facilities

3.2 PLANNED PROJECTS

The following figure 3.1 gives an overview on the Master Plan development for Rabil airport Phases 1 to 3.

Figure 3.1:
Master Plan Development for Rabil Airport Phase 3





- 1: Topographical modifications,
- 2: Existing Rabil Road,
- 3: New rabil Road,
- 12: Access Road (Phase 3),
- 17: Old Passenger Terminal,
- 29: New Passenger Terminal Facilities,
- 31: New Fuel Farm,
- 32: New Airfield Maintenance Facilities

RUNWAY EXTENSION AND WIDENING

The existing runway is extended by 279 m on heading 21 and 600 m on heading 03 in order to provide a total length of 2,100 m. The runway pavement is strengthened and widened to 45 m together with 7.5 m wide consolidated shoulders. Self-maneuvring turning pads are located at both thresholds. The new apron, located to the west of the runway is designed to accommodate three aircraft on adjacent self-maneuvring stands. The Runway extension on heading 03 will require localised topographical remedial works in order to provide a longitudinal runway slope within the recommended permissible limits.

REALIGNMENT OF RABIL ROAD

Additionally the runway extension requires a realignment of the existing principal Rabil road. The new road alignment is shown to the west of the airport in order to service the future passenger terminal and airfield maintenance complex.

NEW PASSENGER AND AIRFIELD INFRASTRUCTURE FACILITIES

In Phase 1 a new passenger terminal serving both International and Domestic traffic is built adjacent to the new western apron. The new terminal building is serviced by a new access road system, connecting the landside area and the new terminal car parks to the Rabil road.

The existing terminal facility will be adapted for RFF facilities, with covered vehicle parking and fire fighting media storage (foam/water).

Phase 3 also anticipates the introduction of an on site fuel storage and distribution facility and enhanced airfield maintenance provisions. Both these elements are located to the north of the new terminal area.



3.3 TRAFFIC FORECAST: PASSENGERS AND MOVEMENTS

IATA has prepared a traffic forecast for Boa Vista, analysing the likely demand and drawing up the principal perspectives in different scenarios. The environmental impact assessment is based on the Case B, Scenario 3 (High). Case B includes the runway extension to 2,100 m as well as the associated terminal development. Scenario 3 is the highest and most optimistic scenario, which foresees the demand of 30,000 beds developed over the next 15 years. The number of tourist beds already available on the island is currently 700. The traffic forecast goes through to 2023. No assessment is provided in this report concerning the probability of this scenario or for the sustainability aspects of such a development.

Table 3.1 shows passenger numbers (PAX) and movements in the year 2023 for case B and scenario "Medium" (20,000 beds) and "High" (30,000 beds).

Table 3.1:
Traffic forecast: PAX and movements in 2023

| 2023, case B | Medium | | High | |
|---------------|---------------|-------------|---------------|-------------|
| | PAX | movements | PAX | movements |
| Domestic | 157390 | 4536 | 157390 | 4536 |
| International | 453784 | 3328 | 727047 | 5332 |
| Total | 611174 | 7864 | 884437 | 9868 |

3.4 SYSTEM BOUNDARIES

The following phases will be differentiated on:

ACTUAL SITUATION

The actual situation describes the existing environmental situation (baseline) at the specific site as well as in the area potentially affected by the project. Having environmental baseline data is necessary to assess the impacts due to project location.

CONSTRUCTION PHASE

The construction phase describes the situation during construction. Impacts during the construction phase are generally transitory, but may also be consequential.



OPERATIONAL PHASE

The operational phase describes the situation with the planned projects constructed and operating with full capacity. In general, the year 2023 and the case B, scenario 3 "High" out of the traffic forecast from IATA were chosen in order to evaluate the impact of the project on the environment. Environmental impacts from project operation are described.



4. ENVIRONMENTAL ASPECTS

GAPS IN KNOWLEDGE

The environmental impact assessment was performed on the knowledge base mentioned in chapter 2.2. However, there is some information missing in order to assess the project in a more comprehensive manner. In order to perform the environmental impact assessment assumptions were made where necessary.

4.1 INDUCED TRAFFIC ON GROUND

ACTUAL SITUATION

At present, ground traffic around the airport is very low. Almost all traffic of the island is concentrated on this single road connecting the capital Sal-Rei and its harbour. Furthermore, the road, besides the airport, serves all interior villages of the island. It is difficult to estimate the percentage of cars, small buses and trucks circulating on Rabil road. The only public transportation are taxis and small buses, which do not run on a regular schedule, but only when they have collected enough clients. In hours of departures and arrivals, there are about 25 cars around the terminal.

CONSTRUCTION PHASE

There will be a temporarily increase in road traffic during construction phase. However, it is not supposed that blocking of traffic on the access road will occur. The access to the facilities will not be impeded. Furthermore, as the effect is only temporarily, it can be assessed as being minor.

OPERATIONAL PHASE

The increase in road traffic will be mainly from passengers travelling from and to the enhanced airport and from employees. In the Traffic forecast for the airport by IATA, the number of passengers in the case B, scenario 3 is supposed to be 123,912 in 2006 (the first year with international operations) and 884,437 in 2023. This corresponds to approximately 2,400 passengers per day in 2023. Compared to the number of passenger in 2003 of 50,000 this corresponds to an almost 18 fold increase.

Furthermore, the new passenger terminal with its retail shops, commercial, business and airport service will attract people. However, the impact on induced traffic is regarded as negligible in relation to the airport dedicated traffic stream.



The new Rabil road is planned to be completed within Phase 1 of the development. The resulting system appears to have enough capacity to handle the further increase. Nevertheless, options of public transport should be investigated in order to stabilise private traffic on the lowest level possible.

CONCLUSIONS

Induced road traffic on Rabil road due to the airport of Rabil handling both domestic as well as international flights will lead to an increase in traffic. Furthermore, there will be little induced traffic by people attracted by the new facilities at the passenger terminal. However, as traffic is very low at present even under the assumptions of case B, scenario 3 the additional traffic is not expected to lead to any relevant impact on the environment. The overall impact is assessed as being minor.

4.2 IMPACT ON AIR QUALITY

ACTUAL SITUATION

Quantitative data on air quality on Boa Vista were not available. However, due to the very low level of traffic activities and industries in the region, values for air quality (NO_x, VOC and particles) are not expected to be elevated. The Bom Fim 2000 industry produces dust from the grounding of stones. However, its influence does not affect more than its own facilities. Furthermore, due to usually strong winds from NE to SW threshold values for air quality are not expected to be surpassed.

In 2003, 3,346 movements were carried out with the ATR42, the Twin Otter and the LET410. As a rough estimation 200 g of each NO_x and VOC are emitted during an LTO-cycle. This amounts in 670 kg for NO_x as well as for VOC in the year 2003.

CONSTRUCTION PHASE

Construction phase will have a temporary an impact on air quality. Particularly, during the realignment of Rabil road, the extension of the runway and the construction of the new facilities dust and particles will be emitted. However, due to strong winds and the temporarily character of the emissions they can be assessed as being of minor importance.



OPERATIONAL PHASE

The extended airport operations (case B, scenario 3) results in an increase in passenger numbers as well as movements. As movements are expected to grow from 3,346 in 2003 up to 9,868 in 2023 emissions will also increase. Based on engine emissions data from ICAO's Emissions Data Bank, total emissions within the LTO-cycle were performed for NO_x (nitrous oxide), HC (hydrocarbons) and CO (carbon monoxide) (data see Appendix 1). Emissions of particulate matter were not calculated.

The estimations yielded values of 60 t for NO_x, 17 t HC, and 50 t CO for international flights. The estimations for the domestic flights yielded in values of 907 kg NO_x and 907 kg VOC. Compared with other airports the HC-values are rather high, whereas the NO_x-values are elevated. The numbers reflect the age of the fleet operating at Rabil airport. The emission values will certainly change until 2023, as the operating fleet will be at least partly replaced by newer aircraft.

The development plans envision the introduction of GPUs for power supply to parking aircraft. With this, the use of APUs can be minimised, which will result in lower fuel consumption and lower emission of air pollutants during this phase.

Compared to the actual value, this represents a strong increase in emissions. The nearly 100-fold increase in NO_x-emissions compared to the actual values results from the introduction of jet aircraft into Boa Vista. However, the prevailing weather conditions will lead to rapid dilution of the air pollutants, thus resulting in low emission values at and around the site.

The new ground facilities are only service buildings. Activities that could lead to an impact on air quality are not performed. A slight increase of ground traffic will occur. Nevertheless, the impact on air quality can be neglected. Impact on air quality from induced traffic is not relevant.

CONCLUSIONS

Operation of the extended airport of Rabil leads to an increase in emissions of air pollutants. However, even under the assumption of case B, scenario 3 traffic will remain at a low level. The calculated aircraft emissions for NO_x, HC and CO are assessed to have no significant impact on air quality on the island. During the construction phase there will be a temporarily effect on air quality, mainly due to dust exposure. However, the prevailing strong winds on the island lead to a quick dispersion of all emissions.



The overall impact on air quality is assessed as being minor.

4.3 NOISE EXPOSURE

ACTUAL SITUATION

Quantitative data on noise level on Cape Verde are not available. However, due to very little activities on Boa Vista leading to noise emissions, threshold values for noise are not supposed to be surpassed. Nowadays all the movements are performed by turboprop aircraft (ATR42, Twin Otter and LET 410).

CONSTRUCTION PHASE

During construction phase there will be an impact on noise level. The village of Rabil lies about 400 m away from the runway. To the west, the limit for construction of infrastructures for tourism lies about 1 km away from the runway. At both sites, an impact on noise level during construction phase will be remarkable. However, it is not supposed that threshold values will be surpassed.

OPERATIONAL PHASE

The aircraft noise program INM 6.0, developed by FAA Office of Energy and Environment and EPA, was used in order to calculate the noise resulting from the operation of the new airport. Calculation in INM is based in a model with aircraft type-specific characteristics. The take off weight of the specific aircraft is one of the important input factors in order to assess the impact on noise level.

Even with the extended runway length of 2,100 m the runway remains short. For the operation of the A321, the B757 and the B767, a re-fuelling stop at Sal at the way back to Europe is necessary. Taken the short length of the runway into account, take off will be performed with almost maximum thrust. Therefore, INM was run for a case "80% of MTOW" as well as for a case "MTOW". Furthermore, calculations were carried out under standard approach and take-off regime on standardised straight flight paths.

The results are plotted as iso-lines (lines of equivalent noise load) (see appendix 2). For the calculation of noise at Rabil airport no digital elevator model of the region was available. The day-evening-night-levels L_{den} were calculated in accordance with European Union guideline NR. 6660/01. All operations are supposed to be performed at daytime (07 am to 19 pm).

As we consider noise as the most sensitive environmental factor the projections from the case B, scenario 3 for 2023 was taken as the basis for simulation. This approach results in a worst-case scenario concerning noise exposure. The following table shows the assumptions made for movement statistics (see Table 4.1).

Table 4.1:
Movement statistics

| Aircraft Types | Substitution | Engine | Take-off day (07-19) | Approach day (07-19) | Movements |
|----------------|--------------|-------------|----------------------|----------------------|-----------|
| Boeing 757-200 | | RB211-535E4 | 889 | 889 | 1,778 |
| Boeing 767-300 | | PW 4060 | 889 | 889 | 1,778 |
| A321 | A320-211 | CFM56-51-1 | 889 | 889 | 1,778 |
| ATR42 | DHC8-100 | PW 121 | 756 | 756 | 1,512 |
| Twin Otter | DHC6 | PT6A-27 | 1,512 | 1,512 | 3,024 |

When performing the calculations with INM under the assumption of 80% MTOW the area surpassing 55 dB is 1.84 km². Running the calculations with only the MTOW changed to 100% the area surpassing 55 dB is 2.16 km². This corresponds to an increase of 17% on the area affected on noise nuisance of 55 dB.

The new facilities are service buildings. No activities leading to noise emissions will be performed.

CONCLUSIONS

The increase of passenger numbers and movements resulting from airport development as well as of the operation of the new facilities will lead to an increase of noise level. Even under the assumptions of the case B, scenario 3 traffic forecast, no inhabited area will be affected with noise levels surpassing 65 dB. The area surpassing 65 dB lies mostly within the airport boundary. However, in the second settlement of Boa Vista, Rabil, the rise of noise will be perceptible. This zone lies in the area of 55 to 60 dB. As mitigation measure, it is important to guarantee construction lines not coming closer to the airport.

Threshold values are not expected to be surpassed at any time. Therefore, it can be assessed that the operation of the enhanced airport will not have a relevant impact on noise level.



4.4 WATER

ACTUAL SITUATION

The climate of Cape Verde is tropical and dry. The mean temperature on Boa Vista in 2002 was 24.5° C. Precipitation is meagre and very erratic. At Boa Vista, mean annual precipitation is about 250 mm. The rainy season is during August, September and October. From year to year and island to island, the rainfall is quite unpredictable. The region of the airport lies in a semi-arid zone. Most of the area of the airport is unsealed and infiltration is possible. No data were available on the groundwater-level at the airport.

CONSTRUCTION PHASE

As precipitation on Boa Vista is very meagre, no special measures have to be established.

OPERATIONAL PHASE

Within the zone of the airport, there is enough unsealed floor for the infiltration of the little precipitation. Earth works necessary for construction could have an impact on the natural drainage system within the airport perimeter.

CONCLUSIONS

As precipitation is very low, infiltration of the little precipitation poses no problem. The impact from earthworks and sealing on the water infiltration regime can be assessed as negligibly.

4.5 SOLID WASTE

ACTUAL SITUATION

Comprehensive quantitative data about waste volume at GBVA were not available. Based on the available information, three types of solid waste could be differentiated:

- Solid waste from aircraft
- Waste from terminals and offices



- Construction waste

The solid waste produced at the airport is included into the municipal system. However, the system for the recollection of residues does not always work satisfying.

CONSTRUCTION PHASE

For the construction of the new facilities sand and stones should be removed and relocated. If surplus material is deposited, certain precautions may be necessary. Taking into account the geographic characteristics of the island, the torrential precipitation and the proximity to the shoreline of Rabil, runoff loaded with sand may be produced. The accumulation of residues may pose problems because the torrential rain could drag it and contaminate the Sal-Rei bay. Further plans can be developed during project planning.

OPERATIONAL PHASE

The operation of the enhanced airport, inclusive the new facilities, will lead to an increase of solid waste production. As passenger numbers will increase about eighteen folds, accordingly more solid waste will be produced. We estimate that on average, about 1 kilogram solid waste is produced per passenger. Under the assumption of the case B, scenario 3, this corresponds to about 900 tons in 2023.

As there is no independent waste treatment system at the airport, waste produced at the airport and from the new facilities will have to be dealt with by the existing municipal system. A waste separation system (based on the concept of reuse and recycling of waste) could be taken into consideration for future airport use.

Normal operation of the airport will not produce any hazardous wastes. Whether maintenance work of aircraft will result in hazardous wastes or wastes with other special treatment requirements could not be established based on available data.

Catering services will be supplied by companies not situated at the airport. Therefore, there will be no further waste produced at the airport.

CONCLUSIONS

Waste generated at the new airport will not lead to relevant impacts on the environment if a waste treatment option is designed to handle the amounts of solid waste produced at the airport. Either a solid waste management system has to be established at the



airport or the solid waste generated has to be included into the municipal system. However, the municipal system for the recollection of residues should be improved.

Special attention should be given to the final disposal of excavated material. Only if a sustainable option, which does not pose a risk during torrential rains, is found the impact on the environment can be assessed as not being relevant.

4.6 LIQUID WASTE

ACTUAL SITUATION

The amount of liquid waste produced at the airport is about 30 m³ per day.

CONSTRUCTION PHASE

During construction phase, no hazardous waste will be produced.

Special care should be given to prevent accidental fuel spills during construction. Measures should be in place for immediate remedial action in case of an accident.

OPERATIONAL PHASE

Under the assumption of the case B, scenario 3 passenger numbers will increase from actually about 50,000 eighteen fold up to 884,500 in 2023. Therefore the demand for freshwater will increase and consequently the amount of liquid waste produced. In this report, the availability of sufficient freshwater for the operation of the enhanced airport with the capacity assumed in the high case scenario could not be evaluated. However, the availability of fresh water on Boa Vista is a sensitive factor. Freshwater is produced and distributed by the company "Electra" in Sal-Rei, which runs a desalination plant with an evaporation system.

The design quantities of liquid waste produced per passenger are about 25 litres per passenger and day. Under the assumption of the case B, scenario 3 scenario, this corresponds to about 22,000 m³ in 2023. Options of liquid waste management have to be studied taking into account the insular scale.

The liquid waste from aircraft toilets has to be treated separately. This requires a special facility due its chemical contents. However, the high cost of its installation and maintenance and the number of flights initially expected suggest postponing its implementation in a later construction phase. Measures need to be taken to either



ensure proper disposal of liquid waste until construction of such a facility or to ascertain that toilet waste dumping is performed at Sal.

Water from surface drainage is not considered as relevant for liquid waste management, as precipitation is low.

The water from the apron drainage will be treated to avoid contamination in case of fuel spilling.

CONCLUSIONS

Based on the data available it is not possible to provide a final assessment of the impact of liquid waste on the environment. However, if a liquid waste management system is established the operation of the enhanced airport will not lead to relevant impacts.

4.7 ENERGY

ACTUAL SITUATION

There are no data available on the actual amount of energy consumption at Rabil airport. Energy is a scarce and expensive good on Cape Verde. For electric power production, fuel is used, which is imported from abroad.

OPERATIONAL PHASE

The operation of the new airport with the capacity assumed in the traffic forecast will lead to a demand on energy rising in proportion to aircraft movements and passenger numbers. The availability of sufficient energy for the new airport could not be investigated in this report.

At present, no detailed information is available on the architectural plans of the facilities. When planning the architectural characteristics, energy saving options should be considered at any point. The operation of the extended airport as well as of the new facilities will consume energy for lighting, air conditioning, etc. Increase of energy consumption, as a scarce resource on Cap Verde should be minimised, especially by planning the buildings facade, to avoid air conditioning requirements as far as possible. Passive air conditioning systems may reduce the need for additional energy consumption. Saving resources also reduces operating costs. Furthermore, induced air pollution by power production is smaller.

CONCLUSIONS

The operation of the new airport will lead to an increase of energy consumption. The impact on the environment cannot be assessed finally with the information available.

4.8 LANDSCAPE

ACTUAL SITUATION

There are no existing human uses of the territory, which will be occupied either for the runway extension or for the new facilities. Only a few constructions of dry stones are used for chickens and a few goats. A few meters of the limits of the airport area in the east, there is the Bon Fim 2000 industry near a discotheque and a carting track. In the southeast there is the town called Rabil, with 1,200 habitants including the Boa Ventura nearby neighbourhood.

Figure 4.1:
Western and northern view



Figure 4.2:
Village of Rabil and Industry zone



The turning approach to the existing runway on heading 03 leads over the northern extremity of the area identified as the 'Reserva Natural Morro de Areia' (see map in Appendix 3). The take-off and Climb surface associated with the existing runway on heading 03 traverses the eastern sector of the 'Reserva Natural Boa Esperanca'. In the report "Cabo Verde Natura 2000" six different categories of protected environmentally sensitive areas are defined. "Nature reserve" represents the most important category.

There are no data available on actual and potential soil contamination on Boa Vista.

CONSTRUCTION PHASE

As the origin of the construction materials are not known at present, a definitive assessment of the impact on the environment is not possible. It is important to avoid landscape damage due to the non-rehabilitation of quarrying sites. Furthermore, the accumulation of construction residues in the nearby sea-bays may pose problems because the torrential rain.

OPERATIONAL PHASE

The operation of the enhanced airport will not have significant effects on the landscape. However, it has to be taken into account that the limits of the Natural Park of Boa Esperanza are close and the zone is used for dry agriculture.

The new passenger and airport facilities will occupy fallow land. However, this corresponds only to a small loss of habitat.



CONCLUSIONS

The small loss of habitat is not considered significant for landscape. However, an environmentally sound option has to be found in order to manage the removed sand and stone (see chapter 4.5). Furthermore, landscape damage due to the non-rehabilitation of quarrying sites should be avoided. It can finally be assessed the project will not have a relevant impact on landscape.

4.9 BIOSPHERE

ACTUAL SITUATION

The low altitude of the island in the area of the airport and the dry environment allows only one type of ecological ambient, semi-desertic steppe. The development of the local communities on Boa Vista has eliminated many reference points both botanic and zoological, leaving only testimonial elements. The airport and its surroundings do not receive marine influence, as it is far away from the littoral coast.

VEGETATION

In the airport area, we have one type of habitat: steppe semi-desertic over lime substratum with very little sand and without vegetation. Its productive capacity in humid periods is scarce.

The vegetation in this part of the island is almost nil with exclusive presence of annual species like *Sporoborus sp* and *Sparagus sp* which occurs after the rains and dries quickly, although *Sporobolus sp* is persistent. In the southwest, a small agglomeration of *Prosopis* and *Acacia* are found. There is a large number of ornamental species (*Acacia spp*) introduced into the garden areas of the airport, including the parking lot. There is not an endemic or endangered species or other rare plants in the airport area.

FAUNA

The area of the existing airport can be divided into two ecological zones. In the zone of the passenger terminal and the runway, ecological elements exist in a testimonial way. The second zone corresponds with an isolated area within the airport perimeter. Here the elements of bio-diversity have a certain value.

In the zone of the passenger terminal the scarce diversity of the existent resources only allows the presence of *Passer iagoensis*, endemic specie of Cabo Verde. This specie nest on human construction and in the wholes of the walls. Actually, there are a few



couples in reproduction activity in the older part of the airport. A few couples of *Passer hispaniolensis* are nesting in the buildings of the actual airport (terminal and VIP construction, introduced species in the island since the XIX century).

In the second zone, the steppe birds are principally represented by *Eremopterix nigriceps* and *Ammomames cincturus*. Both species nest in the zone although the first one is very common; the second one is more scarce in nesting activity and more common in feeding activity. *Cursorius cursor* and *Alaemon alaudipes* are observed occasionally but they do not nest here.

At present three endemic species of reptiles are observed in the zone: *Mabuya spinalis* (*Sauria, Scincidae*) and among the nocturnal species (*Sauria gekkonidae*). Furthermore, we have identified *Hemidactylus boavistensis* and *Tarentola maioensis*. All these species are distributed extensively on Cape Verde islands.

CONSTRUCTION PHASE

Whenever possible, construction activities should be avoided in the zone of the passenger and VIP buildings during reproduction activity of *Passer iagoensis*.

OPERATIONAL PHASE

There is no environmental impact that expected within the zone of the airport. Furthermore, the small habitat loss due to the construction of the new facilities is not considered important for the local bird and reptile species, as neither is rare on the island. Artificial orifices could be provided for *Passer iagoensis* as mitigation measures to the loss of habitat, in the upper part of some of the walls at the down wind side, where these birds could build their nests.

CONCLUSIONS

The small loss of habitat is not considered significant for the local biosphere. It can be assessed the project will not have a relevant impact on biosphere.



5. CONCLUSIONS

The environmental impact analysis arrives at the conclusion that NO significant impact on the environment will result from the operation of the enhanced airport as long as the described conditions and mitigation measures are incorporated. This holds especially for waste disposal, excavation waste and liquid waste treatment.

For the new facilities, the analysis come to the conclusion that NO significant additional impact on the environment will result from the construction and subsequent use of the new facility.

As no significant environmental impact will result, there is no need for additional mitigation measures. However, additional minor measures might be considered for further improvement. Construction details of the building could be selected to reduce the need of air-conditioning. Waste handling may benefit from additional management measures on the island in total.



ENVIRONMENTAL IMPACT ANALYSES FOR
RABIL AIRPORT, BOA VISTA – CAPE VERDE

APPENDICES

- APPENDIX 1: AIR EMISSION DATA
- APPENDIX 2: MAP 1 – AIRCRAFT NOISE PREDICTION 2023: OVERVIEW
MAP 2 – AIRCRAFT NOISE PREDICTION 2023: DETAIL
- APPENDIX 3: MAP OF PROTECTED ENVIRONMENTALLY SENSITIVE AREAS



A1: Air Emission Data

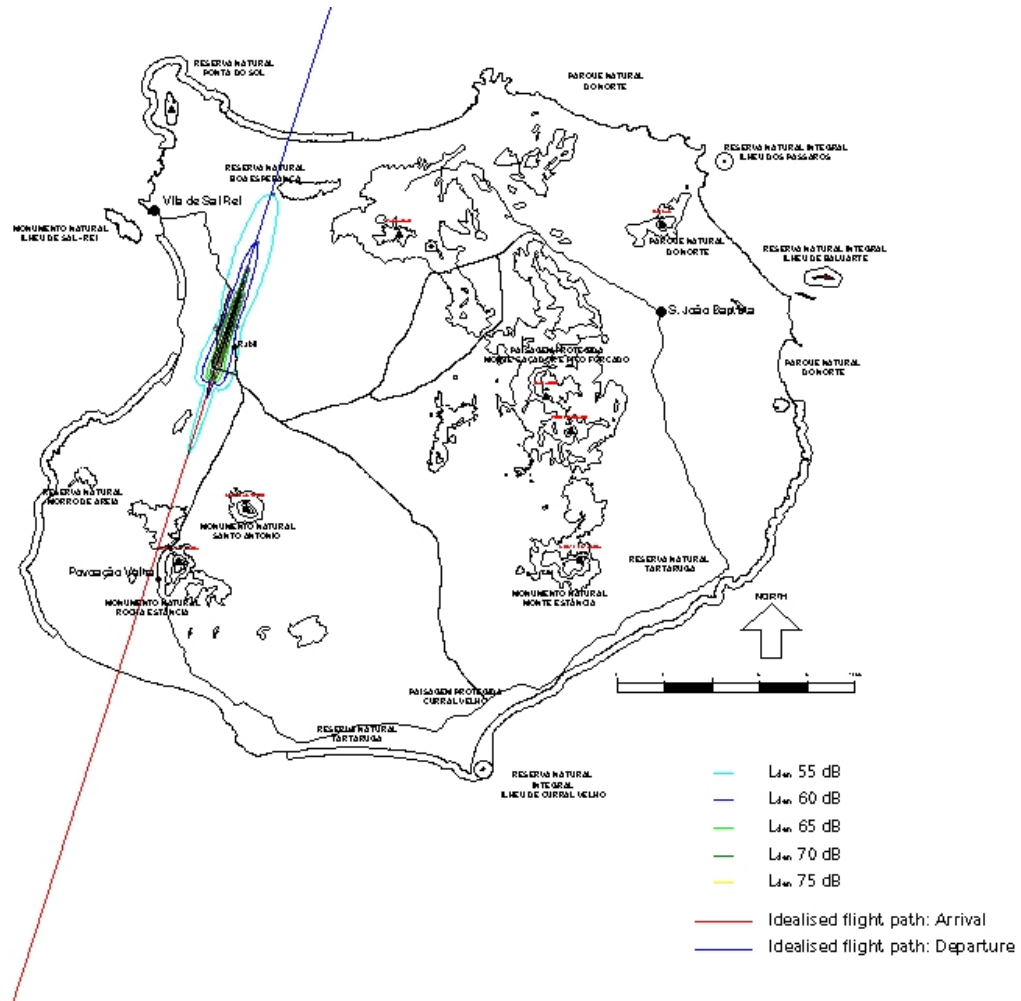
Forecast for 2023

| Aircraft Types | Engine | | LTO-cycles | | NOx | | VOC | | CO | |
|--------------------------|--------------------------------------|---|------------|------|-----------|----------|-----------|----------|-----------|----------|
| | Type | # | | % | ICAO (g)* | Kg /year | ICAO (g)* | Kg /year | ICAO (g)* | Kg /year |
| A-321 | V-25xx | 2 | 889 | 33% | 6,443 | 11,455 | 38 | 67 | 2,524 | 4,488 |
| B-757 | Rolls-Royce RB211 | 2 | 889 | 33% | 14,701 | 26,138 | 8,252 | 14,671 | 16,688 | 29,671 |
| B767 | Pratt & Whitney/ General Electric | 2 | 888 | 33% | 12,884 | 22,881 | 1,375 | 2,442 | 9,110 | 16,179 |
| Twin Otter, ATR42 LET410 | PW120/1 | 2 | 2,268 | 100% | 200 | 907 | 200 | 907 | S | S |

*Values of total mass of oxides of nitrogen, carbon monoxide and hydrocarbons emitted during the LTO cycle are average values of the corresponding engine subtypes.

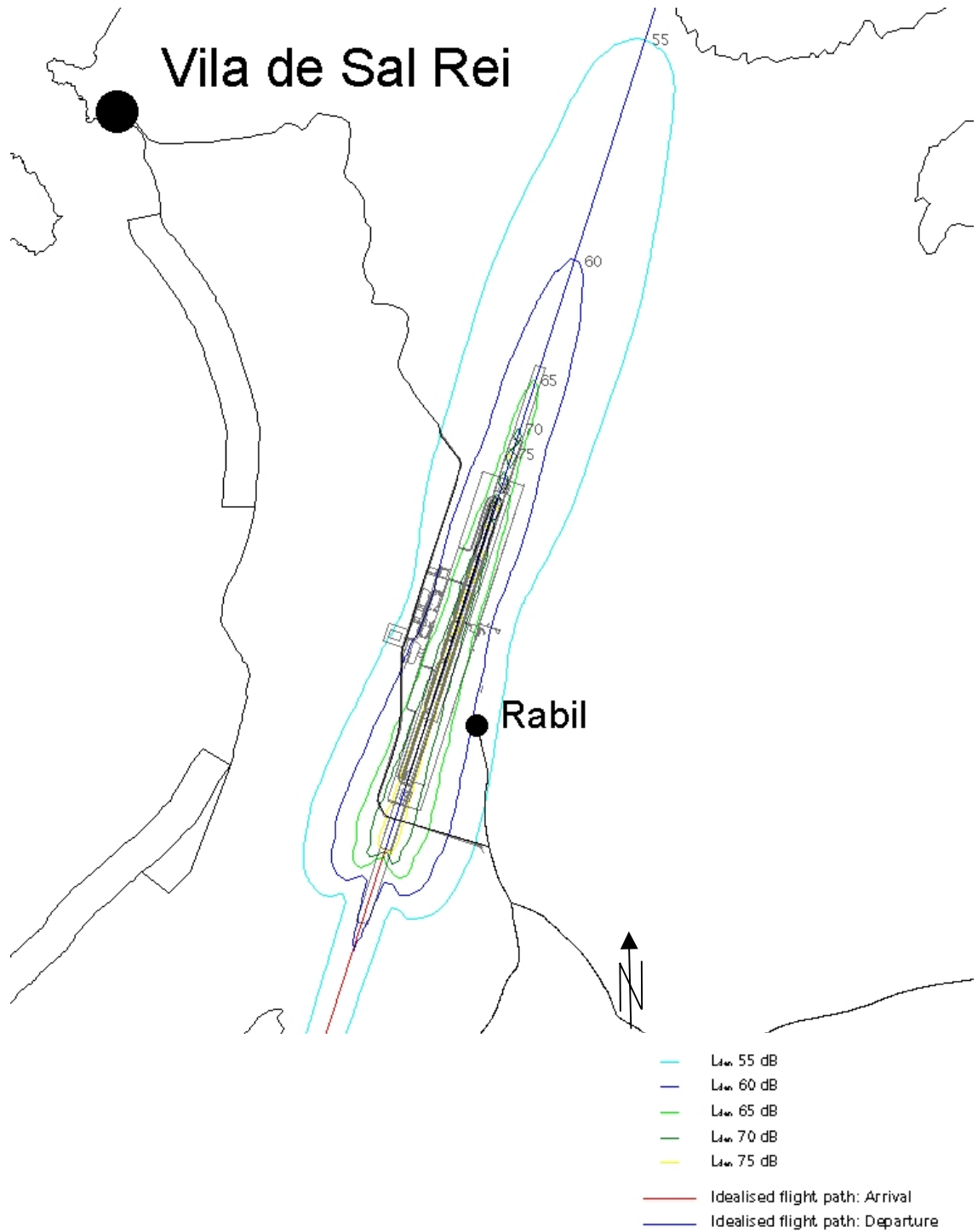


A2: Map 1 – Aircraft Noise Prediction 2023: Overview





A2: Map 2 – Aircraft Noise Prediction 2023: Detail



A3: Map of Protected environmentally Sensitive Areas

