Airport of Rodrigues Ltd

Proposed Expansion of Rodrigues Airport

APPENDICES 9.2 Specialists Reports

VOLUME 4 OF 4

Report Reference – 09053999

Prepared by

setec (Mauritius) Ltd

setec hydratec

Enviro-Consult Ltd

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Airport of Rodrigues Ltd

Proposed Expansion of Rodrigues Airport

Traffic Management & Impact Factual Report for the purpose of the Environmental and Social Impact Assessment Report

Report Reference – 09053999

Prepared by

setec (Mauritius) Ltd

LUXCONSULT

28 April 2023

Report Prepared by

NAME	ROLE	COMPANY
ENVIRONMENTAL CONSULTANT TEAM		
Frederic TRANQUILLE	Project Director	SETEC (Mauritius) Ltd
SPECIALIST TEAM		
Slim DRIDI	Traffic Expert	SETEC (Mauritius) Ltd & Specialist sub-consultant Luxconsult (Mtius) Ltd

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0 Executive Summary

0.1 Introduction

This project is about constructing the new runway of “Plaine Corail Airport” in Rodrigues Island, which is managed by Airport of Rodrigues Ltd. (ARL), a subsidiary of the Airports of Mauritius Co. Ltd. (AML).

An Environmental and Social Impact Assessment for the New runway was prepared in 2019 to meet the requirements of the Government of Mauritius and those of the “Agence Française de Développement (AFD)” and the “European Union (EU)”.

Airport of Rodrigues Ltd is seeking financing support from the World Bank for the proposed expansion of the Rodrigues Airport, and therefore it is required to update the ESIA study to meet the requirements of the World Bank Environmental and Social Framework (ESF).

As such, this Traffic Management and Impact (TMI) report aims to comprehensively assess the Airport's current traffic management practices and their impact on the surrounding environment.

The study will be based on the baseline scenario, followed by a projection of the traffic volumes during the construction phase of the new runway of Plaine Corail Airport, which will start in October/November 2023 for an estimated period of 27 months.

The Traffic survey will present the key performance indicators of traffic volume on the island for both scenarios (Baseline scenario, Scenario during constrction works and scanrio during operation phase 2026 & 2046). These indicators will allow a better understanding of traffic behavior during construction and operation phases and thus ensure efficient traffic management

0.2 Traffic Management & Impact

0.2.1 Baseline Scenario

To determine the existing traffic flow, traffic surveys were carried out for 11 hours for three consecutive days from 14 March 2023 to 16 March 2023 at a total of 05 counting stations distributed at crucial points along main access roads leading to Plaine Corail airport as follows:

Counting Station	Study carried out	Road Name	Location
M 1.1	Manual Cross Section Count	Island Road	Baie du Nord
M 1.2	Manual Cross Section Count	Route de L’Autonomie	La Fouche Corail
M 1.3	Manual Cross Section Count	Route de L’Autonomie	Plaine Corail
OD 1	OD Survey	Island Road	Baie du Nord
OD 2	OD Survey	Route de L’Autonomie	La Fouche Corail

.

From the traffic volume obtained, the morning peak hour flow (AM peak) and afternoon peak hour flow (PM peak) have been identified and used in all the analyses undertaken. The maximum traffic flow was obtained on Wednesday, 15 March 2023. The analysis of the existing performance of the roads was assessed using the directional traffic flow occurring during the peak hour.

0.2.2 Construction phase Scenario

The existing traffic flow was introduced in the VISUM simulation model with key information about the estimated needs of construction materials and sourcing of same, estimated workforce during Construction, amongst others to generate traffic flow during the construction phase and review its impact on the road network.

Following discussions with the Client, it was communicated to the Consultant that that amongst the several materials to be imported, an estimate of the main ones for the permanent works are:

- Bitumen: 10,000T
- Cement: 2,000T
- Reinforcement bars:1000T

For naturally occurring materials as well as crushed materials, it is understood that the materials will be sourced mainly from the excavation/demolition of Mt Travers and Ste Marie area. The runway levels will be designed taking into consideration the optimization of cut and fill volumes i.e balancing of earthworks. Materials to be imported will be mainly cement, bitumen and others for building works. Thus, no trips originating outside of the site will be applicable and not considered in the traffic impact modelling

The Client has furthermore estimated that a labor work force of about 450 will be required. The Project duration is 27 months and 24 months defects liability period. It is expected that about 70% of the labor will be local, Mauritius and Rodrigues and 30 % expatriates.

0.2.3 Operation phase

The Consultant performed VISUM simulations for 2026 and 2046 Horizons corresponding to the analysis period (20 years) since the commissioning date (2026).

Key Performance Indicators (KPI) of the operation phase showed a very slight impact on the project during that phase. We noted that the additional traffic generated by the project represents around 10 light vehicles/day and 2 Heavy Good Vehicle/day in 2026, which is quite low.

0.3 Conclusion

The imported volumes from the port (23,000 tonnes) result in a relatively low average heavy traffic (2 trucks/Hour/direction), which is equivalent to 20 trucks/day/directions, given the following assumptions:

- Average payload of a truck = 10 ≈ 12 tonnes

- Duration of transport for the imported materials = 20 months (out of 27 months of work) x 25 days/month = 500 days.

In terms of transportation for the workers, who will total 450 individuals, with at least 70% - 80% being Mauritians, it is proposed to implement a daily pickup system using shuttle buses as a replacement for collective transportation. This will require either 12 buses with 30 seats or 7 buses with 50 seats per day to transport the workers from a designated pickup point to the construction site. The pickup point location is yet to be defined.

The impact of the above trips on the baseline traffic is being modelled and will be finalized and the conclusions provided by the 28th April 2023

1 Introduction

The project refers to the new runway at Plaine Corail Airport in Rodrigues Island, a dependency of the Republic of Mauritius.

With a runway length of 1200 m, the largest aircraft that it can accommodate currently is the ATR 72, which carries passengers only. The number of flights at PCA amounts to three per day during the low season and can rise to a maximum of twelve flights during the peak season, which coincides with the Christmas and New Year holidays.

The Airport is managed by Airport of Rodrigues Ltd. (ARL), a subsidiary of the Airports of Mauritius Co. Ltd. (AML).

Due to its remote location, 620 kilometres from Mauritius, air transport is vital to the island in every respect and particularly important from a social and economic perspective. Rodrigues Island, through the Rodrigues Regional Assembly, wishes to increase the capacity of its Airport in order to accommodate the A321 Neo / B737 aircraft type, which carries up to a maximum of 244 passengers and is capable of transporting cargo.

The objectives of the Construction of the new longer runway as well as the associated facilities and amenities, are to:

- provide Rodrigues with an efficient, reliable, safe and affordable air transport facility to improve the national, regional and international connectivity and accessibility of the island and;
- contribute to its social and economic development in key economic sectors such as tourism, agriculture, and fishery.

The initial Environmental and Social Impact Assessment report 2019 had two objectives:

- Compliance to the procedure for obtaining the EIA Licence from the Government of Mauritius
- Evaluation of the environmental and social impacts of the project in line with the requirements of the two Funding Agencies: Agence Française de Développement (AFD) and the European Union (EU).

Airport of Rodrigues Ltd is now proposing to seek financing support from the World Bank for the proposed expansion of the Rodrigues Airport, and is therefore required to update the ESIA 2019 to meet the requirements of the World Bank Environmental and Social Framework (ESF).

The present factual study report is for the Traffic Management & Impact study based on field survey undertaken in Rodrigues in March 2023.

2 Traffic Management & Impact

2.1 Introduction

The Plaine Corail Airport on Rodrigues Island is a crucial gateway to the region, providing essential connectivity for the island's residents and visitors. The Airport has experienced significant growth in recent years, with increased air traffic and development in the surrounding areas. While this growth is undoubtedly beneficial for the island's economy, it has also led to concerns about the impact of the Airport on the environment and local communities.

As such, this Traffic Management and Impact (TMI) report aims to comprehensively assess the Airport's current traffic management practices and their impact on the surrounding environment.

The study will be based on the baseline scenario, followed by a projection of the traffic volumes during the construction phase of the new runway of Plaine Corail airport, which will start in **October/November 2023** for an estimated period of **27 months**.

The Traffic survey will present the key **performance indicators** of traffic volume on the island for both scenarios (Baseline scenario and Scenario during constrction works). These indicators will allow a better understanding of traffic behavior during the construction phase and thus ensure efficient traffic management.

2.2 Baseline Scenario

2.2.1 Private transport network

The road network of Rodrigues Island is composed of several roads classified into three categories:

***Table 1**: Road Classification in Rodrigues*

	Road Capacity (vehicles/hour)	Average speed for Light vehicles (Km/h)	Average speed for Heavy Load vehicles (Km/h)
Primary	1 500	50 - 70	< 60
Secondary	1 000	40 - 50	-
Tertiary	500	< 40	-

Figure 1: *Road Network in Rodrigues*

During the construction phase, heavy trucks transporting different materials will mainly pass through the Autonomy Road linking the Port Mathurin port and the Plaine Corail airport (construction site).

The Autonomy Road is a primary road that passes through Mont Lubin. This mountain has an altitude of **393 meters** above sea level, presenting a slope up to **14.7%** preventing the articulated trucks from using this itinerary on their way to the Airport.

Figure 2: *The Autonomy Road slope*

2.2.2 Traffic survey results

A total of 05 counting stations were carried out and distributed on crucial points of the road network of the island, distributed as follows:

- 03 cross-section counts;

- 02 origin-destination survey stations.

The traffic surveys were carried out for different categories of vehicles, over 03 days (14/03 to 16/03/2023), from 7 am to 6 pm.

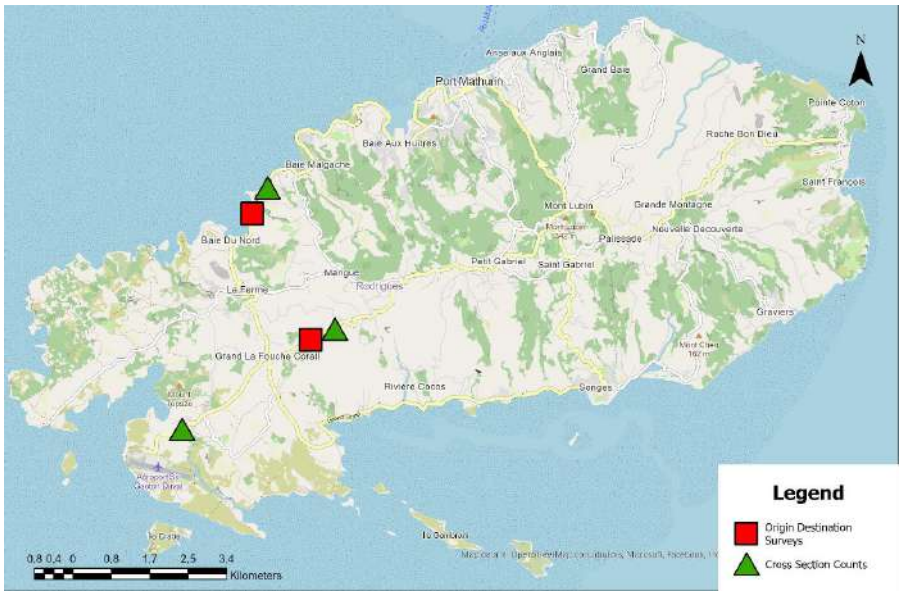


Figure 3: *Counting stations positions*

- **Cross-section counts:**

The location of cross-section counts stations is presented in figure below:

Figure 4: *cross-section counts stations*

- Station n° M 1.1 Towards La Ferme

Table 2: *Traffic counts at station: M 1.1 Towards La Ferme*

	Morning					Afternoon						Total
	7h-8h	8h-9h	9h-10h	10h-11h	11h-12h	12h-13h	13h-14h	14h-15h	15h-16h	16h-17h	17h-18h	
Two wheels	12	26	297	17	16	16	18	28	27	27	31	**238**
Light vehicle	25	22	39	18	20	24	21	26	39	49	34	**297**
Heavy Load vehicle	3	4	574	2	2	3	3	6	6	5	3	**39**
Total	**40**	**53**	Total	**37**	**38**	**42**	**42**	**59**	**71**	**81**	**68**	**574**
		AM Peak hour								PM Peak hour		

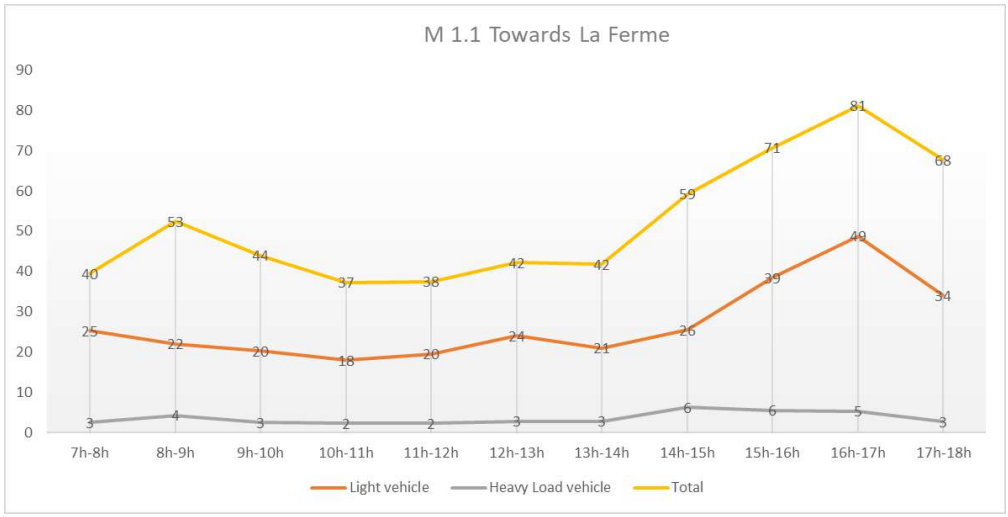


Figure 5: *M 1.1 Towards La Ferme graph*

- Station n° M 1.1 Towards Port Mathurin

Table 3: *Traffic counts at station: M 1.1 Towards Port Mathurin*

	Morning					Afternoon						Total
	7h-8h	8h-9h	9h-10h	10h-11h	11h-12h	12h-13h	13h-14h	14h-15h	15h-16h	16h-17h	17h-18h	
Two wheels	28	24	17	18	13	13	9	17	14	15	14	**181**
Light vehicle	36	36	23	14	18	13	14	15	24	22	14	**227**
Heavy Load vehicle	2	5	3	3	2	2	3	4	4	3	2	**31**
Total	**66**	**64**	**43**	**34**	**33**	**27**	**26**	**35**	**42**	**40**	**29**	**439**
	AM Peak hour								PM Peak hour			

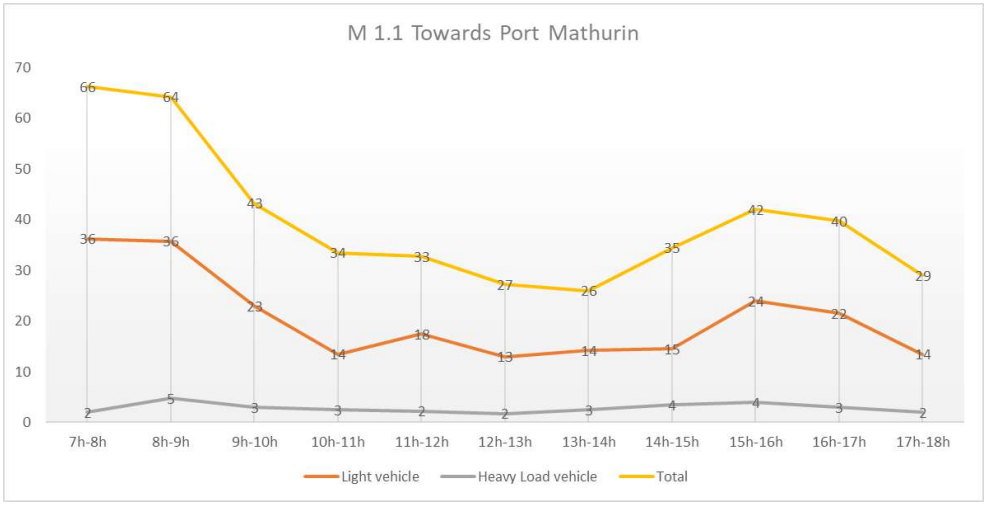


***Figure 6**: M 1.1 Towards Port Mathurin graph*

- Station n° M 1.2 Towards Grand la Fouche Corail

***Table 4:** Traffic counts at station: M 1.2 Towards Grand la Fouche Corail*

	Morning					Afternoon						Total
	7h-8h	8h-9h	9h-10h	10h-11h	11h-12h	12h-13h	13h-14h	14h-15h	15h-16h	16h-17h	17h-18h	
Two wheels	18	38	28	16	19	21	16	20	28	29	22	**253**
Light vehicle	32	41	28	16	14	26	22	24	42	50	28	**320**
Heavy Load vehicle	6	9	5	7	5	6	6	5	6	5	2	**60**
Total	**55**	**87**	**60**	**39**	**37**	**52**	**44**	**49**	**75**	**83**	**52**	**632**
		AM Peak hour								PM Peak hour		

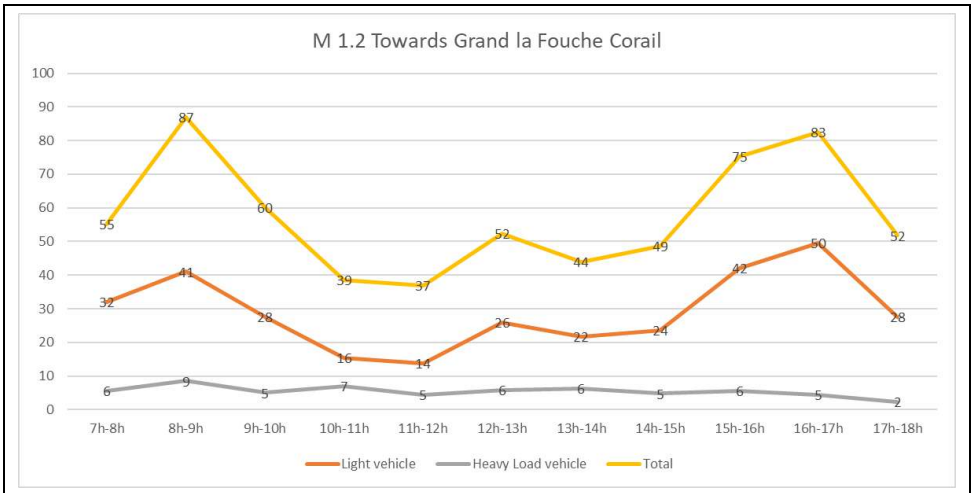


***Figure 7**: M 1.2 Towards Grand la Fouche Corail graph*

- Station n° M 1.2 Towards Mt Lubin

Table 5: *Traffic counts at station: M 1.2 Towards Mt Lubin*

	Morning					Afternoon						Total
	7h-8h	8h-9h	9h-10h	10h-11h	11h-12h	12h-13h	13h-14h	14h-15h	15h-16h	16h-17h	17h-18h	
Two wheels	24	26	24	23	14	18	19	24	24	23	17	**236**
Light vehicle	34	34	20	20	16	27	22	24	25	26	28	**277**
Heavy Load vehicle	6	8	6	10	6	6	5	10	7	6	2	**70**
Total	**63**	**68**	**50**	**53**	**37**	**51**	**46**	**58**	**56**	**54**	**47**	**582**
		AM Peak hour						PM Peak hour				

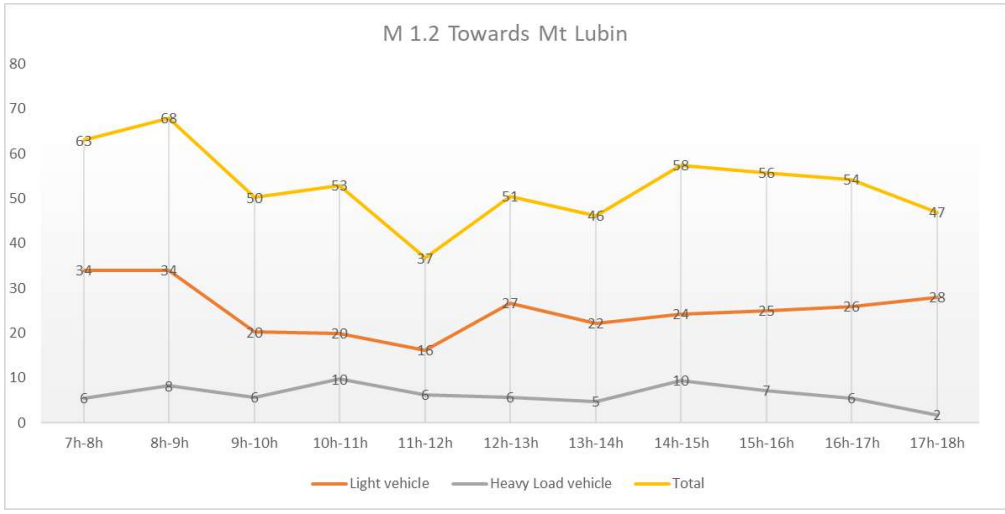


Figure 8*: M 1.2 Towards Mt Lubin graph*

- Station n° M 1.3 Towards Airport

Table 6: *Traffic counts at station: M 1.3 Towards Airport*

	Morning					Afternoon						Total
	7h-8h	8h-9h	9h-10h	10h-11h	11h-12h	12h-13h	13h-14h	14h-15h	15h-16h	16h-17h	17h-18h	
Two wheels	40	28	29	18	13	15	25	22	13	11	11	**224**
Light vehicle	48	28	29	17	21	23	24	20	18	12	17	**256**
Heavy Load vehicle	14	7	7	8	6	7	6	3	5	3	2	**67**
Total	**101**	**62**	**65**	**42**	**40**	**45**	**55**	**45**	**36**	**26**	**30**	**546**
	AM Peak hour						PM Peak hour					

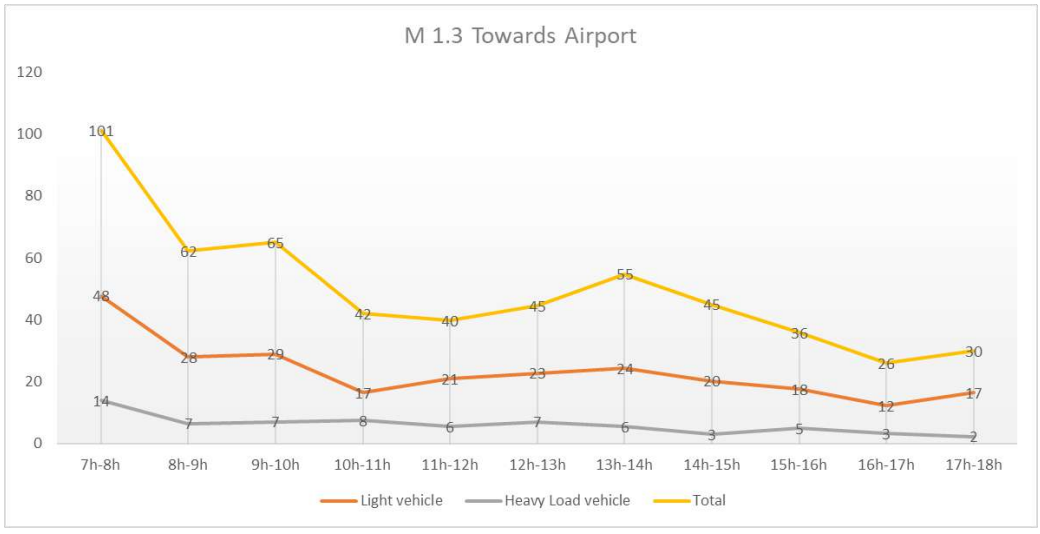


Figure 9: *M 1.3 Towards Airport graph*

- Station n° M 1.3 Towards La fouche Corail

Table 7: *Traffic counts at station: M 1.3 Towards La fouche Corail*

	Morning					Afternoon						Total
	7h-8h	8h-9h	9h-10h	10h-11h	11h-12h	12h-13h	13h-14h	14h-15h	15h-16h	16h-17h	17h-18h	
Two wheels	25	13	25	22	14	15	16	24	11	11	9	**185**
Light vehicle	26	20	23	17	17	23	21	22	18	16	18	**221**
Heavy Load vehicle	9	9	5	7	4	3	5	3	2	2	3	**53**
Total	**60**	**42**	**53**	**46**	**36**	**41**	**42**	**49**	**32**	**29**	**30**	**458**
	AM Peak hour							PM Peak hour				

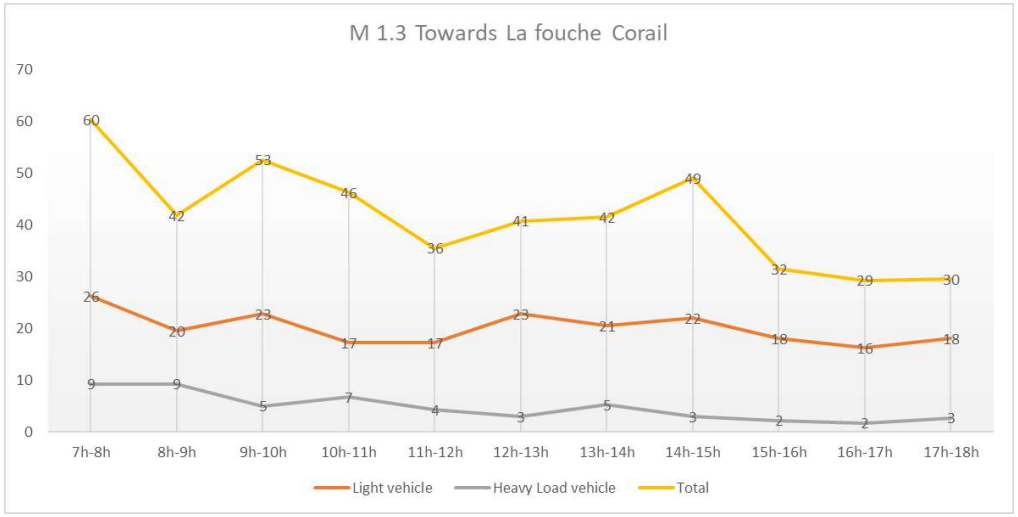


Figure 10: *M 1.3 Towards La fouche Corail graph*

Traffic counts will be used to calibrate the Travel Demand Model VISUM (Ptv).

- **Origin-Destination surveys:**

The origin-destination survey stations are presented in figure below:

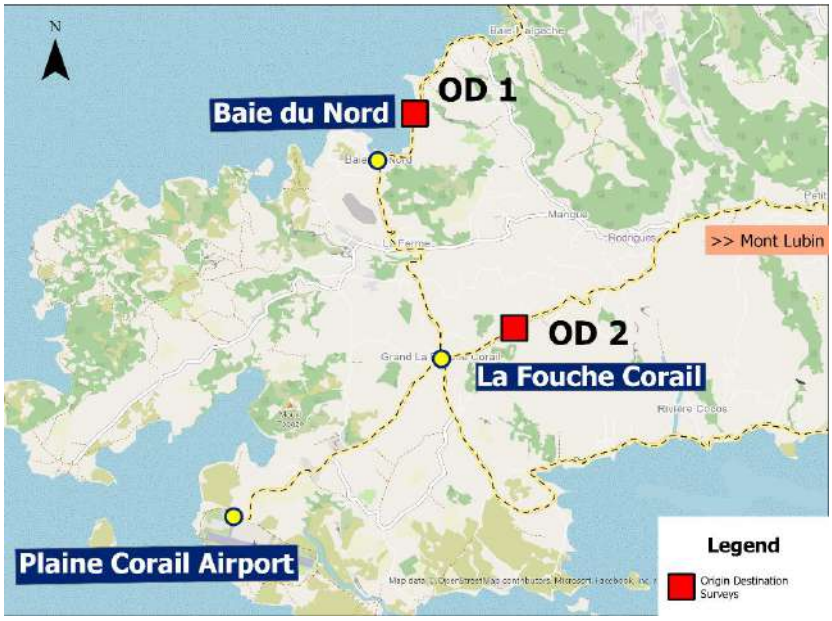


Figure 11: *Origin-Destination surveys stations*

The area of influence was divided into 20 “Traffic Analysis Zones (TAZ)”, as presented in the table below.

Table 8: *O/D Survey zoning*

N°	Traffic Analysis Zone (TAZ) Name	TAZ code
1	Baladirou/ Dan Bebe/ Mt Goyaves	Baladirou
2	Grand Baie/ Jeantac/ Caverne Proverb	Grand Baie
3	Anse aux Anglais/ Terre Rouge	Anse aux Anglais
4	Port Mathurin/ Camp du Roi	Port Mathurin
5	Baie aux Huitres/ Pointe L'Herbe/ Accacia/ Allee Tamarin/ Pointe La Geule	Baie aux Huitres
6	Baie Malgache/ Anse Goeland	Baie Malgache
7	Baie du Nord	Baie du Nord
8	La Ferme/ Pistache	La Ferme
9	La Fouche Corail/ Marechal	La Fouche Corail
10	Plaine Corail Airport	Plaine Corail Airport
11	Caverne Patate/ Petite Butte/ Anse Quitor/ Ile Michel/ Riviere Coco	Riviere Coco
12	Quatre Vents/ Mangues	Quatre Vents
13	Petit Gabriel/ St Gabriel	Petit Gabriel
14	Le Chou/ L'Union/ Malabar/ Mt Plaisir	Le Chou
15	Mon Lubin/ Citronelle/ Orange/ Vangar/ Solitude	Mon Lubin
16	Roseux/ Solitude/ Creve Coeur/ Pointe Canon	Roseux
17	Grande Montagne/ Palissade	Grande Montagne
18	Riviere Banane/ Grenade	Riviere Banane
19	>> Est (Roche Bon Dieu/ Pointe Coton/ Trou D'Argent/ Anse Bouteille)	>> Est
20	>> Sud (Gravier/ Mourouk/ Port Sud Est/ Songes)	>> Sud

Figure 12: *Centroids of the Traffic Analysis Zones*

The Origin/Destination survey sample is detailed as follows:

Table 9: *Origin Destination survey sample*

	OD 1	OD 2	Total
Light vehicle	359	330	689
Heavy Load vehicle	74	91	165
Total	**433**	**421**	**854**

The outputs of the origin-destination surveys are two matrices **(20x20)** that will be used to calibrate the VISUM (PTV) travel demand forecasting model.

Table 10: *Origin Destination OD 1 matrix (total traffic)*

OD 1 zones	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total
1										1											1
2										2											2
3				1				1	2	5	2								1		12
4				1			3	22	16	24	15										81
5				2			1	2		2		1									8
6			1	6	1			1							2			1			12
7				25	2	1		1	1												30
8	1		3	47	2				1						1	2					57
9			3	27	3		1	3	2	4		1	1	1				1	1		48
10		1	2	11	2						1	1				3	1				22
11	1		2	16	2				1	2											24
12				6	3			1	3	2	1										16
13				1			1	3	8	1	4			1					1		20
14				2				3	11	4	2									1	23
15				1	1			7	6	7	7	1									30
16									3	4	4										11
17								4	1	5	2										12
18																					0
19								3	2	7	2										14
20								2	2	3	3										10
Total	2	1	11	146	16	1	6	53	59	73	43	4	1	2	3	5	1	2	3	1	433

Table 11: *Origin Destination OD 2 matrix (total traffic)*

OD 2 zones	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total
1							2	1	2		1										6
2				1						6	2										9
3							1	1	2		1										5
4		1		2			18	15	22	24	12	1	2							7	104
5							2	2				1	1								6
6	1			3	1		2	2	2	2		5	2		4	1	1	1			27
7				8					1												9
8		1	1	26		2			2			7	5	5	8	1	1		1	2	62
9			6	20	4	1		1	10	2		5	6	5	4	3	1		3	3	74
10	2	1	3	14					1			3	7	5		5	3	2	1	3	50
11	1			15	1				1			1	1	1	1	1	1	1	1		26
12								2		1											3
13								3	3		3										9
14									5		1										6
15				1					5	2	3			1							12
16											1										1
17						1				1	1										3
18									2												2
19								1	1	2	1										5
20								1		1											2
Total	4	3	10	90	6	4	25	29	59	41	26	23	24	17	17	11	7	4	6	15	421

2.2.3 Transport demand (Land Use)

Table 12: *Travel demand rates of different TAZ*

N°	Zone Name	*Population based on Land Use				Generation vectors (Veh/Peak hour) – 2023	
		*Permanent[1]	*Employment	*Transit/ visitors	TOTAL	Production	Attraction
1	Baladirou	214	20	38	**272**	**16**	**11**
2	Grand Baie	375	84	145	**604**	**29**	**30**
3	Anse aux Anglais	799	224	464	**1 487**	**64**	**85**
4	Port Mathurin	2 371	1 365	1 966	**5 702**	**218**	**359**
5	Baie aux Huitres	1 872	858	700	**3 430**	**154**	**186**
6	Baie Malgache	915	82	153	**1 150**	**65**	**45**
7	Baie du Nord	432	50	103	**585**	**32**	**25**
8	La Ferme	1 816	225	501	**2 542**	**136**	**109**
9	La Fouche Corail	1 592	327	1 237	**3 156**	**151**	**159**
10	Plaine Corail Airport	695	222	414	**1 331**	**60**	**71**
11	Riviere Coco	2 124	231	610	**2 965**	**163**	**122**
12	Quatre Vents	1 522	164	529	**2 215**	**121**	**92**
13	Petit Gabriel	1 175	180	240	**1 595**	**84**	**70**
14	Le Chou	1 080	323	334	**1 737**	**84**	**86**
15	Mon Lubin	2 455	242	506	**3 203**	**178**	**130**
16	Roseux	827	159	438	**1 424**	**68**	**72**
17	Grande Montagne	1 070	332	1 160	**2 562**	**115**	**139**
18	Riviere Banane	1 255	245	353	**1 853**	**91**	**90**
19	>> Est	1 337	214	281	**1 832**	**98**	**79**
20	>> Sud	2 335	343	759	**3 437**	**182**	**151**
	Total	**26 261**	**5 890**	**10 931**	**43 082**	**2 110**	**2 110**

[1] * Based on collected data and Consultant assumptions

2.3 Construction phase

2.3.1 Traffic Flow and Material Transportation

The existing traffic flow was introduced in the VISUM simulation model with key information about the estimated needs of construction materials and sourcing of same, estimated workforce during Construction amongst others to generate traffic flow during the construction phase and review its impact on the road network.

The imported volumes from Port Mathurin **23 000 Tonnes** :

- Bitumen : 10 000 tonnes
- Cement : 12 000 tonnes
- Reinforcement bars : 1 000 tonnes

result in a relatively low average heavy traffic (6 trucks/day/direction), which is equivalent to 12 trucks/day/two directions, given the following assumptions:

- Average payload of a truck = 10 ≈ 12 Tonnes
- Number of Heavy Load = 2 300 trucks
- Duration of transport for the imported materials = 20 months (out of 27 months of work)
- **Number of Heavy Load/ Peak Hour = 2 truck/Hr/direction**

In terms of transportation for the workers, who will total 450 individuals, with at least 70% - 80% being Mauritians, it is proposed to implement a daily pickup system using shuttle buses as a replacement for collective transportation.

This will require either **15 mini-buses/ day** with 30 seats to transport the workers from two pickup points: Port Mathurin and Mont Lubin, toward the airport construction site.

2.4 Operation Phase (2026 – 2046) Induced traffic

Based on GIBB report: "*Consultancy services for the design, cost estimation and tender documentation for the extension of the Runway at plaine corail airport, Rodrigues - APPENDIX B - Aircraft Movements And Traffic Forecast Calculations, Nov. 2018*", and Using an induction factor of (**10%**) comparing between the Scenario without project and the Scenario with project, we can detail the traffic forecast in this way :

Table 13 : *Number of passengers forcast*

	Number of passengers / year (Baseline Scenario)	Number of passengers / year (With Project)	Number of passengers induced / year
2023	112 535	-	-
2026	121 330	133 463	12 133
2046	194 122	213 534	19 412

Based on these results, the Consultant estimates daily induced traffic during the operation phase from the Airport zone (TAZ n°10) : Plaine Corail Airport equal to :

	Induced Light Vehicles / day	**Induced Heavy Load Vehicles / day**
2026	10	2
2046	15	4

2.5 Main simulation results

The study was conducted for two horizons:

- 2023, the current situation (baseline scenario),
- 2025, with and without Construction works,
- 2026, with and without Project and,
- 2046, with and without Project.

The Consultant has adopted an annual traffic increase rate of 3%.
The total traffic flow used in the VISUM model is presented in the table below:

Table 14: *Total vehicle flow in the road network on peak hour*

Scenario		**Light vehicle / Hr**	**Heavy Load vehicle / Hr**	**Total Traffic / Hr**
2023	Baseline scenario	1 775	335	2 110
2025	Without construction works	1 883	356	2 239
	With construction works	1 887	357	2 244
2026	Without Project	1 940	366	2 306
	With Project	1 942	367	2 309
2046	Without Project	3 504	661	4 165
	With Project	3 507	662	4 169

The figures below present the VISUM outputs, showing the traffic loads for the analyzed scenarios (Light vehicles represented in blue and Heavy Load vehicles illustrated in red).

The figures below present the Annual Average Daily Traffic AADT.
The transition from hourly traffic to daily traffic was based on the following coefficients:
Hourly traffic represents an average of 10% of daily traffic.

***Table 15** : Percentage of peak hour traffic compared to AADT*

cross-section counts	Light vehicle	Heavy Load vehicle
TC 1.1 Towards La Ferme	11,5%	7,1%
TC 1.1 Towards Port Mathurin	11,2%	9,9%
TC 1.2 Towards La Fouche Corail	9,0%	9,3%
TC 1.2 Towards Mt Lubin	8,6%	9,1%
TC 1.3 Towards Airport	13,1%	13,7%
TC 1.3 Towards La Fouche Corail	8,3%	11,5%
Average	**10,28%**	**10,08%**

All A.A.D.Traffic volumes (VISUM Output) are detailed in the appendix for the different scenarios for the following horizons: 2023, 2025, 2026, and 2046.

The key performance indicators (KPI) of the road network are presented in the table

Table 16 : *Key performance indicators*

N°	Scenario	Veh x Km (LV)	Veh x Hr (LV)	Average speed for Light Vehicle (Km/Hr)	Veh x Km (HLV)	Veh x Hr (HLV)	Average speed for Heavy Load Vehicle (Km/Hr)
(1)	**2023 – Baseline Scenario**	14 031,28	223,23	**62**	1 361,59	28,47	**47**
(2)	**2025 – Without Construction works**	15 722,40	252,98	**62**	3 222,65	3 222,65	**47**
(3)	**2025 – With Construction works**	15 803,83	254,46	**62**	3 238,71	3 238,71	**47**
(4)	**2026 – Without Project**	17 342,42	274,69	**62**	3 316,52	3 316,52	**47**
(5)	**2026 – With Project**	17 366,66	275,06	**62**	3 321,31	3 321,31	**47**
(6)	**2046 – Without Project**	31 308,64	521,18	**62**	5 991,75	5 991,75	**47**
(7)	**2046 – With Project**	31 347,51	521,82	**62**	6 001,21	6 001,21	**47**

When comparing Scenario (2) with Scenario (3), we noted that the average speed (at peak hour) is consistent at 62 Km/Hr for Light vehicles and slightly increased from 15 722,40 (Veh x Km) to 15 803,83 (Veh x Km), due to the additional traffic inducing from the Construction works at the Airport. The impact of the Construction works on traffic flow is not significant.

We also note that the operation phase does not have a considerable impact on the average speed of vehicles, given the size of the island on the one hand and the fact that its road network is not overly congested (even by 2046) on the other hand. The volume/capacity factor remains relatively low and we do not reach saturation thresholds in the road network.

Figures below show the difference in terms of traffic load (AADT) :

- between Scenario (2) and Scenario (3) – 2025;
- between Scenario (4) and Scenario (5) – 2026 and
- between Scenario (6) and Scenario (7) – 2046.

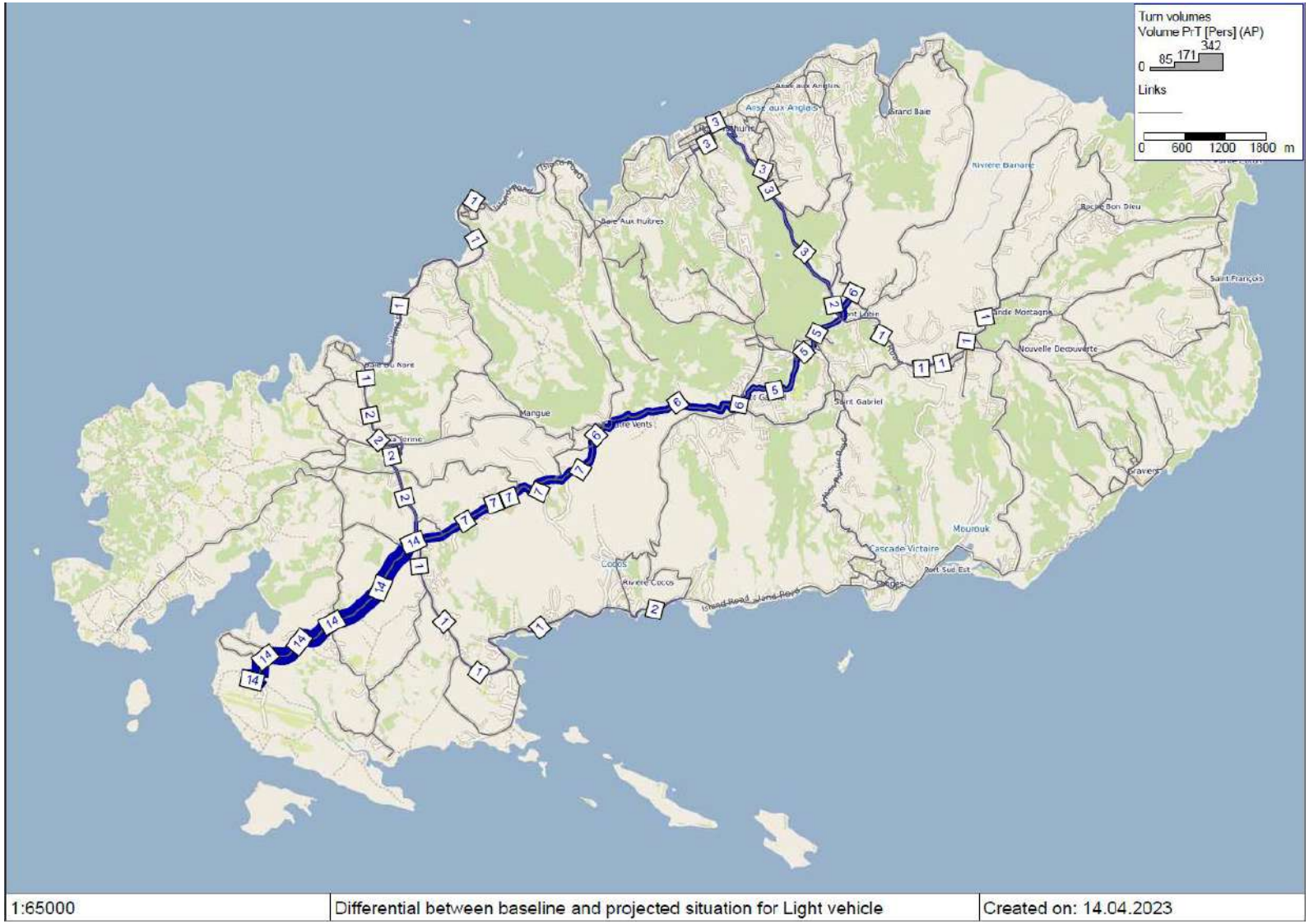


***Figure 13** : Differential between Scenario (2) and Scenario (3) - Light vehicles (2025 – Construction Phase)*

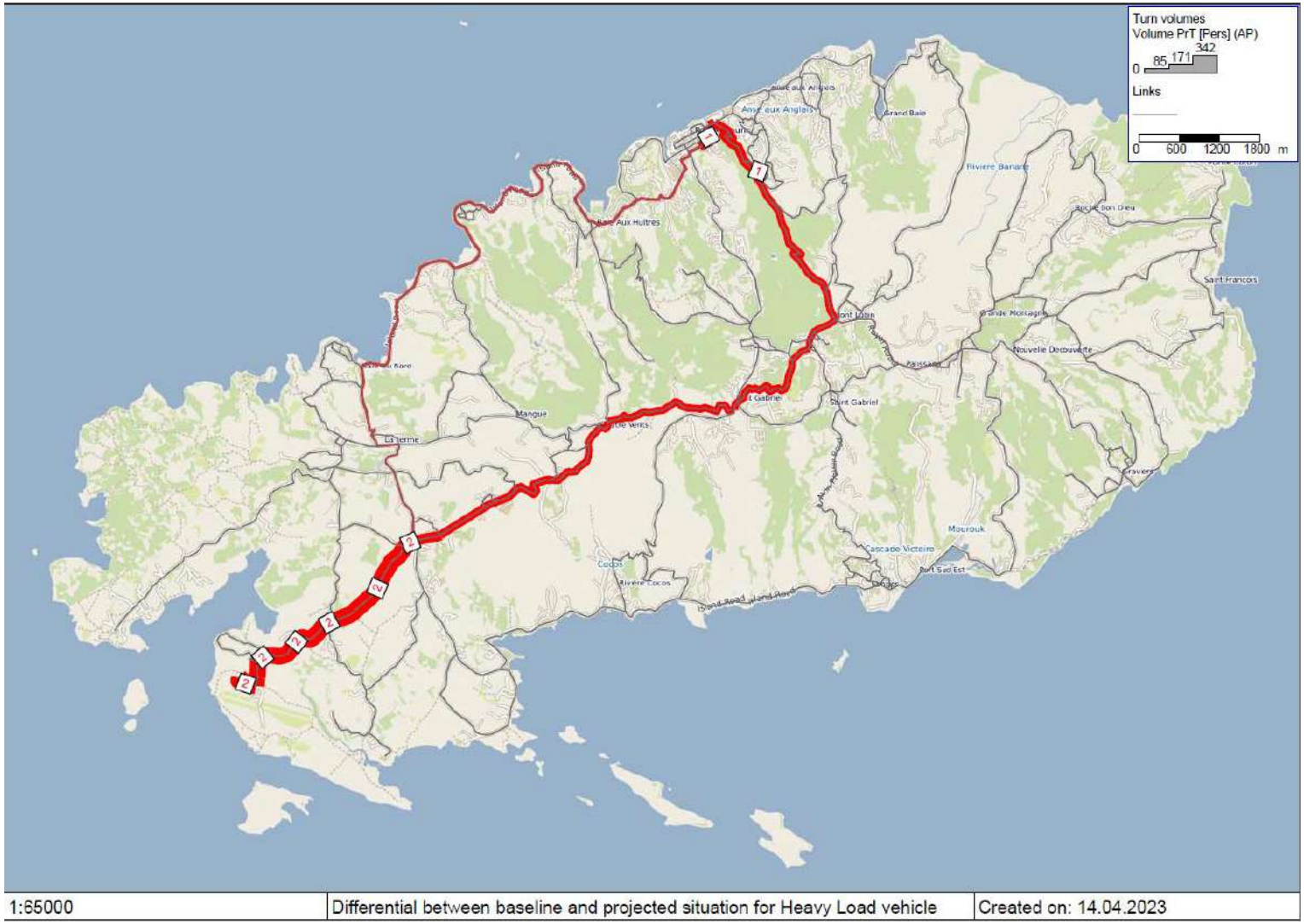


Figure 14 : *Differential between Scenario (2) and Scenario (3) - Heavy Load Vehicles (2025 – Construction Phase)*

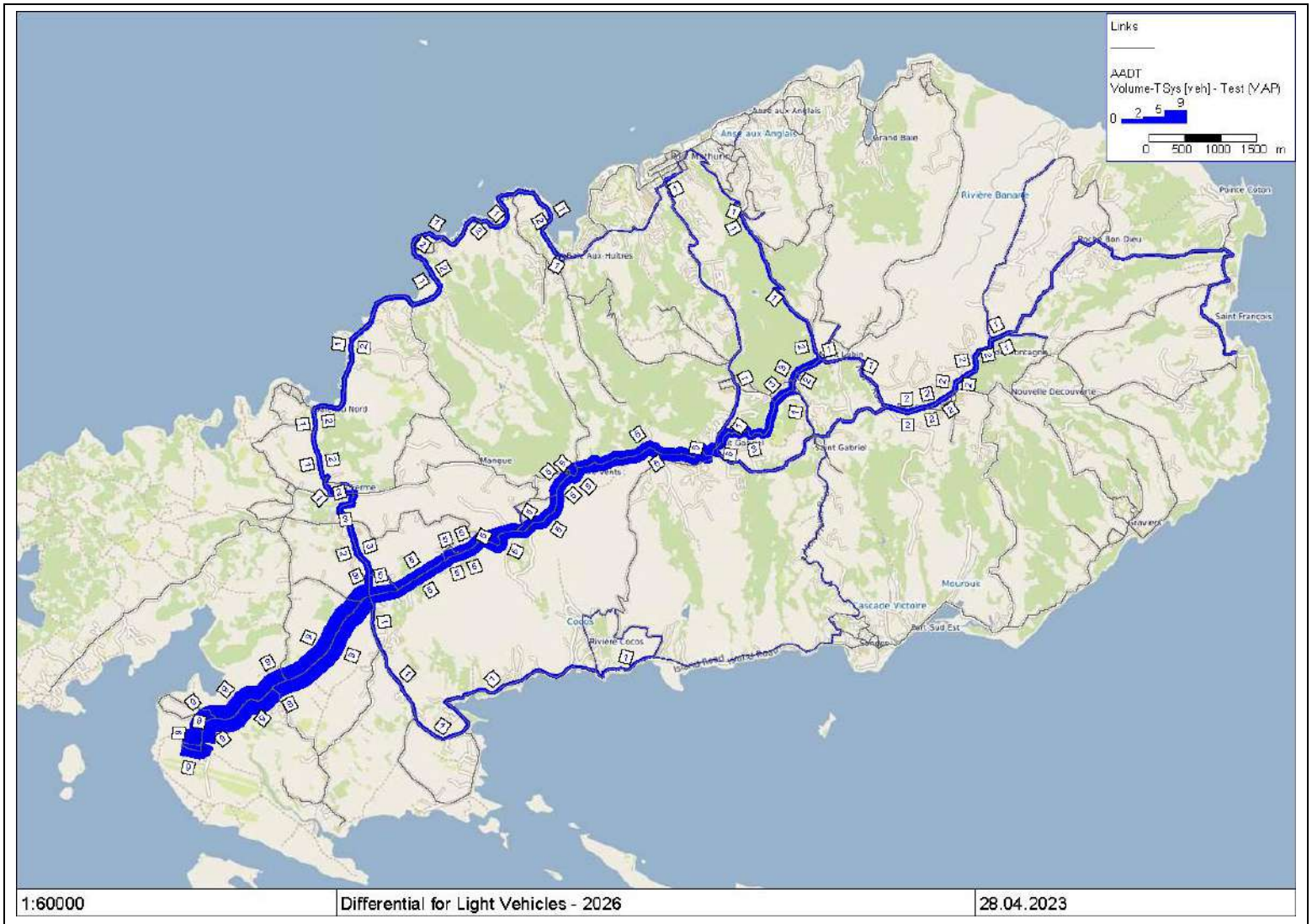


Figure 15 : *Differential between Scenario (4) and Scenario (5) – Light Vehicles (2026 – Operation Phase)*

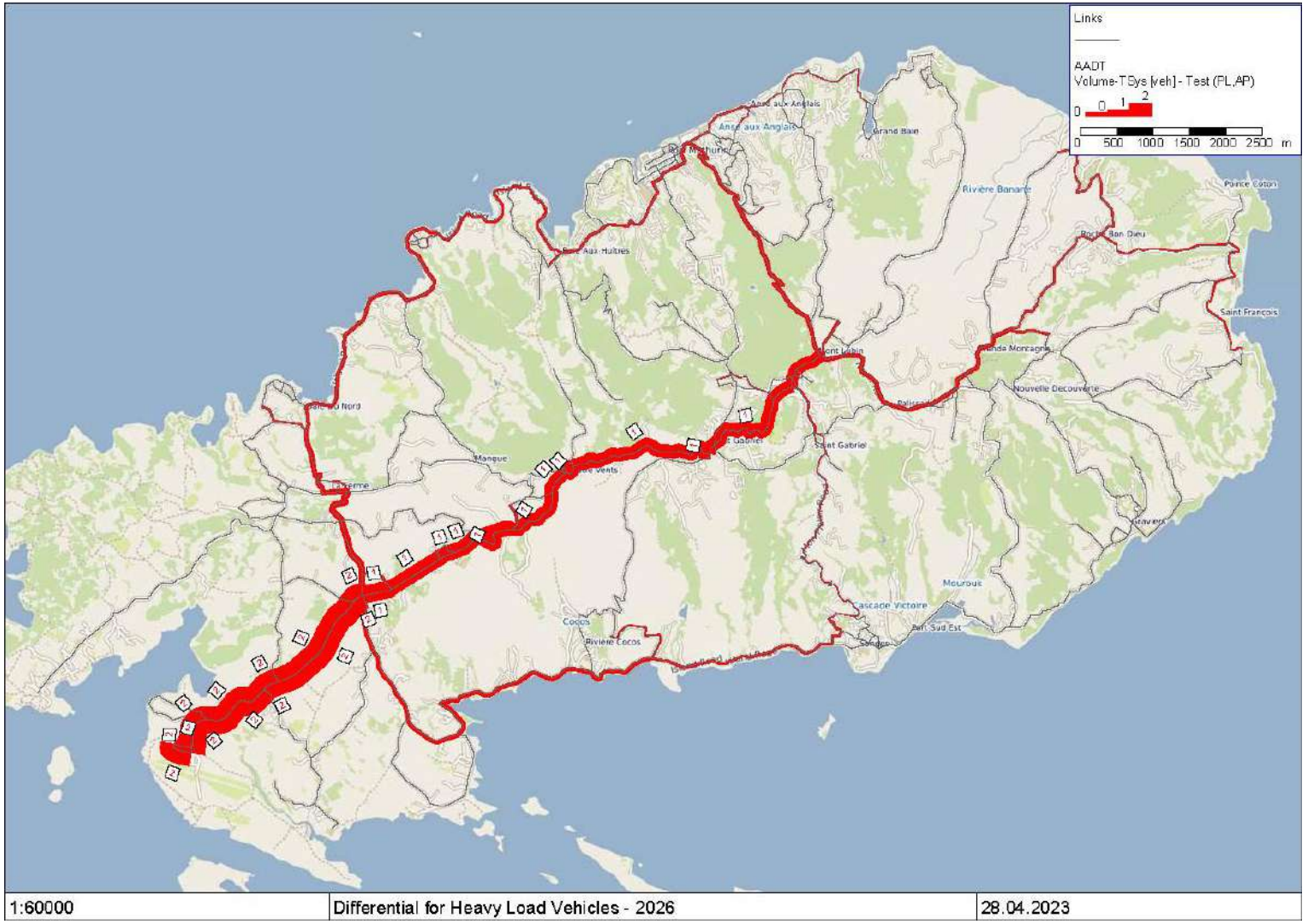


Figure 16 : *Differential between Scenario (4) and Scenario (5) - Heavy Load Vehicles (2026 – Operation Phase)*

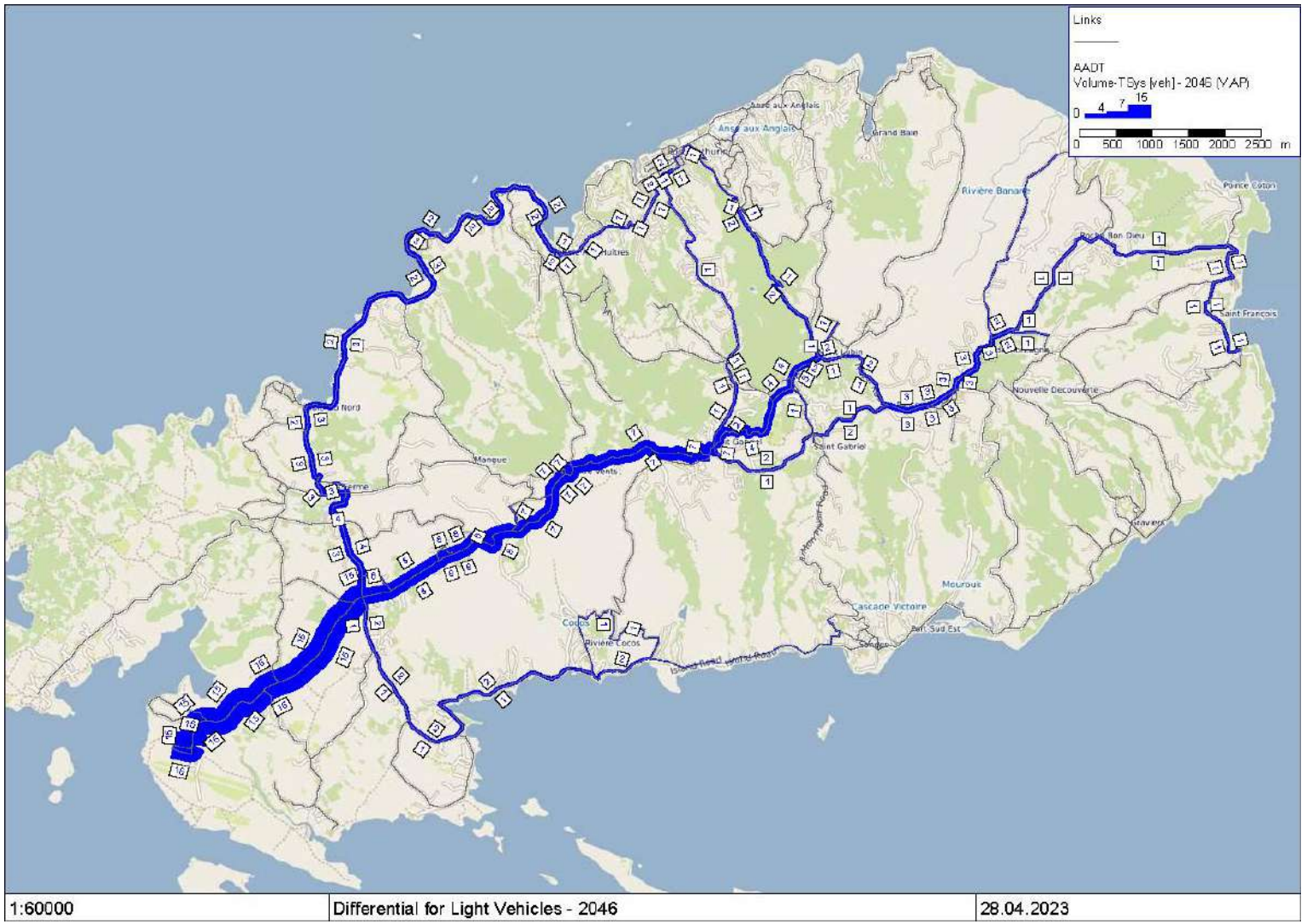


Figure 17 : *Differential between Scenario (6) and Scenario (7) – Light Vehicles (2046 – Operation Phase)*

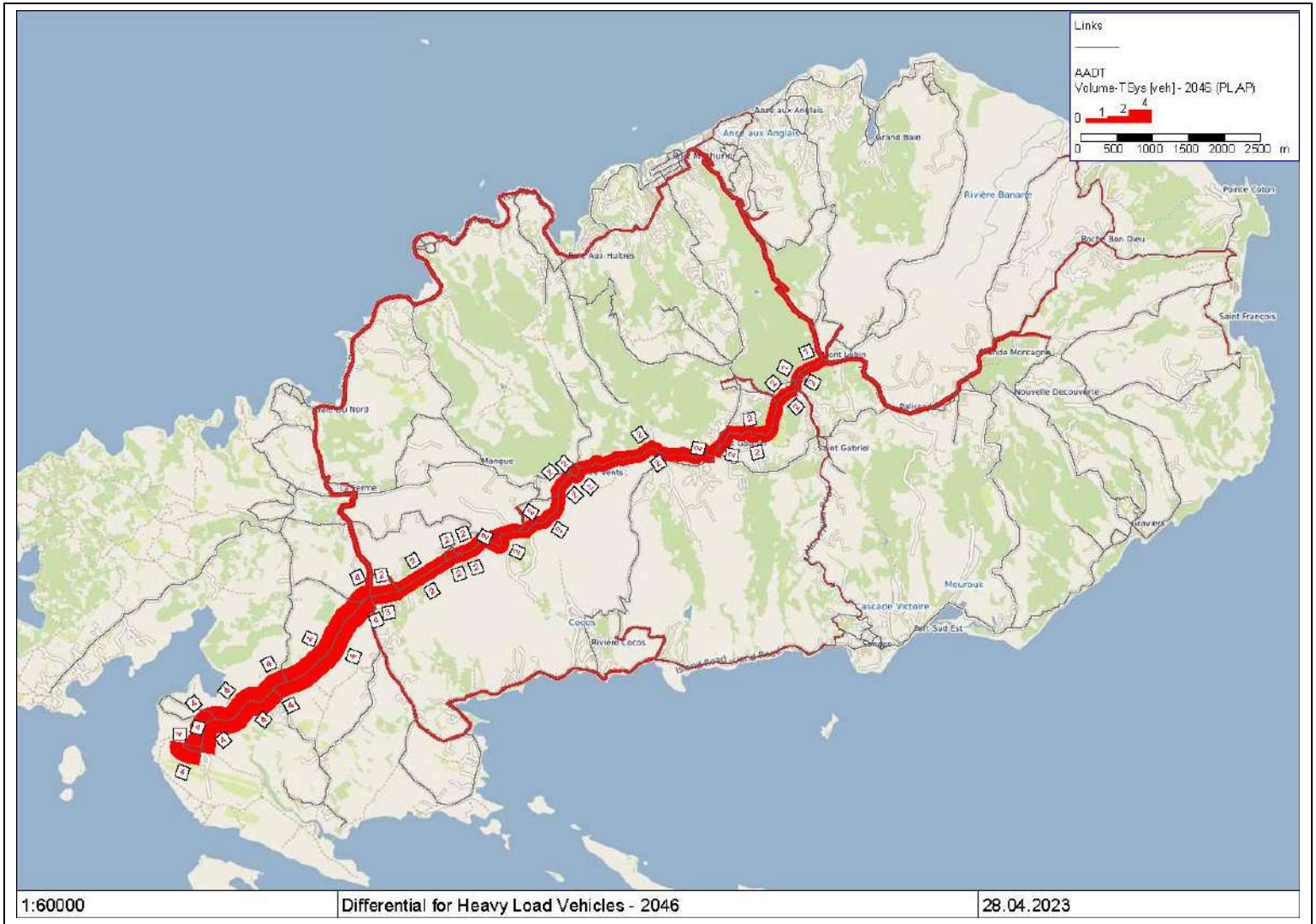


Figure 18 : *Differential between Scenario (6) and Scenario (7) - Heavy Load Vehicles (2046 – Operation Phase)*

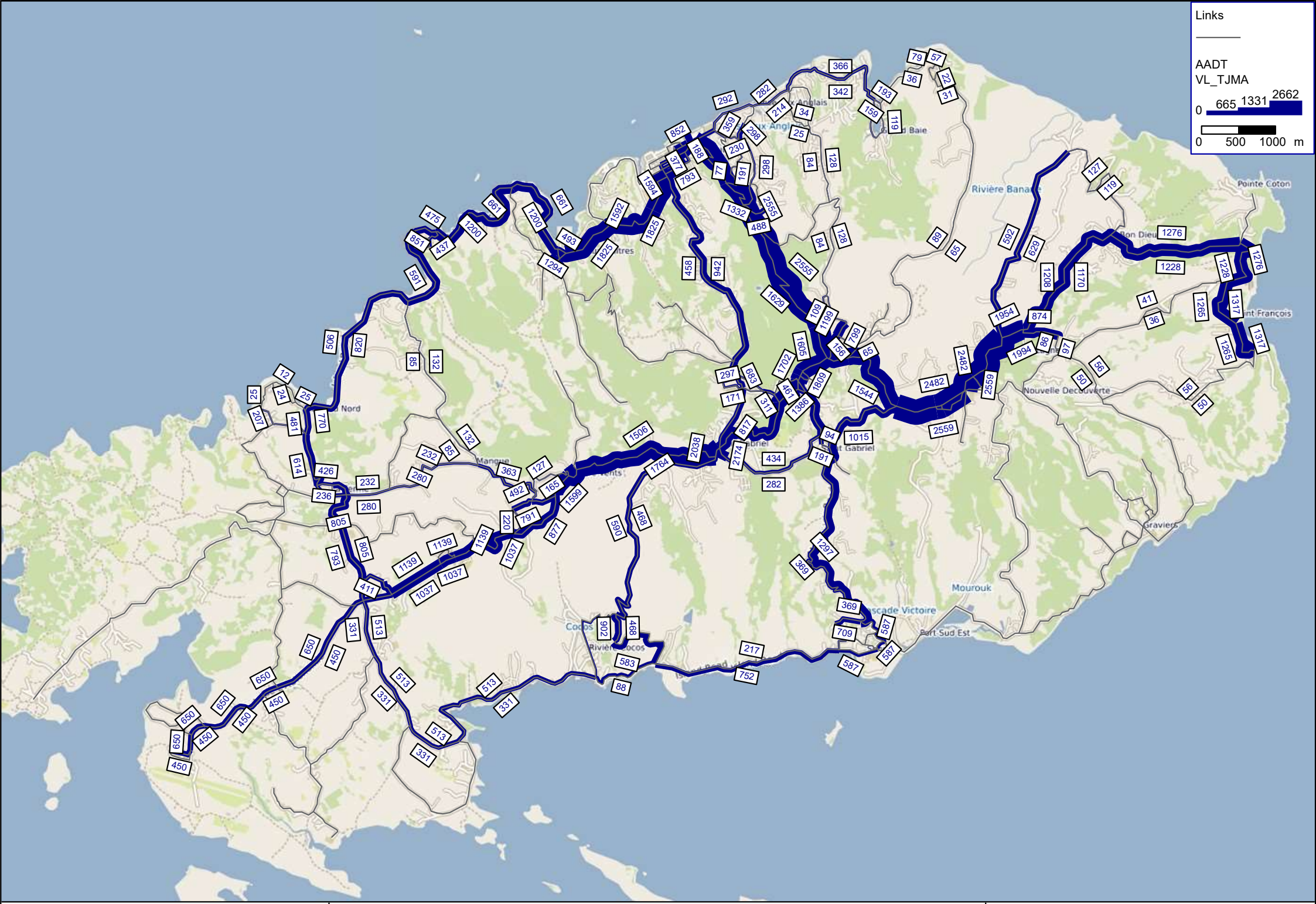
2.6 Conclusion

As a result of this study, we can conclude that the traffic volume generated by the Construction works phase has no significant impact on the traffic fluidity on Rodrigues Island.

The main impact on users is the slowing down the traffic speed along the “Route de l’Autonomie”, presenting a steep gradient due to the trucks that will travel at a low speed along this main road, linking the port to the Airport.

We also note that the additional traffic generated during the **operation phase** represents only about 15 light vehicles and 4 heavy vehicles per day by 2046, which remains quite low.

APPENDICES



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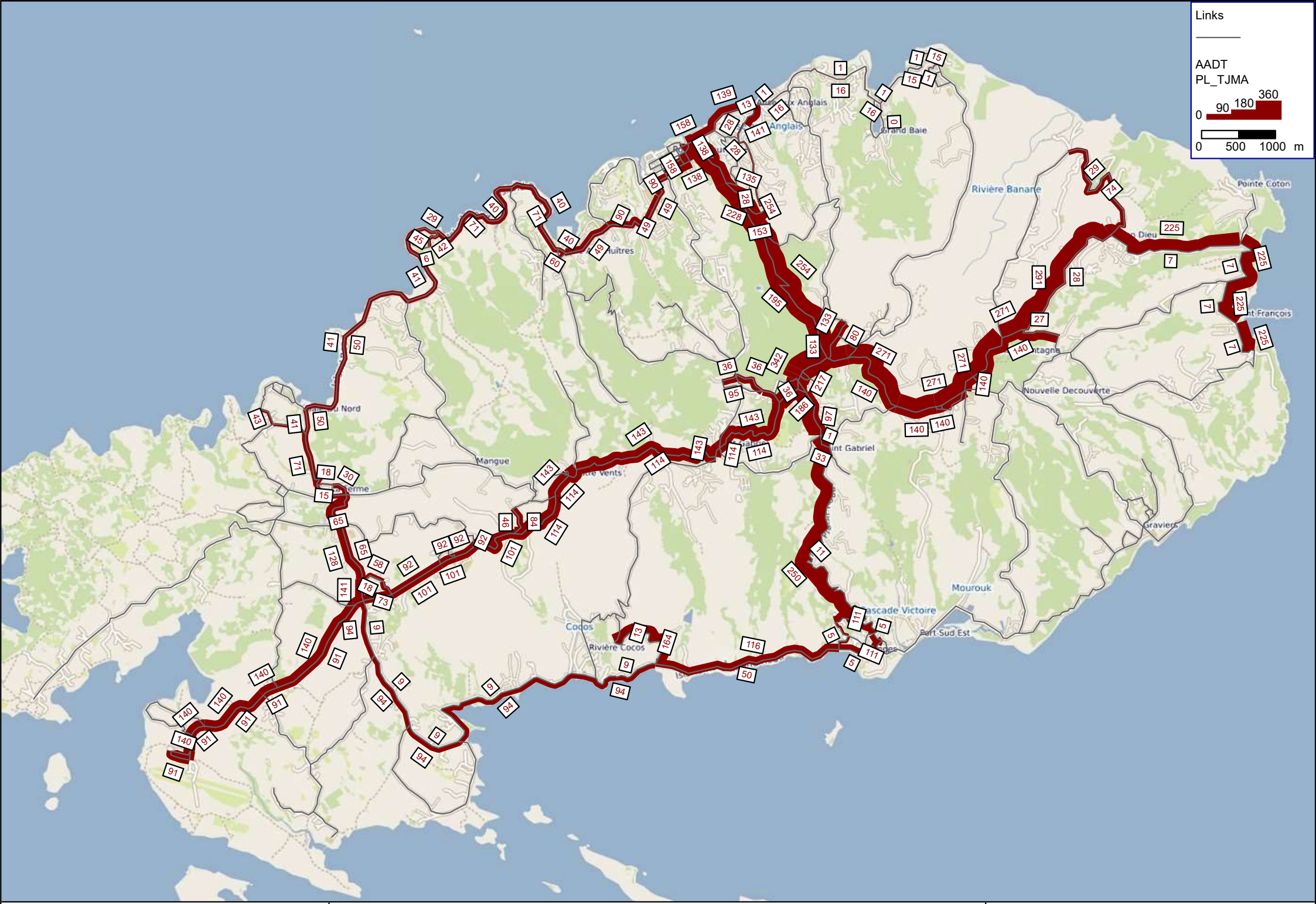

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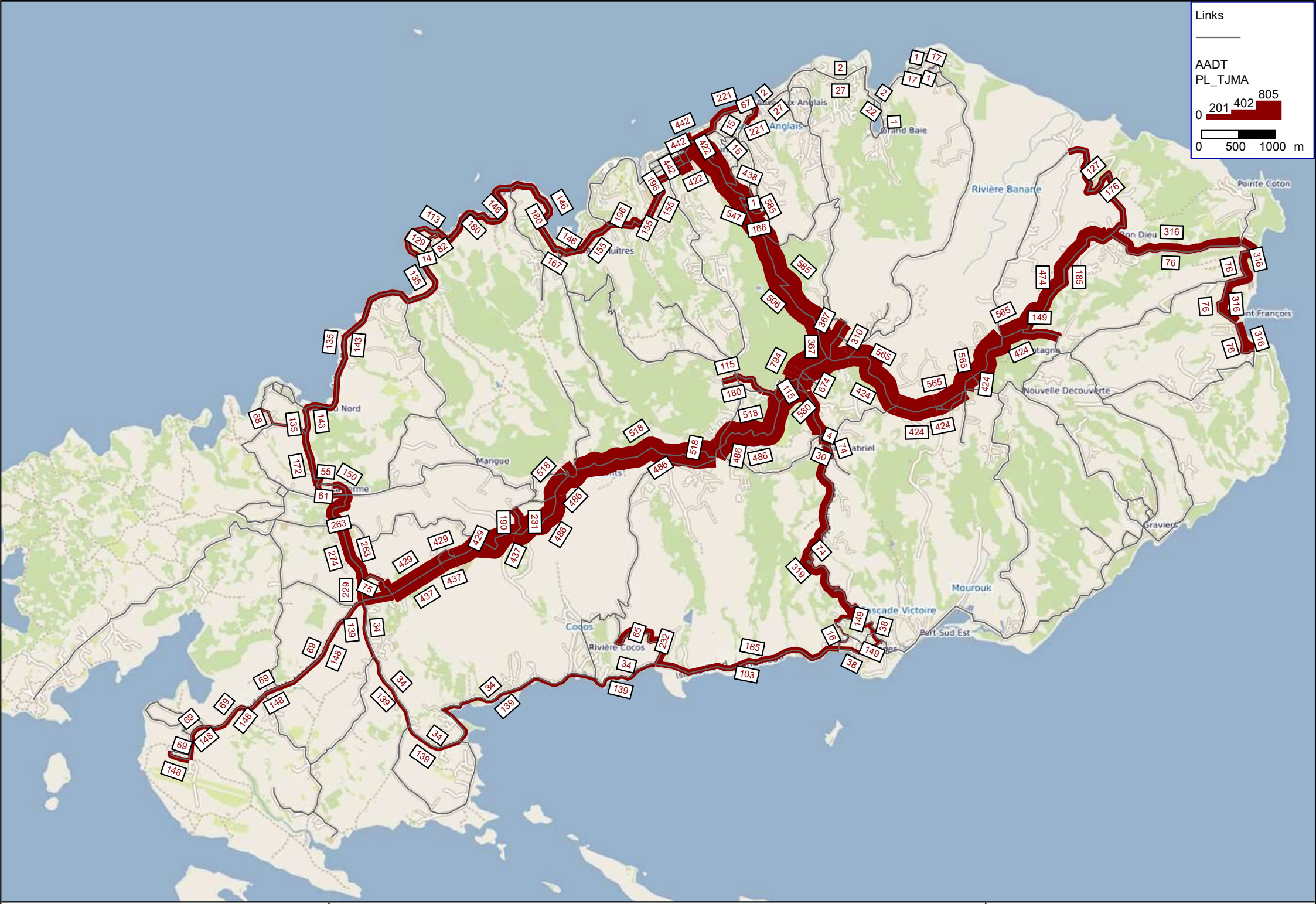

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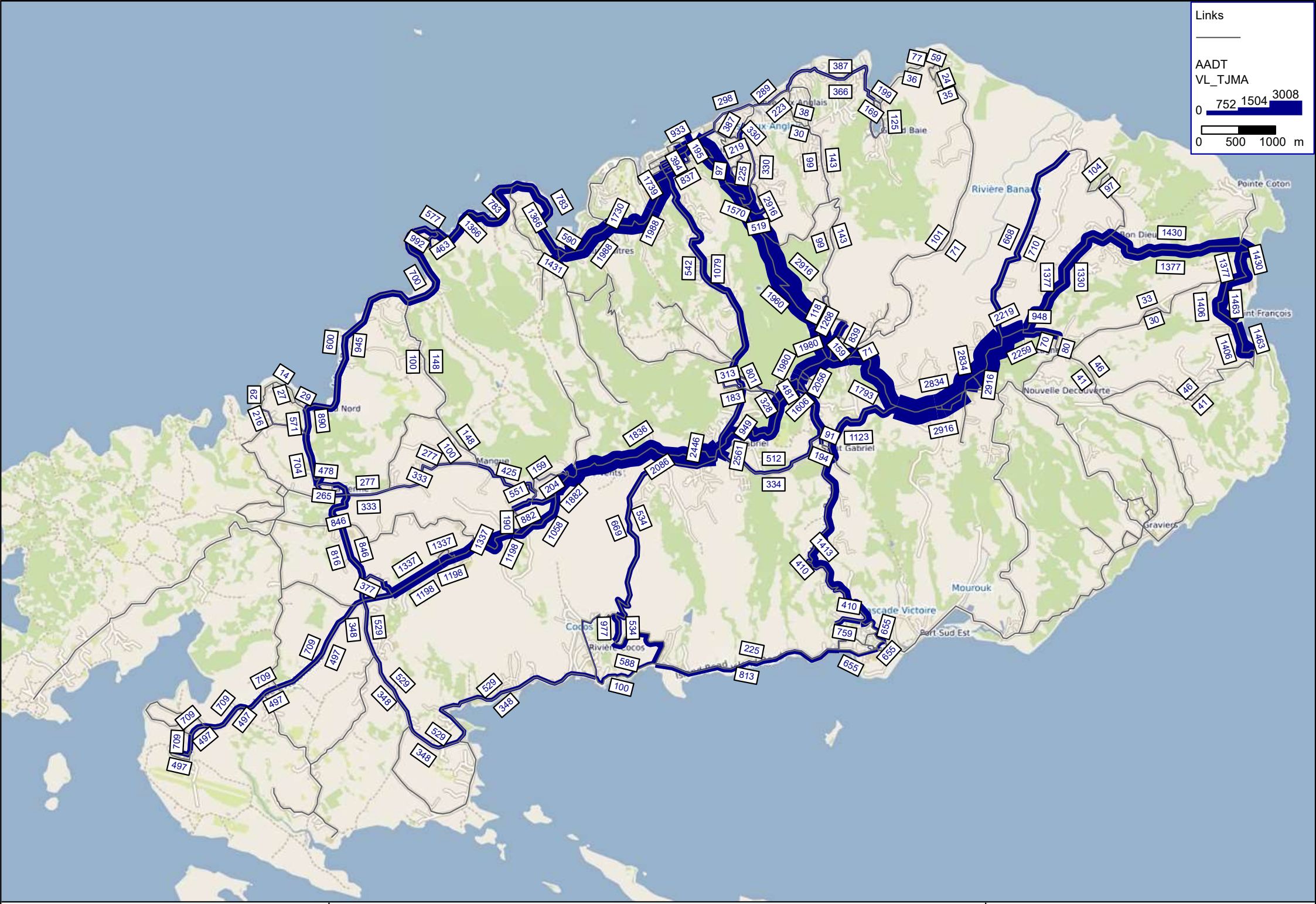

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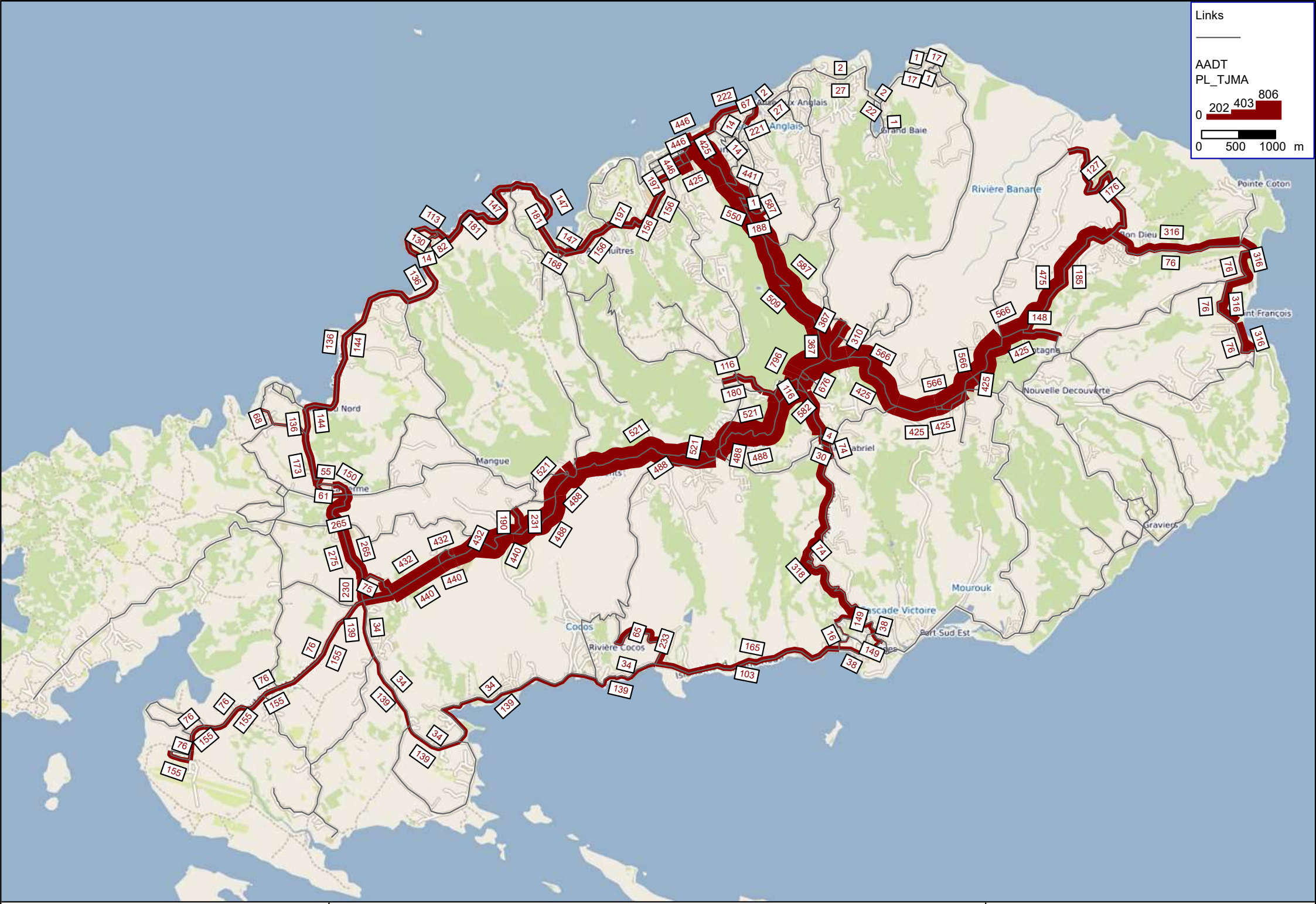

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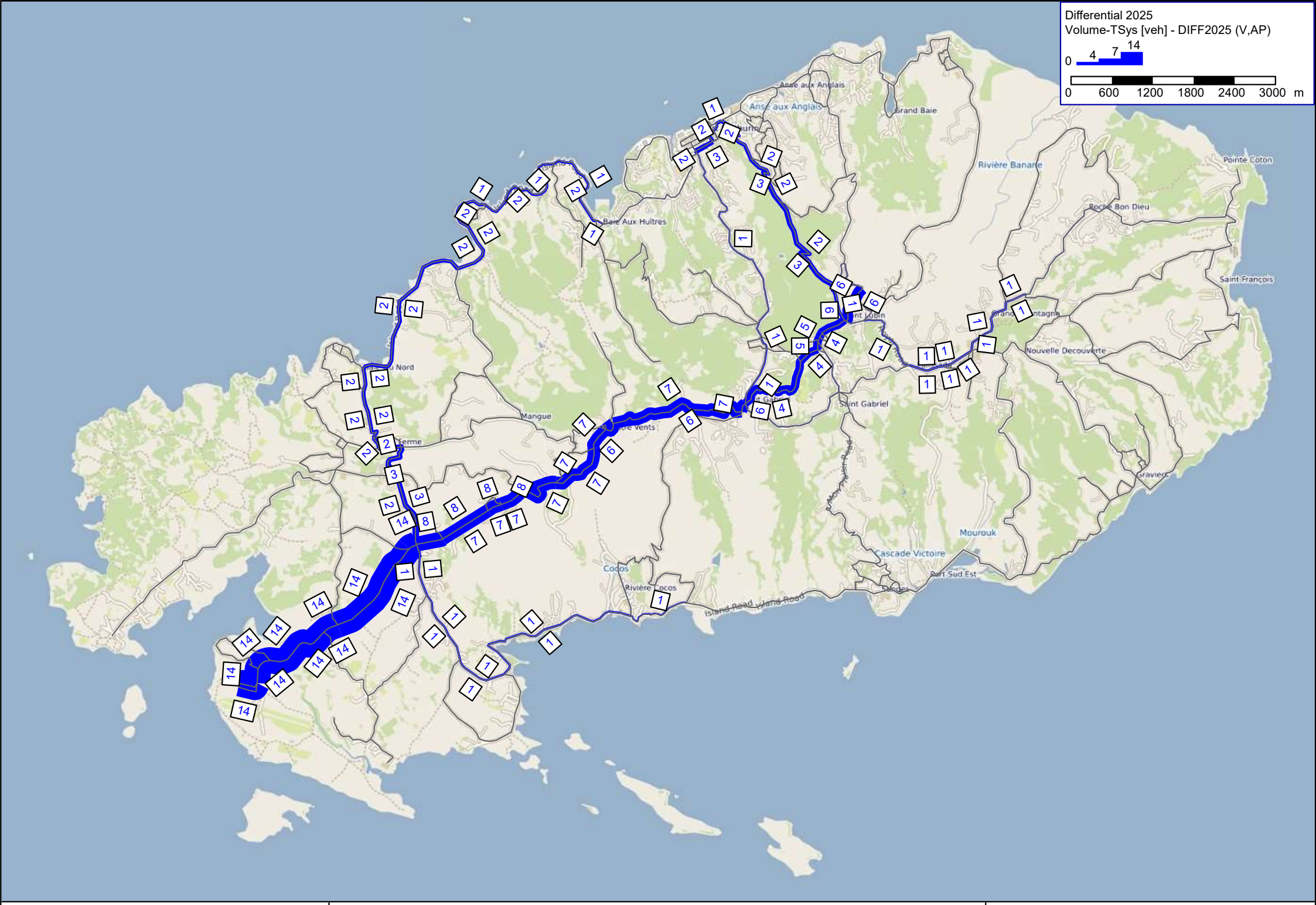

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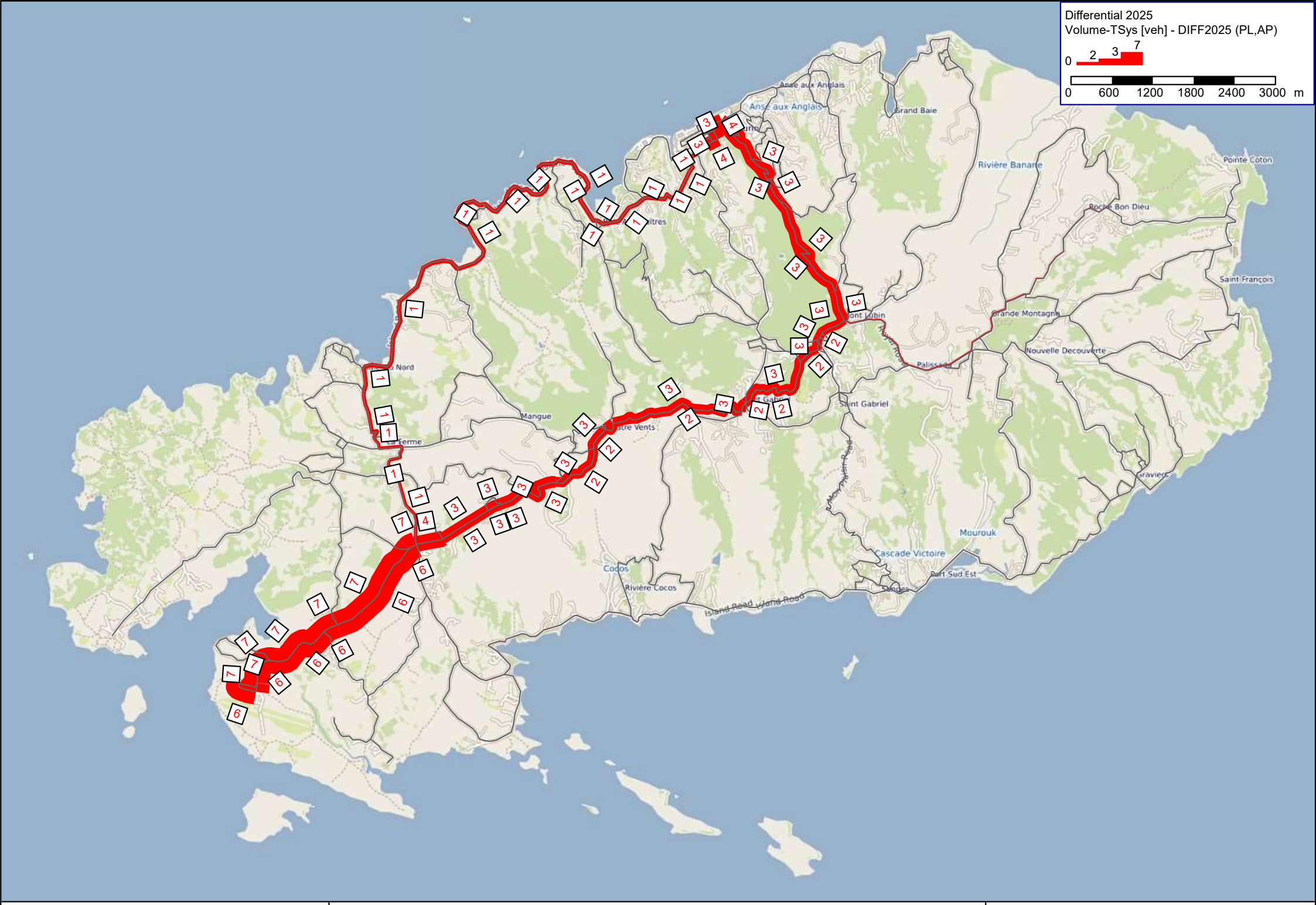

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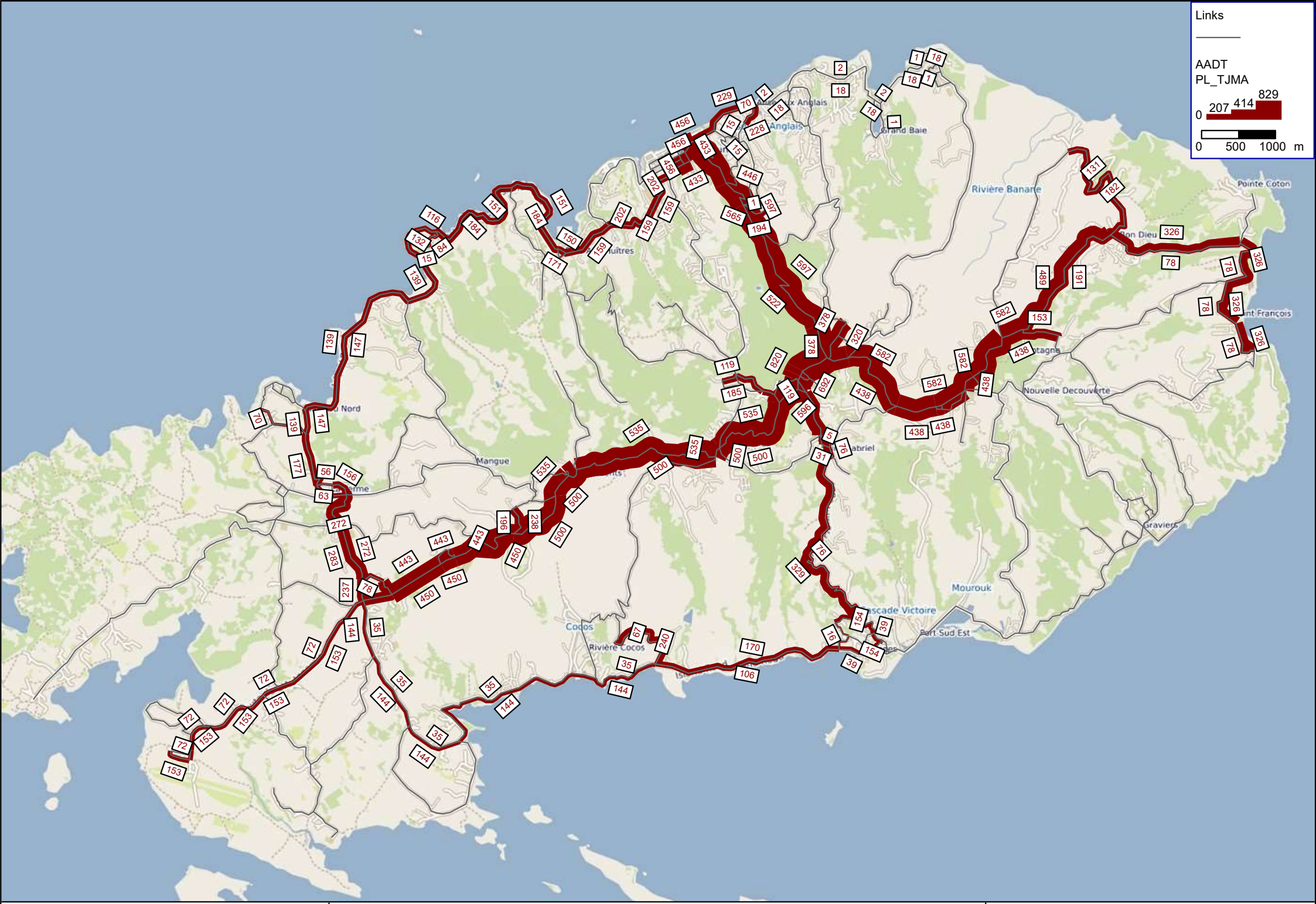

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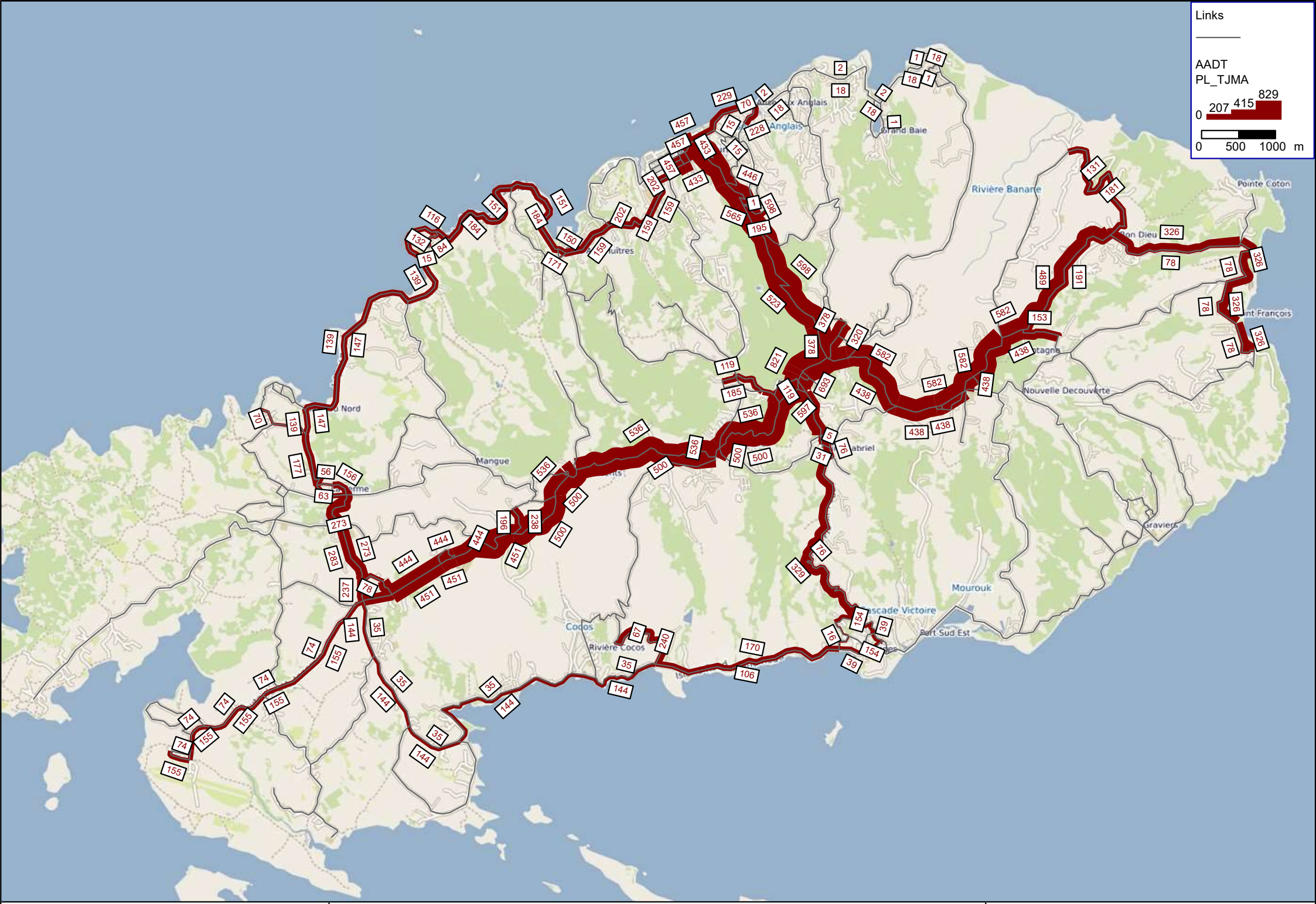

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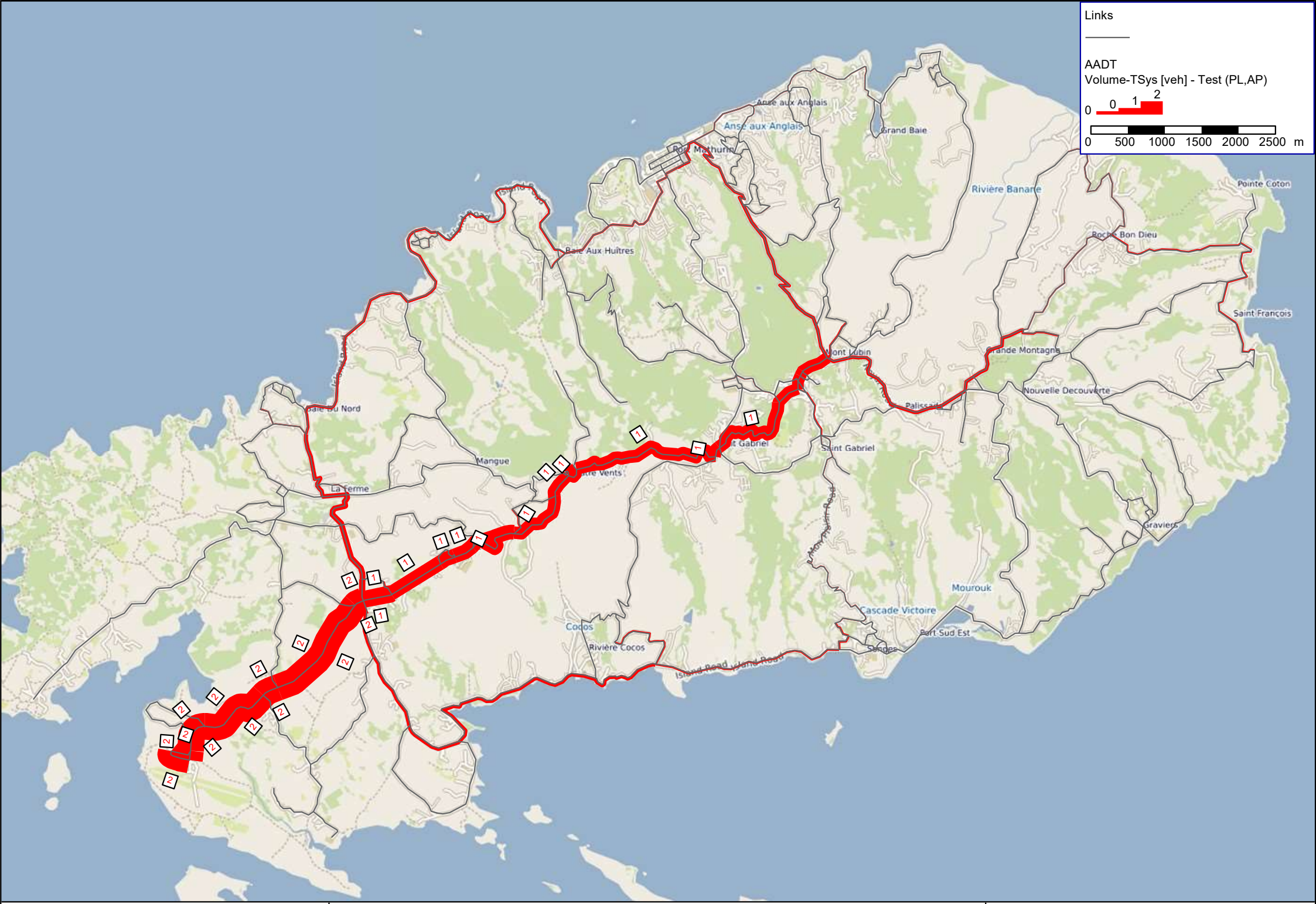

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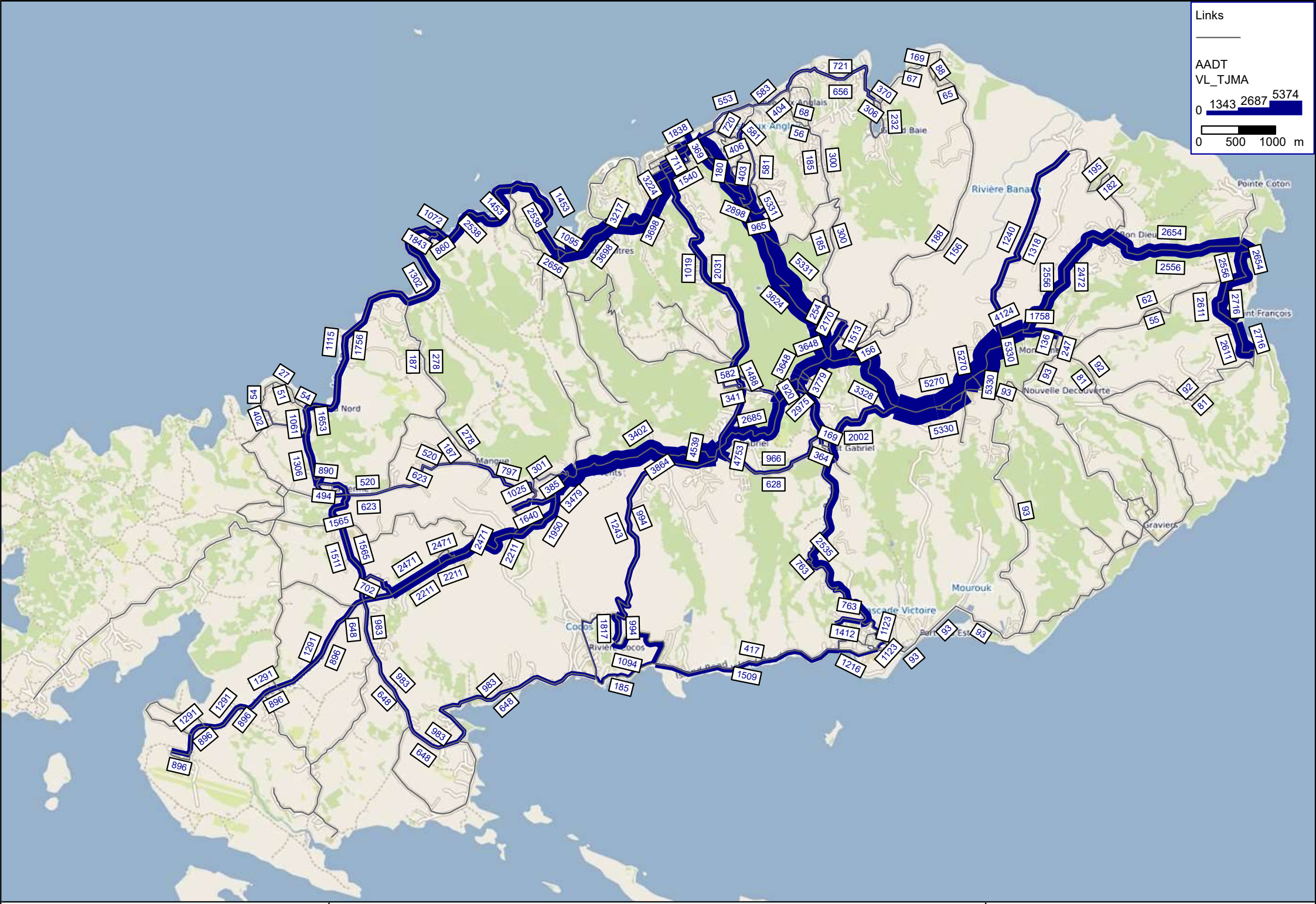

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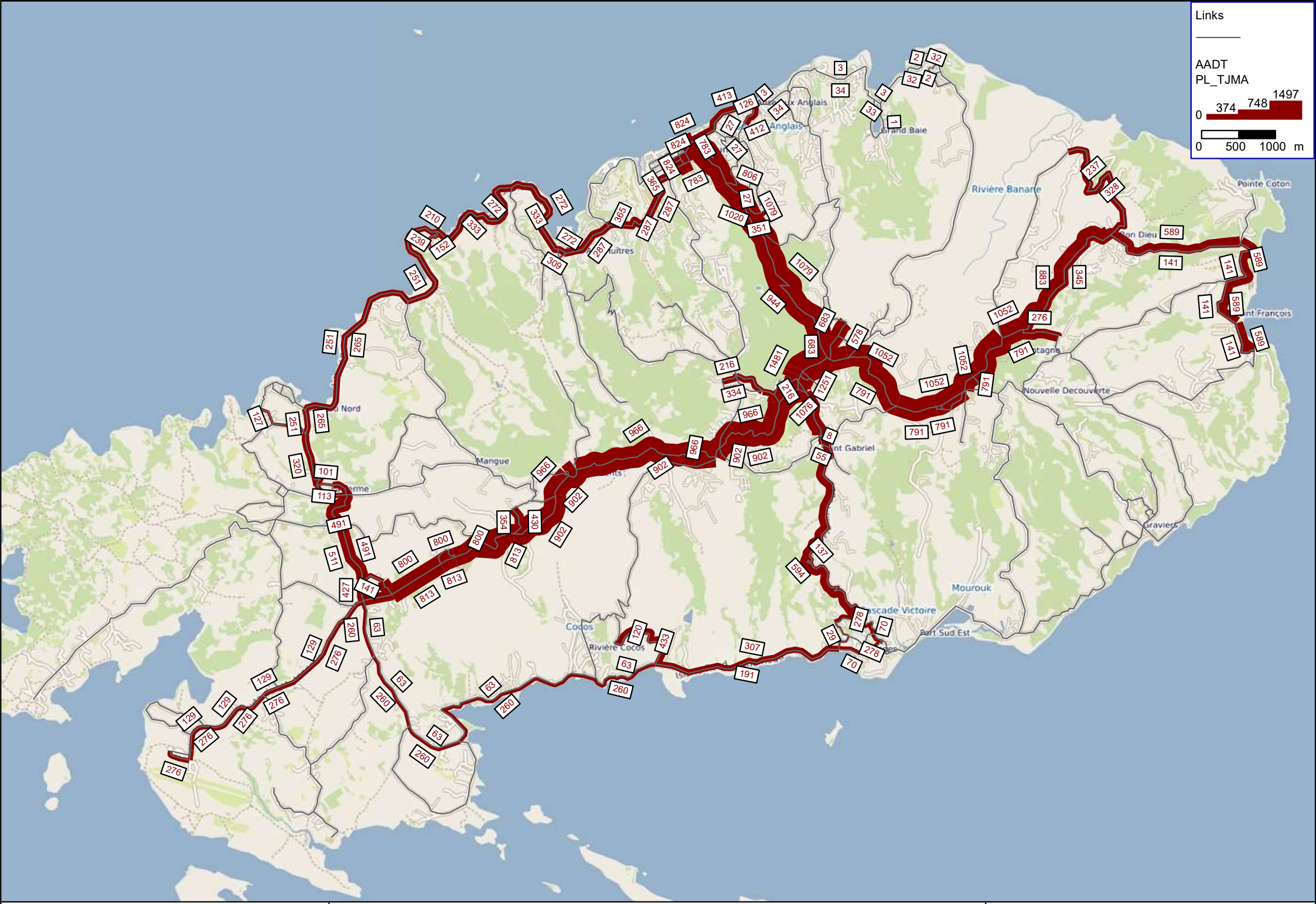

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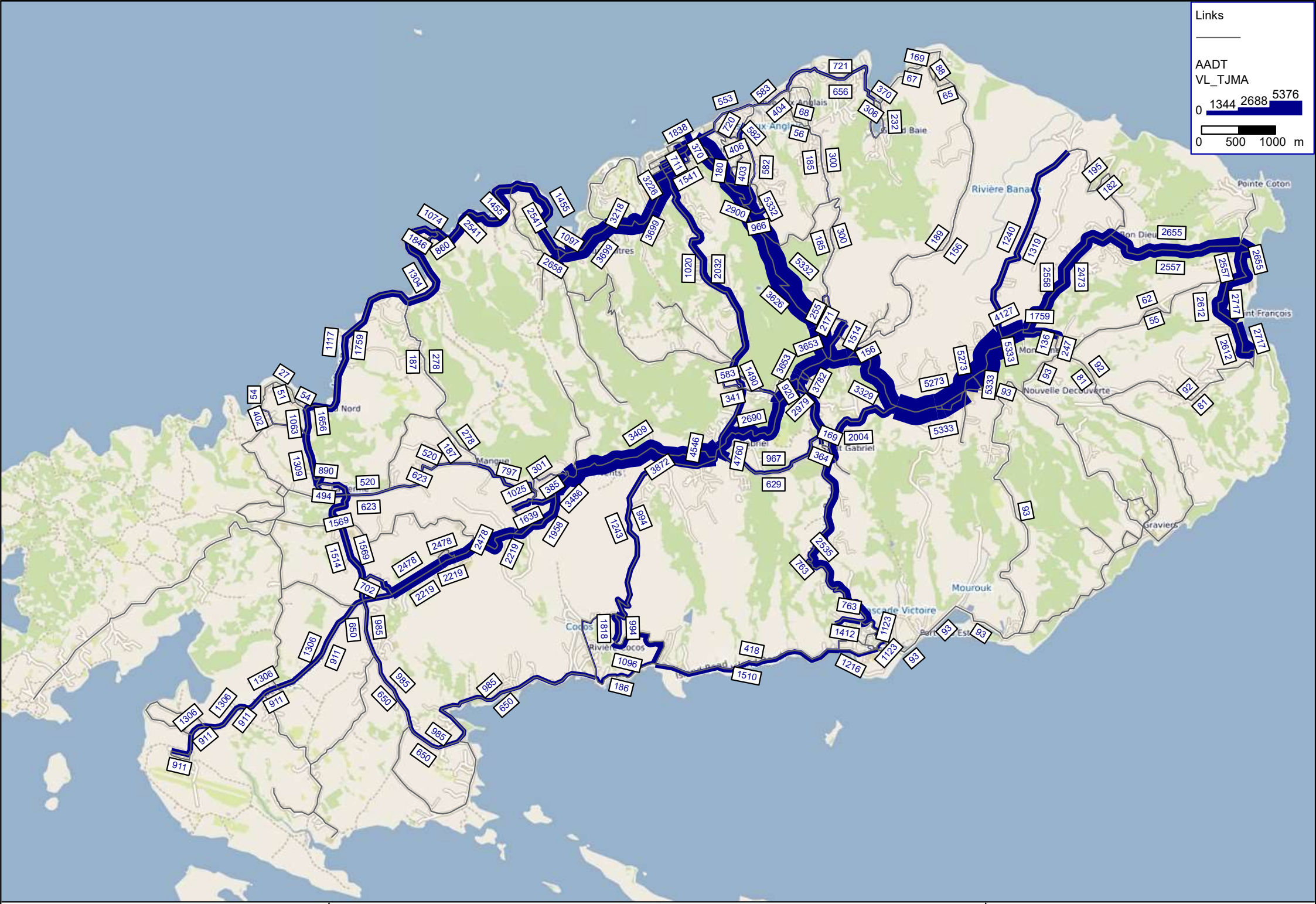

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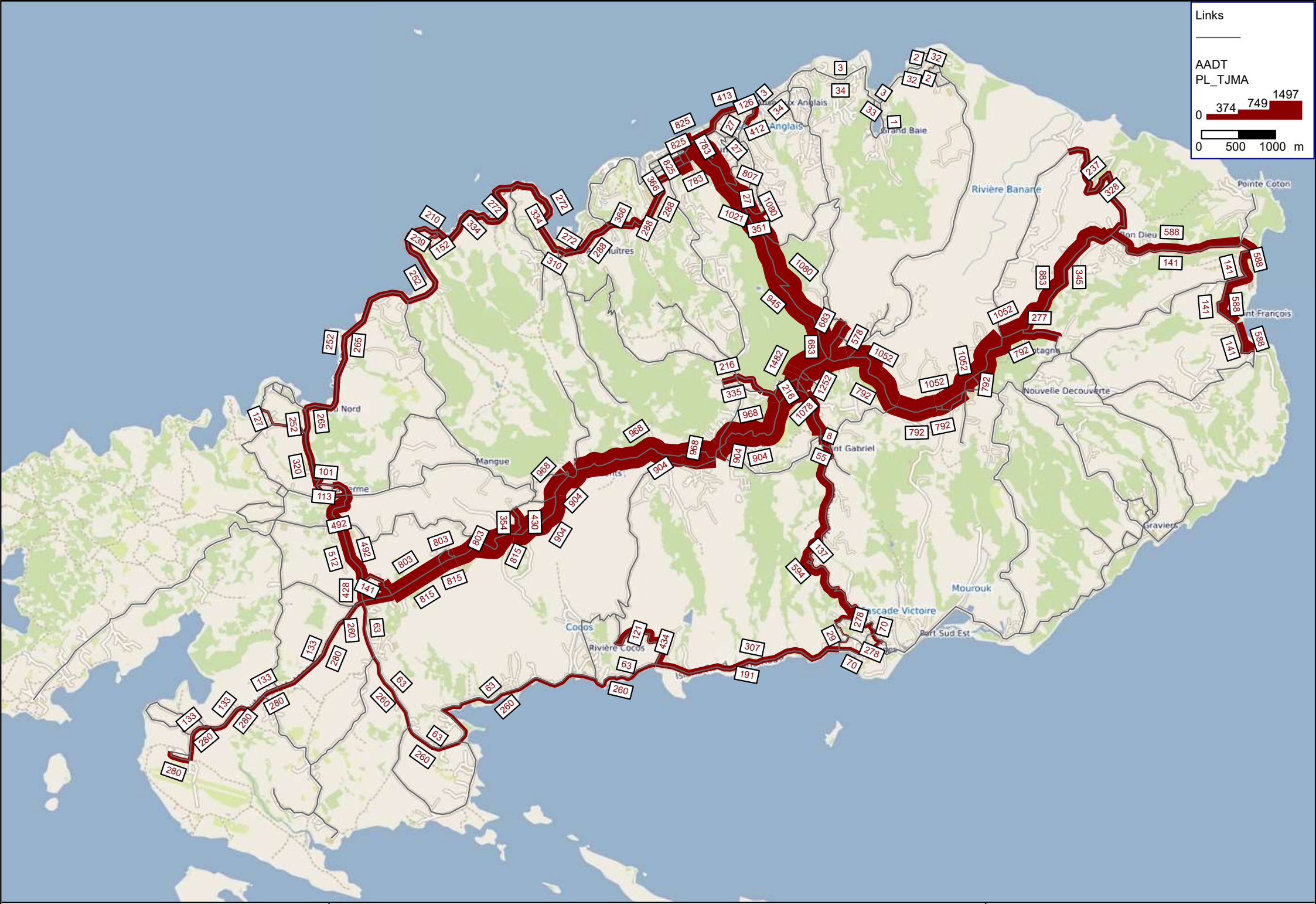

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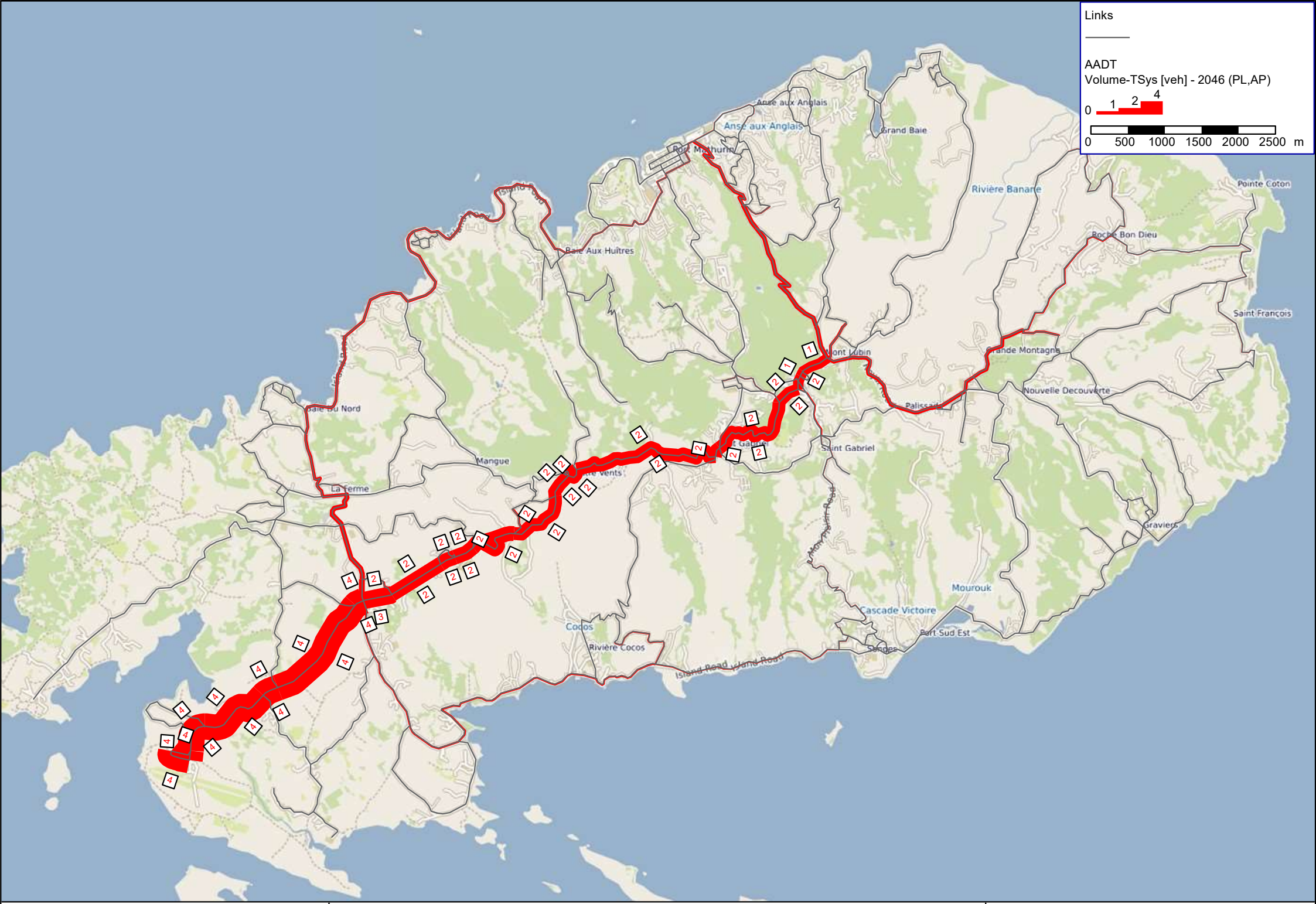

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Review

of

New Runway of Plaine Corail Airport Environmental and Social Impact Assessment Report

As part of Gap Analysis to Suit the new requirements

CONTROLLED DOCUMENT

Title:	**Review of** **New Runway of Plaine Corail Airport Environmental and Social Impact Assessment Report** **As part of Gap Analysis to Suit the new requirements**
Document No:	2022/1081/06/R01

Status:	APPROVAL	*Copy No:*	

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Prepared by:	B.Dabee		19 Dec 2022
Checked by:	B.Dabee		19 Dec 2022
Approved by:	B.Dabee		19 Dec 2022

Revision Record

Rev.	*Date*	*By*	*Summary of Changes*	*Chkd*	*Aprvd*

B. Dabee
VAT 17252628 BRN I13007370
B. Tech (Hons), MSc, DIC, LLB (Hons)
C.Eng MICE (UK) MIStructE (UK) RPEM No 688
Consulting Civil & Structural Engineer

Contents

1.0 Introduction

The aim of this report is to update the existing Environmental and Social Impact Assessment Report (ESIA) to address the gaps identified to meet the requirements of the World Bank ESF in addition to the legislative requirements of the Republic of Mauritius with particular reference to the geological aspects.

2.0 Methodology

The assessment shall be carried out as follows

(a) Review the current ESIA report to understand the baseline information presented in 2019 with particular reference to the geological information.

(b) Understand the most recent proposal for the construction of the new runway including proposed position and physical characteristics.

(c) Align the requirements as laid down in the latest design guidance and statutory requirements

3.0 Reference

D.A. Burney, J.P. Hume, G.J. Middleton, L. Steel, L.P. Burney and N. Porch (2015) – Stratigraphy and chronology of karst features on Rodrigues Island, Southwestern Indian Ocean. Journal of Cave and Karst Studies, v. 77, no. 1, p. 37–51.

SETEC Ltd (2019). New Runway of Plaine Corail Airport Environmental and Social Impact Assessment Report prepared for Airport of Rodrigues Ltd. Report prepared by Setec / Reference – 01245162 Dated 04 November 2019.

World Bank Group (2017) Environmental, Health, and Safety Guidelines Ports, Harbors, and Terminals.

4.0 Review

The current ESIA report section ***6.3.4.1.4 :Geology of the restricted area of influence*** provides details about the geology of the area. That section was largely developed based on the investigations carried out in three stages from January 2017 to September 2018.

The works carried out provided enough information to understand the ground model within that area. The intrusive works show that the area consists of the following

(a) Calcarenites – composed of alternating fine to coarse sands and grained corals, separated by clayey beds (average thickness of 5 m),

(b) Basalts – composed, from top to bottom of Basalt series, of highly to slightly weathered basalts, with high plasticity silty clays with intervals of gravels and cobbles (average thickness of 9.5m),

(c) Breccias – composed of highly weathered breccia, often located beneath Calcarenite deposits up to depths of 10 m, with high plasticity silty clays and medium to fine gravels of weathered basalts (average thickness of 3 m).

Sections drawn across the site shows that the Calcarenites layer varies from the St Marie mount area increases towards the coastline.

Ground penetrating radar (GPR) surveys were carried out over the area and revealed that **541 voids** were determined this way, but more can be found deeper. Over the **541 voids determined with the following distribution:**

- none are found between 0 and 5 m below the surface.
- 11% are found between 5 and 10 m
- 38 % between 10 and 15m,
- 30% between 15 and 20
- 21% beyond 20 m.

Most of voids are thus located between 10 and 20 m below the surface. The effect of karstic dissolution in the formation of the voids identified was not investigated considering the absence of ground water monitoring.

5.0 Proposed Development

With the current alignment as shown in figure 1, it was noted towards the South East end of the run way, a number of significant geological features were identified including caves. In addition, part of the proposed structure shall be constructed beyond the coastline. It has been noted the geotechnical investigation carried out was focused mainly onshore.

Figure 1: Proposed Development and Location of the New Runway

6.0 Assessment

Following previous works, karstic cave networks have been mapped in the region (Burney, et al. 2015), and surface observation suggests that the Plaine Corail likely contains similar karstic features. Karstic features near the project, as reported by Burney, et al. and observed on the site during their site works, include Grotte Fougere, Caverne Bouteille, Petit Lac and 2No. small surface voids found to the south east of the investigations site near Anse Quitor (Table 1).

Name	Coordinates	
	Northing (m)	Easting (m)
Caverne Bouteille (Cave)	539185.5	7814474.6
Petit Lac (Pond)	539361.2	7814206.8
Grotte Fougere (Cave)	539434.4	7814129.2
Surface Void 01	539195.0	7814306.0
Surface Void 03	539270.0	7814100.0

Caverne Bouteille is found approximately 240m from the proposed new runway thus may have any impact on the proposed project. Grotte Fougere is a partially collapsed cave containing a small pond beneath the cave overhang. Petit Lac is a natural depression (Pond) containing no significant sediment accumulation.

Review of the works carried out suggest that the caves may extend with a network tunnels. The extent of the tunnels need to be investigated in detail so as to assess the implication of the proposed runway and associated embankments on the underground features.

In addition, it has been noted that the footprint of graded area to the runway shall extend beyond the existing coastline over a length of about 500m. Construction of that portion shall entail the following

(a) Construction of a suitable earth retaining structure

(b) Land reclamation over an area of about 500m long by about 50m wide to form the graded area to the runway.

(c.) Proposed Construction of new buildings on the slope of Mont Travers.

Proposed Development and Location of the New Runway

Figure 2: Positions of ground features in the South East of the Site associated with Karstic Ground Conditions

7.0 Recommendations

The following works are recommended to be carried out

(a) Further assessment of underground ground features associated with Karstic Action with particular reference to the identified caves.

It is strongly recommended to carry out additional GPR surveys in area adjacent to the ground features to assess the existence of underground ground features. The GPR shall be specified to have an accurate model. For example, with survey lines at centres not less than five metres, characteristics of the voids can be accurately mapped. The findings shall then be used to relate the likelihood of positions of these underground features (voids and tunnels) with the proposed locations of the runway and embankments.

(b) Assess impact of offshore works

Also, along the South East, with the proposed graded area embankment forming the runaway partly built beyond the existing coastline, it is recommended to carry out additional investigations offshore to not only determine the geotechnical design parameters but more importantly extend the ground models in that area. The new structure will have an implication on the coastal geomorphology and therefore must be investigated.

Figure 3: Blow up of Proposed Runway showing extent to be built offshore. Note Positions of ground features such as Petit Lac, Grotte Fougere and Cavern Bouteille

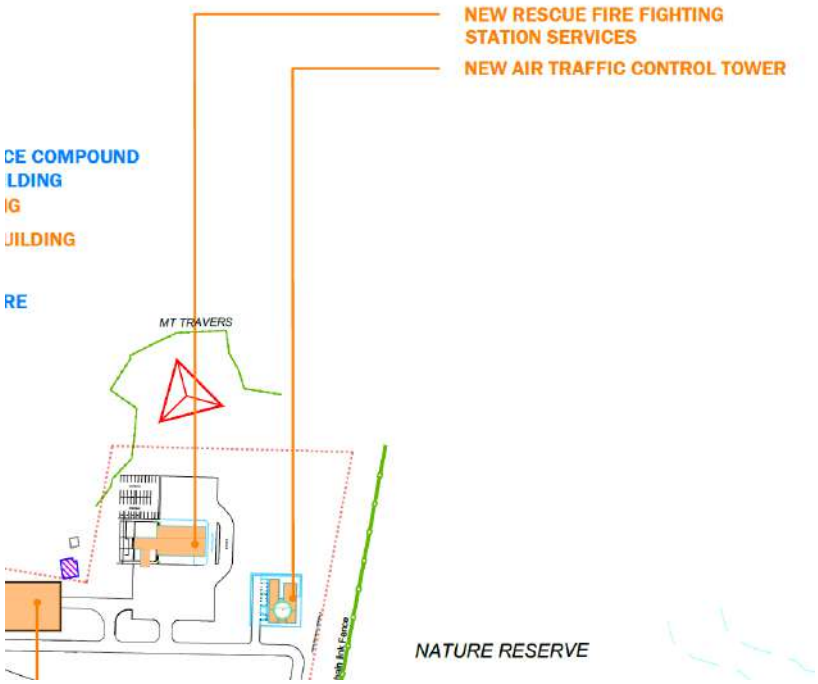

Figure 4: Proposed Development on the Slope of Mt Travers

Surveys, assessment, and modelling of metocean, hydrological, sedimentological and coastal geomorphological conditions should be carried out together with an identification of potential

adverse impacts on coastal processes such as erosion and accretion, from the placement of new earth retaining structures and land reclamation.

The design, siting considerations and coastal protection measures with particular reference to groynes and proposed seawalls shall be considered to minimize adverse impacts from these structures.

(c) Understand the impact of the land reclamation on the coast processes

As part of a coastal processes monitoring and management plan, projects should conduct a risk assessment of littoral sediment transport, shoreline morphology and erosion patterns and trends, and coastal inundation profiles.

In addition, the source of materials to carry out the land reclamation works shall be identified. Risk assessments shall be carried out to identify potential impact of such works and importing of materials from the source.

Airport of Rodrigues Ltd

Proposed Expansion of Rodrigues Airport

Noise and Air Quality Factual Report
For the purpose of the Environmental and Social Impact Assessment Report

Report Reference – 09053999

Prepared by

setec (Mauritius) Ltd

setec international

CIA CONSEIL INGÉNIERIE ACOUSTIQUE BUREAU D'ÉTUDES

CIA CONSEIL INGÉNIERIE AIR BUREAU D'ÉTUDES

16 May 2023

Report Prepared by

NAME	ROLE	COMPANY
ENVIRONMENTAL CONSULTANT TEAM		
Frederic TRANQUILLE	Project Director	SETEC (Mauritius) Ltd
SPECIALIST TEAM		
Samuel LAVEAUD / Pauline JAUSSERAND / Fanny Chagnet / Nathan Bétrancourt	Air Quality	SETEC INTERNATIONAL & specialist sub-consultant CIA
Samuel LAVEAUD / Pierre-Yves NADEAU / Kevin Podolak / Nathan Bétrancourt	Noise	SETEC INTERNATIONAL & specialist sub-consultant CIA

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0 Non-Technical Executive Summary

0.1 Introduction

Plaine Corail Airport in Rodrigues Island is managed by Airport of Rodrigues Ltd. (ARL), a subsidiary of the Airports of Mauritius Co. Ltd. (AML).

An Environmental and Social Impact Assessment for the New runway at Plaine Corail Airport in Rodrigues Island was prepared in 2019 to meet the requirements of the Government of Mauritius and those of the Agence Française de Développement (AFD) and the European Union (EU).

Airport of Rodrigues Ltd is now proposing to seek financing support from the World Bank for the proposed expansion of the Rodrigues Airport, and is therefore required to update the ESIA to meet the requirements of the World Bank Environmental and Social Framework (ESF).

The precedent factual baseline air quality and noise study report was an interim report prepared in 2019.

The factual baseline air quality and noise study is updated in the present report (April 2023) following a field survey that took place in March 2023 in Rodrigues.

0.2 Environmental and social baseline conditions

0.2.1 Air quality and noise

The following map shows the location of the population living near Plaine Corail airport. It was based on field visits and analysis of aerial photographs. As residential buildings are sparse, the populations exposed to noise and pollution are limited. Yet, it should be noted that a school is located to the east of the airport and requires special attention. In general terms, the buildings and sites sensitive to noise and pollution are homes, schools, hospitals, and areas dedicated to sports.

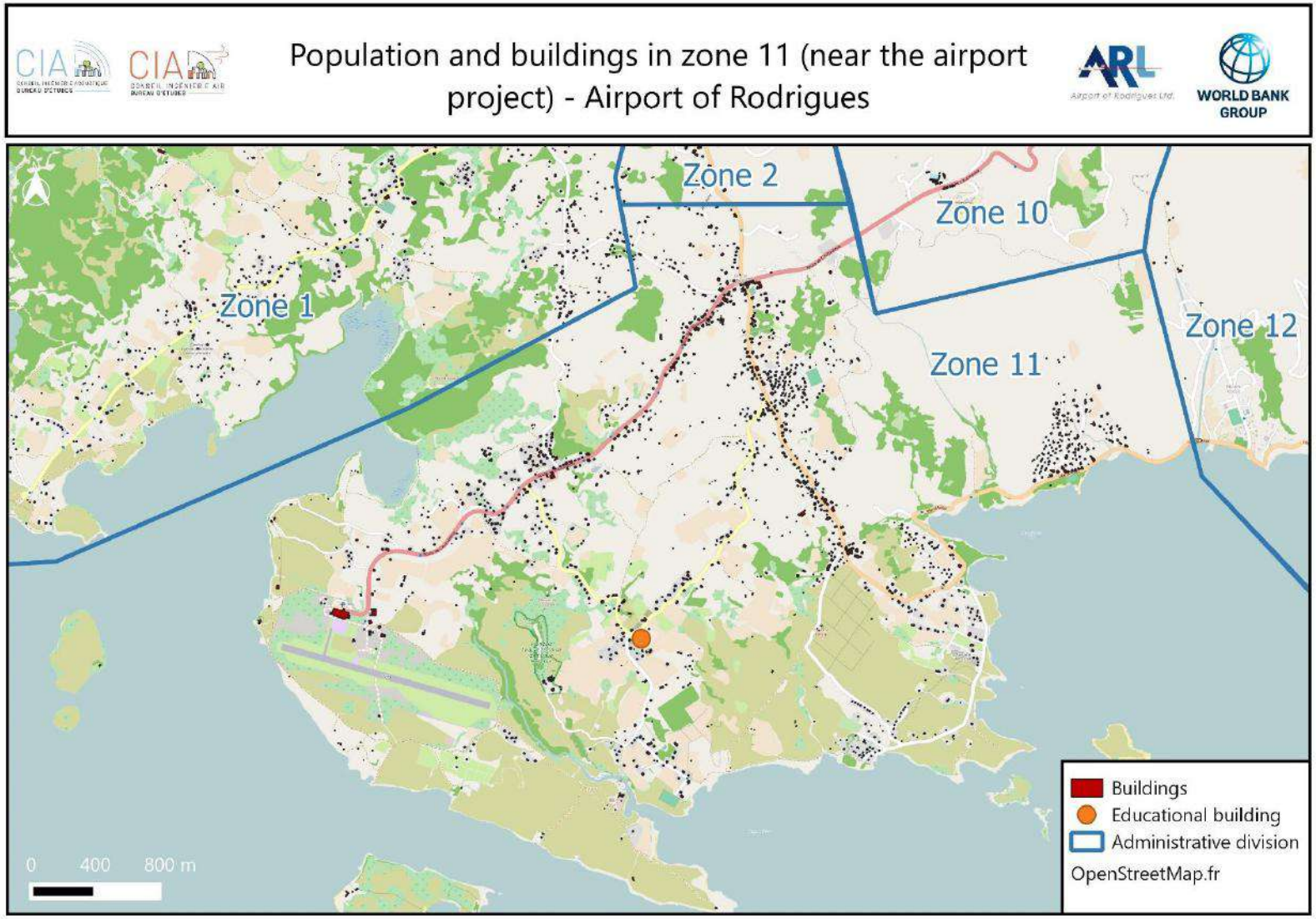


Figure 1: Building location map and administrative division

0.2.1.1 Air quality

The air quality issue is due to the presence of sensitive populations living nearby and of the pre-primary school Le Caneton (located near Anse Quitor). The presence of agricultural parcels is also to be taken into account.

The aircraft traffic and road traffic growth could lead to a significant increase in pollutant emissions.

0.2.1.2 Noise

The noise issue is due to the presence of sensitive populations living nearby and of the pre-primary school Le Caneton.

The aircraft traffic and road traffic growth could lead to a significant increase in noise.

0.2.1.3 Summary: air and noise sensitivity

Table 1: Summary of Air and Noise Sensitivity

Sub-theme	Receptor	Sensitivity
Air quality	Population exposed	High
Noise	Population exposed	High

0.2.2 Final ESIA

The following is to be addressed within the updating exercise of the ESIA (2023):

Update the noise baseline and impact assessment modelling, including maximum noise values, sampling points near the airport, identification of landing/take off events and aircraft types; consider noise from airport ground equipment and the ambient acoustic baseline.

The noise impact assessment will be updated where necessary.

Relevance of baseline update will be discussed in the light of possible changes in the built environment. Displacement of population do not necessarily warrant a baseline update.

On the other hand, the modelling may be reviewed in the light of design considerations (substantial changes from 2019 concept design) and the impact assessment reviewed in the light of the changes in the built environment.

The final ESIA shall further assess the impacts associated with noise based on the projected activities and propose mitigation measures based on ICAO requirements, and long-term noise monitoring plan. The ESMP will include a requirement for the preparation of a noise monitoring plan to be developed for both construction and operational phases.

1 Introduction

The project refers to the Expansion of Rodrigues airport located at Plaine Corail, Rodrigues, a constituent island of the Republic of Mauritius.

With a runway length of 1200 m, the largest aircraft that it can accommodate currently is the ATR 72, which carries passengers only. The number of flights at PCA amounts to three per day during the low season and can rise to a maximum of twelve flights during the peak season which coincides with the Christmas and New Year holidays.

The airport is managed by Airport of Rodrigues Ltd. (ARL), a subsidiary of the Airports of Mauritius Co. Ltd. (AML).

Due to its remote location, 620 kilometres from Mauritius, air transport is vital to the island in every respect and particularly important from a social and economic perspective. Rodrigues Island, through the Rodrigues Regional Assembly, wishes to increase the capacity of its airport in order to accommodate the A321 Neo / B737 aircraft type, which carries up to a maximum of 244 passengers and is capable of transporting cargo.

The objectives of the construction of the new longer runway as well as the associated facilities and amenities, are to:

- provide Rodrigues with an efficient, reliable, safe and affordable air transport facility to improve the national, regional and international connectivity and accessibility of the island;
- contribute to its social and economic development in key economic sectors such as tourism, agriculture, and fishery.

The initial Environmental and Social Impact Assessment report 2019 had two objectives:

- Compliance to the procedure for obtaining the EIA Licence from the Government of Mauritius
- Evaluation of the environmental and social impacts of the project in line with the requirements of the two Funding Agencies: Agence Française de Développement (AFD) and the European Union (EU).

Airport of Rodrigues Ltd is now proposing to seek financing support from the World Bank for the proposed expansion of the Rodrigues Airport, and is therefore required to update the ESIA 2019 to meet the requirements of the World Bank Environmental and Social Framework (ESF).

The precedent factual baseline air quality and noise study report was an interim report prepared in 2019.

The factual baseline air quality and noise study is updated in the present report (April 2023) following a field survey that took place in March 2023 in Rodrigues.

2 Legal and institutional framework applicable to Noise and Air Quality

2.1 Main National Legislation on Environmental Aspects

2.1.1 Main National Environmental Standards under the Environment Protection Act 2002

A number of Standards have been promulgated as Regulations under the EPA2002 (as amended); the following standards deemed applicable to the proposed project include, but are not limited to, the following:

2.1.1.1 Standards for Air

Standards are set under the Environment Protection (Standards for Air) Regulations 1998 (Government Notice No. 105 of 1998).

Table 2-1 below reproduced the First Schedule (Regulation 3): Emission Standards being the maximum limits for the corresponding pollutant.

Table 2-1: Environment Protection (Standards for Air) Regulations 1998 - Ambient Air Quality Standards

Pollutant	*Applicable to*	*Standard*
(i) Smoke	All stationary fuel burning source	Ringelmann No. 2 or equivalent opacity (not to exceed more than 5 minutes in any period of one hour)
(ii) Solid particles	(a) Any trade, industry, process, industrial plant or fuel-burning equipment (b) Any existing trade, industry, process or industrial plant using bagasse as fuel	200 mg/m^3 400 mg/m^3
(iii) Sulphuric acid mist or sulphur trioxide	(a) Any trade, industry or process (other than combustion processes and plants for the manufacture of sulphuric acid) (b) Any trade, industry or process in which sulphuric acid is manufactured	120 mg/m^3 as sulphur trioxide 30 000 mg/m^3 as sulphur trioxide
(iv) Fluorine compounds	Any trade, industry or process in the operation of which fluorine, hydrofluoric acid or any inorganic fluorine compounds are emitted	100 mg/m^3 as hydrofluoric acid
(v) Hydrogen Chloride	Any trade, industry or process	200 mg/m^3 as hydrogen chloride
(vi) Chlorine	Any trade, industry or process	100 mg/m^3 as chlorine
(vii) Hydrogen sulphide	Any trade, industry or process	5 ppm as hydrogen sulphide gas
(viii) Nitric acid or oxides of nitrogen	Any trade, industry or process in which the manufacture of nitric acid is carried out	2 000 mg/m^3 as nitrogen dioxide
(ix) Nitric acid or oxides of nitrogen	Any trade, industry or process other than nitric acid plant	1 000 mg/m^3 as nitrogen dioxide

Pollutant	*Applicable to*	*Standard*
(x) Carbon monoxide	Any trade, industry or process	1 000 mg/m^3 as carbon monoxide

Table 2-2 below reproduced the Second Schedule (Regulation 5): Ambient Air Quality Standards and Measurement Methods

Table 2-2: Environment Protection (Standards for Air) Regulations 1998 - Ambient Air Quality Standards

Ambient Pollutant	*Standard (ug/m^3) maximum*	*Averaging Time*	*Measurement Method**
Total Suspended Particles PM10	150 50 100	24-hour Annual average 24-hour	Hi-volume Sampler Hi-volume Sampler
Sulphur Dioxide	350 200 50	1-hour 24-hour Annual average	Fluorescence SO_2 Analyzer, Colorimetry
Nitrogen Dioxide	200	24-hour	Sodium Arsenite, Chemiluminescence
Carbon Monoxide	25,000 10,000	1-hour 8-hour	Nondispersive Infrared Photometry
Lead	1.5	3-month average	Hi-volume Sampler with Atomic Absorption
Ozone	100	1-hour	Ozone Analyzer, Chemiluminescence
* The measurement methods are those indicated or other methods acceptable to the enforcing agency.			

2.1.1.2 Standards for Noise

Standards are set under the Environment Protection (Environmental Standards for Noise) Regulations 2022 (Government Notice No. 250 of 2022). Control of Noise is regulated by the Environment Protection (Control of Noise) Regulations 2022 (Government Notice No. 251 of 2022).

Table 2-3 below reproduces the Schedule (Regulation 3): Noise Exposure Limits

Table 2-3: Environment Protection (Environmental Standards for Noise) Regulations - Noise Exposure Limits

Noise Type	*Time*	*Noise Exposure Limits In dB(A) Leq*
Industrial Noise	07.00 - 21.00 hrs 21.00 - 07.00 hrs of following day	60 * 55 *
Neighbourhood Noise	7.00 - 18.00 hrs 18.00 - 21.00 hrs 21.00 – 07.00 hrs of following day	60 55 50
Power Station Noise In residential area	07.00 - 21.00 hrs 21.00 - 07.00 hrs of following day	60 55
Power Station Noise In any other area	At any time	70

*Apply a tonal character adjustment of +5 dB(A) to the measured value where the noise has a definite continuous note such as a whine or hiss

Note that “neighbourhood noise’’ does not include noise made by an aircraft or traffic.

2.2 International Guidelines and Standards

2.2.1 World Bank Group Environment, Health, and Safety Guidelines

1. The World Bank Group General Environmental, Health and Safety Guidelines (EHSG)

The Environmental, Health and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). They contain the performance levels and measures that are normally acceptable to the World Bank Group, and that are generally considered to be achievable in new facilities at reasonable costs by existing technology. They are used by the World Bank, IFC and MIGA

The General EHS Guidelines contain the following information:

1. Environmental 1.1 Air Emissions and Ambient Air Quality 1.2 Energy Conservation 1.3 Wastewater and Ambient Water Quality 1.4 Water Conservation 1.5 Hazardous Materials Management 1.6 Waste Management 1.7 Noise 1.8 Contaminated Land	2. Occupational Health and Safety 2.1 General Facility Design and Operation 2.2 Communication and Training 2.3 Physical Hazards 2.4 Chemical Hazards 2.5 Biological Hazards 2.6 Radiological Hazards 2.7 Personal Protective Equipment (PPE) 2.8 Special Hazard Environments 2.9 Monitoring
3. Community Health and Safety 3.1 Water Quality and Availability 3.2 Structural Safety of Project Infrastructure 3.3 Life and Fire Safety (L&FS) 3.4 Traffic Safety 3.5 Transport of Hazardous Materials 3.6 Disease Prevention 3.7 Emergency Preparedness and Response	4. Construction and Decommissioning 4.1 Environment 4.2 Occupational Health and Safety 4.3 Community Health and Safety

The following guidelines/standards are provided in the General EHSG:

Ambient Air Quality. Projects with significant sources of air emissions, and potential for significant impacts to ambient air quality, should prevent or minimize impacts by ensuring that Emissions do not result in pollutant concentrations that reach or exceed relevant ambient quality guidelines and standards by applying national legislated standards, or in their absence, the current WHO Air Quality Guidelines (2021) shown in table 2-4 below.

Table 2-4: WHO Ambient Air Quality Guidelines - 2021

Unit	*Pollutant*	*Averaging Period*	*Guideline value in µg/m³*
µg/m³	**Sulphur Dioxide** SO_2	24-hour[a]	125 (Interim target-1) 50 (Interim target-2) 40 (guideline)
		10 minute	500 (guideline)
	Nitrogen Dioxide NO_2	1-year	40 (Interim target-1) 30 (Interim target-2) 20 (Interim target-3) 10 (guideline)
		24-hour[a]	120 (Interim target-1) 50 (Interim target-2) 25 (guideline)
		1-hour	200 (guideline)
	Particulate Matter PM_{10}	1-year	70 (Interim target-1) 50 (Interim target-2) 30 (Interim target-3) 20 (Interim target-4) 15 (guideline)
		24-hour[a]	150 (Interim target-1) 100 (Interim target-2) 75 (Interim target-3) 50 (Interim target-4) 45 (guideline)
	Particulate Matter $PM_{2.5}$	1-year	35 (Interim target-1) 25 (Interim target-2) 15 (Interim target-3) 10 (Interim target-4) 5 (guideline)
		24-hour[a]	75 (Interim target-1) 50 (Interim target-2) 37.5 (Interim target-3) 25 (Interim target-4) 15 (guideline)
	Ozone O_3	Peak season[b]	100 (Interim target-1) 70 (Interim target-2) 60 (guideline)
		8-hour[a]	160 (Interim target-1) 120 (Interim target-2) 100 (guideline)
mg/m³	**Carbon monoxide** CO	24-hour[a]	7 (Interim target-1) 4 (guideline)
		8-hour	10
		1-hour	35
		15-minute	100

Note [a] : 99th percentile (with 3-4 exceedance days per year)

Note [b] : Average of daily maximum 8-hour mean O_3 concentration in the six consecutive months with the highest six-month running-average O_3 concentration.

Note : interim targets are provided in recognition of the need for a staged approach to achieving the recommended guidelines.

Noise Level Guidelines. Noise impacts should not exceed the levels presented in Table 4-14 or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site

Table 2-5: Noise Level Guidelines

	One Hour L_{Aeq} (dBA)	
Receptor	Day time 07:00 - 22:00	Night time 22:00 - 07:00
Residential; institutional; educational	55	45
Industrial; commercial	70	70

2. The World Bank Group EHSG for Airports projects

This EHS Guidelines for Airports apply to the operation of commercial airports. It provides a summary of EHS issues associated with airports which occur during the operational phase, along with recommendations for their management. This document is organized according to the following sections:

1) Section one provides information about industry-specific impacts and management;

2) Section two describes performance indicators and monitoring; and

3) Section three concludes with references

Standards applicable are those provided in the General EHS Guidelines.

3. The World Bank Group EHSG

The EHS Guidelines for Waste Management cover facilities or projects dedicated to the management of municipal solid waste and industrial waste, including waste collection and transport; waste receipt, unloading, processing, and storage; landfill disposal; physico-chemical and biological treatment; and incineration projects.

These Guidelines provide the following specific Standards related to Air Quality:

- Air Emission Standards for Municipal Solid Waste Incinerators in the EU and US
- Air Emission Standards for Hazardous Waste Incinerators in the EU and US
- Air Emission Standards for Industrial Non-Hazardous Waste Incinerators in the EU

4. Local standards

Local standards about air quality are set in the Environment Protection Act (1998) and are presented below.

Table 2-6: Air Quality regulations

First Schedule ***(regulation 3)***

Emission Standards

The following standards are maximum limits for the corresponding pollutant.

Pollutant	*Applicable to*	*Standard*	Applies to project (construction / operational phase)
(i) Smoke	All stationary fuel burning source	Ringelmann No. 2 or equivalent opacity (not to exceed more that 5 minutes in any period of one hour)	X
(ii) Solid particles	(a) Any trade, industry, process, industrial plant or fuel-burning equipment	200 mg/m^3	X
	(b) Any existing trade, industry process or industrial plant using bagasse as fuel	400 mg/m^3	
(iii) Sulphuric acid mist or sulphur trioxide	(a) Any trade, industry or process (other than combustion processes and plants for the manufacture of sulphuric acid)	120 mg/m^3 as sulphur trioxide	X
	(b) Any trade, industry or process in which sulphuric acid is manufactured	30 000 mg/m^3 as sulphur trioxide	
(iv) Fluorine compounds	Any trade, industry or process in the operation of which fluorine, hydrofluoric acid or any inorganic fluorine compounds are emitted	100 mg/m^3 as hydrofluoric acid	X
(v) Hydrogen Chloride	Any trade, industry or process	200 mg/m^3 as hydrogen chloride	X
(vi) Chlorine	Any trade, industry or process	100 mg/m^3 as chlorine	X
(vii) Hydrogen sulphide	Any trade, industry or process	5 ppm as hydrogen sulphide gas	X
(viii) Nitric acid or oxides of nitrogen	Any trade, industry or process in which the manufacture of nitric acid is carried out	2 000 mg/m^3 as nitrogen dioxide	
(ix) Nitric acid or oxides of nitrogen	Any trade, industry or process other than nitric acid plant	1 000 mg/m^3 as nitrogen dioxide	X
(x) Carbon monoxide	Any trade, industry or process	1 000 mg/m^3 as carbon monoxide	X

SECOND SCHEDULE **(***regulation 5)*

Ambient Air Quality Standards and Measurement Methods

Ambient Pollutant	*Standard (ug/m3) maximum*	*Averaging Time*	*Measurement Method**
Total suspended particles	150 50	24-hour Annual average	Hi-volume Sampler
PM10	100	24-hour	Hi-volume Sampler
Sulphur Dioxide	350 200 50	1-hour 24-hour Annual average	Fluorescence SO_2 Analyser, Colorimetry
Nitrogen Dioxide	200	24-hour	Sodium Arsenite, Chemiluminescence
Carbon Monoxide	25 10	1-hour 8-hour	Nondispersive Infrared Photometry
Lead	1.5	3-month average	Hi-volume Sampler with Atomic Absorption
Ozone	100	1-hour	Ozone Analyzer, Chemiluminescence

* The measurement methods are those indicated or other methods acceptable to the enforcing agency

3 Environmental and social baseline conditions

3.1 Air quality and noise environment

This chapter deals with noise and air quality. It aims at stating the current air quality and noise level around the airport, and to identify how the airport activity contributes to the ambient pollution and noise.

It aims at basing the assessment of the project impact on noise and air. During the construction, impacts might be due to work activities and road traffic for supplying the works. During the operational phase, air and noise pollution are due to the changes of air traffic and road traffic.

To assess the consequences on human health, the population exposed is first analysed.

3.1.1 Demography and exposed population

The following map shows the location of the population living near Plaine Corail airport. It was based on field visits and analysis of aerial photographs. As residential buildings are sparse, the populations exposed to noise and pollution are limited. Yet, it should be noted that a school is located to the east of the airport and requires special attention. In general terms, the buildings and sites sensitive to noise and pollution are homes, schools, hospitals, and areas dedicated to sports.

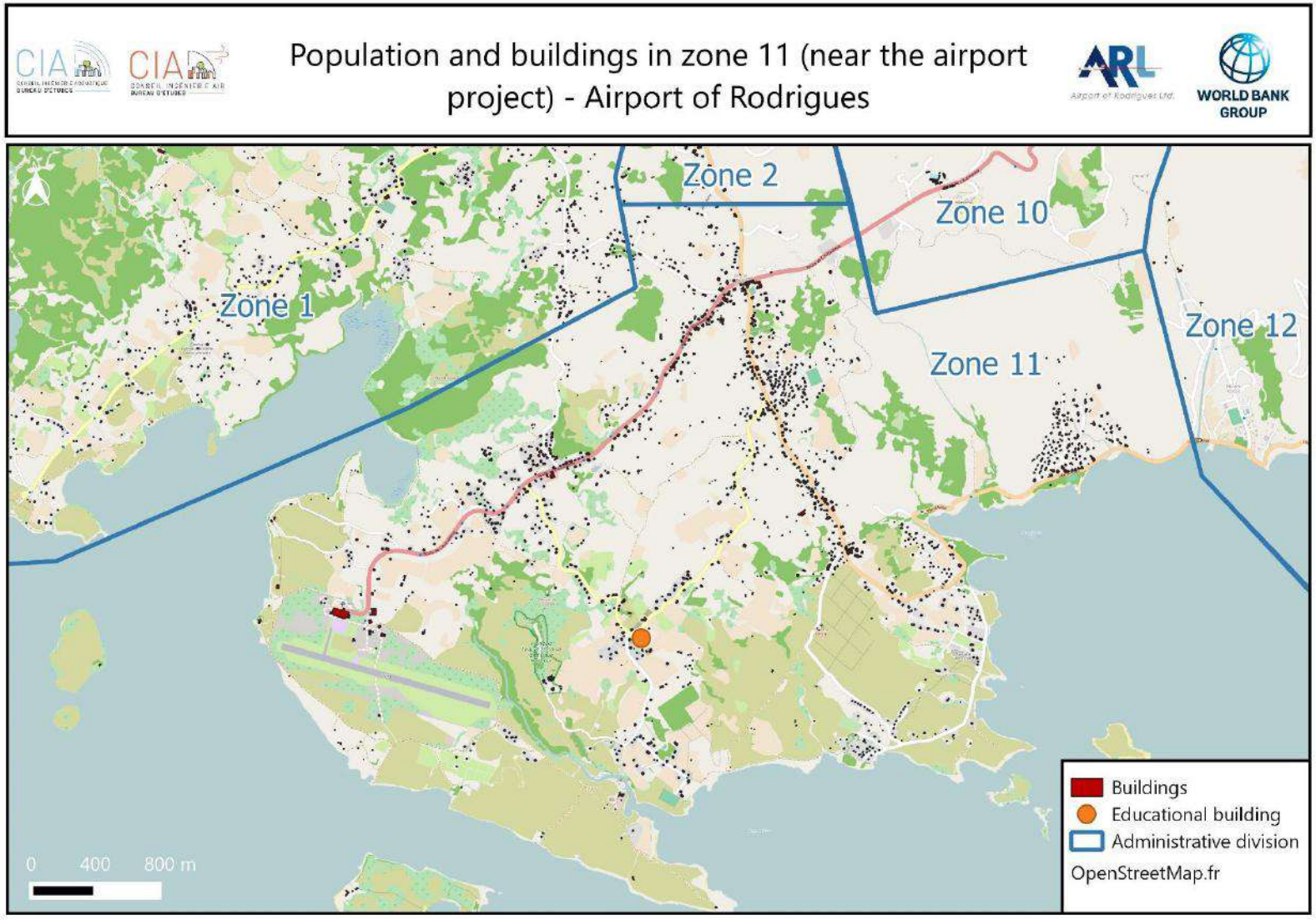


Figure 2: Building location map and administrative division

3.1.2 Aircraft study methodology

The aircraft study is based on the following elements:

- 2022 traffic provided by Rodrigues Airport :
  - Aircraft type (ATR72-500 or Dornier 228) ;
  - Flight type: commercial, governmental, repatriation, other;
  - Scheduled hour of operation (departure or arrival);
  - Runway in use (30 or 12);

The following table and graphics describe the 2022 aircraft traffic at the Rodrigues Airport:

Table 3-1: 2022 Airport traffic's statistics – Plaine Corail

Runway	Aircraft	Type	Path	Day 6am-6pm	Evening 6pm-10pm	Night 10pm-6am	Total
12	ATR72-500	Arrival	IMR/Visual	33,25%	12,81%	0,10%	46,17%
			NDB	1,75%	0,67%	0,01%	2,43%
		Departure	Direct	34,31%	14,18%	0,15%	48,63%
	Dornier 228	Arrival	IMR/Visual	0,59%	0,00%	0,00%	0,59%
			NDB	0,03%	0,00%	0,00%	0,03%
		Departure	Direct	0,55%	0,07%	0,00%	0,62%
30	ATR72-500	Arrival	IMR/Visual	0,48%	0,24%	0,00%	0,73%
			NDB	0,03%	0,01%	0,00%	0,04%
		Departure	Direct	0,47%	0,29%	0,00%	0,77%
	Dornier 228	Arrival	IMR/Visual	0,00%	0,00%	0,00%	0,00%
			NDB	0,00%	0,00%	0,00%	0,00%
		Departure	Direct	0,00%	0,00%	0,00%	0,00%
TOTAL				71,45%	28,29%	0,26%	2743 operations

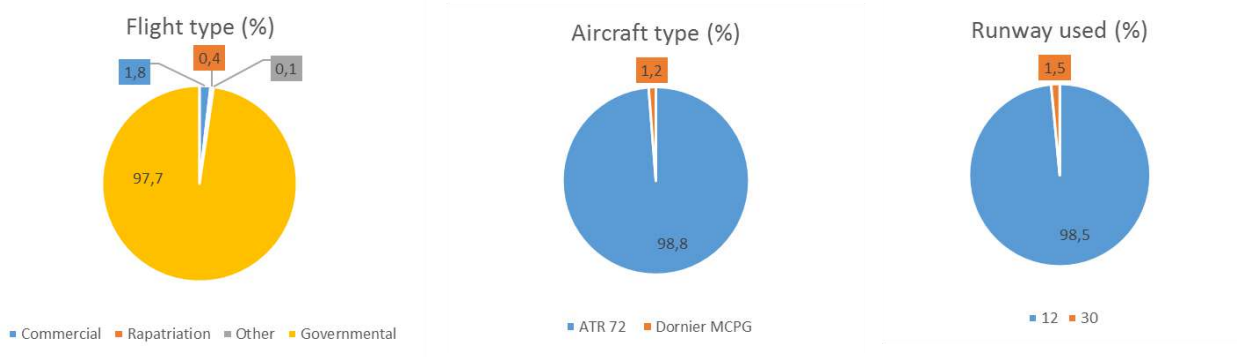


Figure 3: 2022 Airport traffic's statistics – Plaine Corail

- Average meteorological data : Temperature : 29,9°C ; Pressure (hypothetical) : 1013 HPa ; Humidity (hypothetical) : 77% ; Headwind (hypothetical) : 13,0 Kt;
- Technical information about the airport : Elevation : 93 ft ; distance and localisation of the runways;
- Statistical data about population:

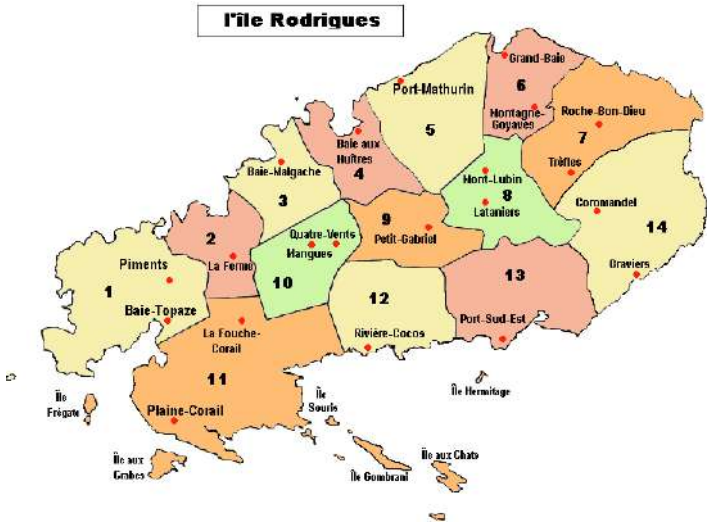


Figure 4: Population's data – administrative division

Table 3-2: Population's data

N°	Administrative Division	2000	2021	2023
1	Piments-Baie Topaze	1445	1794	1904
2	La Ferme	1112	1381	1465
3	Baie Malgache	1076	1336	1417
4	Baie-aux-Huîtres	2594	3221	3417
5	Port Mathurin	5929	7362	7810
6	Grand Baie-Montagne Goyaves	844	1048	1112
7	Roche Bon Dieu-Trèfles	2059	2557	2712
8	Lataniers-Mont Lubin	3806	4726	5014
9	Petit Gabriel	3658	4542	4819
10	Mangues-Quatre Vents	2870	3564	3781
11	Plaine Corail-La Fouche Corail	2832	3517	3731
12	Rivière Cocos	2893	3592	3811
13	Port Sud-Est	2717	3374	3579
14	Coromandel-Graviers	1944	2414	2561
TOTAL		**35779**	**44427**	**47133**

- The approach path (NDB 5%, IMR 90%, Visual 5%) or take-off path (because of the missing information about the take-off path, it is considered as a straight line) provided by the department of civil aviation of the Republic of Mauritius.

The following figures present the different paths:

(Note: It is hypothetically considered that the visual approach is the same path that IMR approach).

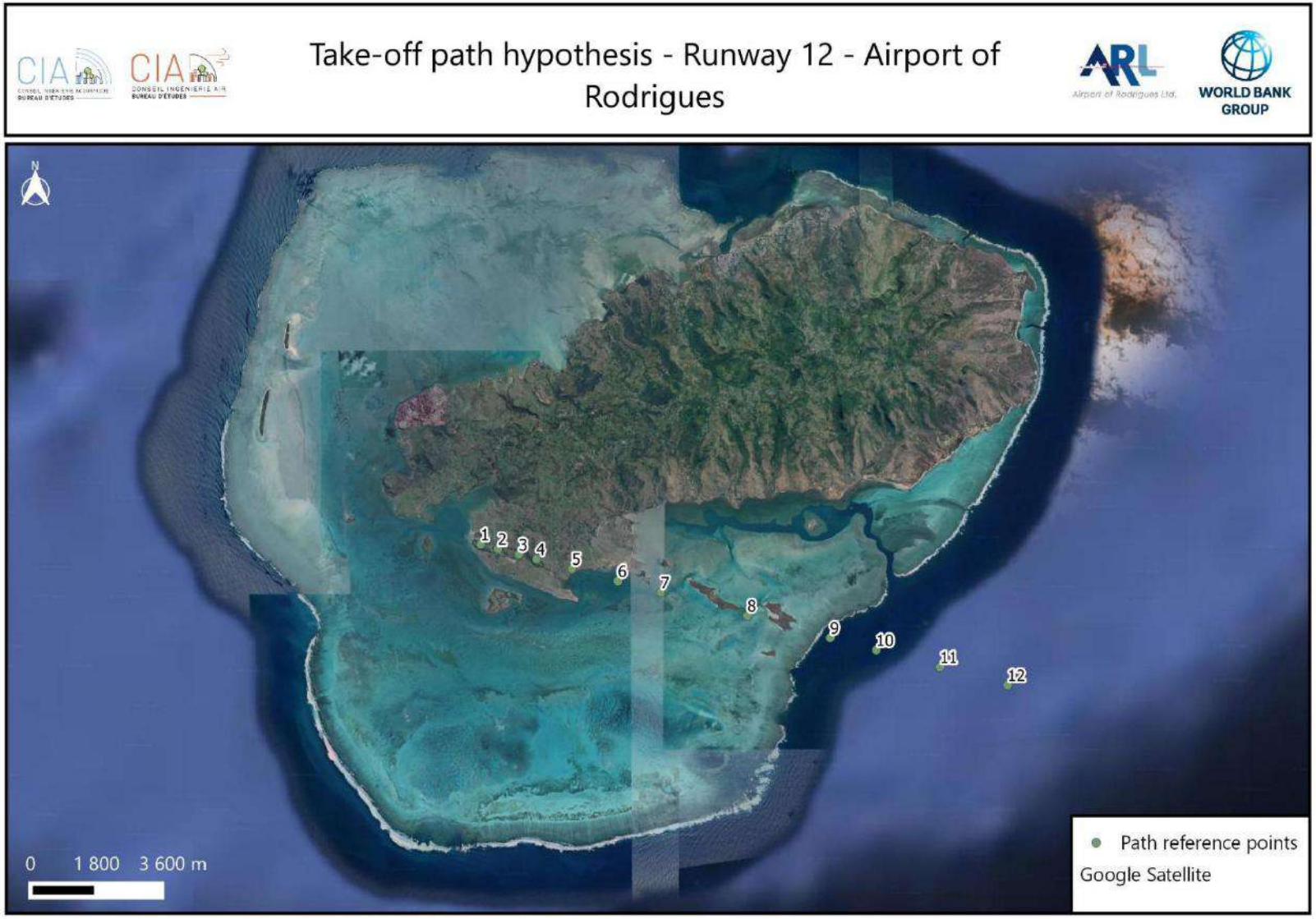


Figure 5 : Take-off path hypothesis – Runway 12 – Plaine Corail

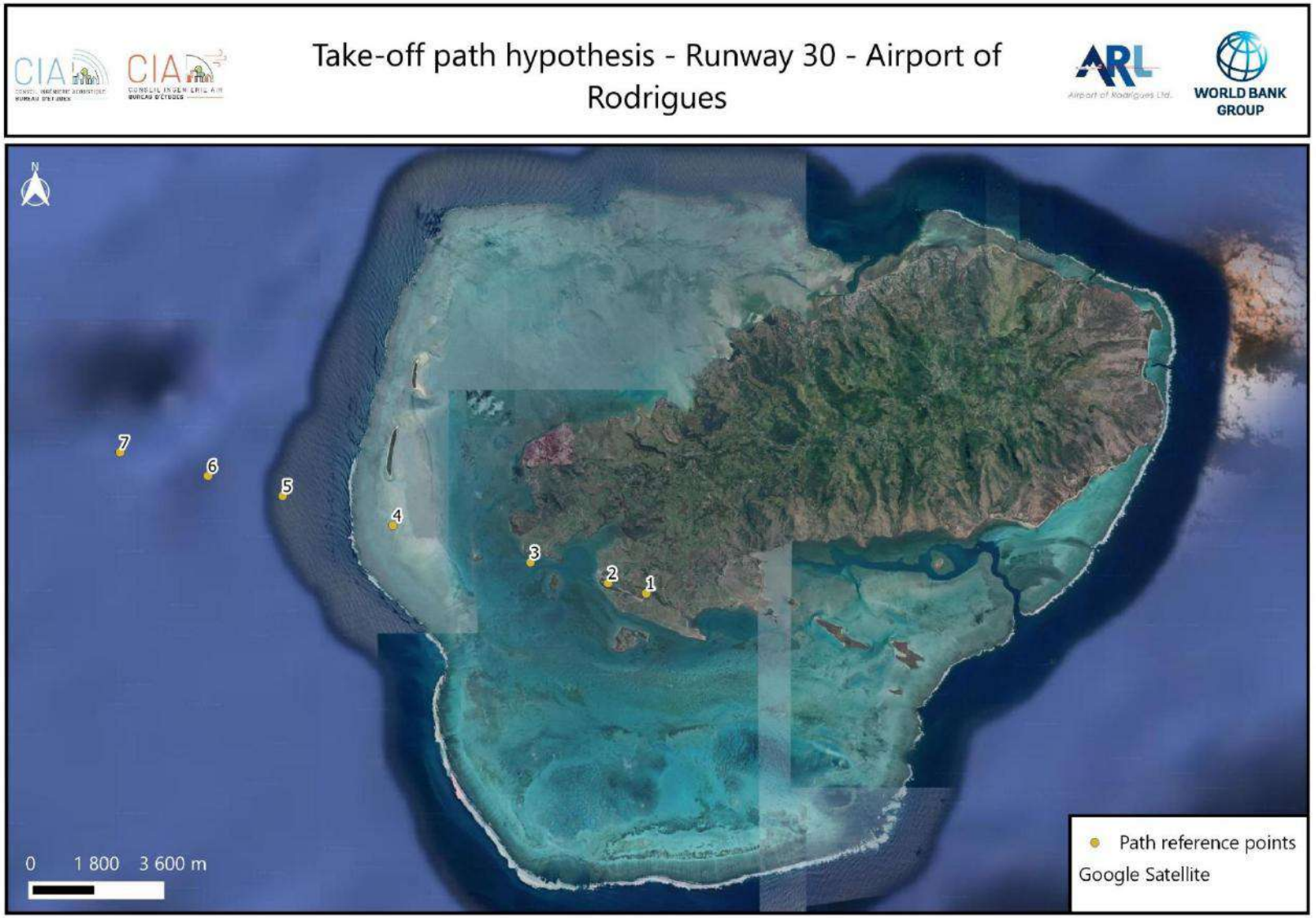


Figure 6: Take-off path hypothesis – Runway 30 – Plaine Corail

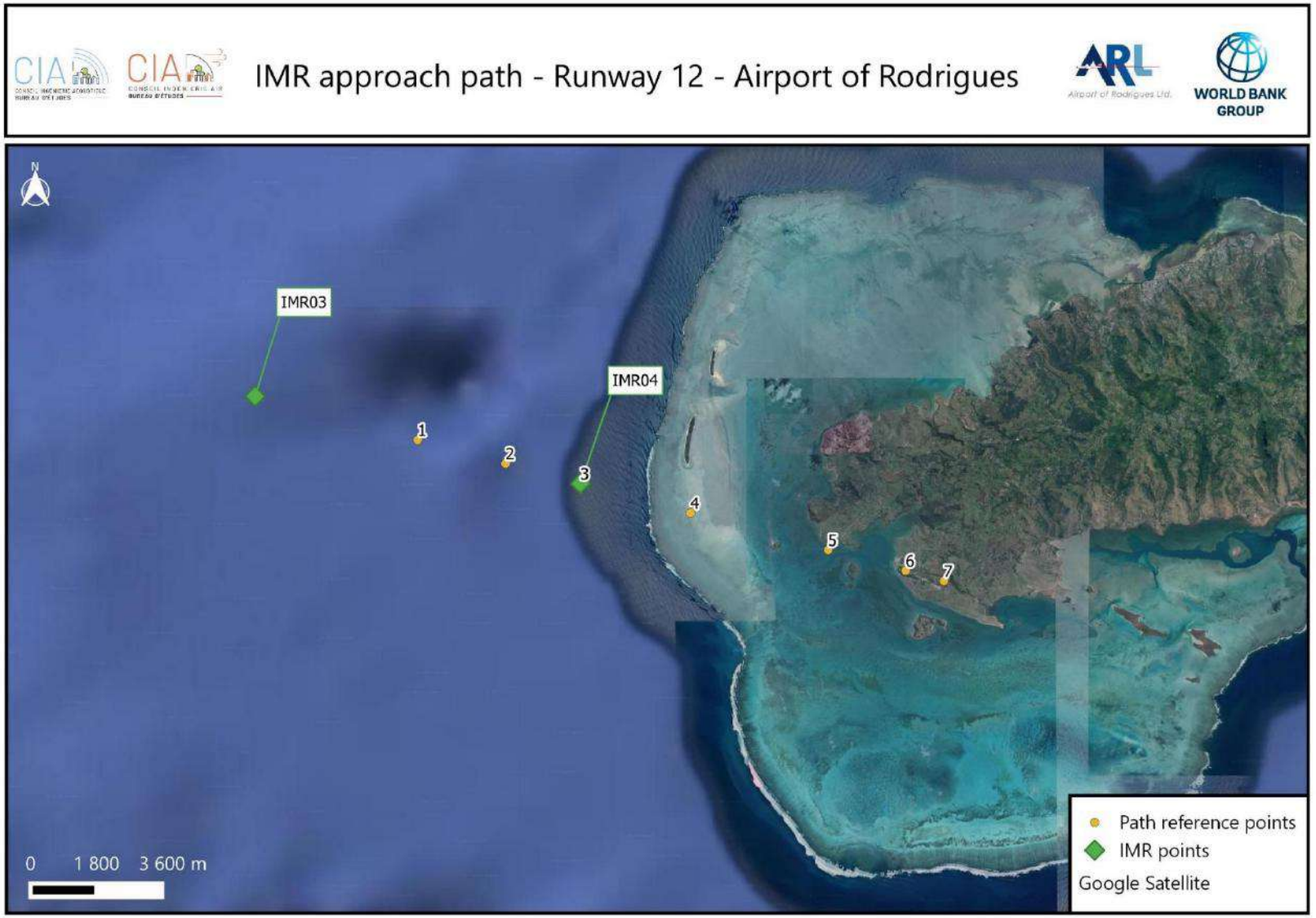


Figure 7: IMR approach path– Runway 12 – Plaine Corail

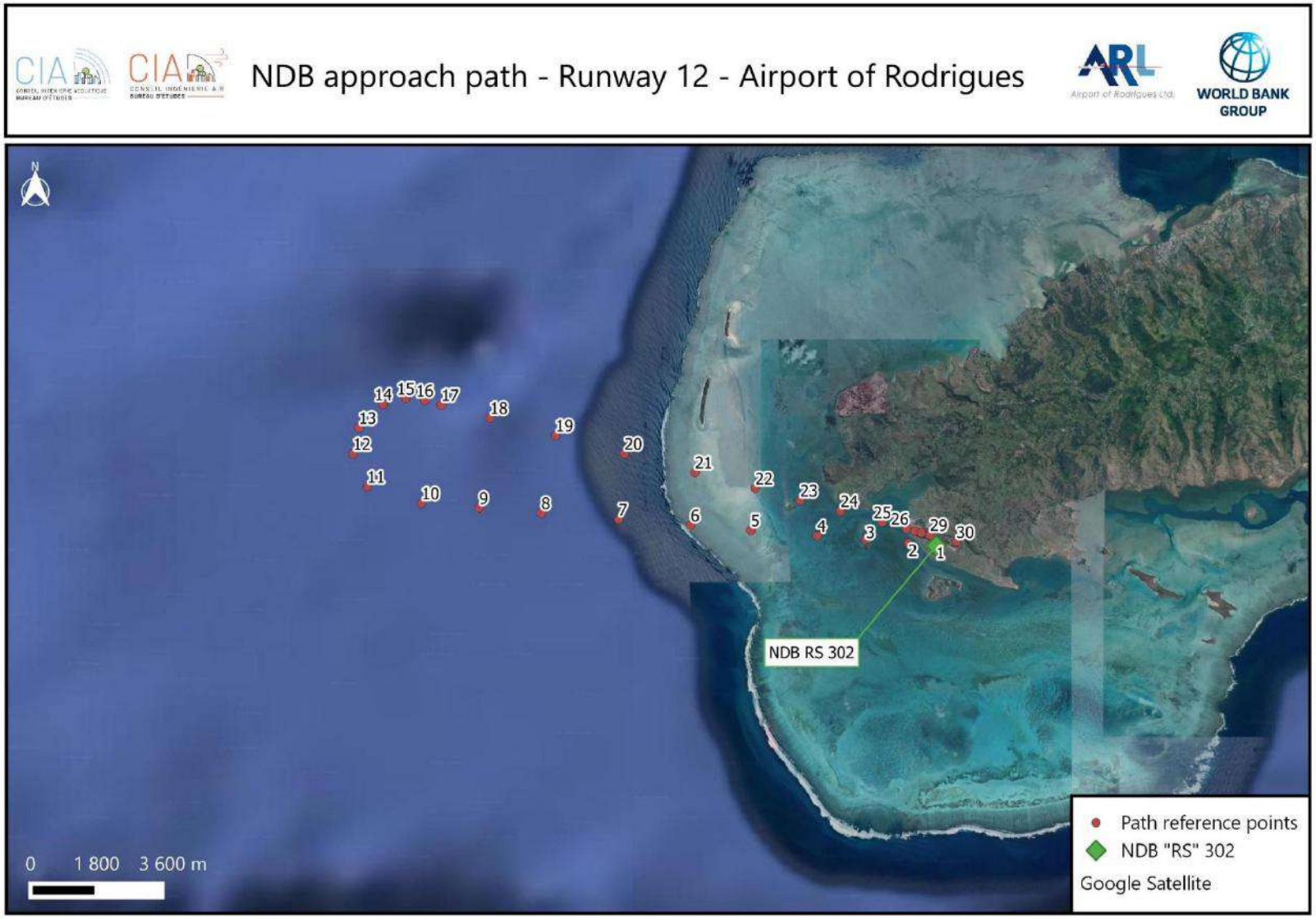


Figure 8 : NDB approach path– Runway 12 – Plaine Corail

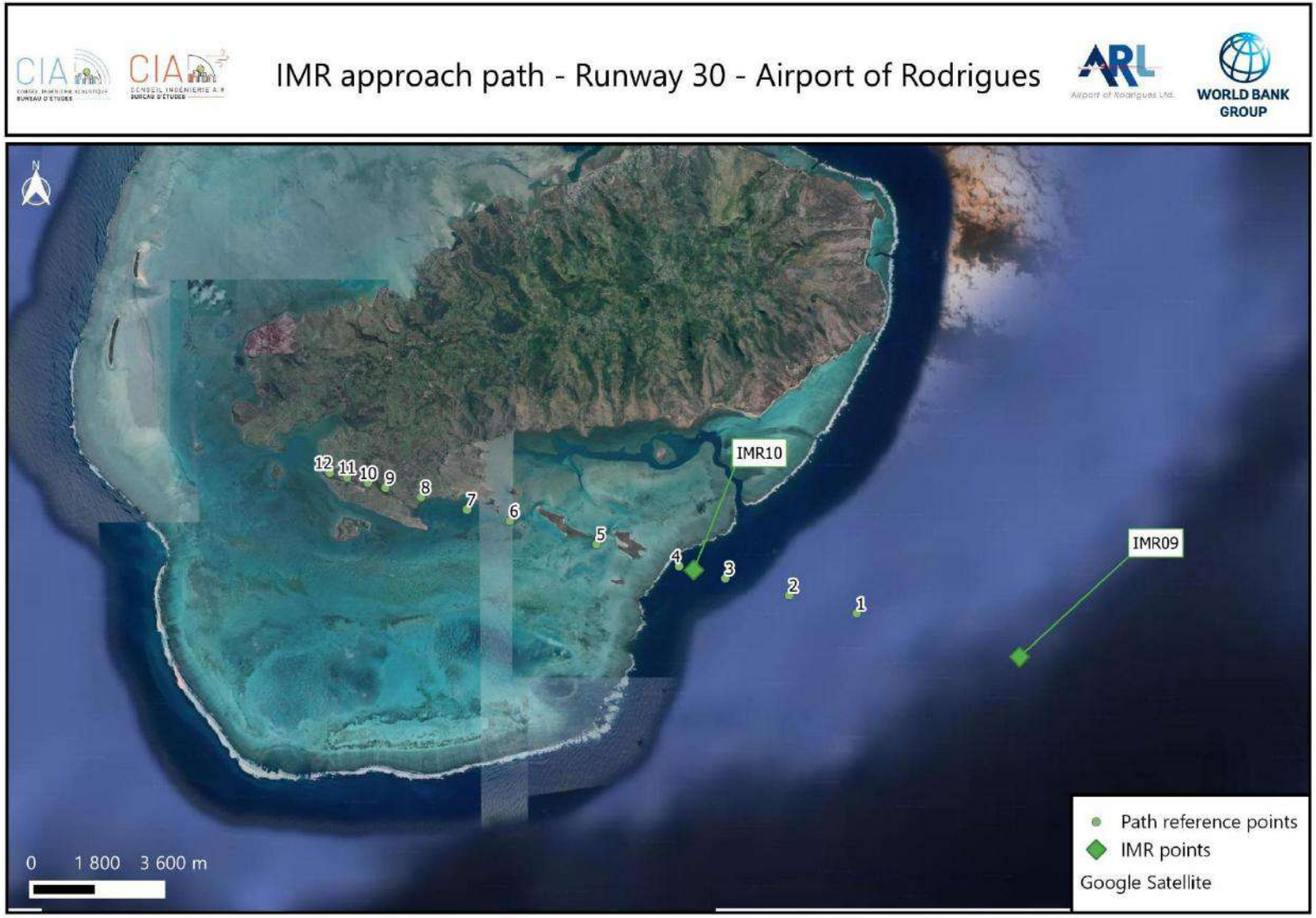


Figure 9 : IMR approach path– Runway 30 – Plaine Corail

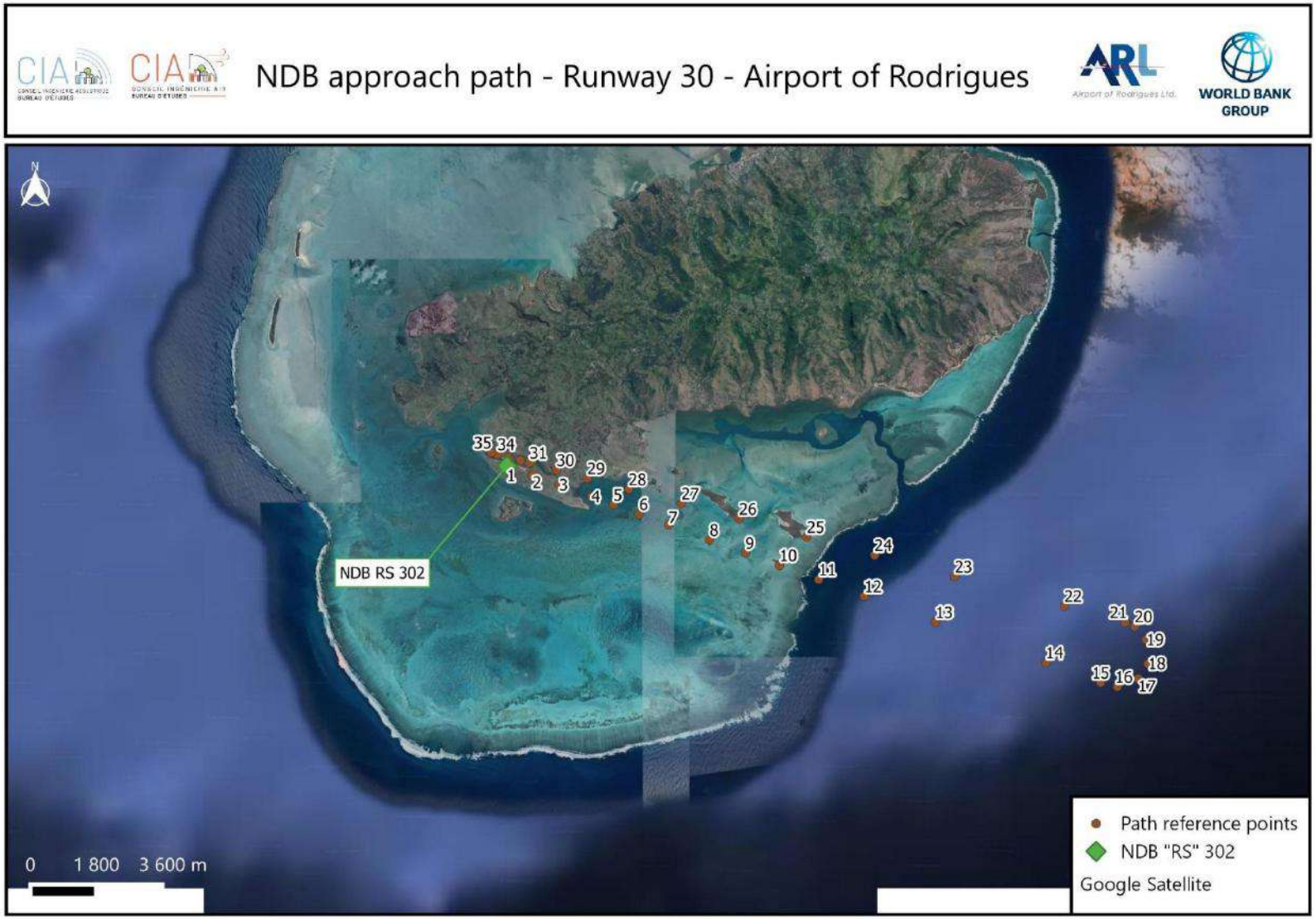


Figure 10: NDB approach path– Runway 30 – Plaine Corail

3.1.3 Air quality

3.1.3.1 General information about air pollution

Air pollution can be defined as an alteration of air quality that can be harmful to human health, living things, the climate, or material goods. Below is a description of the main air pollutants.

Table 3-3: Description of main air pollutants

Carbon Monoxide (CO)

Origin	CO is produced by incomplete burning of carbon in fuels. Most of emissions are from transportation sources, especially road traffic. Industrial sources or incinerators might also produce CO.
Pollution mechanism	CO is involved in reactions creating ozone in the lower atmosphere. When transformed into carbon dioxide, it also contributes to greenhouse effect.
Effects on health and environment	CO is colourless and odourless. Carbon monoxide attaches itself instead of oxygen to the haemoglobin and causes a lack of oxygenation that can lead to death.

Hydrocarbons (HCs)

Origin	HCs are part of VOCs (volatile organic compounds), which is a large group of pollutants that come from industrial processes, incomplete combustion, solvents, agriculture or natural sources. Hydrocarbons are compounds of carbon among VOCs (except methane, ethane, and non-reactive compounds).
Pollution mechanism	HCs promote the formation of compounds contributing to the greenhouse effect and the formation of ozone in the lower atmosphere.
Effects on health and environment	The effects are very diverse depending on the pollutants, and range from respiratory effects to mutagenic and carcinogenic risks.

Nitrogen Oxides (NOx)

Origin	NO and NO_2 form during combustion process. Main sources are motor vehicles, stationary fuel combustion installations and aviation activities.
Pollution mechanism	NOx are involved in reactions creating ozone in the lower atmosphere and contribute to acid rain.
Effects on health and environment	NO_2 irritates the respiratory tract. Acid rain leads to soil degradation and forest dieback.

Carbon Dioxide (CO_2)

Origin	CO_2 comes from any combustion reaction of carbonaceous products.
Pollution mechanism	CO_2 is one of the main greenhouse gases.
Effects on health and environment	It is not harmful to humans but it contributes to the increase of greenhouse effect.

Sulphur Dioxide (SO_2)

Origin	Sulphur dioxide mainly comes from the combustion of fossil fuels containing sulphur (fuel oil, coal).
Pollution mechanism	In the presence of moisture, SO_2 forms sulfuric acid.
Effects on health and environment	SO_2 contributes to acid rain and also irritates the respiratory tract.

Suspended particulates

Origin	Particulates result from many different sources, such as industrial or household combustion, fuel consumption, vehicles, or are formed by an interaction of various gazes with other compounds in the air.
Pollution mechanism	Toxic compounds are transported by particulates into the respiratory tract. Particulate matter is classified according to the maximum diameter in micrometres: PM2,5 and PM10 are the inhalable and respirable classes.
Effects on health and environment	Depending on their size, particulates penetrate more or less deeply into the lungs. The finest can impair respiratory function; some are carcinogenic. Particulates also affect soil, buildings and monuments.

3.1.3.2 Ambient air quality around Plaine Corail Airport

As there is no polluting industry and no significant agglomeration around Plaine Corail Airport, local sources of atmospheric pollutants are:

- Road traffic, and
- Air traffic and airport activities.

3.1.3.2.1 Polluting activities at an airport

3.1.3.2.1.1 Aircrafts: daily activities

Final approach, taxi in, taxi out, take-off and climb-out are the main polluting phases. The use of APU before the start-up and aircraft refuelling also contribute to air pollution.

3.1.3.2.1.2 Aircrafts: one-off activities

Aircraft, service vehicles and buildings are cleaned regularly and are subject to maintenance operations emitting air pollutants.

3.1.3.2.1.3 Stationary sources

Various sources related to the operation of the airport can produce pollution: fuel storage, petrol station, power plant, auxiliary generators.

3.1.3.2.1.4 Mobile sources

Road traffic in connection with passenger and cargo transportation emits air pollutants. Airport activities also require the use of special equipment, such as pushback tractors, and various service vehicles. The use of Ground Power Units (GPUs) is to be noted.

The road traffic has also been considered in the study. Indeed, the expansion of the airport will increase the traffic on the road that needs to be quantified.

3.1.3.3 Air quality measurement campaign

3.1.3.3.1 Measurement protocol

3.1.3.3.1.1 Location

Four sites representative of the site's environment were selected for measurements. They are located on the following map.

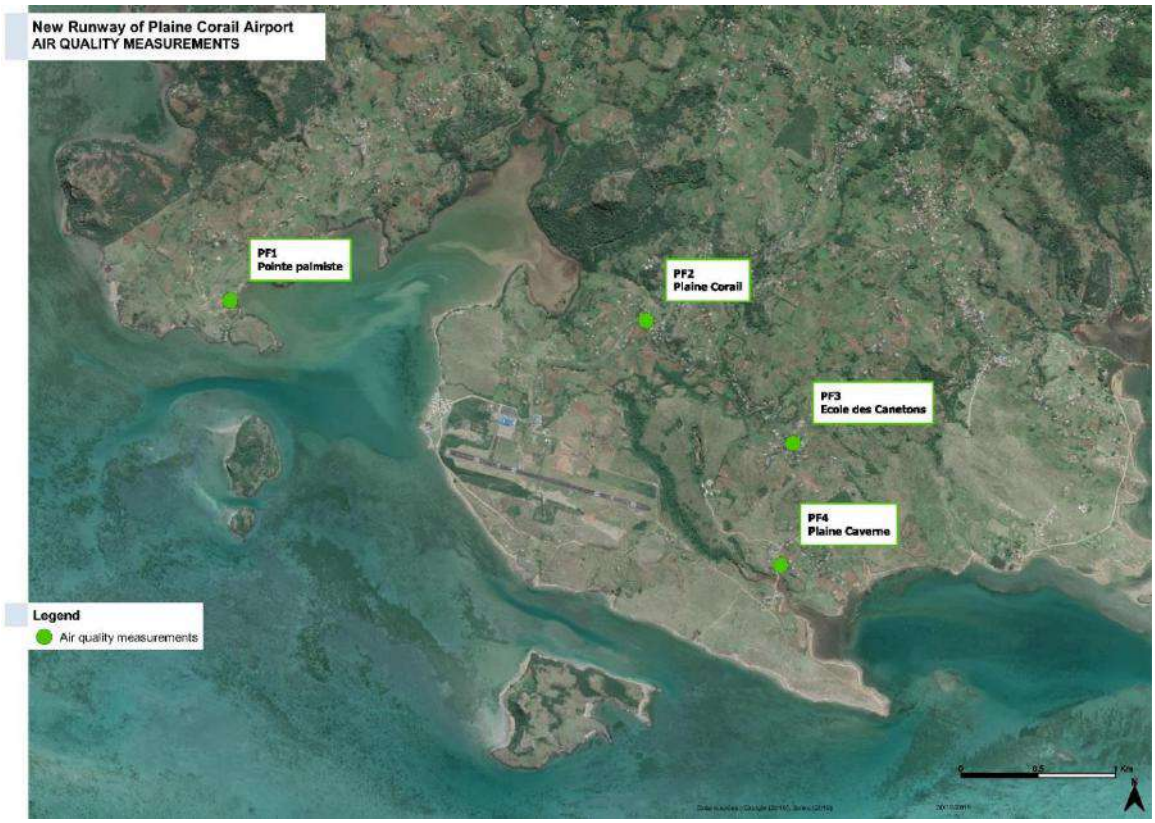


Figure 11 Air quality measurements location

3.1.3.3.1.2 Typology

Two different types of measurements were performed:

- Active measures

These measurements were carried out using a continuous "NEMo" device to analyze in real time the concentrations of particulate matter (PM10 and PM2.5).

The microsensor was placed near the homes affected by aircraft overflights on a larger perimeter around the airport. The device allows the concentration of the above-mentioned pollutants to be recorded every 10 minutes.

The NEMo was moved every day to obtain a dynamic result in each of the 4 fixed points.

- Measure 1 Pointe Palmiste: from 15/03/2023 to 16/03/2023
- Measure 2 Plaine Corail: from 15/03/2023 to 16/03/2023
- Measure 3 Ecole des Canetons: from 14/03/2023 to 15/03/2023
- Measure 4 Plaine Caverne: from 14/03/2023 to 15/03/2023

- Passive measures

The dynamic measurement was completed by passive tube measurements at each of the 4 measurement points over a 24-hour period, between the 14/03/2023 and the 16/03/2023. nitrogen dioxide, sulphur dioxide and ozone were measured by Radiello tube and analyzed by the "TERA Environnement" laboratory.

3.1.3.3.1.3 Weather conditions

Weather conditions were recorded at the airport station.

Table 3-4: Meteorological Data, Plaine Corail

Weather conditions	Day		
	14/03/2023	15/03/2023	16/03/2023
Wind speed m/s (2m high)	7.1	4.9	4.8
Temperature °C	26.3	27.4	27.9
Rainfall mm	0.1	0.0	0.0

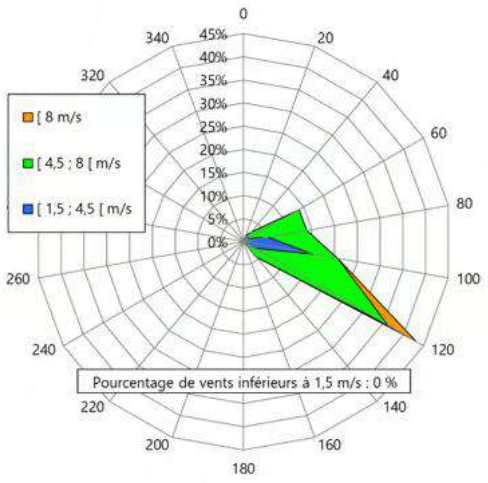


Figure 12 : Wind Rose at the airport Plaine Corail: 14/03/2023 – 16/03/2023

It should be noted than the absence of rain during the measurements' periode could lead to higher concentrations of particles in the atmosphere.

3.1.3.3.1.4 Aircraft overflights

The table below shows the aircraft movements recorded during the air quality measurement campaign. All aircraft are Air Mauritius or Air Austral ATR-72.

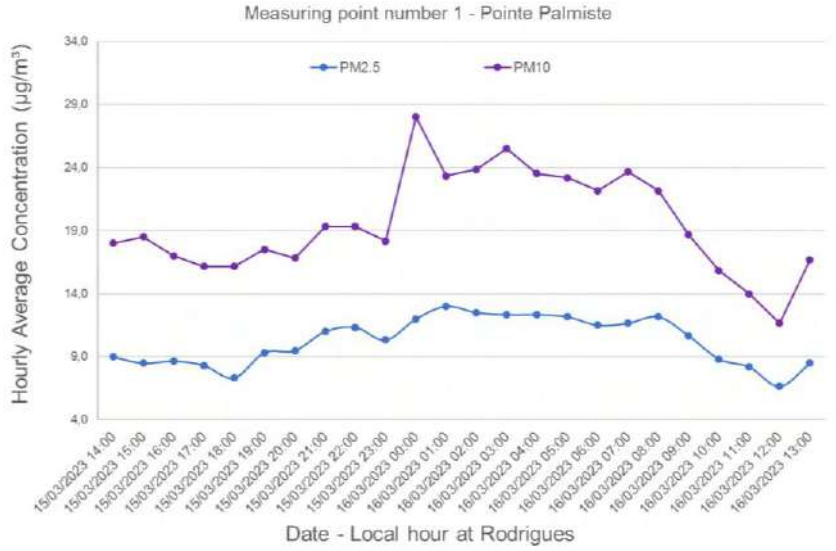
Table 3-5: aircraft movements recorded during the air quality measurement

Date	14/03/2023	15/03/2023	16/03/2023
Flight	Start/Finish Time	Start/Finish Time	Start/Finish Time
MK120	9:35 a.m.	9:35 a.m.	9:35 a.m.
MK121	10:15 a.m.	10:15 a.m.	10:15 a.m.
MK126	10:10 am	10:10 am	10:10 am
MK127	10:50 am	10:50 am	10:50 am
MK130	2:05 pm	2:05 pm	2:05 pm
MK131	2:45 pm	2:45 pm	2:45 pm
MK136	2:40 pm	-	2:40 pm
MK137	3:20 pm	-	3:20 pm
MK140	6:35 pm	6:35 pm	6:35 pm
MK141	7:15 pm	7:15 pm	7:15 pm
MK144	7:10 pm	-	-
MK145	7:50 pm	-	-
UU751	-	5 :20 pm	-

3.1.3.3.2 Results

The results are presented hereinafter.

Measuring point number 1 – POINTE PALMISTE
15/03/2023 au 16/03/2023

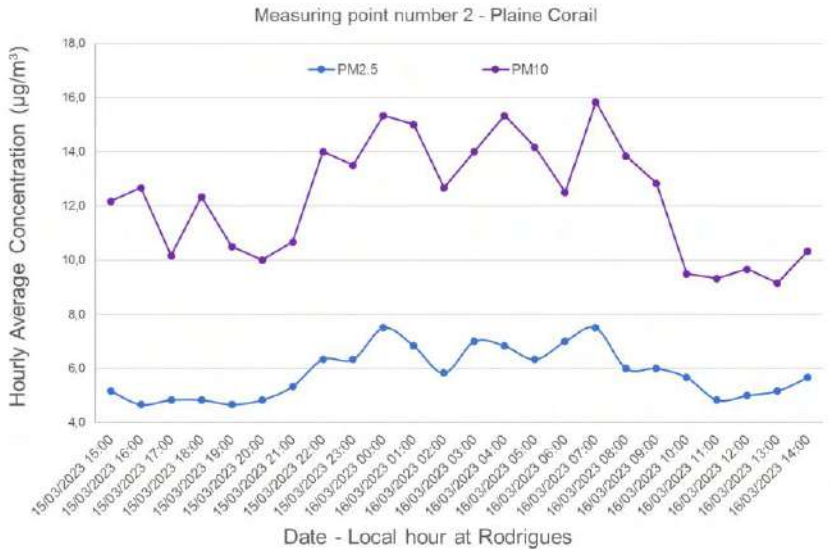


Passive sampling	Beginning – Ending date	Concentration

	of the sampling	µg/m³
RAD 145 – total VOC	15/03/2023 13:00 - 16/03/2023 15:30	61.7
RAD172 – Ozone	15/03/2023 13:00 - 16/03/2023 15:30	< 12.8
RAD166 – NO_2	15/03/2023 13:00 - 16/03/2023 15:30	< 9.4
RAD166 – SO_2	15/03/2023 13:00 - 16/03/2023 15:30	< 1.1

Hourly mean µg/m³	PM2.5	PM10
14h-15h	9.0	18.0
15h-16h	8.5	18.5
16h-17h	8.7	17.0
17h-18h	8.3	16.2
18h-19h	7.3	16.2
19h-20h	9.3	17.5
20h-21h	9.5	16.8
21h-22h	11.0	19.3
22h-23h	11.3	19.3
23h-00h	10.3	18.2
00h-01h	12.0	28.0
01h-02h	13.0	23.3
02h-03h	12.5	23.8
03h-04h	12.3	25.5
04h-05h	12.3	23.5
05h-06h	12.2	23.2
06h-07h	11.5	22.2
07h-08h	11.7	23.7
08h-09h	12.2	22.2
09h-10h	10.7	18.7
10h-11h	8.8	15.8
11h-12h	8.2	14.0
12h-13h	6.7	11.7
13h-14h	8.5	16.7
8 hour mean µg/m³	**PM2.5**	**PM10**
14h-21h	9.0	17.4
22h-5h	12.0	23.1
5h-13h	9.8	18.1
Maximum of Moving average (8h)	12.2	24.1
24 hour mean µg/m³	**PM2.5**	**PM10**
	10.2	19.5

Measuring point number 2 – PLAINE CORAIL
15/03/2023 au 16/03/2023

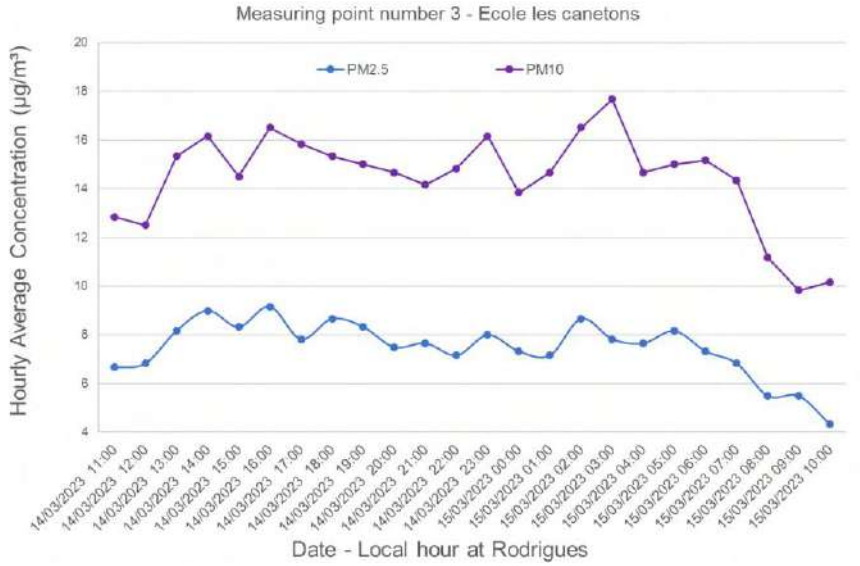


Passive sampling	Beginning – Ending date of the sampling	Concentration µg/m³
RAD 145 – total VOC	15/03/2023 12:00 - 16/03/2023 16:00	79.8
RAD172 – Ozone	15/03/2023 12:00 - 16/03/2023 16:00	< 12.1
RAD166 – NO_2	15/03/2023 12:00 - 16/03/2023 16:00	< 9.4
RAD166 – SO_2	15/03/2023 12:00 - 16/03/2023 16:00	< 1.1

Hourly mean µg/m³	PM2.5	PM10
15h-16h	5.2	12.2
16h-17h	4.7	12.7
17h-18h	4.8	10.2
18h-19h	4.8	12.3
19h-20h	4.7	10.5
20h-21h	4.8	10.0
21h-22h	5.3	10.7
22h-23h	6.3	14.0
23h-00h	6.3	13.5
00h-01h	7.5	15.3
01h-02h	6.8	15.0
02h-03h	5.8	12.7
03h-04h	7.0	14.0
04h-05h	6.8	15.3
05h-06h	6.3	14.2
06h-07h	7.0	12.5
07h-08h	7.5	15.8
08h-09h	6.0	13.8
09h-10h	6.0	12.8
10h-11h	5.7	9.5
11h-12h	4.8	9.3
12h-13h	5.0	9.7
13h-14h	5.2	9.2
14h-15h	5.7	10.3
8 hour mean µg/m³	**PM2.5**	**PM10**
15h-22h	5.1	11.6
23h-06h	6.7	14.1
7h-14h	5.7	11.3
Maximum of Moving average (8h)	6.9	14.4
24 hour mean µg/m³	**PM2.5**	**PM10**
	5.8	12.3

Measuring point number 3 – ECOLE DES CANETONS
14/03/2023 au 15/03/2023

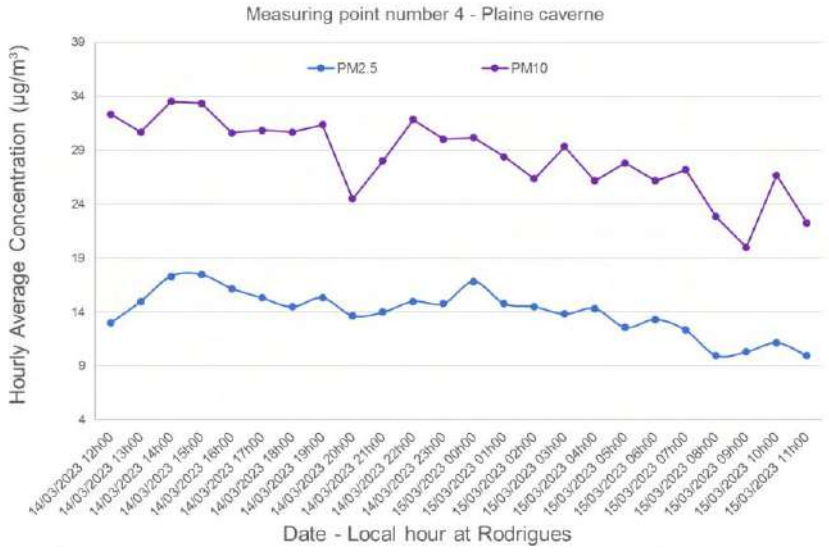
Passive sampling	Beginning – Ending date of the sampling	Concentration µg/m³
RAD 145 – total VOC	14/03/2023 11:00 - 15/03/2023 11:30	78.8
RAD172 – Ozone	14/03/2023 11:00 - 15/03/2023 11:30	< 13.8
RAD166 – NO_2	14/03/2023 11:00 - 15/03/2023 11:30	< 10.2
RAD166 – SO_2	14/03/2023 11:00 - 15/03/2023 11:30	< 1.1



Hourly mean µg/m³	PM2.5	PM10
11h-12h	6.7	12.8
12h-13h	6.8	12.5
13h-14h	8.2	15.3
14h-15h	9.0	16.2
15h-16h	8.3	14.5
16h-17h	9.2	16.5
17h-18h	7.8	15.8
18h-19h	8.7	15.3
19h-20h	8.3	15.0
20h-21h	7.5	14.7
21h-22h	7.7	14.2
22h-23h	7.2	14.8
23h-00h	8.0	16.2
00h-01h	7.3	13.8
01h-02h	7.2	14.7
02h-03h	8.7	16.5
03h-04h	7.8	17.7
04h-05h	7.7	14.7
05h-06h	8.2	15.0
06h-07h	7.3	15.2
07h-08h	6.8	14.3
08h-09h	5.5	11.2
09h-10h	5.5	9.8
10h-11h	4.3	10.2
8 hour mean µg/m³	**PM2.5**	**PM10**
11h-18h	8.1	14.9
19h-02h	7.7	15.0
03h-10h	6.6	13.5
Maximum of Moving average (8h)	8.4	15.5
24 hour mean µg/m³	**PM2.5**	**PM10**
	7.5	14.5

Measuring point number 4 – PLAINE CAVERNE
14/03/2023 au 15/03/2023

Passive sampling	Beginning – Ending date of the sampling	Concentration µg/m³
RAD 145 – total VOC	14/03/2023 12:30 - 15/03/2023 11:50	81.1
RAD172 – Ozone	14/03/2023 12:30 - 15/03/2023 11:50	< 14.5
RAD166 – NO_2	14/03/2023 12:30 - 15/03/2023 11:50	< 10.7
RAD166 – SO_2	14/03/2023 12:30 - 15/03/2023 11:50	7.0



Hourly mean µg/m³	PM2.5	PM10
12h-13h	13.0	32.3
13h-14h	15.0	30.7
14h-15h	17.3	33.5
15h-16h	17.5	33.3
16h-17h	16.2	30.6
17h-18h	15.3	30.8
18h-19h	14.5	30.7
19h-20h	15.3	31.3
20h-21h	13.7	24.5
21h-22h	14.0	28.0
22h-23h	15.0	31.8
23h-00h	14.8	30.0
00h-01h	16.8	30.2
01h-02h	14.8	28.4
02h-03h	14.5	26.3
03h-04h	13.8	29.3
04h-05h	14.3	26.2
05h-06h	12.6	27.8
06h-07h	13.3	26.2
07h-08h	12.3	27.2
08h-09h	10.0	22.8
09h-10h	10.3	20.0
10h-11h	11.2	26.7
11h-12h	10.0	22.3
8 hour mean µg/m³	**PM2.5**	**PM10**
12h-19h	15.5	31.7
20h-03h	14.7	28.6
04h-11h	11.8	24.9
Maximum of Moving average (8h)	15.6	31.7
24 hour mean µg/m³	**PM2.5**	**PM10**
	14.0	28.4

3.1.3.3.2.1 Analysis

Active measurements

PM10: The Air Quality Guideline (WHO 2021: 45 µg/m³ for 24 hours) is respected in each measurement sites during the campaign period.

PM2.5: The Air Quality Guideline (WHO 2021: 15 µg/m³ for 24 hours) is respected for each measurement sites during the campaign period.

No influence of the aircraft overflight could be observed on the dynamic measurement results. Indeed, no significant variation is observed on the results as they approach or leave. Thus, the low influx of aircraft is not currently noticeable on Rodrigues Island air quality.

Passive measurements

PF1

PF2

PF3

PF4

Measure	Sampling date	Location	Concentration µg/m³			
			NO_2	SO_2	Total VOC	Ozone
PF1	15/03/2023 13:00 - 16/03/2023 15:30	Pointe Palmiste	< 9.4	< 1.1	61.7	< 12.8
PF2	15/03/2023 12:00 - 16/03/2023 16:00	Plaine Corail	< 9.4	< 1.1	79.8	< 12.1
PF3	14/03/2023 11:00 - 15/03/2023 11:30	Ecole les Canetons	< 10.2	< 1.1	78.8	< 13.8
PF4	14/03/2023 12:30 - 15/03/2023 11:50	Plaine Caverne	< 10.7	7.0	81.1	< 14.5

The NO_2 concentrations measured by passive tubes are below 10.7 µg/m³. The Air Quality Guideline (WHO 2021: 25 µg/m³ for 24 hours) is respected in each measurement sites during the sampling period.

At the exception of point 4 (with 7.0 µg/m³), all the sulphur dioxide concentrations measured are very low (below 1.1 µg/m³). The Air Quality Guideline (WHO 2021: 40 µg/m³ for 24 hours) is respected in each measurement sites during the sampling period.

The ozone concentrations during the campaign are low (below 14.5 µg/m³). The Air Quality Guideline (WHO 2021: 100 µg/m³ for 8 hours) can't be compared to these 24 hours measurements.

The total VOC concentrations, measured during the 24 hours sampling period, are between 61.7 µg/m³ and 81.1 µg/m³.

During the measurement period, the concentrations are globally low, reflecting good air quality.

3.1.3.3.2.2 Conclusion

Despite unfavourable conditions (absence of rain) the measures still allow positive conclusions to be drawn about air quality on Rodrigues Island. No measurements exceed regulatory thresholds which apply to PM10, PM2.5 and NO_2.

The concentrations measured are globally low, reflecting very good air quality on Rodrigues Island.

Concerning aircraft overflight, no influence is observed on concentrations for the current 4 daily overflights.

3.1.3.3.3 Emissions inventory: Airport traffic

3.1.3.3.3.1 Definition

An emissions inventory is based on the theoretical calculation of the pollutants emitted into the atmosphere. A simplified method that helps to establish orders of magnitude of polluting emissions consists of calculating the product of the activity and the emission factors:

$$E(X) = \sum_{\text{type d' aéronef Y}} N(\text{cycle LTO})_{\text{aéronef Y}} * FE_X$$

E (X), emissions of pollutant X (kg)
N (cycle LTO) $_{\text{aeronef Y}}$, the number of LTO cycles for the aircraft type Y
FE_X the emission factor, for the pollutant X, by LTO cycle.

This method is compliant with the French guide “Guide de calcul des émissions dues aux aéronefs” (DGAC - STAC, 2015).

It does not directly estimate the concentration of pollutants in the air, which requires a complex dispersion model, yet an emissions inventory is a useful tool for managing air quality and its impact, and for informing the public. Based on the results of an emissions inventory, the gain from an emissions reduction policy can be assessed, and air quality modelling tools (concentrations) can be fed.

3.1.3.3.3.2 Inputs

The calculations take into account the overall annual commercial aircraft traffic (year 2022) and the type of aircraft.

3.1.3.3.3.3 Study area and pollutants investigated

Calculations are based on a standard "Landing-Take-Off" (LTO) cycle per aircraft, as defined by OACI vol II, appendix 16. This cycle includes all aircraft operations from the ground to a height of 3000 feet, as only emissions below this height have a direct impact on local air quality.

Aircraft engine emissions are calculated from the emission factors established for the "ICAO" LTO cycle. An ICAO database lists fuel consumption and emission factors for the four phases of movement in the atmospheric layer between 0 and 3000 ft: taxi, take-off, cruise and approach. Each phase is associated with an engine speed and its duration (see table and image below **taken here by default**).

Table 3-6: Duration and engine speed associated with the different phases of LTO cycle

Phases of the LTO cycle	Duration (minutes)	Engine speed (%)
Approach	4	30
Taxi	26	7
Takeoff	0,7	100
Climb-out	2,2	85

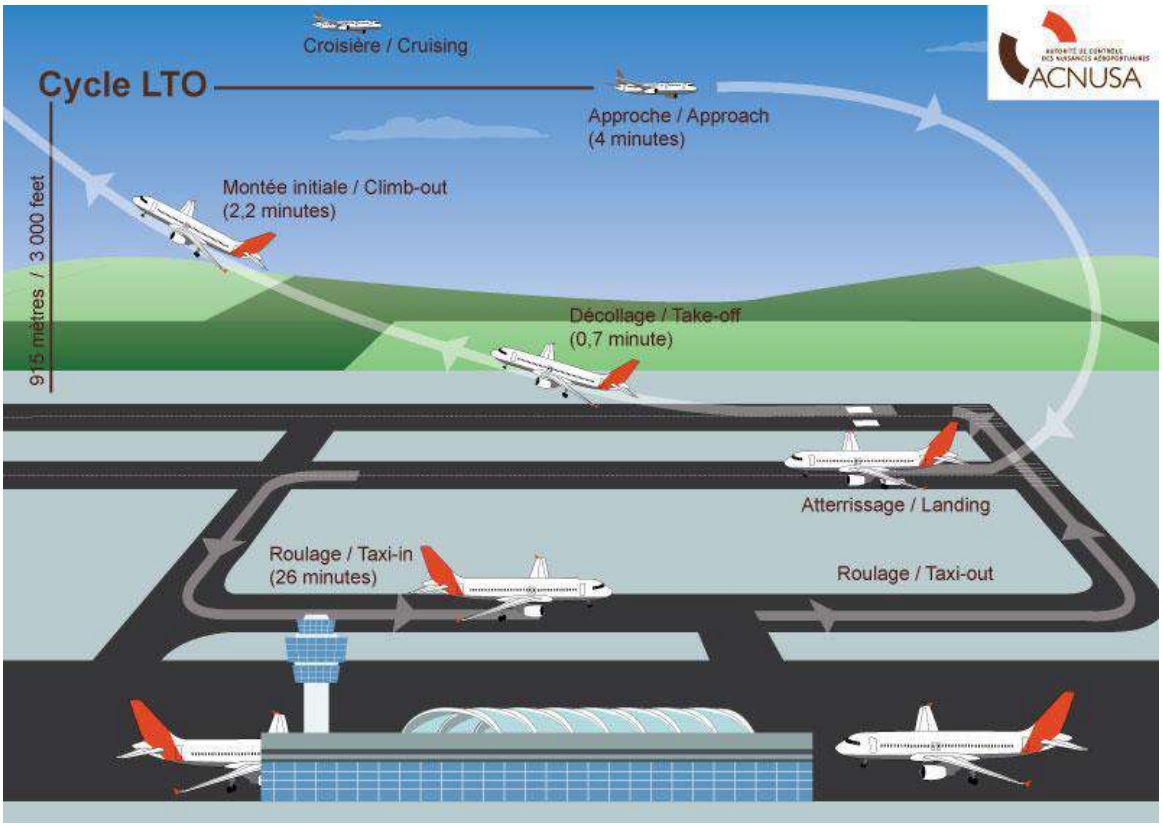


Figure 13: LTO cycle (Source: Acnusa)

The calculation tool IMPACT provided by Eurocontrol, a pan-European Organisation dedicated to supporting European aviation is used. The calculations take into account:

- Aircraft movements,
- Aircraft types,
- Flight paths,
- Runway alignment;
- Annual average weather conditions.
- Other emission sources from airport activities are assumed to be limited compared to aircraft emissions.
- Limit of height: 1000m

IMPACT uses the OACI database of EEDB aircraft motor emissions (AEM DATA – 254 – ICAO EDDB25/FOCA), compliant with the DGAC french methodological guide of impact study for air traffic.

However it should be noted that the database doesn't provide all combination of aircraft/class/motor. In this way, some aircraft can be substituted with another aircraft compliant with the same technical specifications:

- Take-off mass;
- The aircraft and engine manufacturer;
- The engine: number, type (turbojet, turboprop, piston engine), dilution rate, engine position…
- The performance: power-to-weight ratio.

Using this tool, calculations were made for Plaine Corail Airport, for emissions of

- nitrogen oxides
- carbon dioxide;
- sulphur oxides;
- dihydrogen oxide;
- carbon monoxide
- unburned hydrocarbons;
- acetaldehyde, formaldehyde and propianaldehyde;
- acrolein;
- 16 PAH;
- 7 PAH;
- styrene, 1.3-butadiene, benzene, ethylbenzene, toluene, xylene;
- PM total and volatile.

The results of the current situation, expressed in kg per year, are presented in the following table.

Table 3-7: Gas emissions and fuel consumption per year

	NOX emitted	**CO2** emitted	**SOX** emitted	**H20** emitted	**CO** emitted	**HC** emitted	**ACETALDEHYDE** emitted	**ACROLEIN** emitted	**16 PAH** emitted	**7 PAH** emitted	**Fuel consumption (kg/year)**
Emissions (kg/year)	1661	1044640	278	408930	344436	5271	262	150	0	0	330 582
-	**STYRENE** emitted	**1.3 BUTADIENE** emitted	**BENZENE** emitted	**ETHYLBENZENE** emitted	**FORMALDEHYDE** emitted	**PROPIANALDEHYDE** emitted	**TOLUENE** emitted	**XYLENE** emitted	**PM Total** emitted	**PM Volatile** emitted	
Emissions (kg/year)	19	103	103	11	754	45	39	27	42	0	

These results will have to be compared with the forecast emission balances, taking into account the traffic linked to the new runway (with the new type of aircraft: A321Neo and 737-900 Max).

This baseline emissions inventory was supplemented by an air quality measurement campaign carried out by ARL in 2023 (see above).

The measurement campaign will be representative of the week in which it took place (including weather conditions and number of aircraft movements).

In the absence of a permanent air quality monitoring system, the assessment of the initial annual air quality requires to carry out measurement campaigns lasting several months, spread over the island's two seasons. ESIA's planning was not compatible with such a campaign, yet ARL could implement a monitoring program to this end.

3.1.3.3.4 Air quality issues

The air quality issue is due to the presence of sensitive populations living nearby and of the pre-primary school Le Caneton (near Anse Quitor). The presence of agricultural parcels is also to be taken into account.

The aircraft traffic and road traffic growth could lead to a significant increase in pollutant emissions; thus, the receptor sensitivity to the project is considered high.

3.1.3.3.5 Emissions inventory: Road traffic

The emissions due to road traffic have been calculated from the road traffic data provided on the roads shown in the map below.

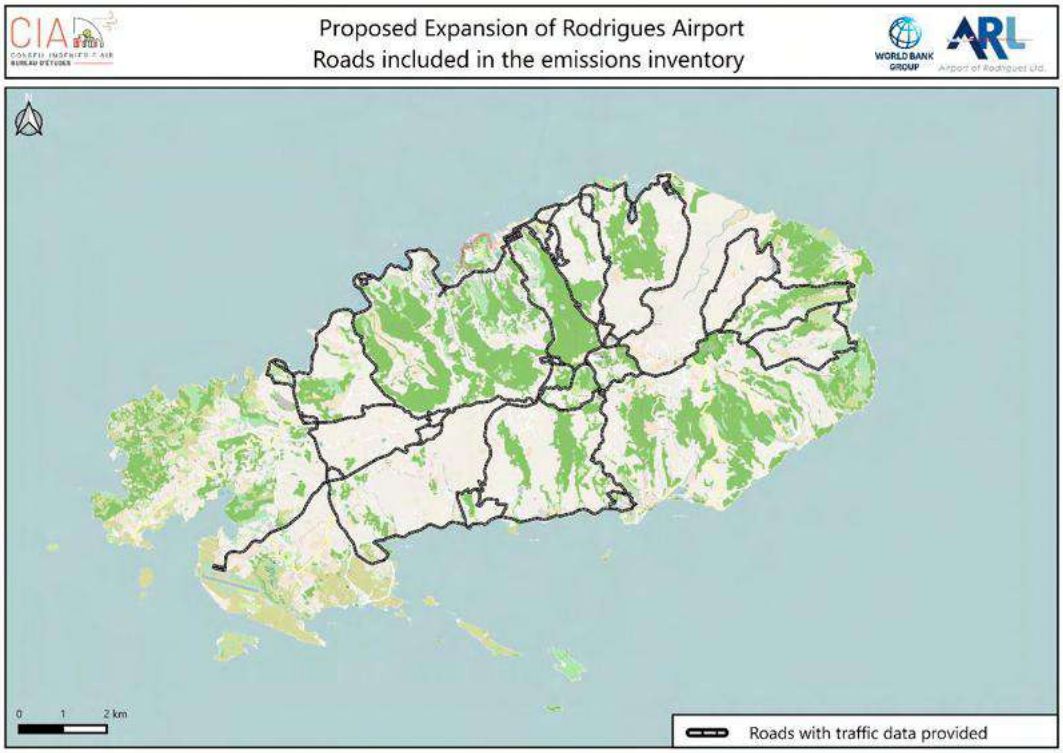


Figure 14: Roads included in the emissions inventory

The number of vehicles multiplied but the number of km driven are presented in the table below.

Table 3-8: Pollutants emissions per day due to road traffic

all the roads included	**Vehicles * Km driven**
Current situation 2023	166871

The emissions are calculated thanks to TREFIC 5.2.1 with the fleet IFSTTAR (until 2050), based on the emissions factors from COPERT V.

The emissions calculated are presented in the tables below:

Table 3-9: Pollutants emissions per day due to road traffic

Emissions of all the roads included	**CO**	**NOx**	**NMVOC**	**SO_2**	**PM10**	**PM2.5**	**benzene**	**Benzo(a)pyrene**	**Nickel**	**Arsenic**
Unit	kg/day	kg/day	kg/day	kg/day	kg/day	kg/day	kg/day	g/day	g/day	g/day
Year 2023 Current situation	32,5	77,1	1,8	0,4	6,4	4,2	0,0	0,2	62,4	12,8

Table 3-10: Greehouse gas emissions per day due to road traffic

Emissions of all the roads included	**CO_2**	**N_2O**	**CH_4**
Unit	T/day	kg/day	kg/day
Year 2023 Current situation	34,2	1,8	0,6

The spatial distribution of the NOx emissions for the current situation (2023) is presented in the following map.

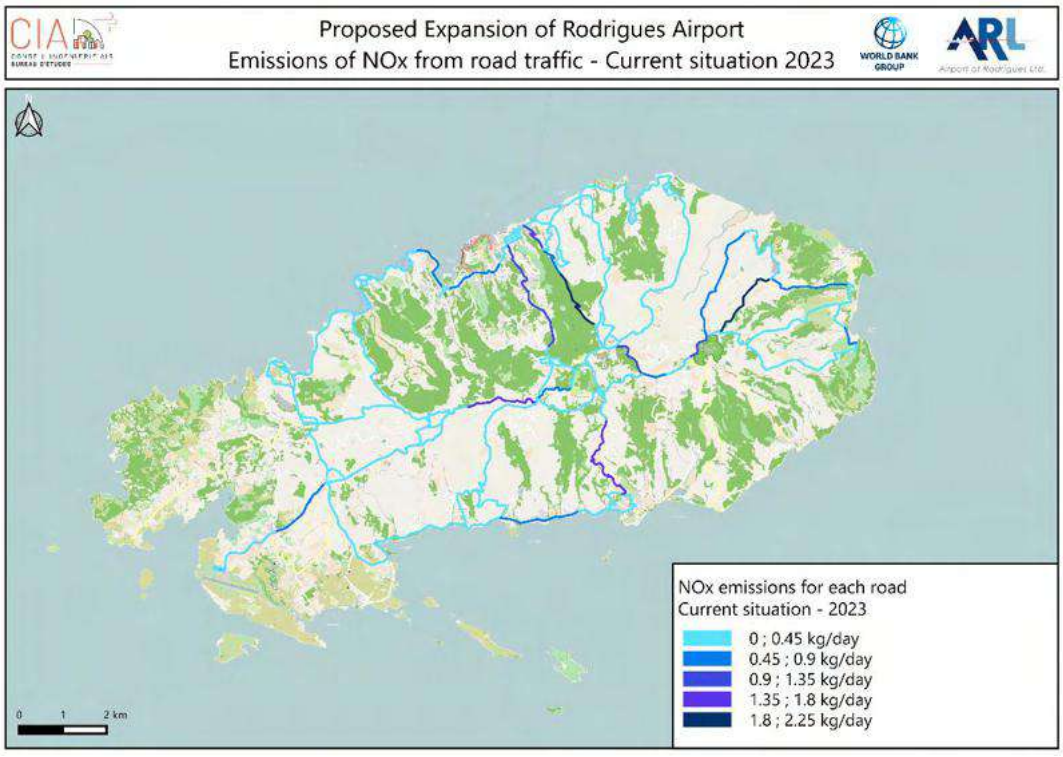


Figure 15: Spatial distribution of the NOx emissions – Current situation 2023

The NOx emissions near the airport at “Route de l’autonomie”, are low compared to the other roads, with less than 1 kg/day of NOx emitted in the current situation 2023.

3.1.3.3.6 Modeled air ambient concentrations : road traffic

The software ARIA Impact 1.8 is used to model the concentrations from the emissions calculated in the previous section and from the weather conditions.

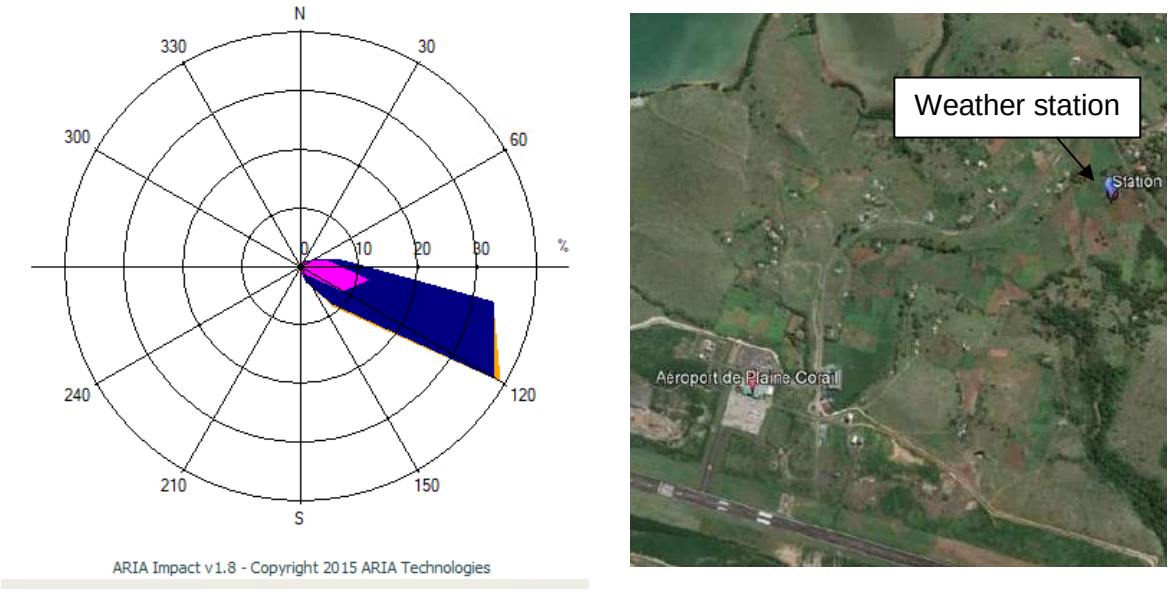


Figure 16 : Wind Rose used in the calculations – based on the three-hourly wind direction and velocity furnished by numtech between the 01/01/2022 and the 31/12/2022 – Station SYNOP of Plaine Corail at Rodrigues

The pollutants modeled are the nitrogen dioxide and the particles PM10 and PM2.5. A background concentration is included in the calculation to approach the most representative result of the real concentrations.

Due to the lack of bibliography on concentrations in Rodrigues Island, the data measured during the 15th to 16th of March 2023 at Pointe Palmiste (a site distant from road sources) has been used as background concentration. It should be noted that this assumption is overrated: The annual mean concentrations are usually lower than the daily concentrations.

Table 3-11: Background concentrations included in the calculations of the modeled concentrations

Pollutant	Background concentration used µg/m³	Source	WHO annual Air Quality Guideline 2021	Comment / Remark
NO_2	9.4	Measurements between the 15th and the 16th march 2023 at Pointe Palmiste (measuring point number 1)	10	Lack of bibliography at Rodrigues Island Background concentrations used are daily concentrations -> overrating the annual mean The annual Air Quality Guideline (WHO 2021) are already exceeded by these background concentrations for the particles PM10 and PM2.5
PM10	19.5		15	
PM2.5	10.2		10	

3.1.3.3.6.1 Results in the 500 meters around the road

Table 3-12: Statistics of the modelled concentrations in the area of 500 m around the roads

Statistics in the area of 500 m around the roads - Unit : µg/m³	Nitrogen dioxide	Particles PM10	Particles PM2.5
Maximum :	9.9	19.6	10.2
Percentile 90 :	9.6	19.5	10.2
Mean :	9.5	19.5	10.2
Median :	9.5	19.5	10.2
Percentile 25 :	9.4	19.5	10.2
Minimum :	9.4	19.5	10.2
Standard deviation :	0.1	0.01	0.01

The concentrations modeled in the area of 500 meters around the roads are superior to the WHO Annual Air Quality Guidelines for the particles: Indeed, the background concentrations included in the calculation are already superior to those guidelines.

For the nitrogen dioxide, the WHO Annual Air Quality Guideline is respected in all the area.

These statistics are also shown in the maps presenting the spatial distribution of the concentrations in the following sections.

3.1.3.3.6.1.1 Nitrogen dioxide

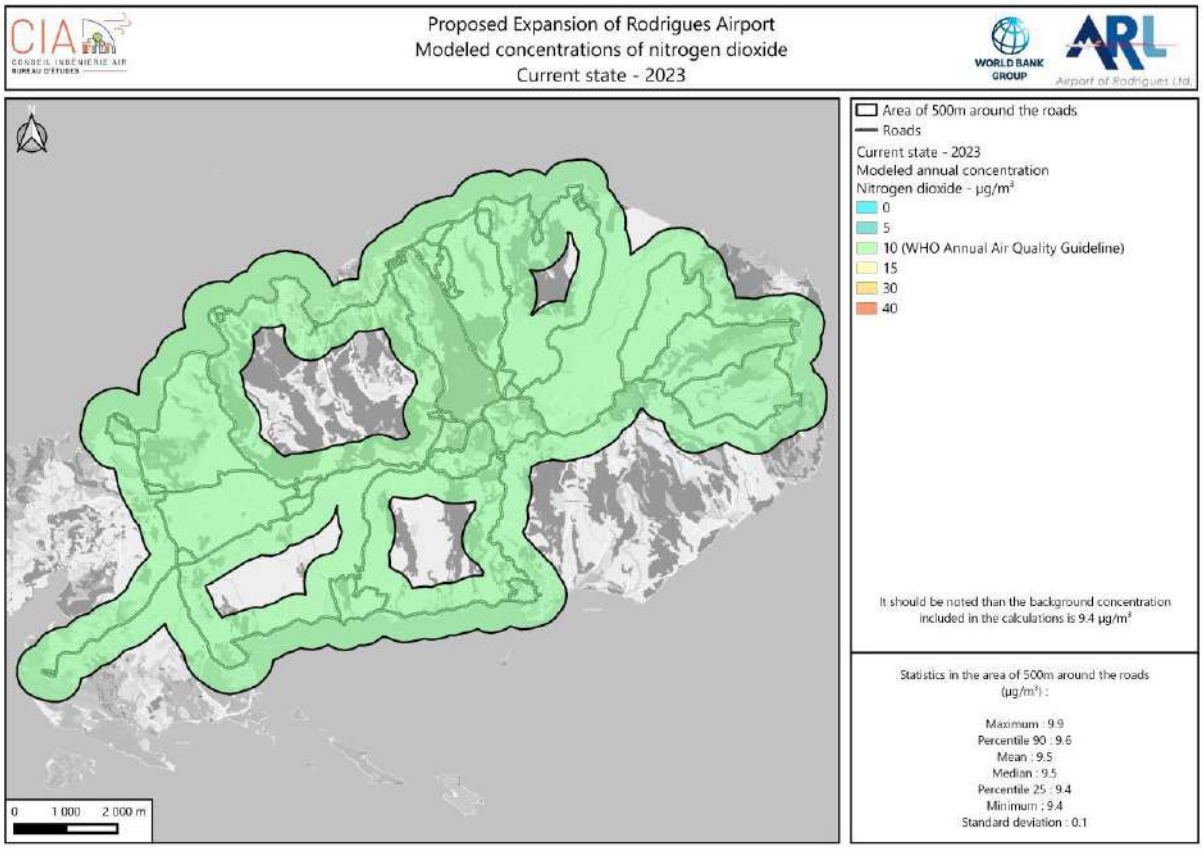


Figure 17 : Map of the modeled nitrogen dioxide's concentrations at Rodrigues – Current situation 2023

No specific spatial distribution is observed in the map above: the concentrations are close to one another, with a very low standard deviation of 0.07 µg/m³. The concentrations modeled are close to the background concentration included in the calculations (9.4 µg/m³).

3.1.3.3.6.1.2 Particles PM10

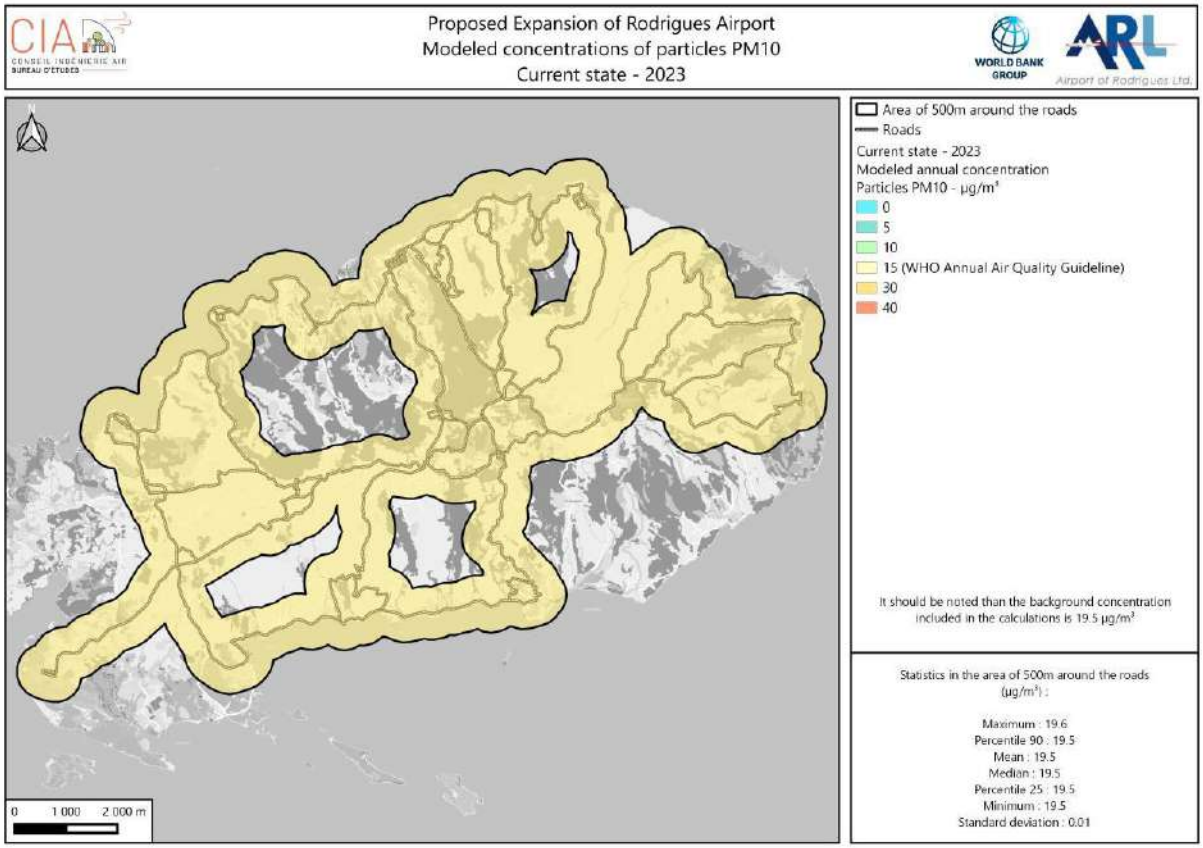


Figure 18 : Map of the modeled concentrations of PM10 at Rodrigues – Current situation 2023

No specific spatial distribution is observed in the map above: the concentrations are close to one another, with a very low standard deviation of 0.01 µg/m³. The concentrations modeled are close to the background concentration included in the calculations (19.5 µg/m³).

3.1.3.3.6.1.3 Particles PM2.5

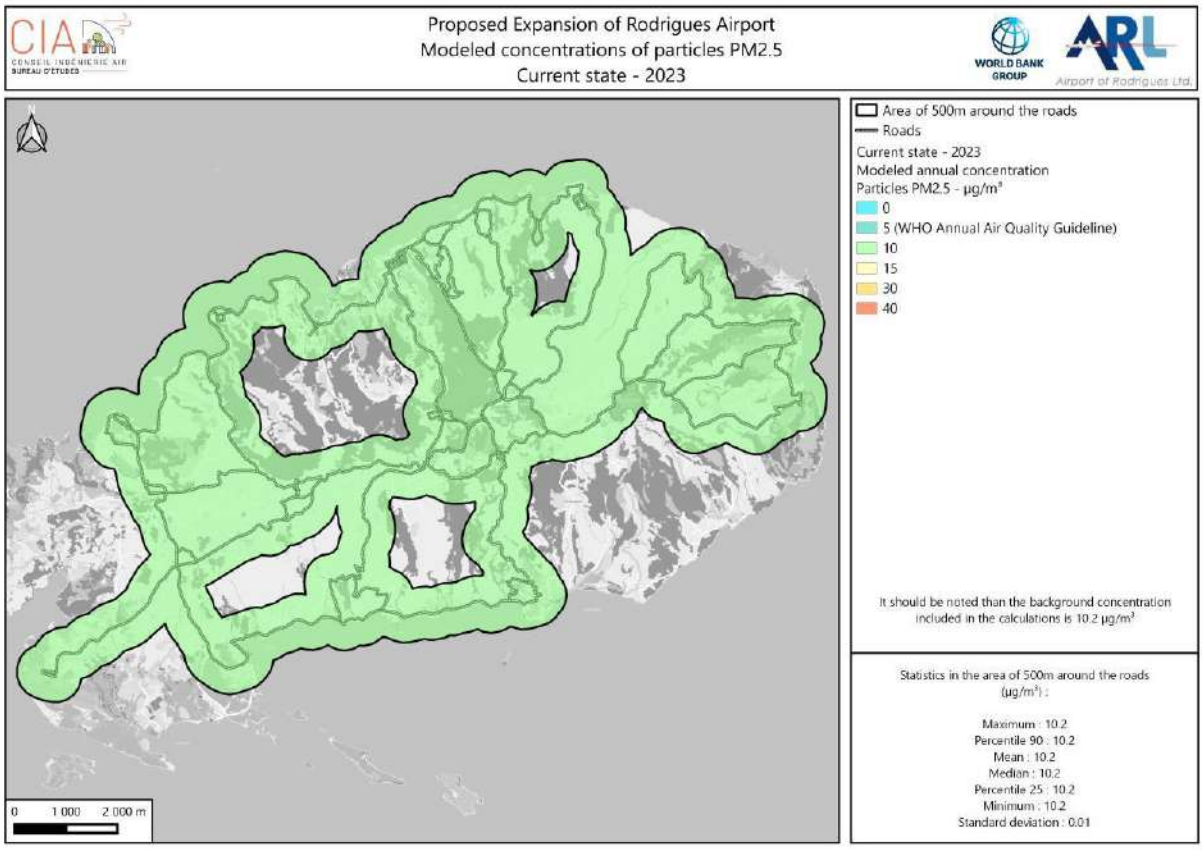


Figure 19 : Map of the modeled concentrations of PM2.5 at Rodrigues – Current situation 2023

No specific spatial distribution is observed in the map above: the concentrations are close to one another, with a very low standard deviation of 0.01 µg/m³. The concentrations modeled are close to the background concentration included in the calculations (10.2 µg/m³).

3.1.3.3.7 Indicator Pollution-Population (IPP) : road traffic

The Indicator Pollution Population (IPP) is calculated by multiplying the number of inhabitants of each zone by the mean concentration of nitrogen dioxide of the zone.

It allows to discriminate the areas with higher population and/or higher concentrations.

Table 3-13: Number of inhabitants by area, mean concentration in each area and Indicator Pollution Population calculated in each zone

Zone	Number of inhabitants - 2023	Mean concentration of NO_2 For the current situation 2023	Indicator Pollution Population of NO_2 For the current situation 2023
1	1904	9.48	18046
2	1465	9.51	13933
3	1417	9.52	13487
4	3417	9.55	32644
5	7810	9.52	74361
6	1112	9.44	10493
7	2712	9.47	25689
8	5014	9.52	47724
9	4819	9.54	45989
10	3781	9.52	36014
11	3731	9.46	35279
12	3811	9.45	36019
13	3579	9.42	33698
14	2561	9.41	24106

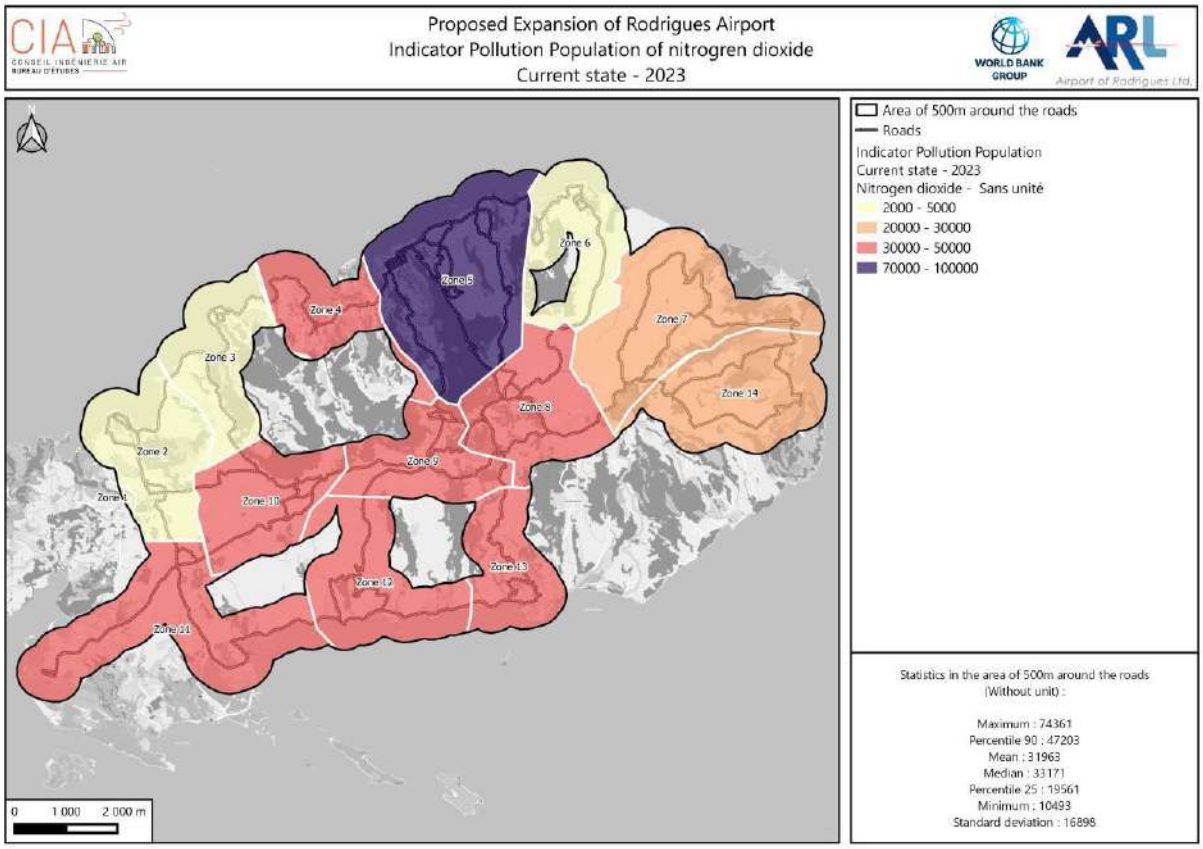


Figure 20 : Map of the Indicator Pollution Population of NO2 at Rodrigues – Current situation 2023

The higher IPP is located in the zone 5: it's the zone with the higher number of inhabitants.

The zone 11 where the airport is located, has a low IPP compared to the zones 5, 8, 9 and 12.

3.1.4 Noise

3.1.4.1 General information about noise

Sound is a wave that travels through the air and makes it vibrate, from the sound source to the receiver: the ears. The vibration of air molecules causes a vibration of the eardrums, which results in an auditory sensation. Noise is used to describe the generally unpleasant perception associated with an unbalanced set of sounds.

A noise can be characterized by several objective criteria, such as level (or volume: low, high), frequency (or pitch: low, high) and duration of occurrence.

The usual scale for measuring noise is a logarithmic scale, which reflects the sensitivity of the human ear to pressure variations associated with the vibration of air molecules. Noise levels are thus expressed in decibels (dB). As low and high frequencies are not perceived in the same way by the human ear, a filter is applied to the decibel value to take this feature into account. This is referred to as "A" decibels, noted dB(A).

The diagram below shows some examples of sound levels associated with everyday noise and the associated auditory sensation.

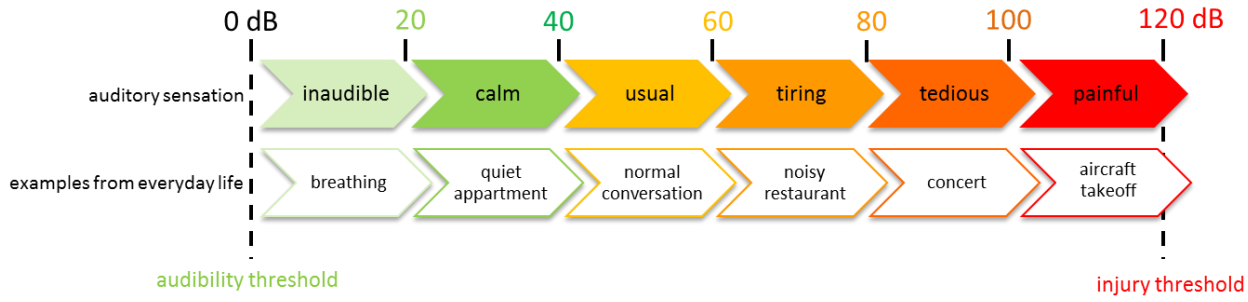


Figure 21: Diagram of sound levels

The propagation of noise in a given site depends on the conditions of the surrounding environment and in particular on the distance travelled, the ground effect (reflection or absorption of sound), the presence of obstacles and meteorology (temperature, wind, and/or humidity).

3.1.4.1.1 Noise indicators

*3.1.4.1.1.1 **LAeq:** equivalent sound pressure level (A-weighted)*

Noise is an essentially fluctuating phenomenon. It is the accumulation of sound energy received by an individual that is the most representative indicator of the effects of noise on humans.

This accumulation is reflected by the equivalent energy level noted LAeq. The LAeq is expressed in dB(A) and is defined as follows: "the equivalent LAeq level of a variable noise is equal to the level of a constant noise that would have been produced with the same energy as the noise perceived during the same period. It represents the average acoustic energy perceived during the observation period".

The following diagram illustrates this definition.

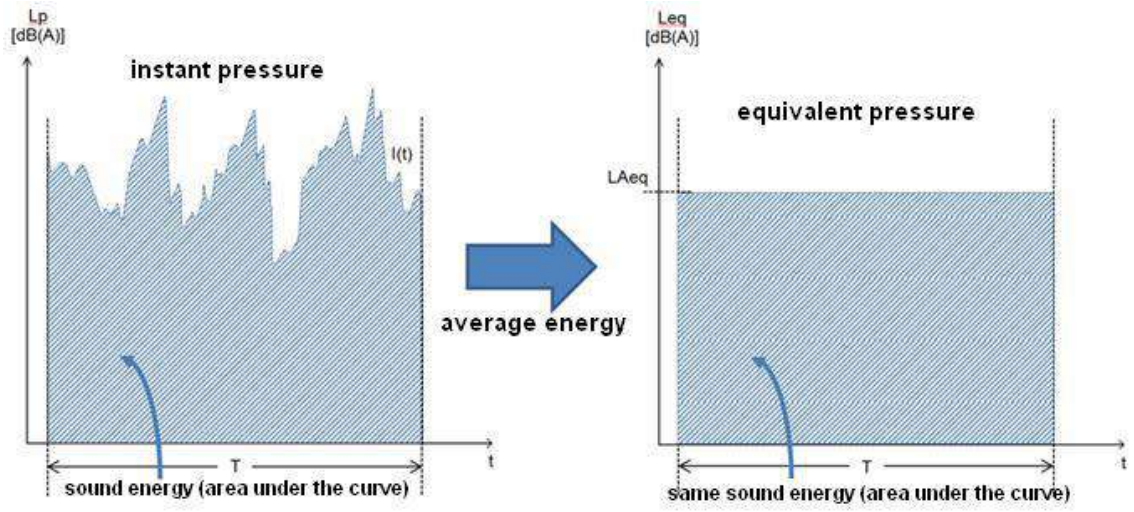


Figure 22: Illustration of the definition of the LAeq

*3.1.4.1.1.2 **DNL** "Day Night Level"*

This noise indicator is a LAeq noise level with a 10 dB weighting for the night-time period (22:00 to 7:00). This means a penalty of 10 dB is taken into account for noise caused by any aircraft movement at night (considered more annoying than during day-time).

*3.1.4.1.1.3 **Lden** "Level Day Evening Night"*

This noise indicator is a LAeq noise level with a 5 dB weighting for the evening period (18:00 to 22:00) and a 10 dB weighting for the night-time period (22:00 to 7:00). This means a penalty of 5 dB is taken into account for noise caused by any aircraft movement in the evening and 10 dB at night (movements during these periods are considered more annoying than during day-time).

*3.1.4.1.1.4 **LAmax** "Level Day Evening Night"*

The noise indicator LAmax is the maximal LAeq noise level reached during the flight operations (dB(A)) with a representative traffic.

*3.1.4.1.1.5 **NA62 (LAmax)** "Number of event with LAmax ≥ 62dB(A)"*

The noise indicator NA62 is the number of event with LAmax ≥ 62dB(A) per day with a representative traffic.

*3.1.4.1.1.6 **NA65 (LAmax)** "Number of event with LAmax ≥ 65dB(A)"*

The noise indicator NA62 is the number of event with LAmax ≥ 65dB(A) per day with a representative traffic.

3.1.4.1.2 Noise contours

A noise contour is a line on a map that represents equal levels of noise exposure. The contours for airport noise are usually shown in 5-decibel increments, for noise values from 45 to 80 and more.

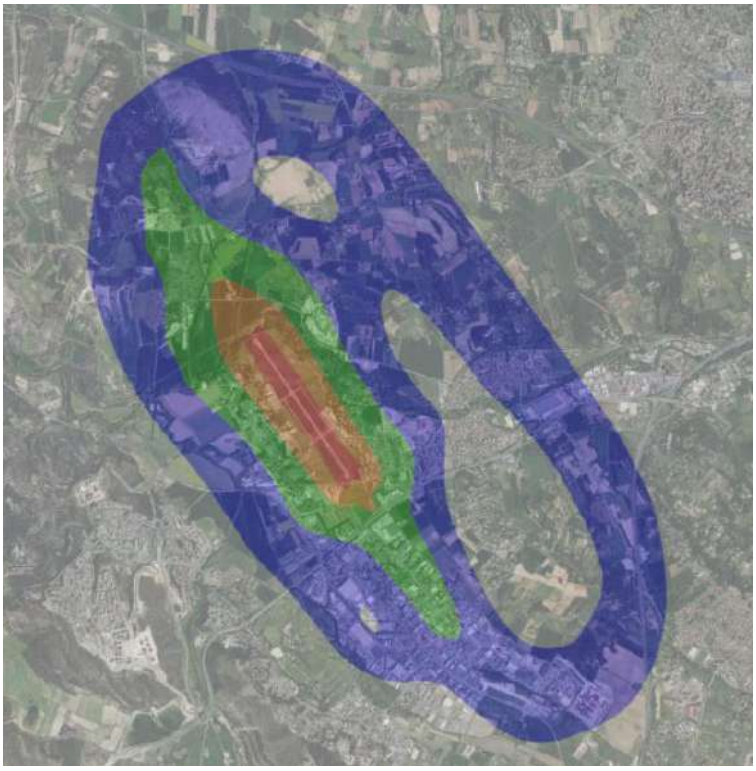


Figure 23: Example of noise contours – French aerodrome Aix Les Milles

3.1.4.2 Noise guidelines

The environmental noise standards in Rodrigues are described in the Environment Protection Act. The regulations are:

Noise exposure limits to industrial noise
07.00 – 21.00 hrs 60 dB(A) LAeq

21.00 – 07.00 hrs 55 dB(A) LAeq

Noise exposure limits to neighbourhood noise
07.00 – 18.00 hrs 60 dB(A) LAeq

18.00 – 21.00 hrs 55 dB(A) LAeq

21.00 – 07.00 hrs 50 dB(A) LAeq

No specific regulation applies to airport noise.

In the “Environmental noise guidelines for the European Region”, published in 2018, the World Health Organisation (WHO) recommends limiting the exposure value to road and airborne noise in order to avoid health impacts:

- Airborne noise: Lden 45 dB (40 dB for night-time noise),
- Road noise: Lden 53 dB (45 dB for night-time noise).

3.1.4.3 Ambient noise around Plaine Corail Airport

Noise sources around Plaine Corail Airport are mainly:

- Road traffic,
- Air traffic, and
- Airport activities.

As the local road network is sparsely used, except to serve the airport and the houses nearby, the ambient noise is mostly due to the activity of Plaine Corail Airport: aircraft movements, ground support vehicles and heavy vehicles used to transport goods and supplies.

3.1.4.4 Noise measurements campaign

3.1.4.4.1 Measurement protocol

The acoustic measurement campaign was carried out from 14/03/2023 to 16/03/2023.

3.1.4.4.1.1 Location

In total, 4 long-term measurements over 24 hours points were distributed over the study area. They are located on the map shown below (see § results).

3.1.4.4.1.2 Typology

The positions of the long term measurement points were defined from the 4 existing residential areas to the east, north and west of the airport. These are the most immediate sectors on which the project can potentially have an impact.

The short-term measurements are positioned to characterize the sound environment at the level of the houses around Mont Travers with a view to its future exploitation (quarry), linked to the project.

Noise measurements were performed with Class 1 equipment in accordance with French standard NFS 31-009 for precision sound level meters. Each measuring instrument was equipped with a rainproof kit and large windproof equipment to limit its effects.

These measurements are used to define the regulatory indices LAeq (07.00 – 18.00 hrs), LAeq (18.00 – 21.00 hrs) and LAeq (21.00 – 07.00 hrs).

3.1.4.4.1.3 Weather conditions

Weather conditions were recorded at the airport station.

Table 3-14: Meteorological Data, Plaine Corail

Weather conditions	Day		
	14/03/2023	15/03/2023	16/03/2023
Wind speed m/s (2m high)	7.1	4.9	4.8
Temperature °C	26.3	27.4	27.9
Rainfall mm	0.1	0.0	0.0

These results can be interpreted as follows.

Table 3-15: Interpretation of the Meteorological Data, Plaine Corail

Weather conditions	Day		
	14/03/2023	15/03/2023	16/03/2023
Wind speed m/s (2m high)	Strong wind	Strong wind	Strong wind
Wind direction	East	East	East
Temperature °C	From 22.6 to 28.7	From 25.6 to 29.2	From 26.0 to 30.2
Rainfall mm	Very low	None	None

Day 1: The weather conditions were very windy, measurements were disrupted a lot.

Day 2 and 3: Weather conditions were more stable, there was less wind, the impact of the weather was moderate.

In this area, conditions contributed to a slight decrease in measured noise levels.

It is always difficult when taking noise measurements in a windy place to ensure the validity of the measured data. Therefore, the microphones have been positioned close to the facades in order to avoid the effects of gusts which could disrupt measurements.

3.1.4.4.1.4 Aircraft overflights

The table below shows the aircraft movements recorded during the air quality measurement campaign. All aircraft are Air Mauritius ATR-72 or Air Austral ATR-72.

Table 3-16: aircraft movements recorded during the air quality measurement

Aircraft movement at Plaine Corail Airport for the period 14-16 march 2023

Date	14/03/2023	15/03/2023	16/03/2023
Flight	Arrival Time	Arrival Time	Arrival Time
MK120	9:35 a.m.	9:35 a.m.	9:35 a.m.
MK121	10:15 a.m.	10:15 a.m.	10:15 a.m.
MK126	10:10 am	10:10 am	10:10 am
MK127	10:50 am	10:50 am	10:50 am
MK130	2:05 pm	2:05 pm	2:05 pm
MK131	2:45 pm	2:45 pm	2:45 pm
MK136	2:40 pm	-	2:40 pm
MK137	3:20 pm	-	3:20 pm
MK140	6:35 pm	6:35 pm	6:35 pm
MK141	7:15 pm	7:15 pm	7:15 pm
MK144	7:10 pm	-	-
MK145	7:50 pm	-	-
UU751	-	5 :20 pm	-

3.1.4.4.1 Results

The table and map below show the overall noise levels measured by regulatory period.

Note: it should be noted that the passages of planes are mainly distributed over the period 07-18h (3 or 4 planes), only 1 or 2 planes circulate on the period 18h-21h and none during the night period. The planes land and take off systematically facing the wind, either on Rodrigues Island, from West to East.

Each measurement was treated separately in order to highlight the contribution of each aircraft to the overall level measured. This contribution is not always detectable depending on the specific environment at each point: ambient noise, wind gust, rain...

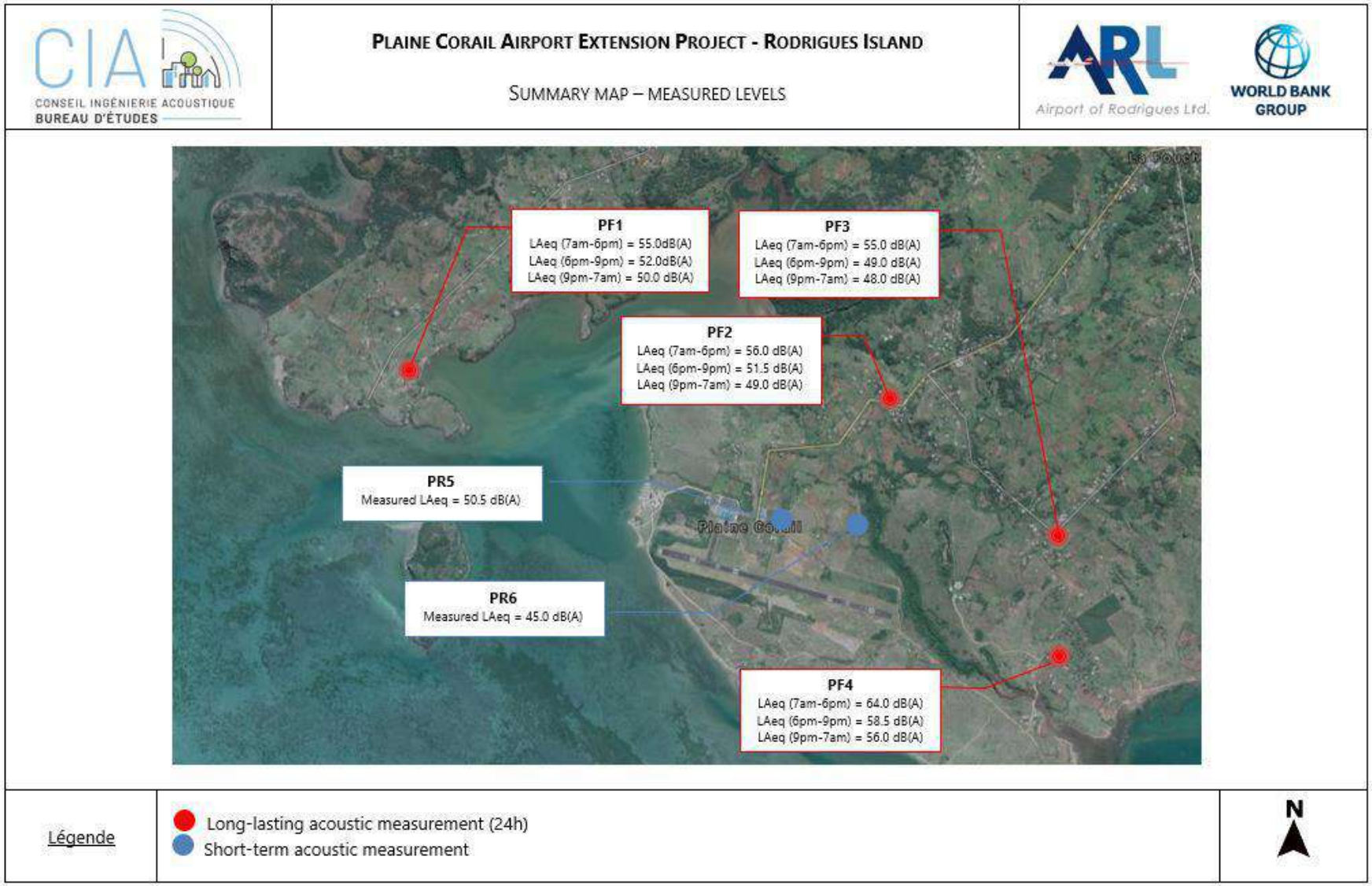


Figure 24 Noise measurements - location and results

3.1.4.4.1.1 Analysis

The detailed results of the noise measurements are shown below:

- The measured noise levels (LAeq and L50);
- The location (Name, Address, Location...);
- The noise level;
- A photo showing the position of the microphone on the front panel;
- A photo showing the vision from the microphone;
- The equipment used;
- The temporal evolution of the recorded signal;
- The main and secondary noise sources recorded;
- The impact of meteorology.

ACOUSTIC MEASUREMENT SHEET – PF1

Photos measuring points & location

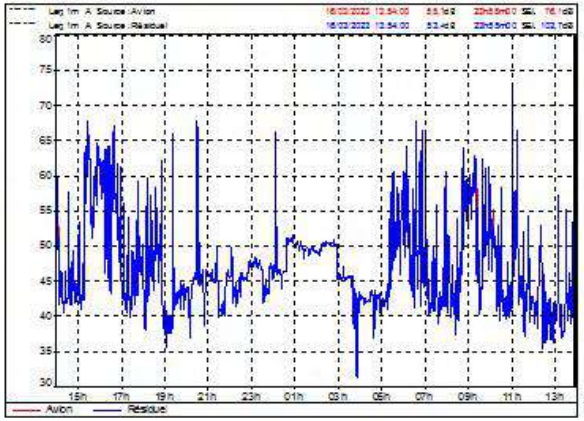
Details of the measuring point

Measuring point	PF1
Date and duration of the measurement	15 au 16/03/2023 (24h)
Name & Address	M. Allas - Pointe Palmiste - Rodrigues island
Material used	Svan 971 class 1 – Svantek
Receiver position	Gf
Noise source - main	Wind
Noise source - secondary	Environnement & housing
Distance airport	#1800m
Disturbance measurement	Punctually rain & wind, stationary noise at night, occasional noises

Feedback

In view of our on-site investigations, road traffic on this part of the island seems very low. The measured noise therefore comes mainly from the environment. The measurement was disturbed by occasional noise during the day, stationary noise at night, as well as weather conditions. Despite these disturbances, we tried to detect landing peaks (western area of the airport) on the temporal evolution below. The presence of aircraft is not really perceptible on this measurement point. The red coding on the above signal corresponds to the coding of the perceived aircraft. The latter makes it possible to establish the contribution of aerial overflights in the measured noise levels.

Temporal evolution



Kept results

PF1	LAeq measured in dB(A)	L50 measured in dB(A)	Flight over contribution in dB(A)	Neigborhood noise threshold in dB(A)
Day (7am-6pm)	55,0	42,5	30,0	60,0
Evening (6pm-9pm)	52,0	43,0	-	55,0
Night (9pm-7am)	50,0	46,0	-	50,0

(*) rounded at 0.5 dB(A)

The difference between the L50 and LAeq can be explained by weather-related disturbances (strong winds and gusts) and occasional noise. The increase in L50 is explained by the appearance of stationary noises at night.

Despite the disturbances due to climatic contingencies, the contribution of aerial overflight is well below the threshold of neighbourhood noise (30 dB)

ACOUSTIC MEASUREMENT SHEET – PF2

Photos measuring points & location

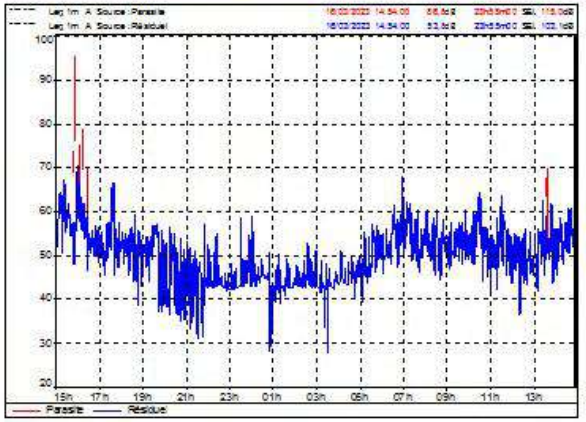
Details of the measuring point

Measuring point	PF2
Date and duration of the measurement	15 au 16/03/2023 (24h)
Name & Address	M. Prudence - Plaine Corail - Rodrigues island
Material used	Svan 971 class 1 – Svantek
Receiver position	Gf
Noise source - main	Plaine Corail road
Noise source - secondary	Wind, environnement
Distance airport	#1200m
Disturbance measurement	Punctually rain & wind, stationary noise at night, occasional noises

Feedback

This measuring point is located at the level of the main road of the island. The measured noise therefore comes mainly from the road. The measurement was disturbed by occasional noise during the day, stationary noise at night, as well as weather conditions. Despite these disturbances, we tried to detect landing peaks (northern area of the airport) on the temporal evolution below. The presence of aircraft is not perceptible at this measuring point.

Temporal evolution



Kept results

PF2	LAeq measured in dB(A)	L50 measured in dB(A)	Flight over contribution in dB(A)	Neigborhood noise threshold in dB(A)
Day (7am-6pm)	56,0	48,5	-	60,0
Evening (6pm-9pm)	51,5	44,5	-	55,0
Night (9pm-7am)	49,0	43,0	-	50,0

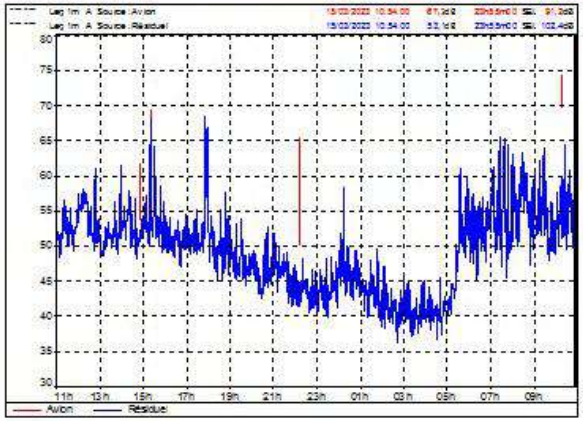
(*) rounded at 0.5 dB(A)

The difference between the L50 and LAeq can be explained by weather-related disturbances (strong winds and gusts) and occasional noise.

ACOUSTIC MEASUREMENT SHEET – PF3

Photos measuring points & location

Temporal evolution



Details of the measuring point

Measuring point	PF3
Date and duration of the measurement	14 au 15/03/2023 (24h)
Name & Address	Canetons School – Rodrigues island
Material used	Svan 971 de classe 1 – Svantek
Receiver position	GF
Noise source - main	School + weather
Noise source - secondary	Environnement and road
Distance airport	#1000m
Disturbance measurement	Punctually rain & wind, children, occasional noises

Kept results

PF3	LAeq measured in dB(A)	L50 measured in dB(A)	Flight over contribution in dB(A)	Neigborhood noise threshold in dB(A)
Day (7am-6pm)	55,0	51,0	44,5	60,0
Evening (6pm-9pm)	49,0	46,0	-	55,0
Night (9pm-7am)	48,0	42,5	36,0	50,0

(*) rounded at 0.5 dB(A)

Feedback

Road traffic on this part of the island is low. The measured noise comes mainly from the environment (especially the school). The measurement was slightly disturbed by occasional noises during the day, as well as by weather conditions. Despite these disruptions, we detect take-off peaks (eastern area of the airport) on the temporal evolution below. The presence of aircraft is perceptible at this measuring point. The red coding on the above signal corresponds to the coding of aerial overflights. The latter makes it possible to establish the contribution of aerial overflights in the measured noise levels. There is an additional plane at night (take-off at 10pm).

The small difference between the L50 and the LAeq (<5 dB) may indicate a small disturbance of the measurement at point noise, but does not exclude an influence of the weather on the sound levels.

Despite the disturbances due to climatic contingencies, the contribution of aerial overflight is well below the threshold of neighbourhood noise (15 dB during the day and 14 dB at night)

.

ACOUSTIC MEASUREMENT SHEET – PF4

Photos measuring points & location

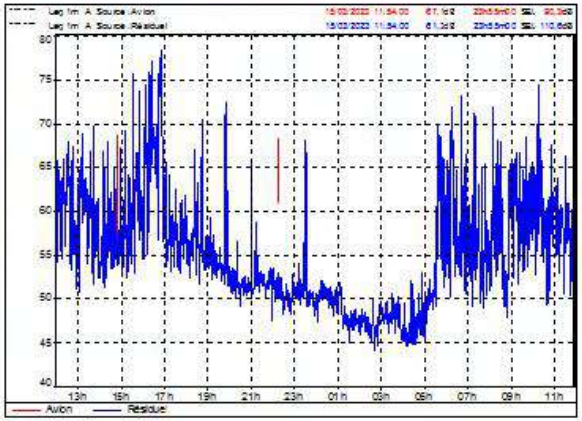
Details of the measuring point

Measuring point	PF4
Date and duration of the measurement	14 au 15/03/2023 (24h)
Name & Address	Mme Larcher - Plaine Caverne - Rodrigues island
Material used	Svan 971 class 1 – Svantek
Receiver position	Gf
Noise source - main	Environnement & housing
Noise source - secondary	Road
Distance airport	#900m
Disturbance measurement	Punctually rain & wind, occasional noises

Feedback

Road traffic on this part of the island is low. The measured noise comes mainly from the environment. The measurement was disrupted by occasional noises during the day, as well as by weather conditions. Despite these disruptions, we detect take-off peaks (eastern area of the airport) on the temporal evolution below. The presence of aircraft is perceptible at this measuring point. The red coding on the above signal corresponds to the coding of aerial overflights. The latter makes it possible to establish the contribution of aerial overflights in the measured noise levels. There is an additional plane at night (take-off at 10pm).

Temporal evolution



Kept results

PF4	LAeq measured in dB(A)	L50 measured in dB(A)	Flight over contribution in dB(A)	Neigborhood noise threshold in dB(A)
Day (7am-6pm)	64,0	54,5	43,5	60,0
Evening (6pm-9pm)	58,5	53,0	-	55,0
Night (9pm-7am)	56,0	49,5	37,5	50,0

(*) rounded at 0.5 dB(A)

The difference between the L50 and LAeq can be explained by weather-related disturbances (strong winds and gusts) and occasional noise.

Despite the disturbances due to climatic contingencies, the contribution of aerial overflight is well below the threshold of neighborhood noise (16.5 dB day and 12.5 dB night)

ACOUSTIC MEASUREMENT SHEET – PR5

Photos measuring points & location

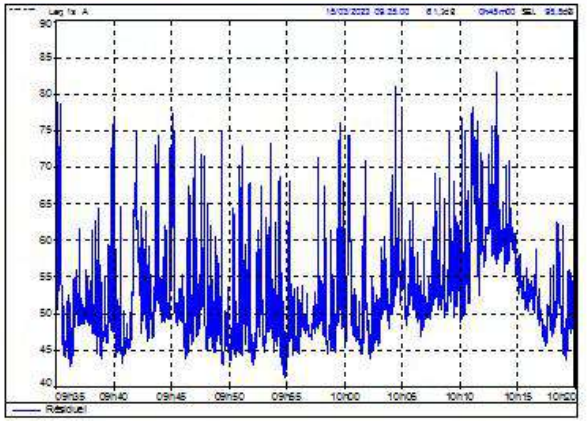
Details of the measuring point

Measuring point	PR5
Date and duration of the measurement	15/03/2023 (1h)
Name & Address	Near Mont Travers
Material used	Svan 971 class 1 – Svantek
Receiver position	Free field
Noise source - main	Environnement
Noise source - secondary	Road ans airport
Distance airport	#30m
Disturbance measurement	wind, occasional noises (animals)

Feedback

The measured noise comes mainly from the environment. The measurement was disrupted by weather conditions (strong wind). One plane took off and another landed during the measurement. The objective of this measure is to determine the noise environment of the site before the passage of trucks near the houses for the exploitation of the Mont Travers quarry, in connection with the project.

Temporal evolution



Kept results

PR5	LAeq measured in dB(A)	L50 measured in dB(A)
Measured LAeq	61,0	50,5

(*) rounded at 0.5 dB(A)

The difference between the L50 and LAeq can be explained by weather-related disturbances (strong winds and gusts).

ACOUSTIC MEASUREMENT SHEET – PR6

Photos measuring points & location

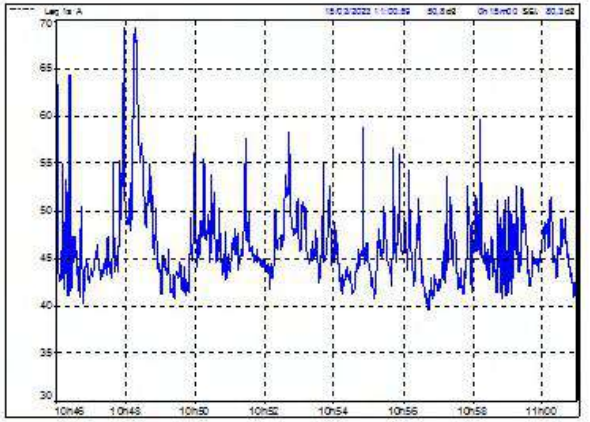
Details of the measuring point

Measuring point	PR6
Date and duration of the measurement	15/03/2023 (15 min)
Name & Address	Near Mont Travers
Material used	Svan 971 class 1 – Svantek
Receiver position	Free field
Noise source - main	Environnement
Noise source - secondary	airport
Distance airport	#200m
Disturbance measurement	Wind

Feedback

The measured noise comes mainly from the environment. The measurement was disrupted by weather conditions (strong wind). A plane took off during the measurement. The objective of this measure is to determine the noise environment of the site before the passage of trucks near the houses for the exploitation of the Mont Travers quarry, in connection with the project.

Temporal evolution



Kept results

PR6	LAeq measured in dB(A)	L50 measured in dB(A)
Measured LAeq	51,0	45,0

(*) rounded at 0.5 dB(A)

The difference between the L50 and LAeq can be explained by weather-related disturbances (strong winds and gusts).

3.1.4.4.1.2 Conclusion

The noise measurements present the pre-existing sound environment. In each of the sectors studied, there is a strong impact of the elements (wind) on the "sound" feeling of the site as well as significant human activity.

The measurements highlight more clearly a greater impact due to aircraft take-offs (on the east side of the airport) while landings are less noticeable to the west of the site (the proximity of the building to the airport in the east also explains this perception).

However, the measurements show that the permissible thresholds for neighbourhood noise are not exceeded by considering the contribution of airport flights alone: overall, air traffic generates noise levels that are nearly between 12 dB(A) to 30 dB(A) lower than the permissible thresholds during the day and night (exceptional at night because there is no overflight).

3.1.4.5 Aircraft noise emissions

The baseline noise levels are assessed with the calculation tool “IMPACT” compliant with ICAO recommendations. This online software is provided by Eurocontrol, a pan-European Organisation dedicated to supporting European aviation.

The calculations take into account:

- Aircraft movements,
- Aircraft types,
- Flight paths,
- Runway alignment;
- Annual average weather conditions.
- Other noise sources from airport activities are assumed to be limited compared to aircraft noise.

IMPACT uses the most recent aircraft databases BADA 3 and 4 of Eurocontrol wich include model specifications for nearly 100% of aircraft types in the ECAC area. BADA enables to reproduce the geometric, kinematic and kinectic aspects of the aircrafts over the entire operation flights envelope.

The resulting noise contours around the airport are represented on the maps below indicating the presence of population with the buildings, thus, this maps illustrate the exposure of populations to current aircraft noise The ratio between the number of building and the number of buildings in the zone 11 give an approximation of the impacted population. The scale representing sound levels range from

- Lden 45 dB(A) (very low noise exposure) to 70 dB(A) (high noise exposure). The noise indicator Lden, used in European noise directives and French noise exposure plans, has been chosen because it takes into account the nuisances felt during evening and night periods ;
- LAmax 60 dB(A) (medium noise exposure) to 100 dB(A) (very high noise exposure). It indicates the daily maximum LAeq reached. The noise indicator LAmax used in French noise exposure plans has been chosen to see the maximum noise level exposure;

- NA62 : 2 to 12 (low number of events LAmax > 62 dB(A)). The NA62 indicator is hepful to contextualize the LAmax indicator. While LAmax indicates the daily maximum LAeq , NA62 indicates the daily number of events with maximum LAeq > 62 dB(A) ;
- NA65 : 2 to 10 (low number of events LAmax > 65 dB(A)). The NA65 indicator is hepful to contextualize the LAmax indicator. While LAmax indicates the daily maximum LAeq , NA65 indicates the daily number of events with maximum LAeq > 65 dB(A)

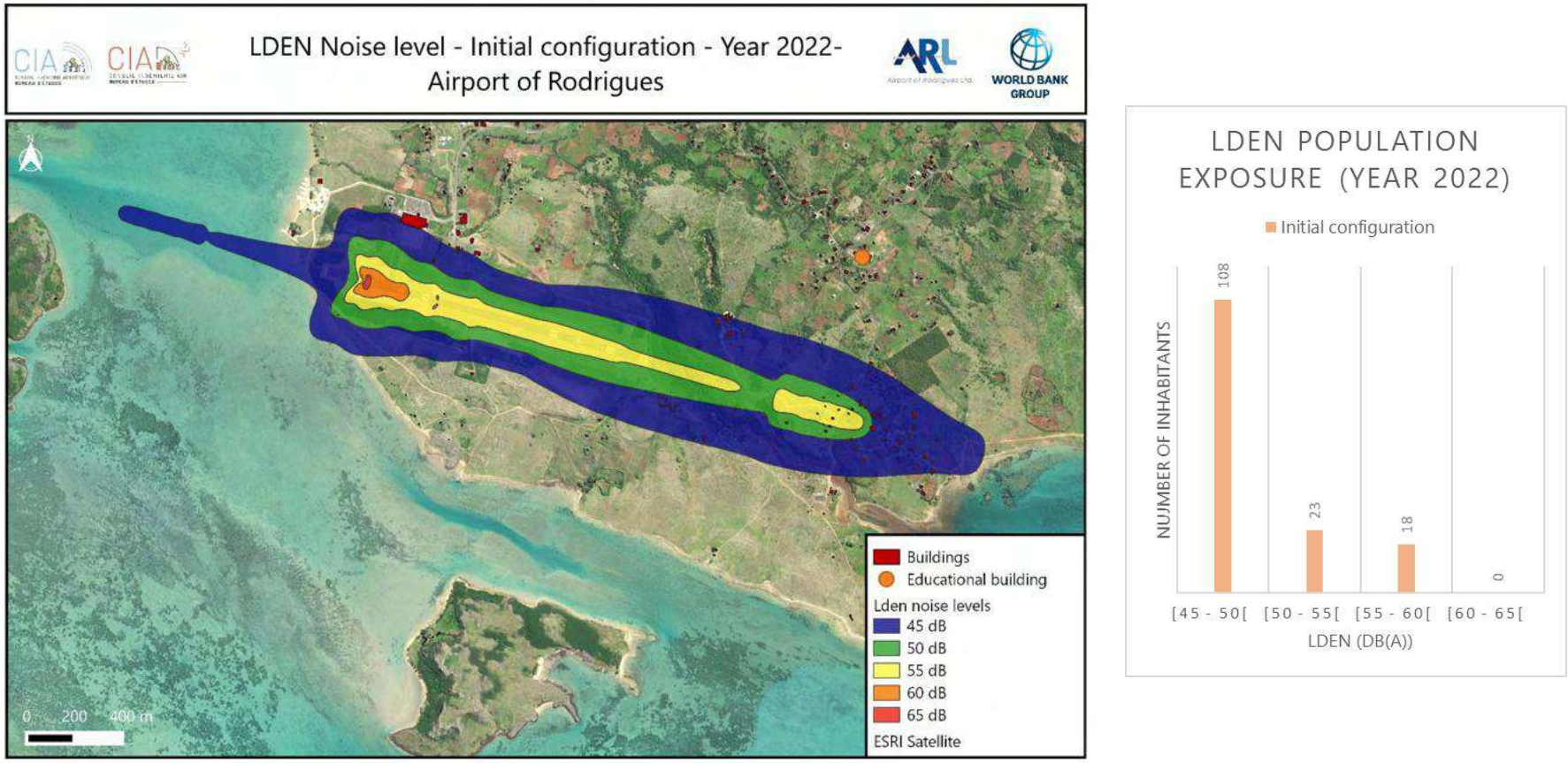
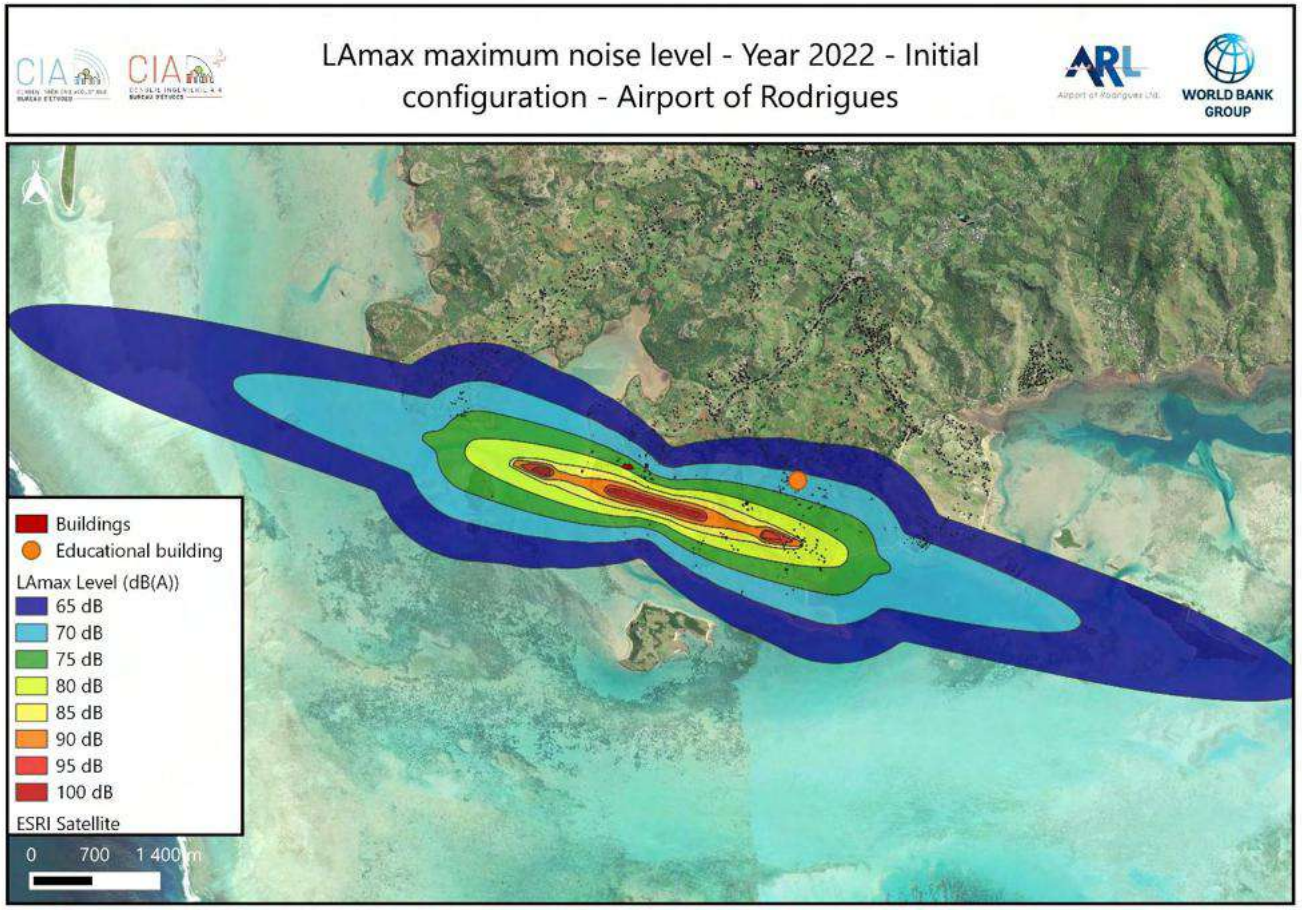


Figure 25 : Lden noise contour and population exposure - initial configuration – Plaine Corail Airport



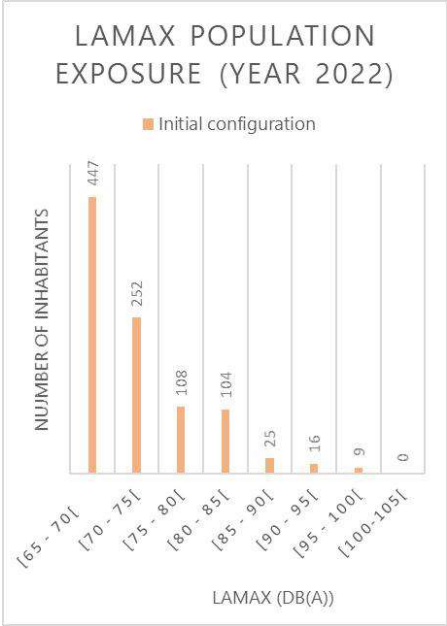


Figure 26 : LAmax noise contour and population exposure - initial configuration – Plaine Corail Airport

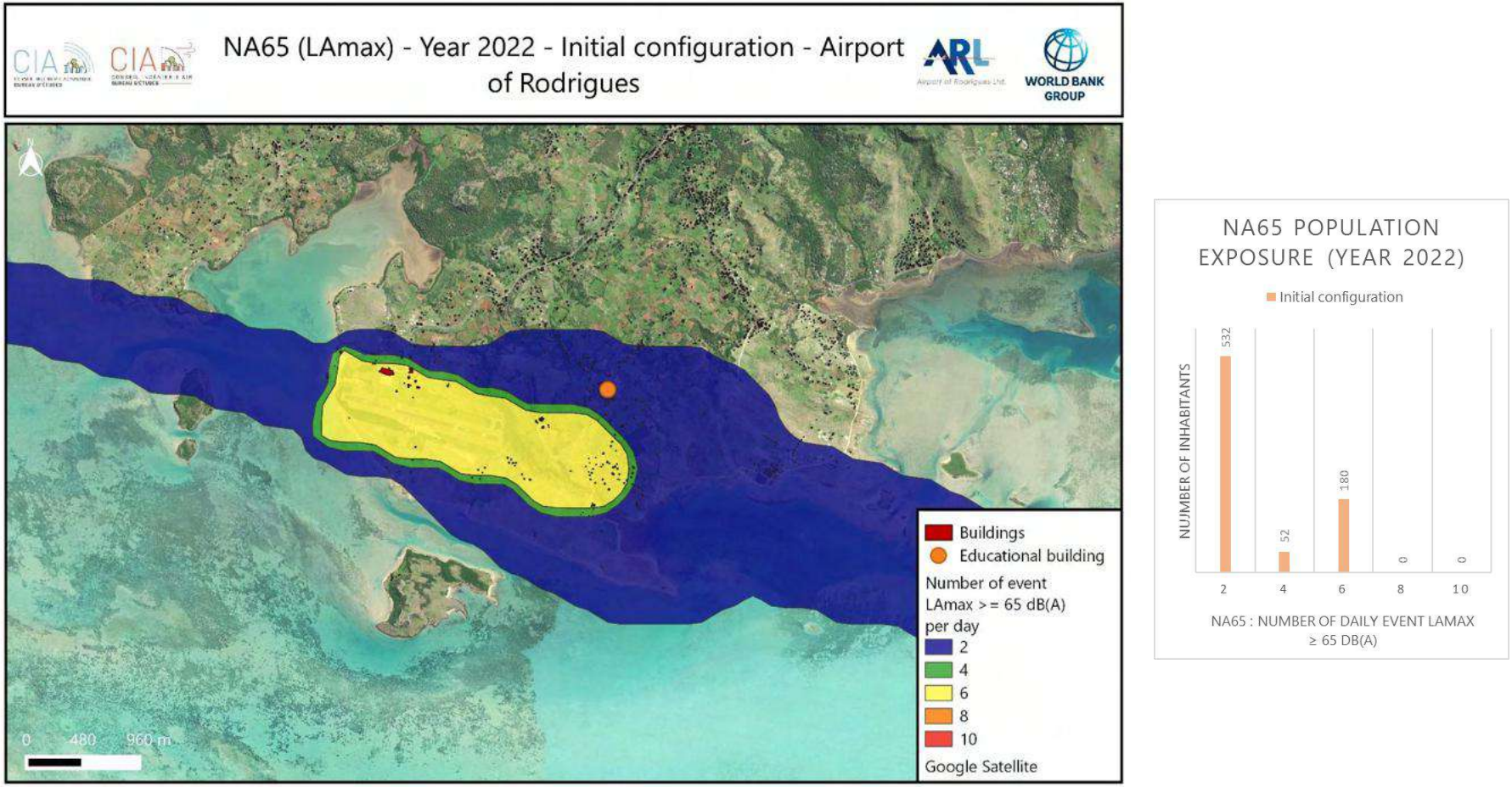


Figure 27 : Number of events LAmax > 65 dB(A) contour and population exposure - initial configuration – Plaine Corail Airport

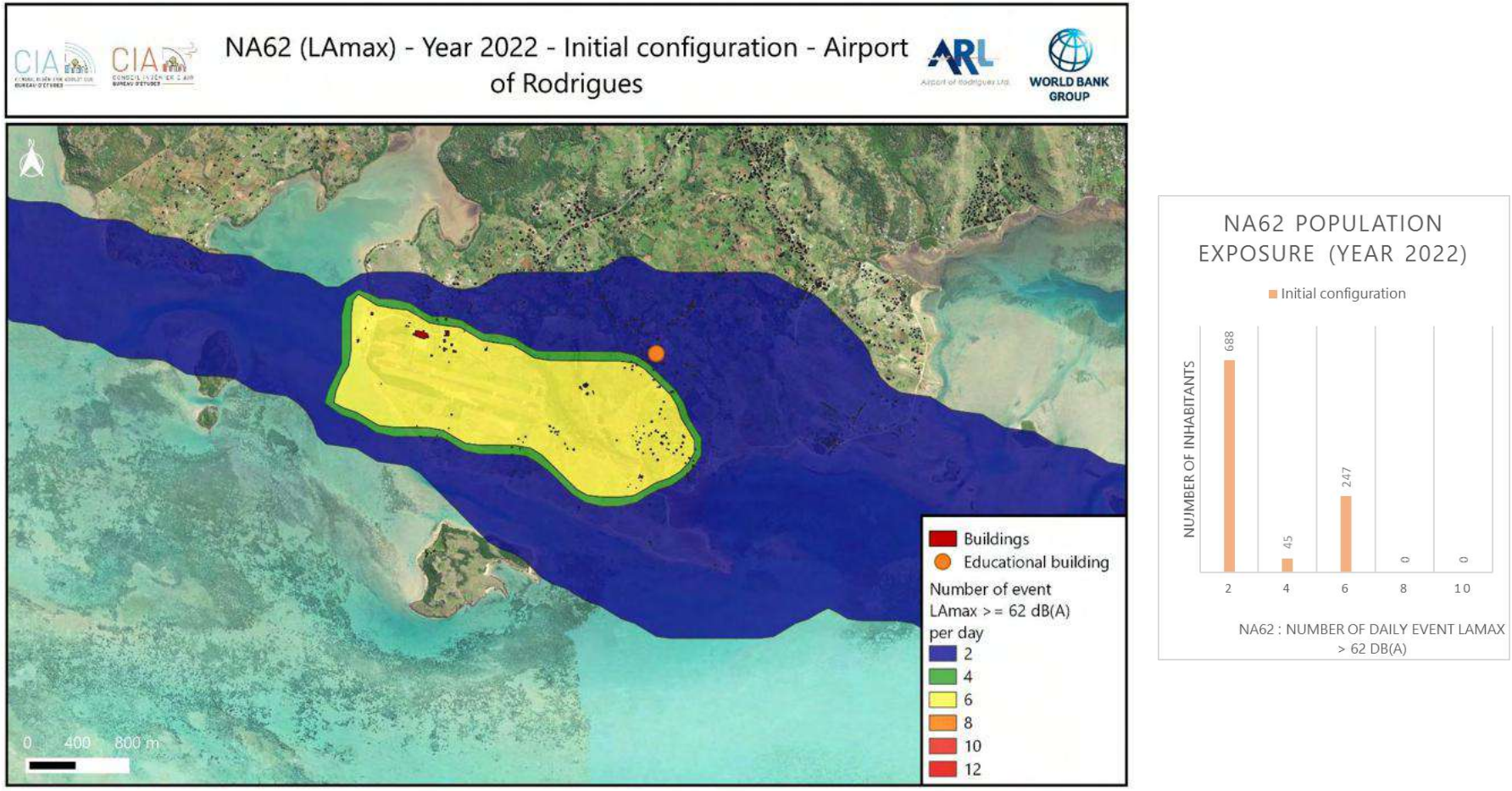


Figure 28 : Number of events LAmax > 62 dB(A) contour and population exposure - initial configuration – Plaine Corail Airport

As few airplanes land on Plaine Corail Airport, and they are quite quiet, the noise curves of Lden indicator are small. No dwelling or noise-sensitive building has been identified in the footprint of the lowest noise curves that define noise exposure down to 45 dB. This confirms that populations are currently almost not exposed to airport noise.

However, it should be noted that the sensitive building pre-primary school Le Caneton is exposed to LAmax = 70dB(A) two times a day (NA65 = 2).

3.1.4.6 Aircraft noise Issues

The noise issue is due to the presence of sensitive populations living nearby and of the pre-primary school Le Caneton.

The aircraft traffic growth will lead to a significant increase in noise; **thus, the receptor sensitivity to the project is considered high**.

3.1.4.7 Road noise emissions

The noise emitted by the roads around the airport is studied in order to establish the acoustic impact on the population. The project does not foresee any modification on the road infrastructures, but an increase of the airport attendance will lead to an increase of traffic in Plaine Corail.

The WHO (World Health Organization) published in 2018 recommendations for average exposure to road traffic noise based on the European Lden and Ln indicators.

Indicator	Maximum noise level	Effect
Lden	53 dB	**Noise levels above this value are associated with adverse health effects**
Ln	**45 dB**	**Nighttime noise levels above this value are associated with adverse effects on sleep.**

3.1.4.7.1 Input data

The traffic data used for the present study was taken from the traffic study conducted by ITMD. The map and table below summarizes the different traffic routes used for the study and the acoustic simulation of the project during the current situation.

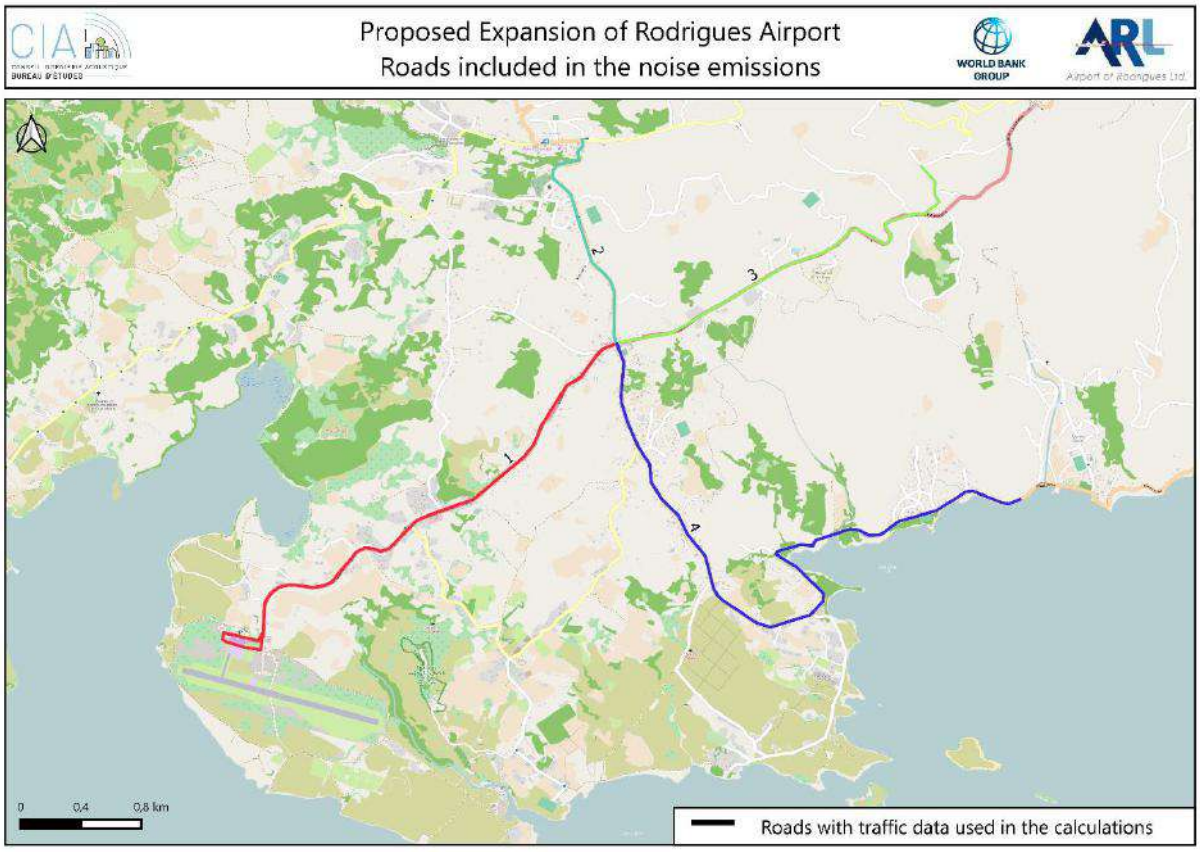


Figure 29: Roads included in the noise emissions

Table 3-17: Road traffic in the current situation

Road	Initial configuration – 2023	
	AADT* All types of vehicles	AADT* Heavy vehicles
1	1331	231
2	1791	193
3	2369	193
4	947	103

**:AADT: Average Annual Daily Draffic*

Note: traffic data are only given for the main roads, secondary roads are not taken into account.

In order to determine the road impact on the population, we must identify the latter in the studied area. The data provided according to the administrative division of the island of Rodrigues are shown in the map and the table below.

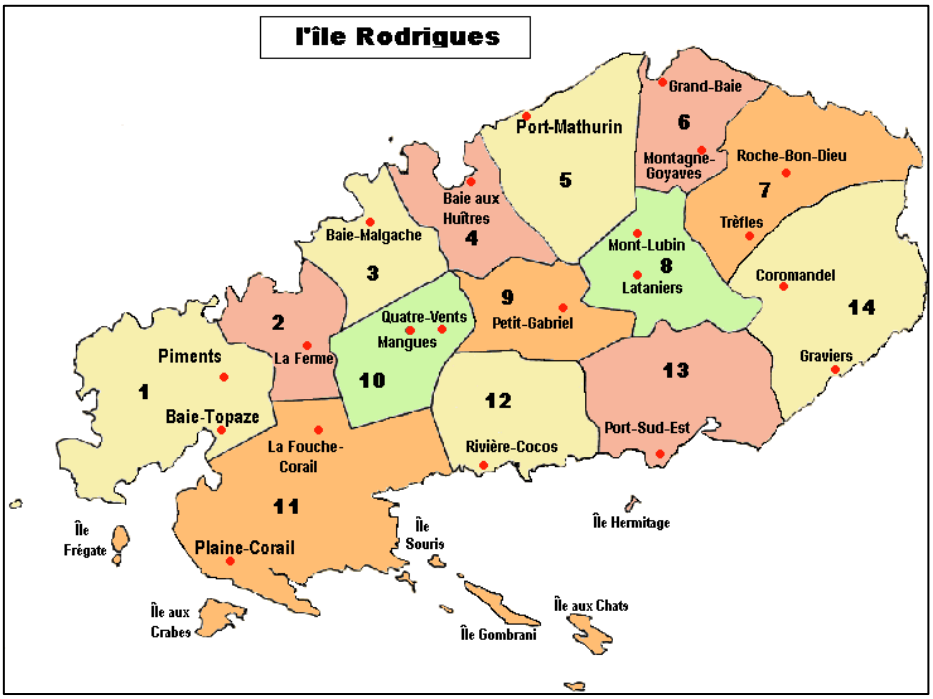


Figure 30: administrative breakdown

Note: The population zones used for the calculations are zones n°2, n°10 and n°11.

Table 3-18: Administrative division by area

N°	Administrative Division	2023
1	Piments-Baie Topaze	1904
2	La Ferme	1465
3	Baie Malgache	1417
4	Baie-aux-Huîtres	3417
5	Port Mathurin	7810
6	Grand Baie-Montagne Goyaves	1112
7	Roche Bon Dieu-Trèfles	2712
8	Lataniers-Mont Lubin	5014
9	Petit Gabriel	4819
10	Mangues-Quatre Vents	3781
11	Plaine Corail-La Fouche Corail	3731
12	Rivière Cocos	3811
13	Port Sud-Est	3579
14	Coromandel-Graviers	2561
TOTAL		**47133**

3.1.4.7.2 Acoustic simulation of the initial state

From the topographic files provided, the studied site has been modeled in 3 dimensions with the Mithra SIG V5 software. The right-of-way and its geometrical characteristics were taken into account.

3.1.4.7.2.1 Calculation in initial situation

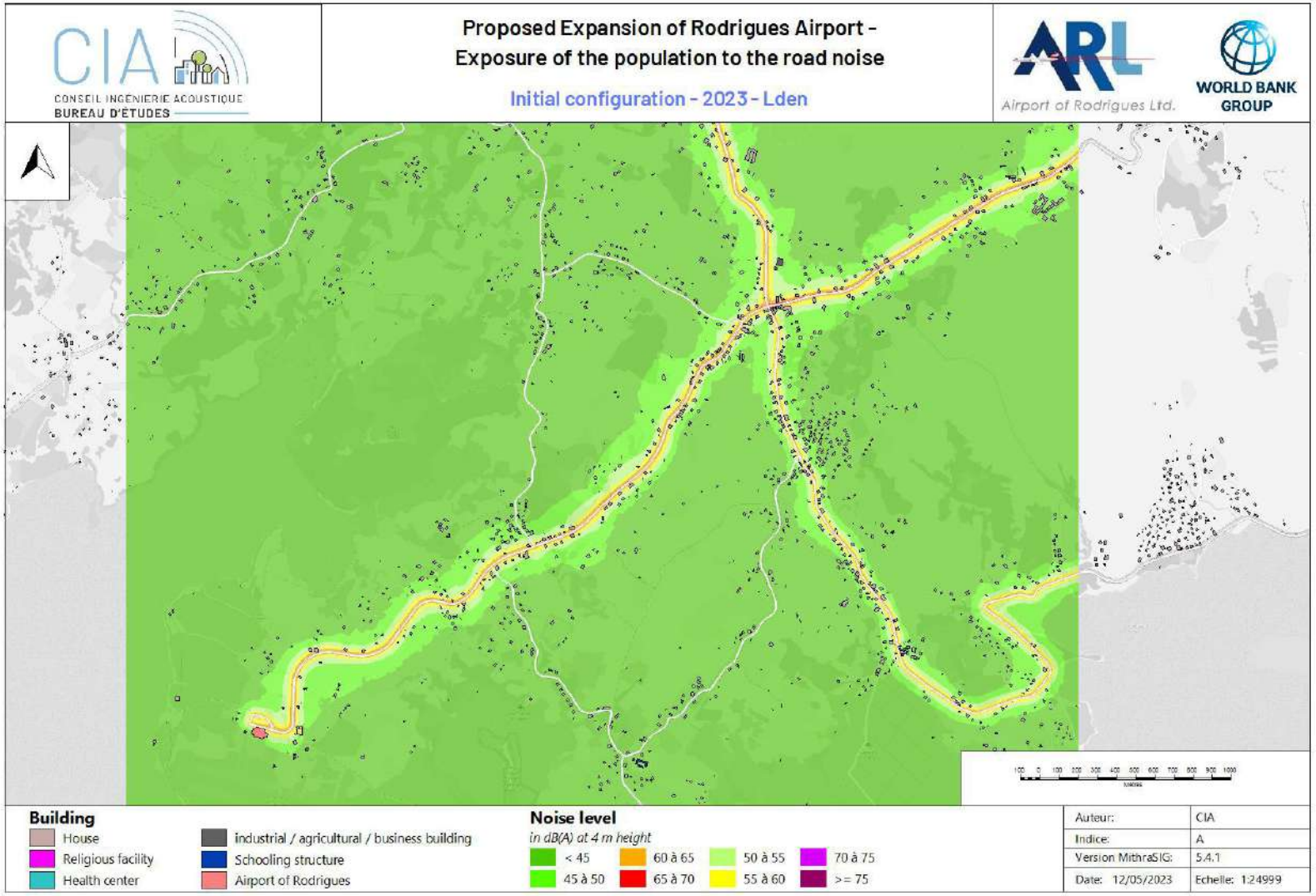
Acoustic calculations were performed on the entire studied area without the project to characterize the impact of noise pollution due to existing road traffic on the population.

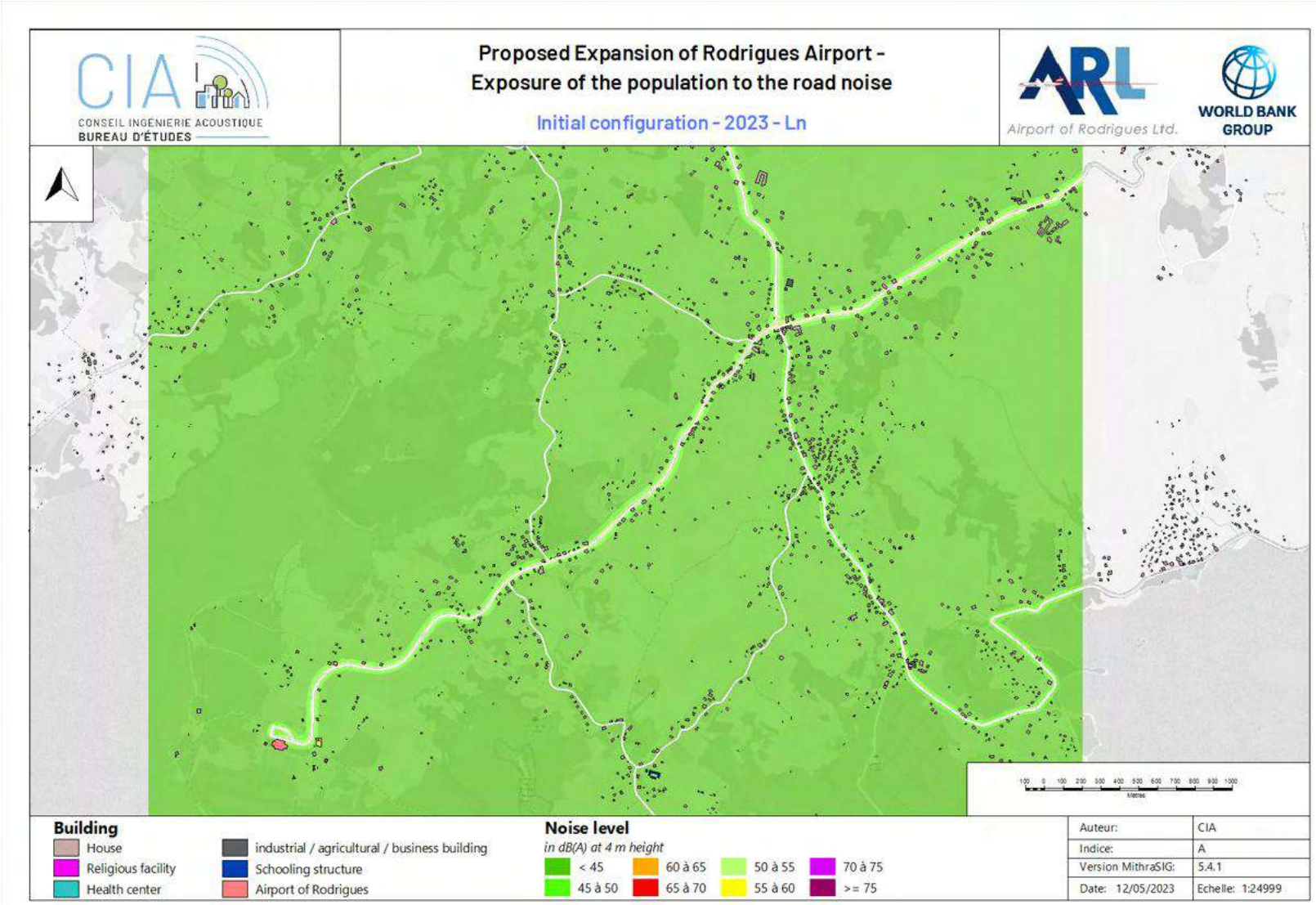
The following calculation parameters were used:

- Calculation method : NMPB 08;
- Meteorological effects: 100% favorable;
- The pavement surface considered is an R2 10-year type pavement (medium asphalt type).
- Traffic and speed:
  - AADT 2023 (traffic study – 3.1.4.7.1 Input data),
  - Speeds were considered to be regulatory (50 km/h).

Results are presented in the form of result maps, which can be broken down as follows:

- Horizontal noise map at 4 meters - Lden (noise level between 45 to 75 dB(A)),
- Horizontal noise map at 4 meters - Ln ((noise level between 45 to 75 dB(A)).


CIA
CONSEIL INGENIERIE ACOUSTIQUE
BUREAU D'ETUDES
Proposed Expansion of Rodrigues Airport -
Exposure of the population to the road noise
Initial configuration - 2023 - Lden
ARL
Airport of Rodrigues Ltd.
WORLD BANK GROUP
Building
House
Religious facility
Health center
industrial / agricultural / business building
Schooling structure
Airport of Rodrigues
Noise level
in dB(A) at 4 m height
< 45
45 à 50
60 à 65
65 à 70
50 à 55
55 à 60
70 à 75
>= 75
Auteur: CIA
Indice: A
Version MithraSIG: 5.4.1
Date: 12/05/2023
Echelle: 1:24999


CIA
CONSEIL INGÉNIERIE ACOUSTIQUE
BUREAU D'ÉTUDES
Proposed Expansion of Rodrigues Airport -
Exposure of the population to the road noise
Initial configuration - 2023 - Ln
ARL
Airport of Rodrigues Ltd.
WORLD BANK GROUP
Building
House
Religious facility
Health center
industrial / agricultural / business building
Schooling structure
Airport of Rodrigues
Noise level
in dB(A) at 4 m height
< 45
45 à 50
60 à 65
65 à 70
50 à 55
55 à 60
70 à 75
>= 75
Auteur: CIA
Indice: A
Version MithraSIG: 5.4.1
Date: 12/05/2023
Echelle: 1:24999

Interpretation:

The use of noise maps at a height of 4 m allows us to estimate the noise exposure of the population in the studied area. The methodology used takes into account the exposure of the residents on the most exposed façade at a height of 4 meters. This calculation method leads to an overestimation of the noise exposure of the population. The number of inhabitants is brought back to the habitable surface of this perimeter, thus a number of persons is attributed to each building.

The table below presents a summary of the results for the dwellings exposed in the current situation.

Table 3-19: Population noise exposure

Intervals (dB)	Initial configuration - 2023 - existing buildings							
	Lden				Ln			
	Nb of homes		Nb of inhabitants		Nb of homes		Nb of inhabitants	
< 45	1486	72%	2532	53%	1849	89%	3872	80%
[45 - 50[	230	11%	929	19%	180	9%	715	15%
[50 - 55[	148	7%	457	9%	45	2%	233	5%
[55 - 60[	171	8%	689	14%	0	0%	0	0%
[60 - 65[	39	2%	213	4%	0	0%	0	0%
[65 - 70[	0	0%	0	0%	0	0%	0	0%
[70 - 75[	0	0%	0	0%	0	0%	0	0%
> 75	0	0%	0	0%	0	0%	0	0%
> Lden* 53 dB	260	13%	1079	22%				
> Ln* 45 dB					225	11%	948	20%
Total	2074	100%	4820	100%	2074	100%	4820	100%

** WHO Recommendation*

Interpretation:

It is noted that 20 % of the population is currently exposed to noise levels above the WHO thresholds.

Note: As the secondary roads are not very frequented, only the main road network has been considered, which may lead to a slight underestimation of the population exceeding the WHO thresholds.

3.1.4.7.2.2 Calculation in future situation

A following report will present these data for the years 2046 with and without project, with a study of the impact of the project.

3.1.5 Summary: air and noise sensitivity

The area around the airport is sparsely populated, yet it should be noted that a school is located to the east of the airport and requires special attention. In the south of the island, ambient air quality and sound environment are directly linked to the airport's activities and to road traffic.

Table 3-20: Air and noise sensitivity

Theme	Sub-theme	Receptor	Sensitivity
Air quality and noise	Air quality	Population exposed	High
	Noise	Population exposed	High

4 Conclusion: current state 2023

This report addresses the current situation 2023. A following report will present the results for the years 2026 and 2046 with and without project, with a study of the impact of the project.

4.1 Air quality

4.1.1 Atmospheric pollutants measured

Despite unfavourable conditions (absence of rain) the measures still allow positive conclusions to be drawn about air quality on Rodrigues Island. No measurements exceed regulatory thresholds which apply to PM10, PM2.5 and NO_2.

The concentrations measured are globally low, reflecting very good air quality on Rodrigues Island.

Concerning aircraft overflight, no influence is observed on concentrations for the current 4 daily overflights.

4.1.2 Road traffic: emissions of pollutants and modeled atmospheric concentrations

The NOx emissions near the airport at “Route de l’autonomie”, are low compared to the other roads, with less than 1 kg/day of NOx emitted in the current situation 2023.

The concentrations modeled in the area of 500 meters around the roads are superior to the WHO Annual Air Quality Guidelines for the particles: Indeed, the background concentrations included in the calculation are already superior to those guidelines.

For the nitrogen dioxide, the WHO Annual Air Quality Guideline is respected in all the area.

The concentrations modeled are close to the background concentration included in the calculations (low standard deviation).

The Indicator Pollution Population (IPP) is calculated by multiplying the number of inhabitants of each zone by the mean concentration of nitrogen dioxide of the zone. The higher IPP is located in the zone 5: it’s the zone with the higher number of inhabitants. The zone 11 where the airport is located, has a low IPP compared to the zones 5, 8, 9 and 12.

4.1.3 Air traffic

It should be noted that air traffic is the most important emission’s source of pollutant. With 274 289 kg/year of fuel consumption, for example the emission of NOX is equal to 1361 kg/year.

However the airplanes emissions are considerably higher in the atmosphere than the road traffic emission. The plane emissions are easily dispersed in the atmosphere (between 0 and 1000 meters): the population is less impacted by plane emissions than by ground level’s emissions.

The project will increase the emissions of pollutants/aiplane because of the turbo-reactor type of the future aircrafts. However the higher capacities of the future planes will allow to reduce the number of flights.

4.2 Noise

4.2.1 Road noise

The road impact on the studied area shows that 20% of the population is currently exposed to noise levels above the WHO thresholds.

4.2.2 Air traffic

As few airplanes land on Plaine Corail Airport, and they are quite quiet, the noise curves of Lden indicator are small. No dwelling or noise-sensitive building has been identified in the footprint of the lowest noise curves that define noise exposure down to 45 dB. This confirms that populations are currently almost not exposed to airport noise.

However, it should be noted that the sensitive building pre-primary school Le Caneton is exposed to LAmax = 70dB(A) two times a day (NA65 = 2).

5 Environmental and Social Risks and Impacts

5.1 Methodology

5.1.1 Air quality and noise

5.1.1.1 Aircraft study

5.1.1.1.1 Input DATA

- To be coherent with the road studies, 2046 long-term air traffic is studied (commissioning horizon + 20 years)
- Because of missing information about air traffic, the commissioning horizon 2026 is not studied
- The 2046 estimated traffic is based on the following hypothesis:
    - Annual passengers arrivals and annual growth : “Air traffic forecast annual passengers arrivals (or departures) are estimated as 159 684 by 2037 (4% annual growth) rising to 172 500 by 2045 (1% growth from 2037)” (PCA – Phase 1 – Terminal Capacity Assessment);
    - Without project, the Aircraft type is estimated as :
        - Commercial : 100 % ATR72-500 assumed to be operating at 85% capacity;
        - Governmental : 100% Dornier 228 with the same traffic as 2022;
    - The hourly breakdown is estimated the same as 2022;
    - The “runway in use” breakdown (30 or 12) is estimated the same as 2022;

The following table and graphics describe the 2046 aircraft traffic at the Rodrigues Airport without project:

Table 5-1: 2046 Airport traffic's statistics (initial configuration) – Plaine Corail

Runway	Aircraft	Type	Path	Day 6h-18h	Evening 18h-22h	Night 22h-06h	Total
12	ATR72-500	Arrival	IMR/Visual	32,76%	12,97%	0,12%	45,85%
			NDB	1,72%	0,68%	0,01%	2,41%
		Departure	Direct	34,48%	13,65%	0,12%	48,26%
	Dornier 228	Arrival	IMR/Visual	0,66%	0,26%	0,00%	0,93%
			NDB	0,03%	0,01%	0,00%	0,05%
		Departure	Direct	0,70%	0,28%	0,00%	0,98%
30	ATR72-500	Arrival	IMR/Visual	0,51%	0,20%	0,00%	0,71%
			NDB	0,03%	0,01%	0,00%	0,04%
		Departure	Direct	0,54%	0,21%	0,00%	0,75%
	Dornier 228	Arrival	IMR/Visual	0,01%	0,00%	0,00%	0,01%
			NDB	0,00%	0,00%	0,00%	0,00%
		Departure	Direct	0,01%	0,00%	0,00%	0,02%
TOTAL				71,45%	28,29%	0,26%	5090 OPERATIONS

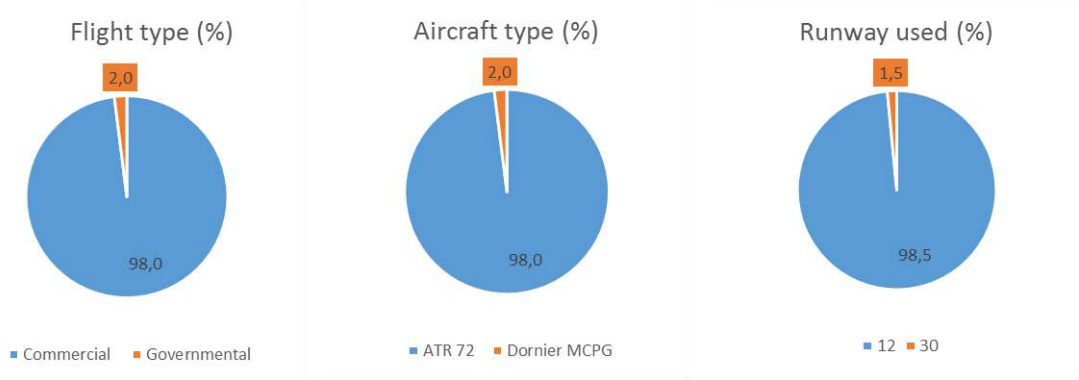


Figure 31: 2046 Airport traffic's statistics (initial configuration) – Plaine Corail

- With project, the Aircraft type is estimated as :
  - Commercial : 80 % A321-neo assumed to be operating at 85% capacity;
  - Commercial : 20 % B739-900Max assumed to be operating at 85% capacity;
  - Governmental : 100% Dornier 228 with the same traffic as 2022;

The following table and graphics describe the 2046 aircraft traffic at the Rodrigues Airport with project:

Table 5-2: 2046 Airport traffic's statistics (project configuration) – Plaine Corail

Runway	Aircraft	Type	Path	Day 6h-18h	Evening 18h-22h	Night 22h-06h	Total
12	A321Neo	Arrival	IMR/Visual	25,79%	10,21%	0,09%	36,09%
			NDB	1,36%	0,54%	0,00%	1,90%
		Departure	Direct	27,15%	10,75%	0,10%	37,99%
	B373-900M	Arrival	IMR/Visual	6,17%	2,44%	0,02%	8,63%
			NDB	0,32%	0,13%	0,00%	0,45%
		Departure	Direct	6,49%	2,57%	0,02%	9,09%
	Dornier 228	Arrival	IMR/Visual	1,46%	0,58%	0,01%	2,05%
			NDB	0,08%	0,03%	0,00%	0,11%
		Departure	Direct	1,54%	0,61%	0,01%	2,15%
30	A321Neo	Arrival	IMR/Visual	0,40%	0,16%	0,00%	0,56%
			NDB	0,02%	0,01%	0,00%	0,03%
		Departure	Direct	0,42%	0,17%	0,00%	0,59%
	B373-900M	Arrival	IMR/Visual	0,10%	0,04%	0,00%	0,13%
			NDB	0,01%	0,00%	0,00%	0,01%
		Departure	Direct	0,10%	0,04%	0,00%	0,14%
	Dornier 228	Arrival	IMR/Visual	0,02%	0,01%	0,00%	0,03%
			NDB	0,00%	0,00%	0,00%	0,00%
		Departure	Direct	0,02%	0,01%	0,00%	0,03%
TOTAL				71,45%	28,29%	0,26%	2306 OPERATIONS

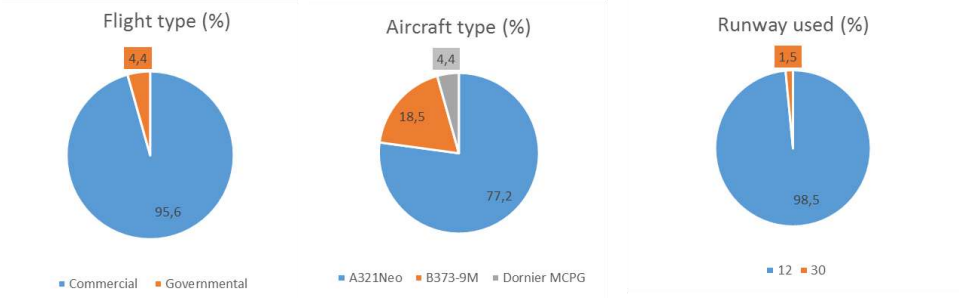


Figure 32: 2046 Airport traffic's statistics (project configuration) – Plaine Corail

- Average meteorological data : Temperature : 29,9°C ; Pressure (hypothetical) : 1013 HPa ; Humidity (hypothetical) : 77% ; Headwind (hypothetical) : 13,0 Kt;
- Technical information about the airport : Elevation : 93 ft ; distance and localisation of the runways (initial and project configuration);
- Statistical data about population (annual rate of population growth: +2,5%):

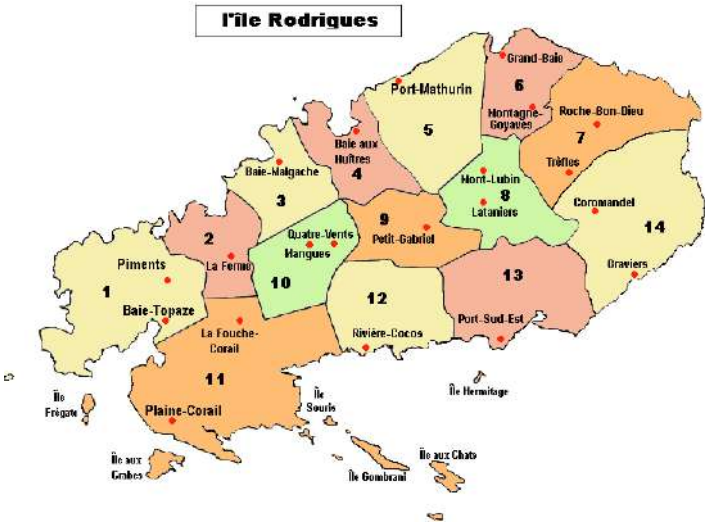


Figure 33: Population's data – administrative division

Table 5-3: Population's data

N°	Administrative Division	2000	2021	2023	2046
1	Piments-Baie Topaze	1445	1794	1904	3360
2	La Ferme	1112	1381	1465	2585
3	Baie Malgache	1076	1336	1417	2500
4	Baie-aux-Huîtres	2594	3221	3417	6030
5	Port Mathurin	5929	7362	7810	13782
6	Grand Baie-Montagne Goyaves	844	1048	1112	1962
7	Roche Bon Dieu-Trèfles	2059	2557	2712	4786
8	Lataniers-Mont Lubin	3806	4726	5014	8848
9	Petit Gabriel	3658	4542	4819	8504
10	Mangues-Quatre Vents	2870	3564	3781	6672
11	Plaine Corail-La Fouche Corail	2832	3517	3731	6584
12	Rivière Cocos	2893	3592	3811	6725
13	Port Sud-Est	2717	3374	3579	6316
14	Coromandel-Graviers	1944	2414	2561	4519
TOTAL		**35779**	**44427**	**47133**	83171

- The approach path (NDB 5%, IMR 90%, Visual 5%) or take-off path (because of the missing information about the take-off path, it is considered as a straight line) provided by the department of civil aviation of the Republic of Mauritius.
    - Initial configuration : The same path as 2022;
    - Project configuration: The same path as 2022 with a rotation angle to match with the planned new runway.

The following figures present the different paths with the project configuration:

(Note: It is hypothetically considered that the visual approach is the same path that IMR approach).

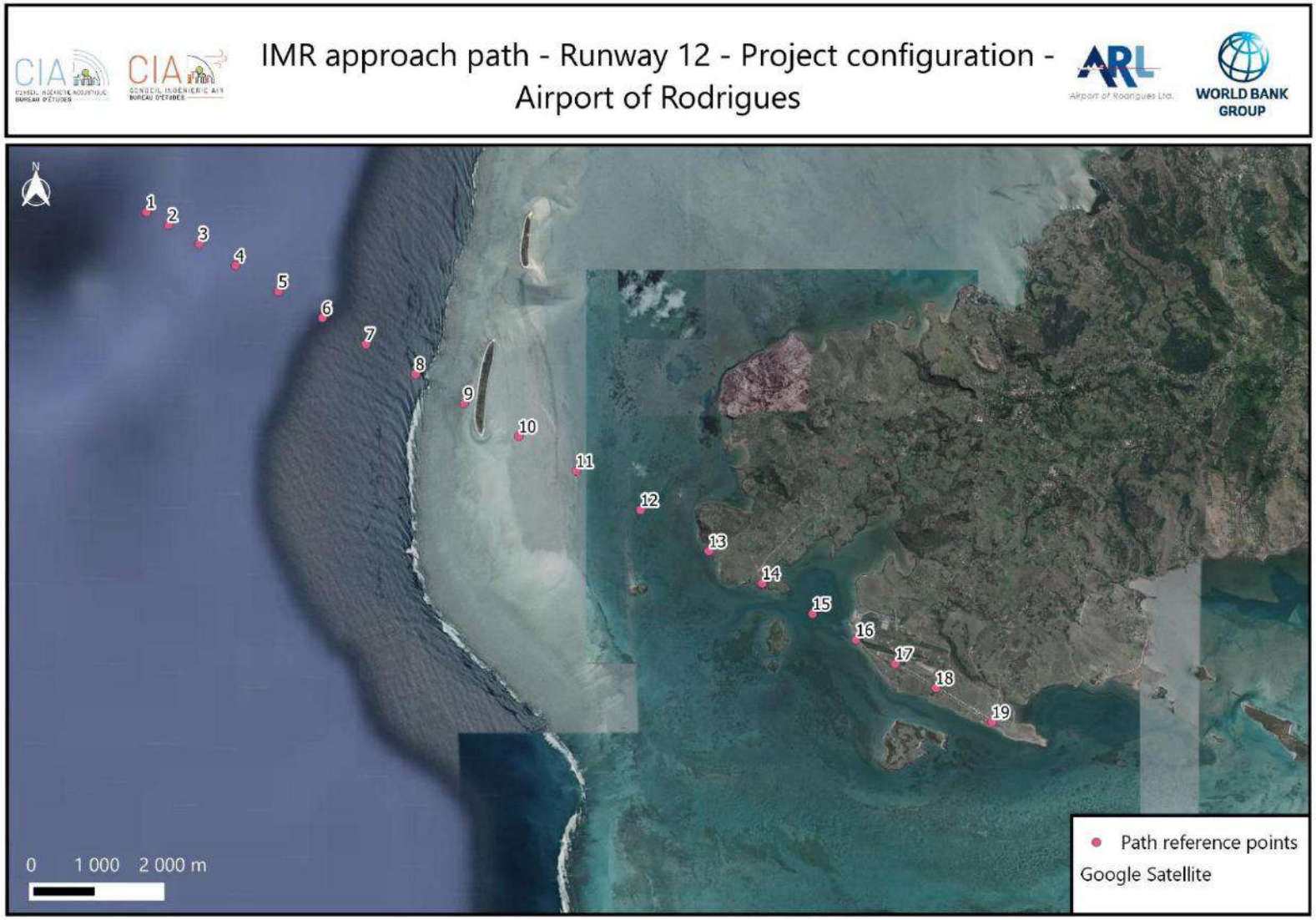


Figure 34: IMR approach path– Runway 12 – Project configuration – Plaine Corail

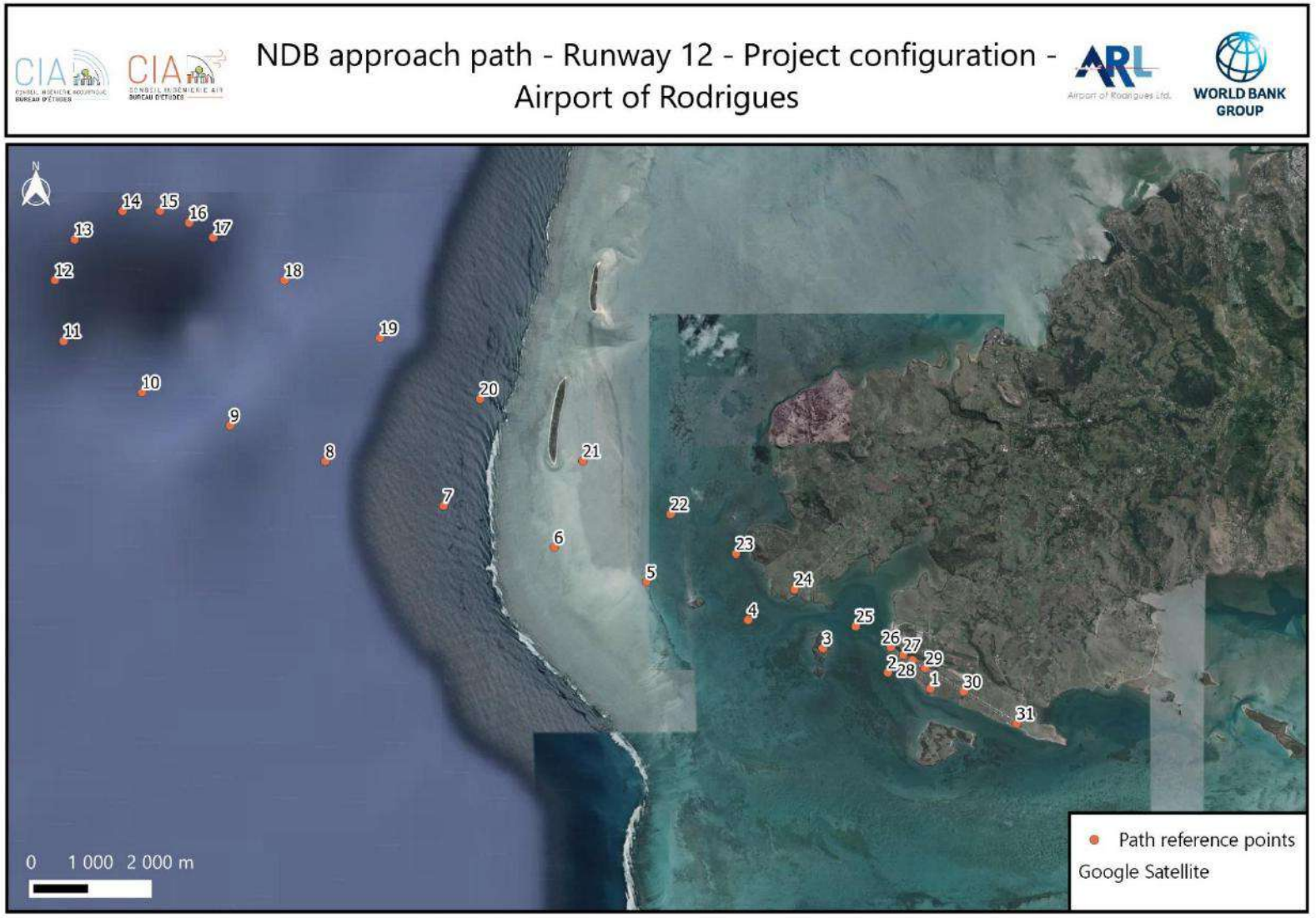


Figure 35: NDB approach path– Runway 12 – Project configuration – Plaine Corail

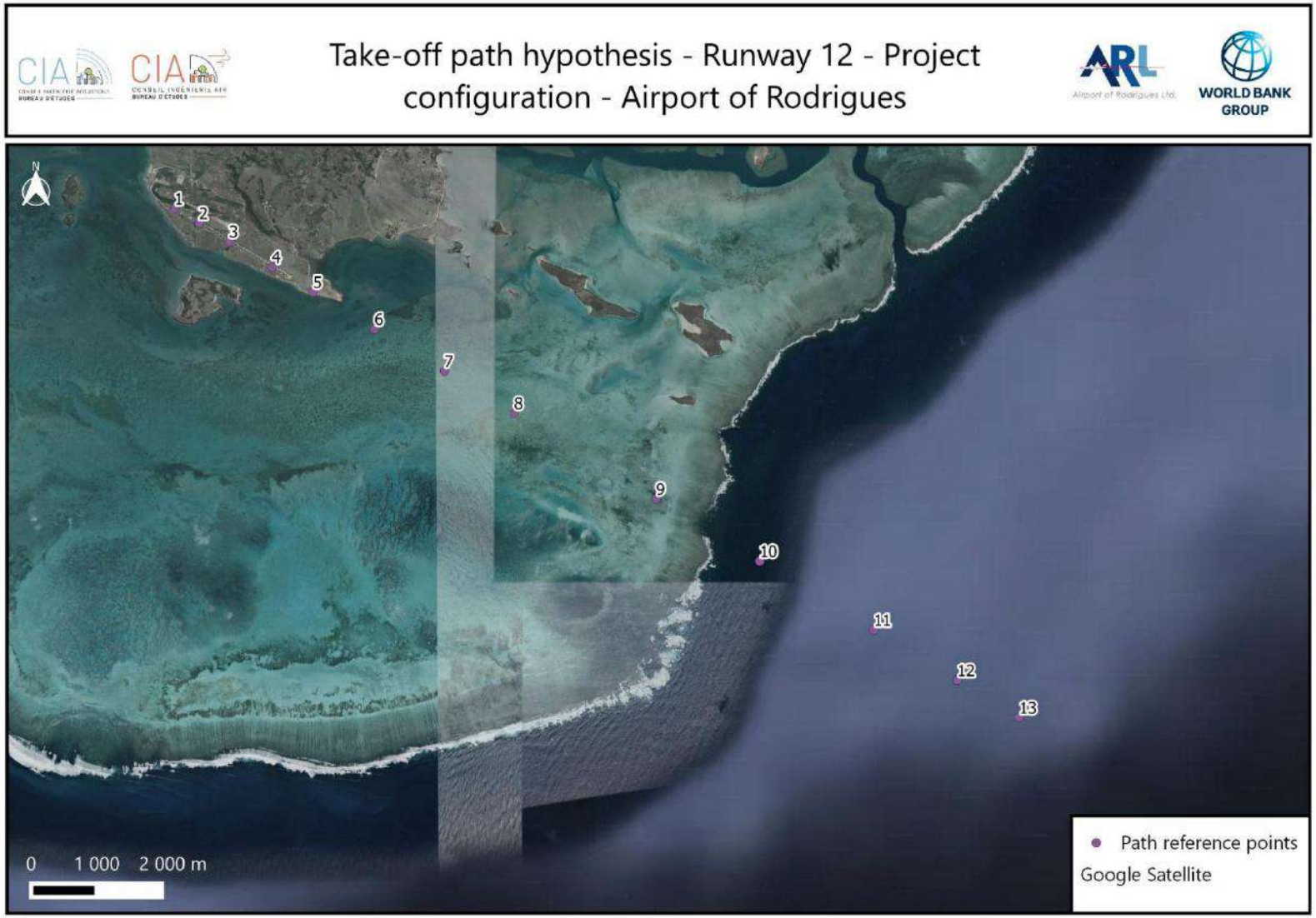


Figure 36: Take-off path hypothesis– Runway 12 – Project configuration – Plaine Corail

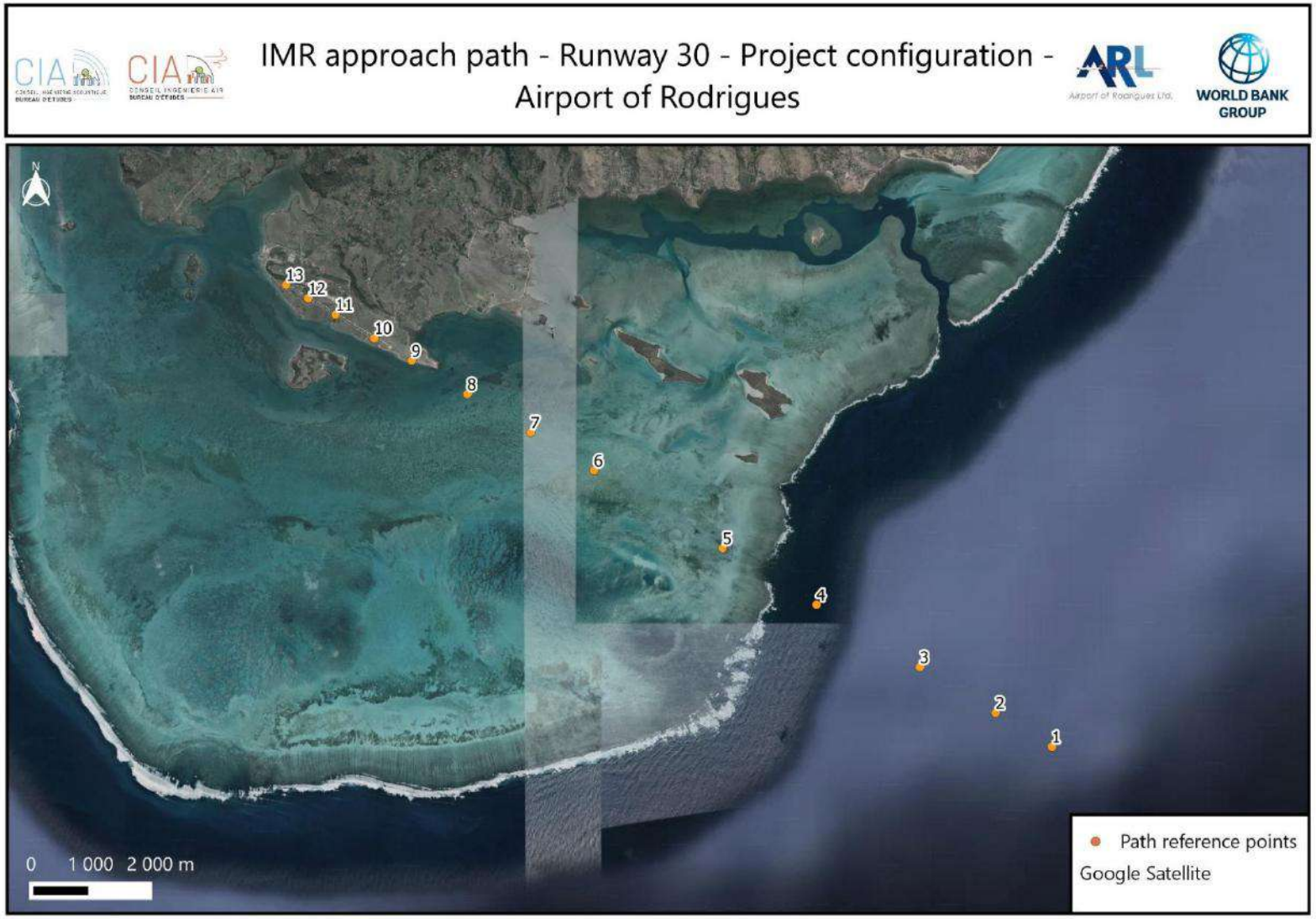


Figure 37: IMR approach path– Runway 30 – Project configuration – Plaine Corail

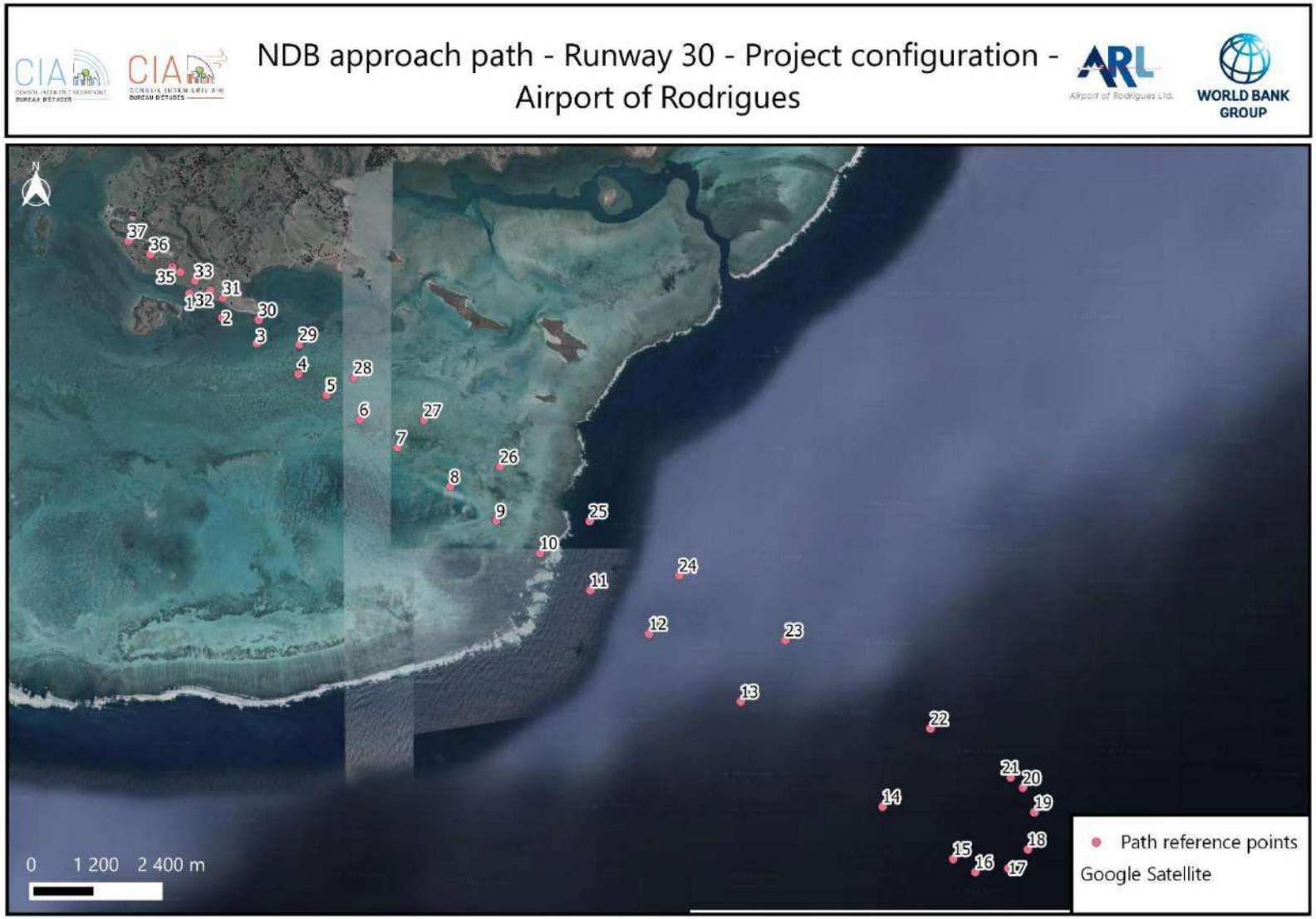


Figure 38: NDB approach path– Runway 30 – Project configuration – Plaine Corail

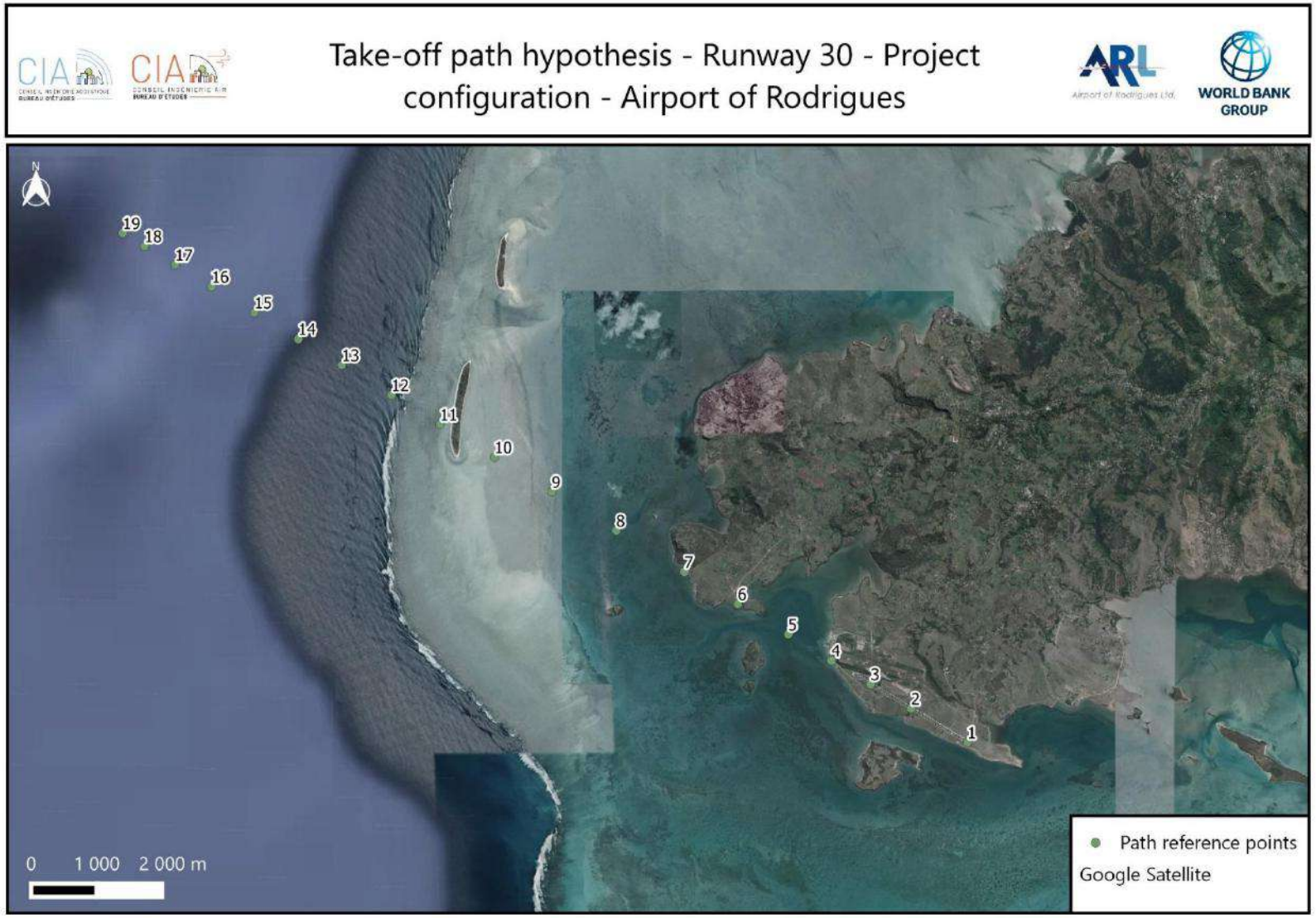


Figure 39: Take-off path hypothesis– Runway 30 – Project configuration – Plaine Corail

5.1.1.1.2 Air quality

An emissions inventory is based on the theoretical calculation of the pollutants emitted into the atmosphere. A simplified method that helps to establish orders of magnitude of polluting emissions consists of calculating the product of the activity and the emission factors:

$$E(X) = \sum_{\text{type d' aéronef Y}} N(\text{cycle LTO})_{\text{aéronef Y}} * FE_X$$

E (X), emissions of pollutant X (kg)
N (cycle LTO) $_{\text{aeronef Y}}$, the number of LTO cycles for the aircraft type Y
FE_X the emission factor, for the pollutant X, by LTO cycle.

This method is compliant with the French guide “Guide de calcul des émissions dues aux aéronefs” (DGAC - STAC, 2015).

It does not directly estimate the concentration of pollutants in the air, which requires a complex dispersion model, yet an emissions inventory is a useful tool for managing air quality and its impact, and for informing the public. Based on the results of an emissions inventory, the gain from an emissions reduction policy can be assessed, and air quality modelling tools (concentrations) can be fed.

5.1.1.1.2.1 Inputs

The calculations take into account the overall annual commercial aircraft traffic (year 2022) and the type of aircraft.

5.1.1.1.2.2 Study area and pollutants investigated

Calculations are based on a standard "Landing-Take-Off" (LTO) cycle per aircraft, as defined by OACI vol II, appendix 16. This cycle includes all aircraft operations from the ground to a height of 3000 feet, as only emissions below this height have a direct impact on local air quality.

Aircraft engine emissions are calculated from the emission factors established for the "ICAO" LTO cycle. An ICAO database lists fuel consumption and emission factors for the four phases of movement in the atmospheric layer between 0 and 3000 ft: taxi, take-off, cruise and approach. Each phase is associated with an engine speed and its duration (see table and image below **taken here by default**).

Table 5-4: Duration and engine speed associated with the different phases of LTO cycle

Phases of the LTO cycle	Duration (minutes)	Engine speed (%)
Approach	4	30
Taxi	26	7
Takeoff	0,7	100
Climb-out	2,2	85

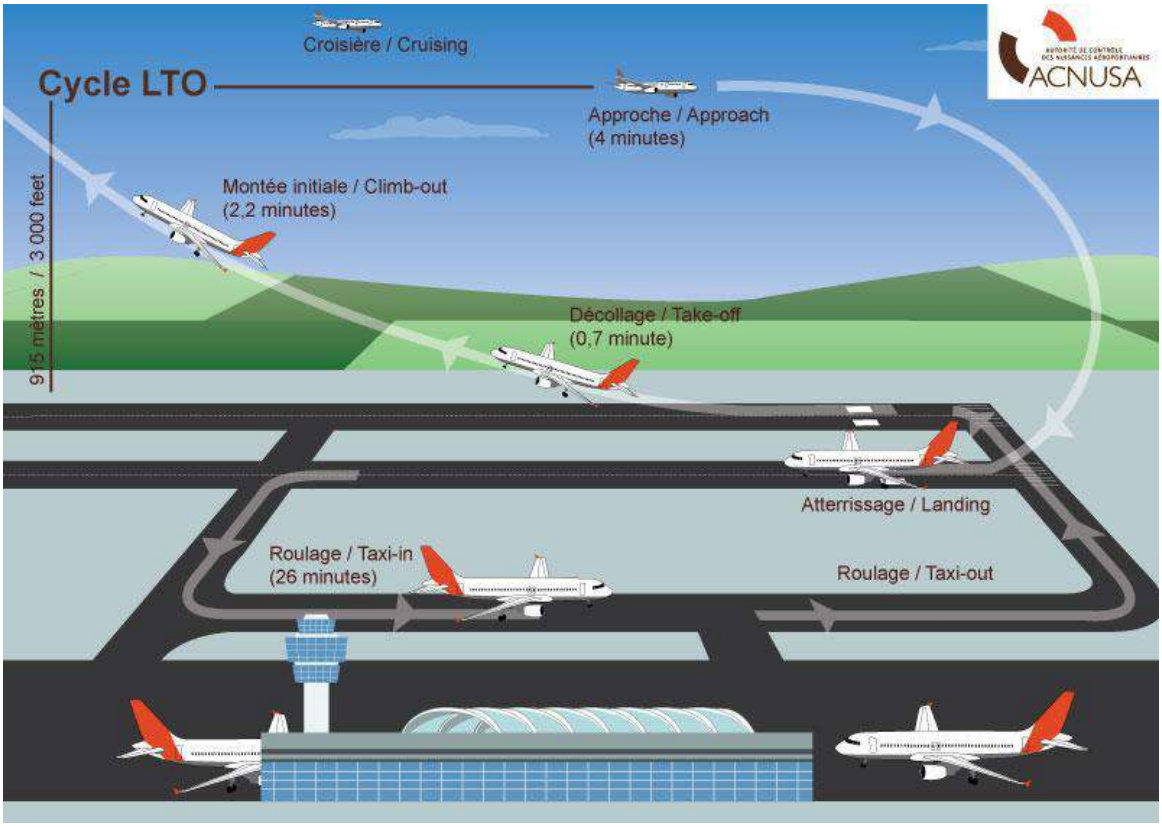


Figure 40: LTO cycle (Source: Acnusa)

The calculation tool IMPACT provided by Eurocontrol, a pan-European Organisation dedicated to supporting European aviation is used. The calculations take into account:

- Aircraft movements,
- Aircraft types,
- Flight paths,
- Runway alignment;
- Annual average weather conditions.
- Other emission sources from airport activities are assumed to be limited compared to aircraft emissions.
- Limit of height: 1000m

IMPACT uses the OACI database of EEDB aircraft motor emissions (AEM DATA – 254 – ICAO EDDB25/FOCA), compliant with the DGAC french methodological guide of impact study for air traffic.

However it should be noted that the database doesn't provide all combination of aircraft/class/motor. In this way, some aircraft can be substituted with another aircraft compliant with the same technical specifications:

- Take-off mass;
- The aircraft and engine manufacturer;
- The engine: number, type (turbojet, turboprop, piston engine), dilution rate, engine position…
- The performance: power-to-weight ratio.

Using this tool, calculations were made for Plaine Corail Airport, for emissions of

- nitrogen oxides
- carbon dioxide;
- sulphur oxides;
- dihydrogen oxide;
- carbon monoxide
- unburned hydrocarbons;
- acetaldehyde, formaldehyde and propianaldehyde;
- acrolein;
- 16 PAH;
- 7 PAH;
- styrene, 1.3-butadiene, benzene, ethylbenzene, toluene, xylene;
- PM total and volatile.

5.1.1.1.3 Noise

The baseline noise levels are assessed with the calculation tool “IMPACT” compliant with ICAO recommendations. This online software is provided by Eurocontrol, a pan-European Organisation dedicated to supporting European aviation.

The calculations take into account:

- Aircraft movements,
- Aircraft types,
- Flight paths,
- Runway alignment;
- Annual average weather conditions.
- Other noise sources from airport activities are assumed to be limited compared to aircraft noise.

IMPACT uses the most recent aircraft databases BADA 3 and 4 of Eurocontrol wich include model specifications for nearly 100% of aircraft types in the ECAC area. BADA enables to reproduce the geometric, kinematic and kinectic aspects of the aircrafts over the entire operation flights envelope.

5.1.1.2 Air quality study: road traffic

The study has been looked for these scenarios :

- Commissioning horizon (2026)
  - Without the project (initial configuration) and with the project (project configuration)
- Commissioning horizon + 20 years (2046)
  - Without the project (initial configuration) and with the project (project configuration)

5.1.1.2.1 Emission of pollutants : road traffic

The emissions are calculated thanks to TREFIC 5.2.1 with the fleet IFSTTAR (until 2050), based on the emissions factors from COPERT V.

The road traffic has be provided by Lux Consult.

5.1.1.2.2 Concentration modelled

The software ARIA Impact 1.8 is used to model the concentrations from the emissions calculated in the previous section and from the weather conditions.

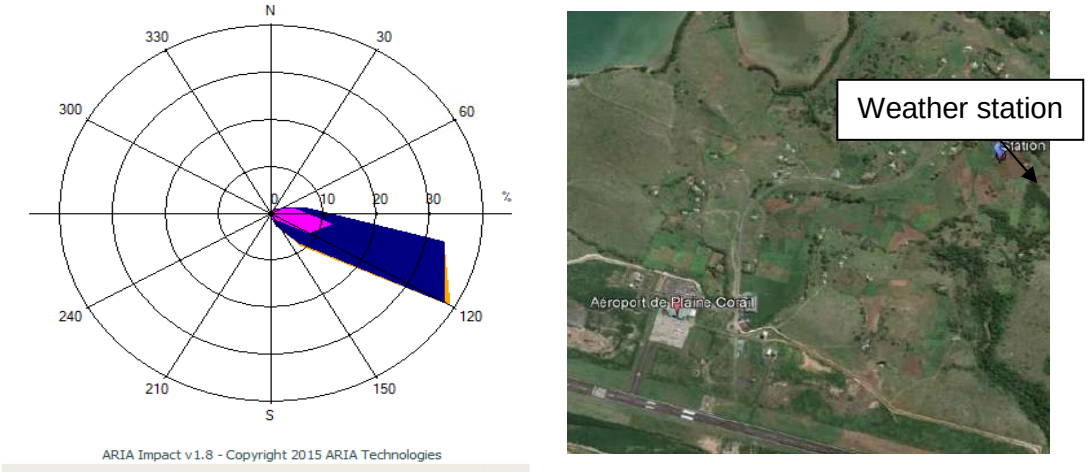


Figure 41 : Wind Rose used in the calculations – based on the three-hourly wind direction and velocity furnished by numtech between the 01/01/2022 and the 31/12/2022 – Station SYNOP of Plaine Corail at Rodrigues

The pollutants modeled are the nitrogen dioxide and the particles PM10 and PM2.5. A background concentration is included in the calculation to approach the most representative result of the real concentrations. The same methodology as the one used for the current state has been used.

To remember, the table below shows the background concentrations included in the model.

Table 5-5: Background concentrations included in the calculations of the modeled concentrations

Pollutant	Background concentration used µg/m³	Source	WHO annual Air Quality Guideline 2021	Comment / Remark
NO_2	9.4	Measurements between the 15th and the 16th march 2023	10	Lack of bibliography at Rodrigues Island

PM10	19.5	at Pointe Palmiste (measuring point number 1)	15	Background concentrations used are daily concentrations -> overrating the annual mean The annual Air Quality Guideline (WHO 2021) are already exceeded by these background concentrations for the particles PM10 and PM2.5
PM2.5	10.2		10	

5.1.1.3 Noise

The noise emitted by the roads around the airport is studied in order to establish the acoustic impact on the population. The project does not foresee any modification on the road infrastructures, but an increase of the airport attendance will lead to an increase of traffic in Plaine Corail.

The WHO (World Health Organization) published in 2018 recommendations for average exposure to road traffic noise based on the European Lden and Ln indicators.

Indicator	Maximum noise level	Effect
Lden	53 dB	**Noise levels above this value are associated with adverse health effects**
Ln	**45 dB**	**Nighttime noise levels above this value are associated with adverse effects on sleep.**

The phases without project and with project at the horizon 2026 and 2046 will be studied. The objective is to compare the two variants in order to determine the impact of the project in terms of road noise pollution on the population.

5.1.1.3.1 Input data

The traffic data used for the present study was taken from the traffic study conducted by ITMD. The map and table below summarizes the different traffic routes used for the study and the acoustic simulation of the project during the future situation, with and without the project in 2026 and 2046.

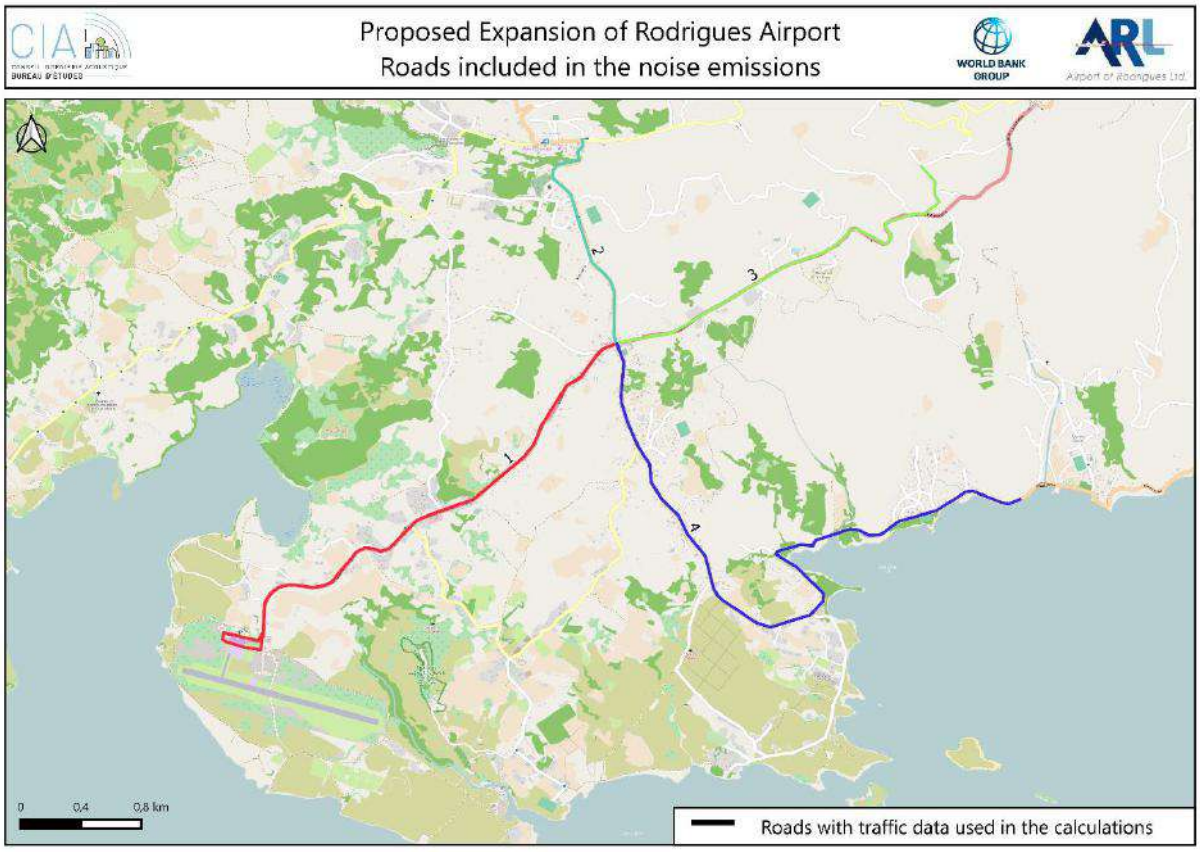


Figure 42: Roads included in the noise emissions

Table 5-6: Road traffic in the future situation

Road	Initial configuration – 2026		Project configuration – 2026		Initial configuration – 2046		Project configuration – 2046	
	AADT* All types of vehicles	AADT* Heavy vehicles	AADT* All types of vehicles	AADT* Heavy vehicles	AADT* All types of vehicles	AADT* Heavy vehicles	AADT* All types of vehicles	AADT* Heavy vehicles
1	1435	225	1459	229	2592	405	2630	413
2	2261	555	2266	556	4078	1002	4087	1004
3	3489	893	3501	895	6295	1613	6315	1618
4	1079	179	1081	179	1954	323	1958	323

**:AADT: Average Annual Daily Traffic*

Note: traffic data are only given for the main roads, secondary roads are not taken into account.

In order to determine the road impact on the population, we must identify the latter in the studied area. The data provided according to the administrative division of the island of Rodrigues are shown in the map and the table below.

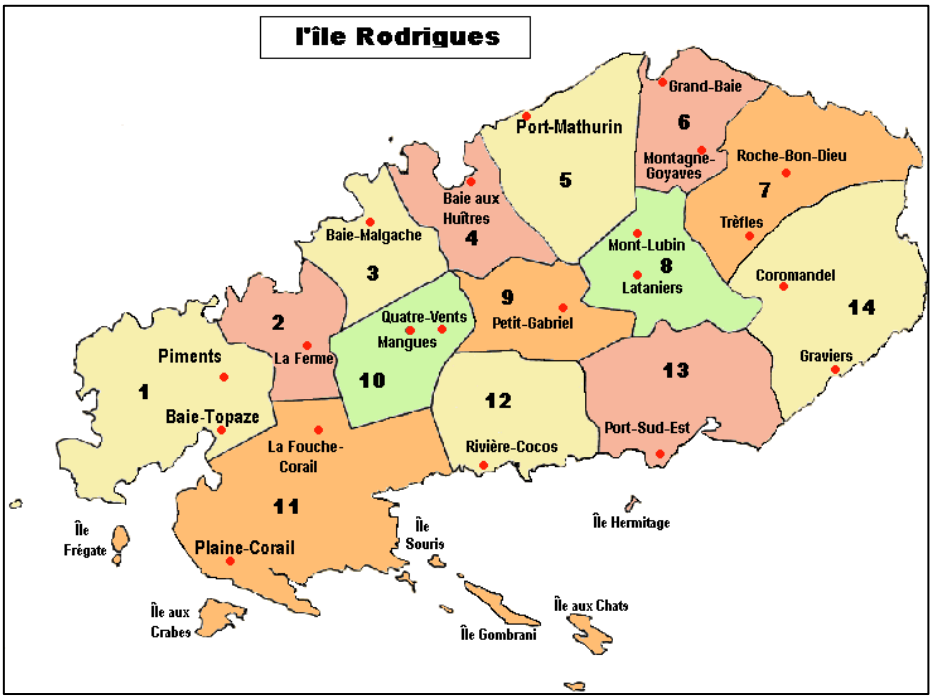


Figure 43: administrative breakdown

Note: The population zones used for the calculations are zones n°2, n°10 and n°11.

Table 5-7: Administrative division by area

N°	Administrative Division	2026	2046
1	Piments-Baie Topaze	2050	3360
2	La Ferme	1578	2585
3	Baie Malgache	1526	2500
4	Baie-aux-Huîtres	3680	6030
5	Port Mathurin	8411	13782
6	Grand Baie-Montagne Goyaves	1198	1962
7	Roche Bon Dieu-Trèfles	2921	4786
8	Lataniers-Mont Lubin	5400	8848
9	Petit Gabriel	5190	8504
10	Mangues-Quatre Vents	4072	6672
11	Plaine Corail-La Fouche Corail	4018	6584
12	Rivière Cocos	4104	6725
13	Port Sud-Est	3854	6316
14	Coromandel-Graviers	2758	4519
TOTAL		**50757**	**83171**

5.2 Temporary Impacts during Construction

5.2.1 Air quality and noise

5.2.1.1 Aircraft study

None

5.2.1.2 Air quality

- **Alteration of air quality due to construction activities**

- Impact before mitigation

The construction phase of the airport project could potentially generate dust and air pollution due to earthworks, infrastructure construction, and demolition activities. The transportation of supplies by road could also contribute to increased emissions. The sensitivity to dust and air pollution in the area is high, with several households located within 1000 m of the work area. The impact on air quality cannot be quantified at this stage, but it is expected to result in increased levels of pollutants such as CO, HC, NOx, and particulate matter, as well as reduced visibility in the immediate vicinity of the construction site.

As these effects will be of limited duration, the impact severity is assessed to be medium.

The impact severity is medium. Considering the receptor sensitivity assessed as high, **the impact magnitude is medium**.

5.2.1.3 Noise

During the construction phase, the project plans to create a quarry at Mont Travers to transport materials for the future runway. In addition to the noise from the quarry, trucks will be used to transport the materials. The houses in the surrounding area are likely to be impacted.

Figure 44: Approximate area of the future quarry

Short-term measurements were carried out in March 2023 to determine the current noise environment (see 3.1.4.4.1 - Results):

- PR5: LAeq 30min= 61.0 dB(A); L50= 50.5 dB(A).
- PR6: LAeq 30 min= 50.5 dB(A); L50 =45.0 dB(A).

Due to the meteorological conditions (strong and gusty wind), the L50 is more representative of the actual noise level. Currently, the main sources of noise are aircraft arrivals and departures and the environment.

The expected heavy vehicle traffic is not known, so we were not able to model the impact of the construction site on the surrounding dwellings.

The Rodrigues noise regulations indicate the thresholds that should not be exceeded:

- 07.00 - 18.00 hrs : 60 dB(A) LAeq
- 18.00 - 21.00 hrs : 55 dB(A) LAeq
- 21.00 - 07.00 hrs : 50 dB(A) LAeq

These levels must not be exceeded at the houses during works.

It is recommended that measurements be taken during the works to check that these levels are respected.

5.3 Permanent and irreversible impacts during Construction Phase

5.3.1 Air quality and noise

5.3.1.1 Air quality

None

5.3.1.2 Noise

None

5.4 Impacts during operation phase

5.4.1 Air quality and noise

5.4.1.1 Air quality

5.4.1.1.1 Emissions of pollutant: aircrafts

The aim of the project is to increase the airport's capacity in terms of aircraft type. The platform currently accommodates small ATR72 aircraft; in the long term, A321 NEOs and B737-900Max will land.

It should be noted that A321 NEO and B737-900Max are aircraft with lower fuel consumption compared to aircraft of the same type. As a result, their polluting emissions are reduced.

The consequence is a low decrease in pollutant emissions (except for NOx because of the engine type) due to air traffic compared to ATR72-500 equivalent traffic (more than twice number of operations).

An increase in road traffic serving the airport is also to be expected, although it is not quantified at this stage.

The impact of operations is assessed by quantifying the polluting emissions of flights through the emissions inventory. The methodology is the same as that used for the baseline assessment. The inventory does not provide direct information on atmospheric concentration, but indicates a lower degradation in air quality at the airport with the project (except for NOx).

Table 5-8: Gas emissions and fuel consumption per year: baseline 2022, initial configuration 2046, project configuration 2046

Emissions (kg/year)	NOX emitted	CO2 emitted	SOX emitted	H20 emitted	CO emitted	HC emitted	ACETALDEHYDE emitted	ACROLEIN emitted	16 PAH emitted	7 PAH emitted	Fuel consumption (kg/year)
Baseline 2022	1661	1044640	278	408930	344436	5271	262	150	<1	<1	330582
Initial configuration -2046	3034	1907365	507	746649	628932	9625	478	274	1	<1	603596
Project configuration - 2046	7604	1741838	463	681852	5840	104	5	3	<1	<1	551215
Emissions (kg/year)-	**STYRENE** emitted	**1.3 BUTADIENE** emitted	**BENZENE** emitted	**ETHYLBENZENE** emitted	**FORMALDEHYDE** emitted	**PROPIANALDEHYDE** emitted	**TOLUENE** emitted	**XYLENE** emitted	**PM Total** emitted	**PM Volatile** emitted	
Baseline 2022	19	103	103	11	754	45	39	27	42	0	-
Initial configuration -2046	35	189	188	19	1376	81	72	50	76	0	
Project configuration - 2046	<1	2	2	<1	15	1	1	1	38	2	

The graphics below present the evolution of the gass emissions per year (kg/year and %) in 2022 (baseline), 2046 (initial configuration) and 2046 (project configuration).

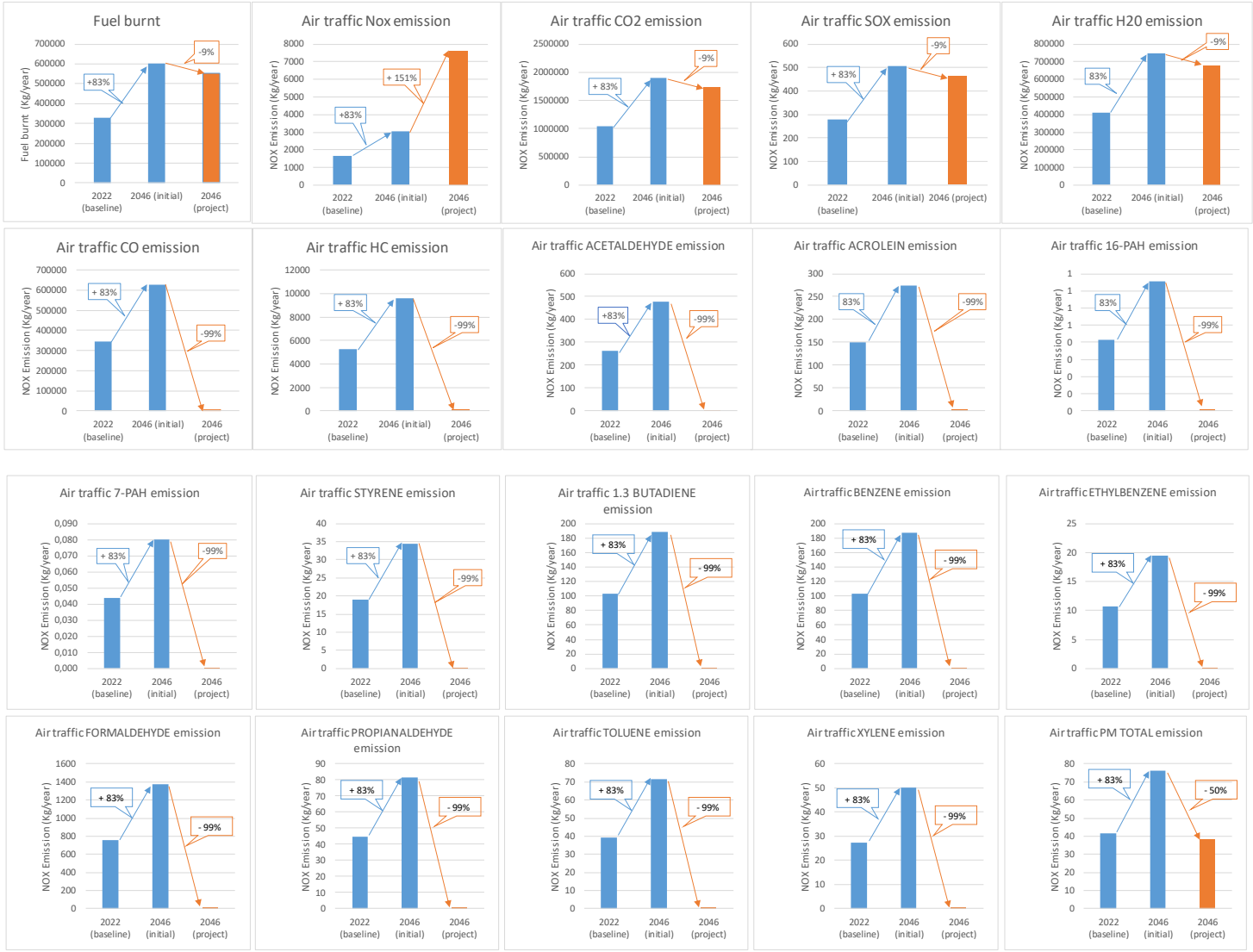


Figure 45: Graphics of gas emissions and fuel consumption per year : Initial configuration 2022 and 2046 ; Project configuration 2046

5.4.1.1.2 Emissions of pollutants : road traffic

The emissions due to road traffic have been calculated from the road traffic data provided on the roads shown in the map below.

The emissions have been calculated for these scenarios :

- Commissioning horizon (2026)
  - Without the project (initial configuration) and with the project (project configuration)
- Commissioning horizon + 20 years (2046)
  - Without the project (initial configuration) and with the project (project configuration)

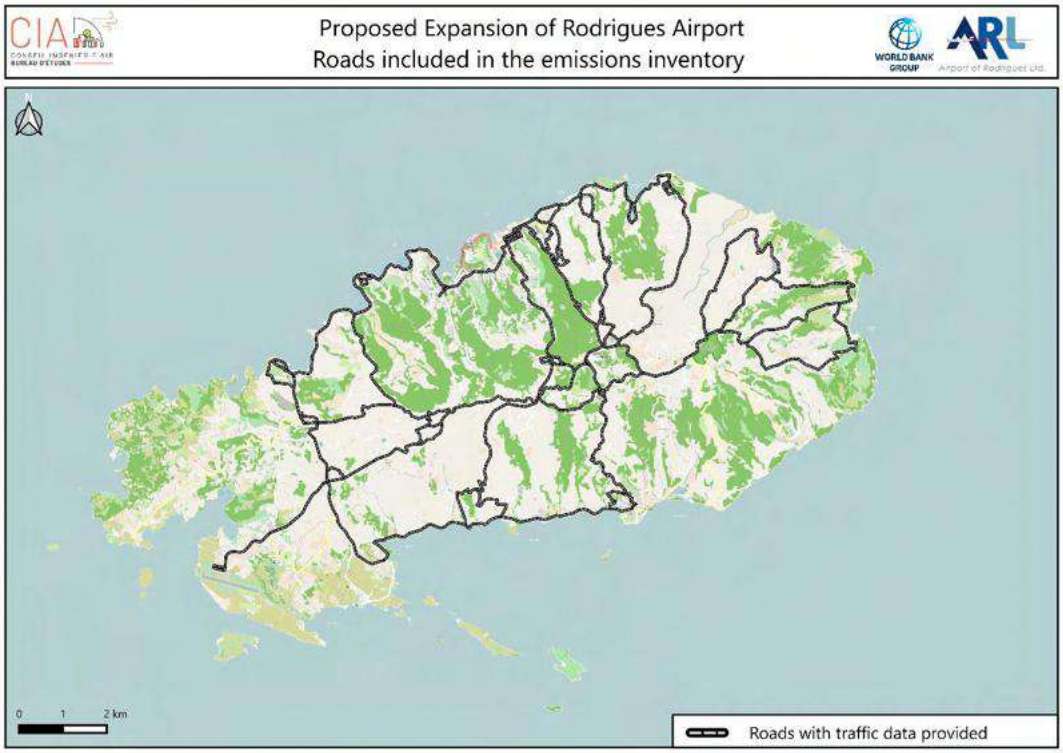


Figure 46: Roads included in the emissions inventory

The number of vehicles multiplied but the number of km driven are presented in the table below.

Table 5-9: Pollutants emissions per day due to road traffic

all the roads included	**Vehicles * Km driven**	**Impact**
Year 2023 Current state	166 871	-
Year 2026 Reference	210 823	26.3 % / current state
Year 2026 Project	211 121	0.1% / reference
Year 2046 Reference	381 529	128.6 % / current state
Year 2046 Projet	382 024	0.1% / reference

The road traffic is not increasing that much. We can observe an increase of the vehicules.km driven of 0.1% on 2026 and 2046.

The emissions calculated are presented in the tables below:

Table 5-10: Pollutants emissions per day due to road traffic

Emissions of all the roads included	CO	NOx	NMVOC	SO_2	PM10	PM2.5	benzene	Benzo(a)pyrene	Nickel	Arsenic
Unit	kg/day	kg/day	kg/day	kg/day	kg/day	kg/day	kg/day	g/day	g/day	g/day
Year 2023 Current state	32.51	77.13	1.84	0.35	6.43	4.18	0.04	0.19	62.42	12.81
Year 2026 Initial config	25.83	61.24	1.78	0.33	6.13	3.84	0.02	0.15	62.67	12.81
Impact / current state	**-20.6%**	**-20.6%**	**-3.1%**	**-7.7%**	**-4.6%**	**-8.3%**	**-51.3%**	**-18.2%**	**0.4%**	**-0%**
Year 2026 Project	25.87	61.34	1.78	0.33	6.14	3.84	0.02	0.15	62.68	12.81
Impact of the project config	**0.2%**	**0.2%**	**0.2%**	**0.2%**	**0.2%**	**0.2%**	**0.0%**	**0.2%**	**0.0%**	**0.00%**
Year 2046 Initial config	31.64	41.77	4.19	0.66	9.91	5.79	0.02	0.19	63.69	12.82
Impact / current state	**-2.7%**	**-45.8%**	**127.7%**	**85.9%**	**54.2%**	**38.4%**	**-57.6%**	**0.9%**	**2.0%**	**0.01%**
Year 2046 Projet config	31.69	41.84	4.19	0.66	9.93	5.80	0.02	0.19	63.69	12.82
Impact of the project	**0.2%**	**0.2%**	**0.2%**	**0.2%**	**0.2%**	**0.2%**	**0.1%**	**0.2%**	**0.0%**	**0.00%**

There is an increase of pollutant emissions of 0.2% for all pollutants except for the benzene, nickel and arsenic for which no change is noted. **The project has no significant impact on air quality emissions.**

Table 5-11: Greenhouse gas emissions per day due to road traffic

Emissions of all the roads included	CO_2	N_2O	CH_4
Unit	T/day	kg/day	kg/day
Year 2023 Current situation	34.22	1.81	0.59
Year 2026 Initial configuration	35.38	1.87	0.46
Impact / current state	**3.4%**	**3.4%**	**-22.3%**
Year 2026 Project configuration	35.44	1.87	0.46
Impact of the project	**0.2%**	**0.2%**	**0.0%**
Year 2046 **Initial configuration**	61.47	2.97	0.64
Impact / current state	**79.6%**	**64.6%**	**8.9%**
Year 2046 Project configuration	61.57	2.98	0.64
Impact of the project	**0.2%**	**0.2%**	**0.2%**

5.4.1.1.3 Modeled air ambient concentrations

5.4.1.1.3.1 Results in the 500 meters around the road

5.4.1.1.3.1.1 Nitrogen dioxide

The table below shows the statistics for the different cases studied:

Table 5-12: Statistics of the modelled concentrations in the area of 500 m around the roads – Nitrogen dioxide

	2023	2026			2046		
Statistics in the area of 500 m around the roads - Unit : µg/m³	Current situation	Initial configuration	Project configuration	Project impact	Initial configuration	Project configuration	Project impact
Maximum :	9.9	10	10	0.0200	9.8	9.8	0.01
Percentile 90 :	9.6	9.6	9.6	0.0020	9.5	9.5	0.002
Mean :	9.5	9.5	9.5	0.0010	9.5	9.5	0.0007
Median :	9.5	9.4	9.4	0.0004	9.4	9.4	0.0003
Percentile 25 :	9.4	9.4	9.4	0.0001	9.4	9.4	0.0001
Minimum :	9.4	9.4	9.4	-0.0001	9.4	9.4	0.0000
Standard deviation :	0.1	0.1	0.1	0.002	0.1	0.1	0.001

For the nitrogen dioxide, the WHO Annual Air Quality Guideline is respected in all the area and for all the different cases.

These statistics are also shown in the maps presenting the spatial distribution of the concentrations in the following sections.

No specific spatial distribution is observed in the maps below: the concentrations are close to one another, with a very low standard deviation of 0.07 µg/m³. The concentrations modeled are close to the background concentration included in the calculations (9.4 µg/m³).

The impact of the project is an increase of 0.02 µg/m³ on the maximum concentration in 2026 and about 0.01 µg/m³ in 2046. **We can easily say that the project has no impact on the concentration of nitrogen dioxide**.

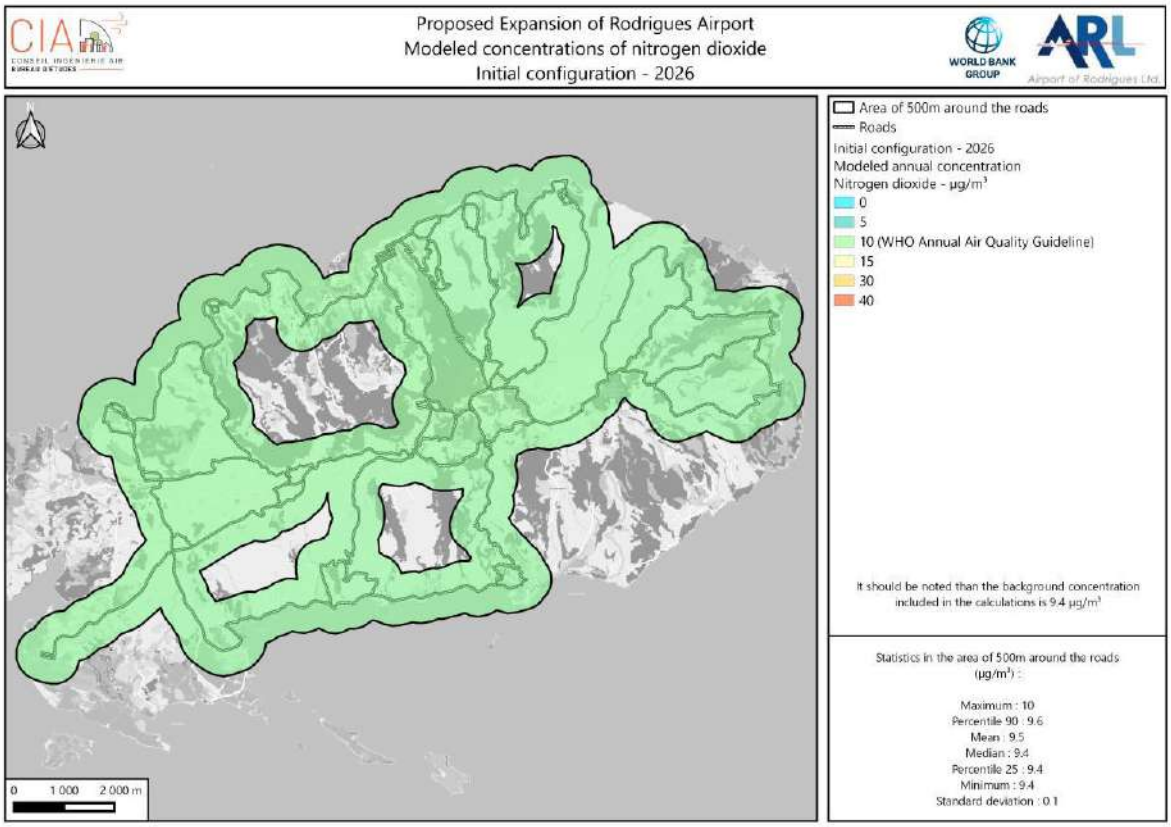


Figure 47 : Map of the modeled nitrogen dioxide's concentrations at Rodrigues – Initial configuration in 2026

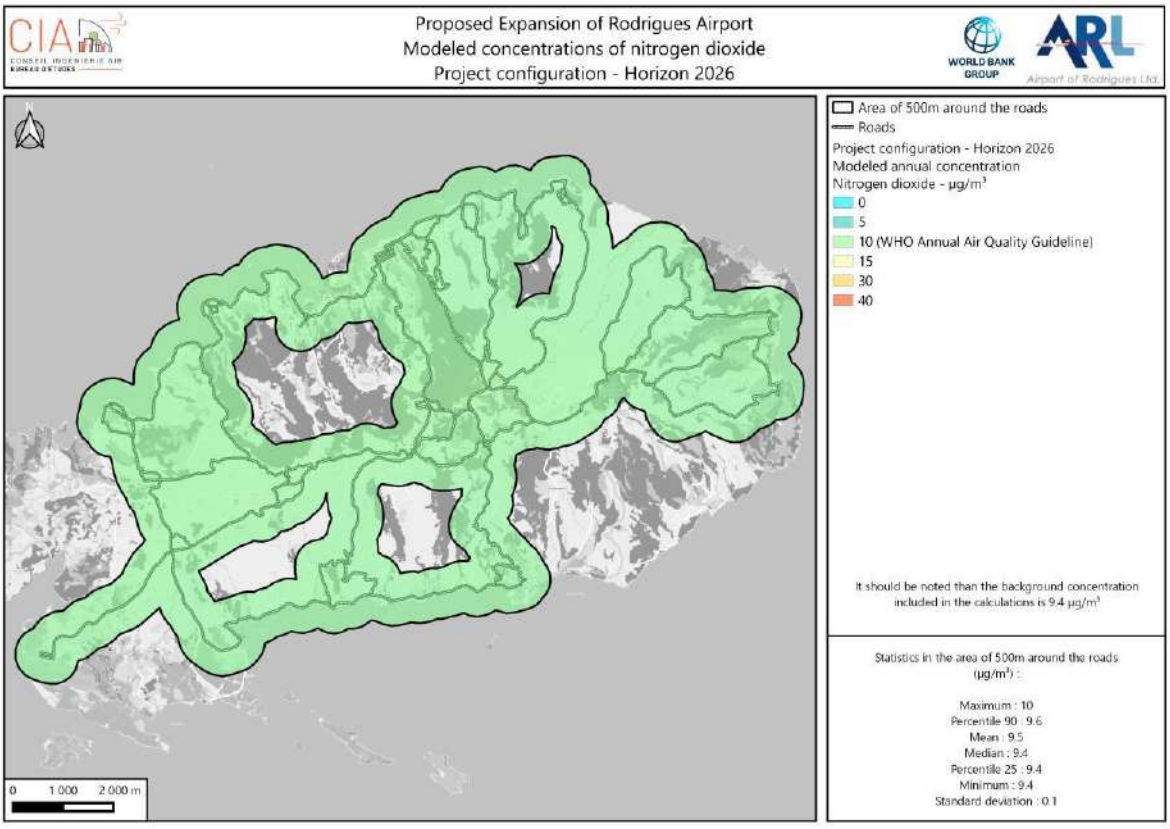


Figure 48 : Map of the modeled nitrogen dioxide's concentrations at Rodrigues – Project configuration in 2026

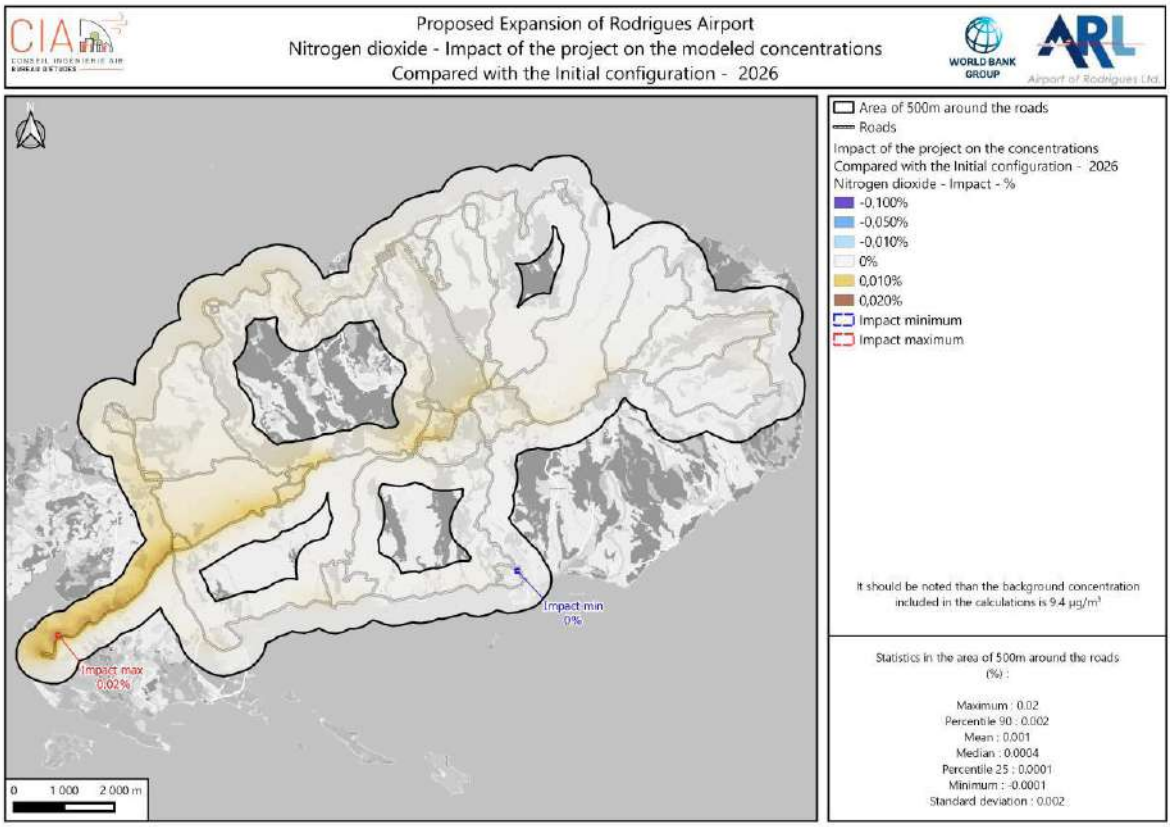


Figure 49: Map of the impact of the project on the concentrations – Compared with the Initial configuration in 2026

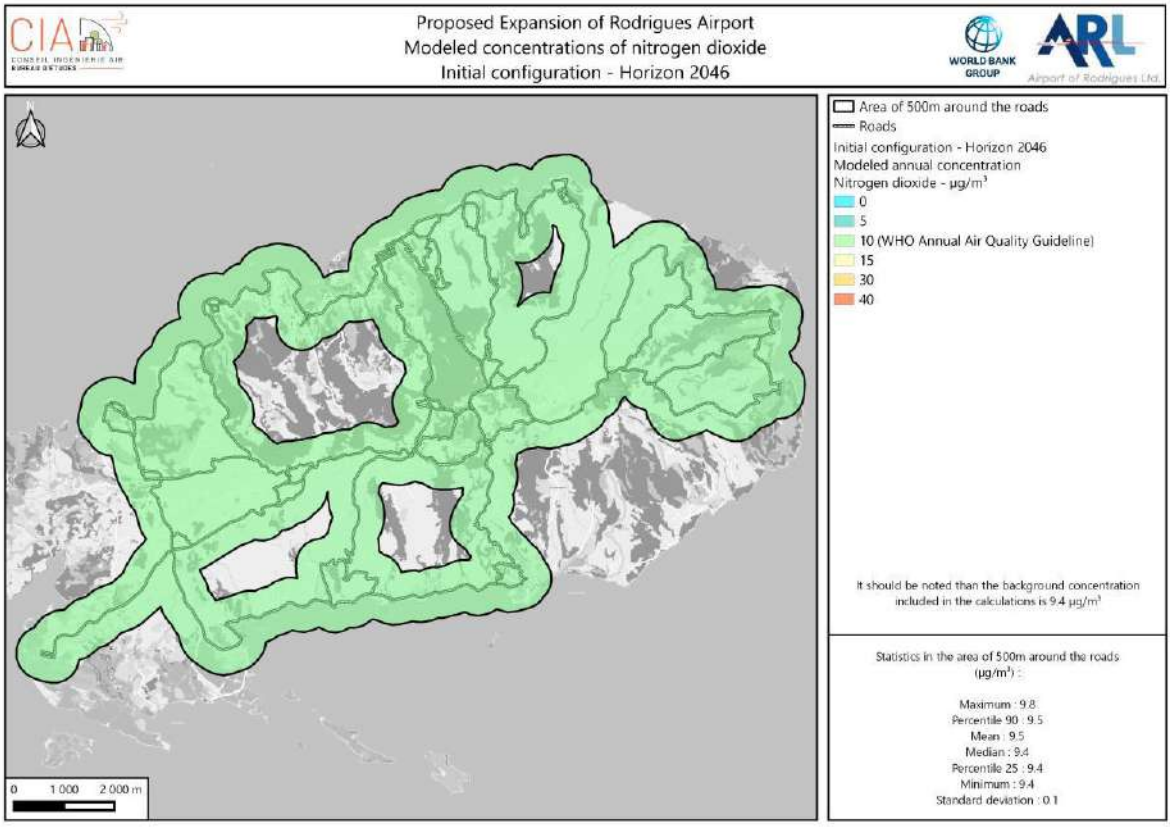


Figure 50 : Map of the modeled nitrogen dioxide's concentrations at Rodrigues – Initial configuration in 2046

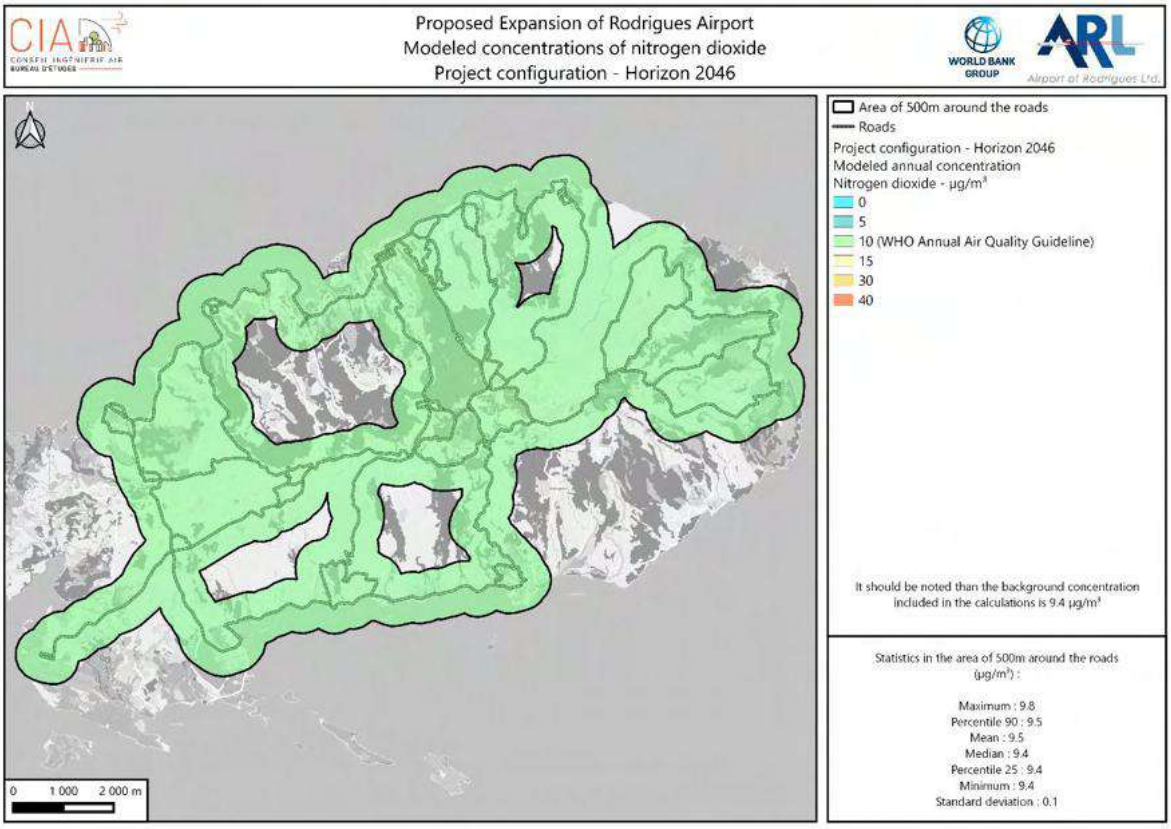


Figure 51 : Map of the modeled nitrogen dioxide's concentrations at Rodrigues – Project configuration in 2046

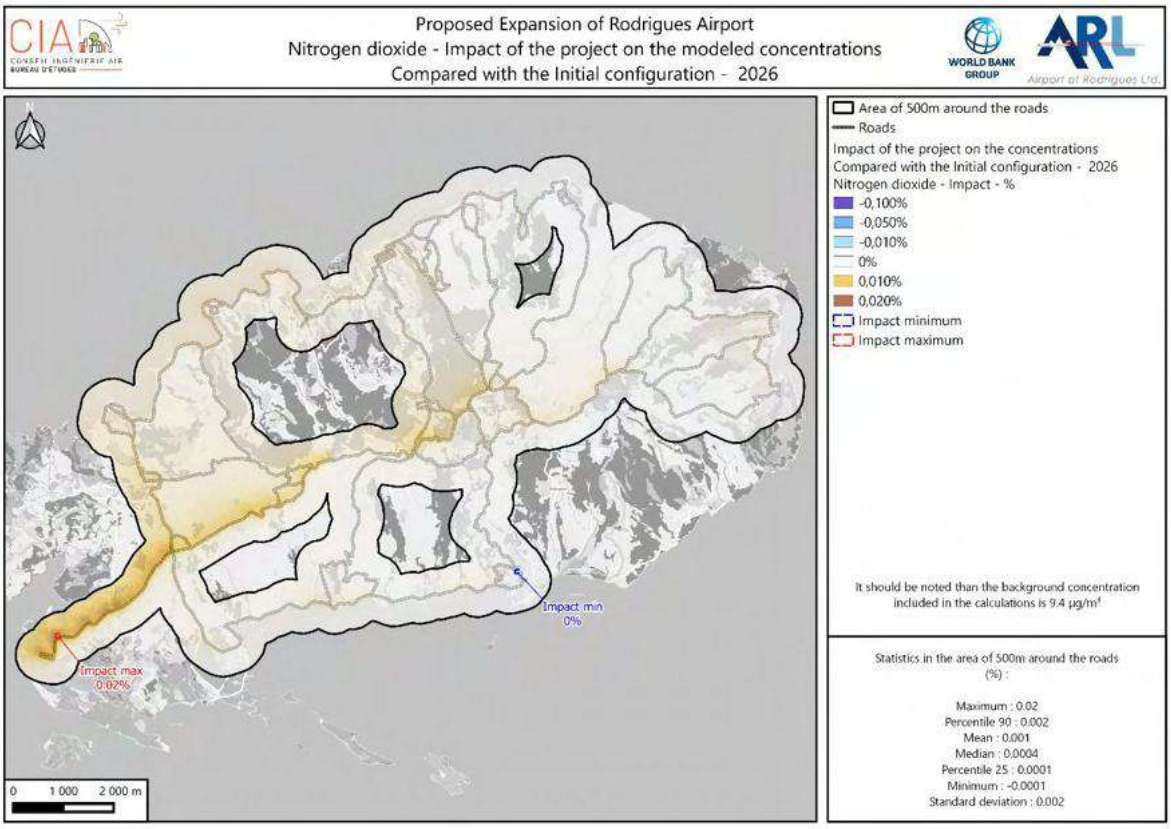


Figure 52: Map of the impact of the project on the concentrations – Compared with the Initial configuration in 2046

5.4.1.1.3.1.2 Particles PM10

Table 5-13: Statistics of the modelled concentrations in the area of 500 m around the roads – Nitrogen dioxide

	2023	2026			2046		
Statistics in the area of 500 m around the roads - Unit : µg/m³	Current situation	Initial configuration	Project configuration	Project impact	Initial configuration	Project configuration	Project impact
Maximum :	19.6	19.6	19.6	0.001	19.6	19.6	0.002
Percentile 90 :	19.5	19.5	19.5	0.0002	19.5	19.5	0.0003
Mean :	19.5	19.5102	19.5	0.0001	19.5	19.5164	0.0001
Median :	19.5	19.50	19.5	0.00003	19.5	19.50	0.00004
Percentile 25 :	19.5	19.5	19.5	0.00001	19.5	19.5	0.00001
Minimum :	19.5	19.5	19.5	-0.00001	19.5	19.5	0.000000
Standard deviation :	0.01	0.01	0.01	0.0001	0.01	0.02	0.0002

The concentrations modeled in the area of 500 meters around the roads are superior to the WHO Annual Air Quality Guidelines for the particles: Indeed, the background concentrations included in the calculation are already superior to those guidelines.

No specific spatial distribution is observed in the map below : the concentrations are close to one another, with a very low standard deviation of 0.01 µg/m³. The concentrations modeled are close to the background concentration included in the calculations (19.5 µg/m³).

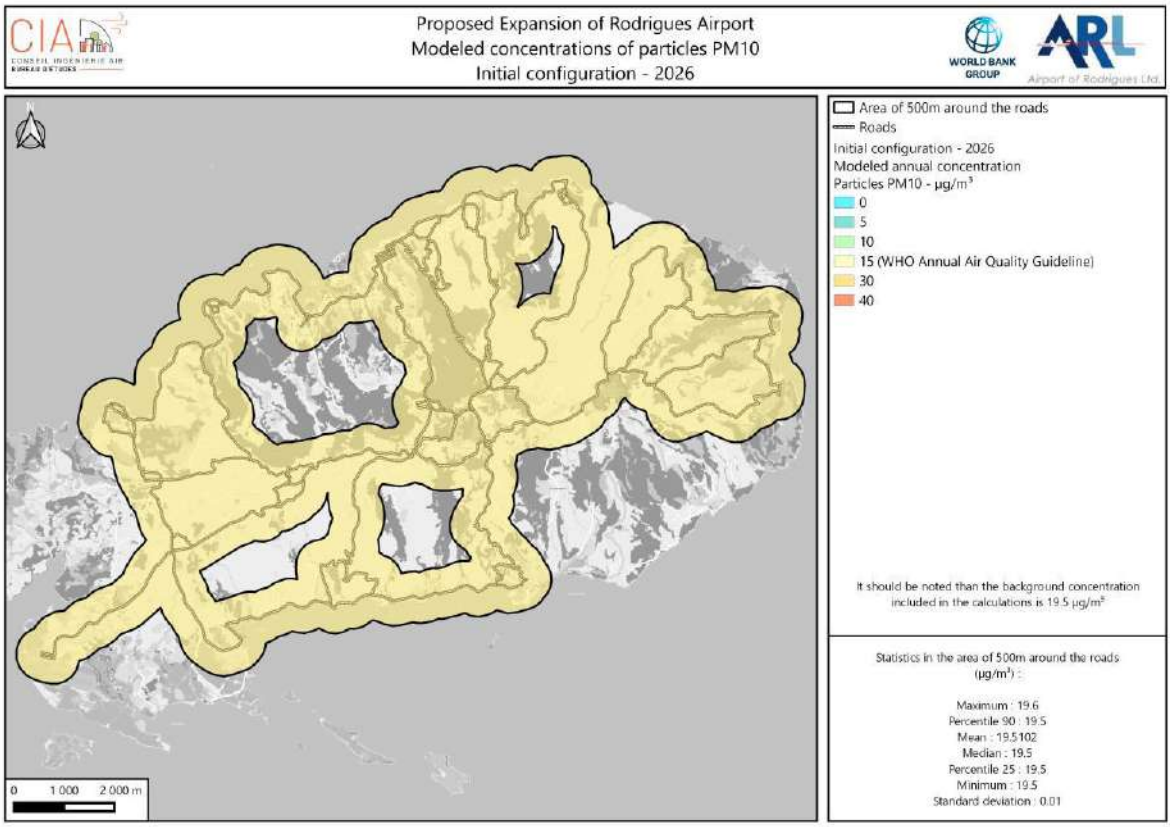


Figure 53 : Map of the modeled concentrations of PM10 at Rodrigues – Initial configuration in 2026

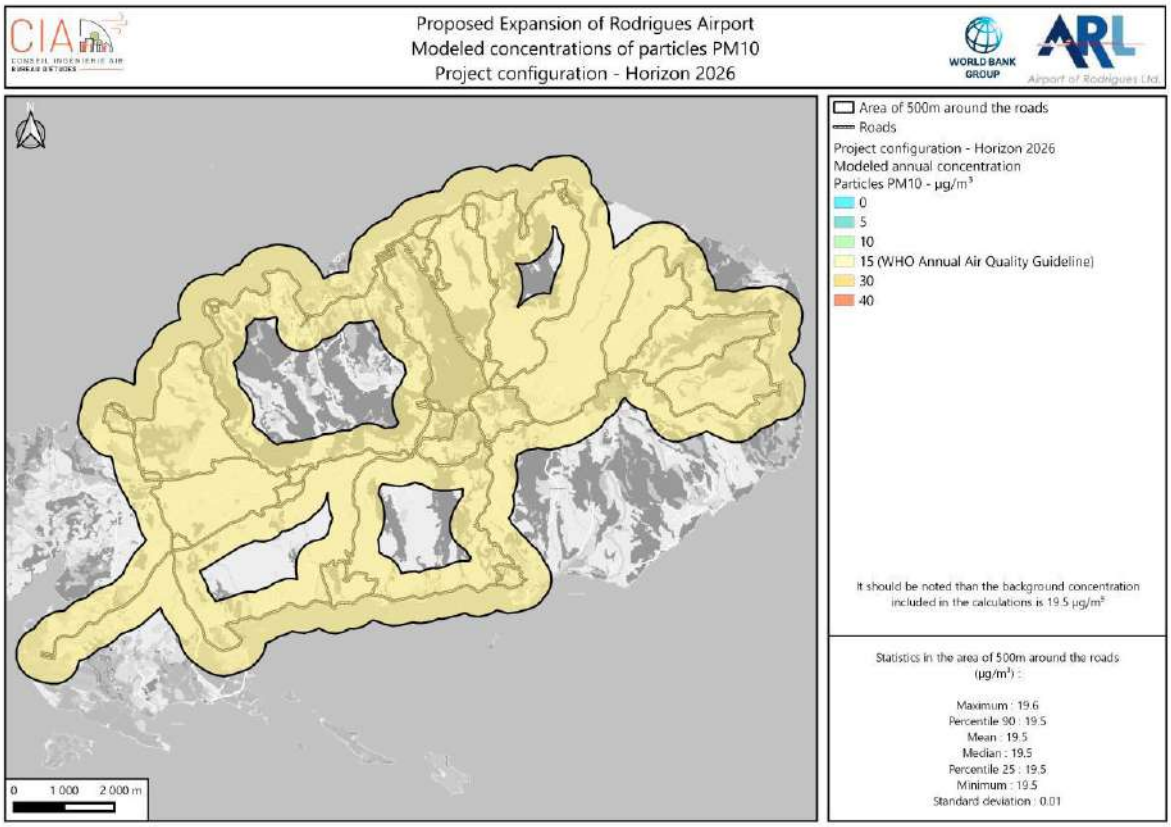


Figure 54 : Map of the modeled concentrations of PM10 at Rodrigues – Project configuration in 2026

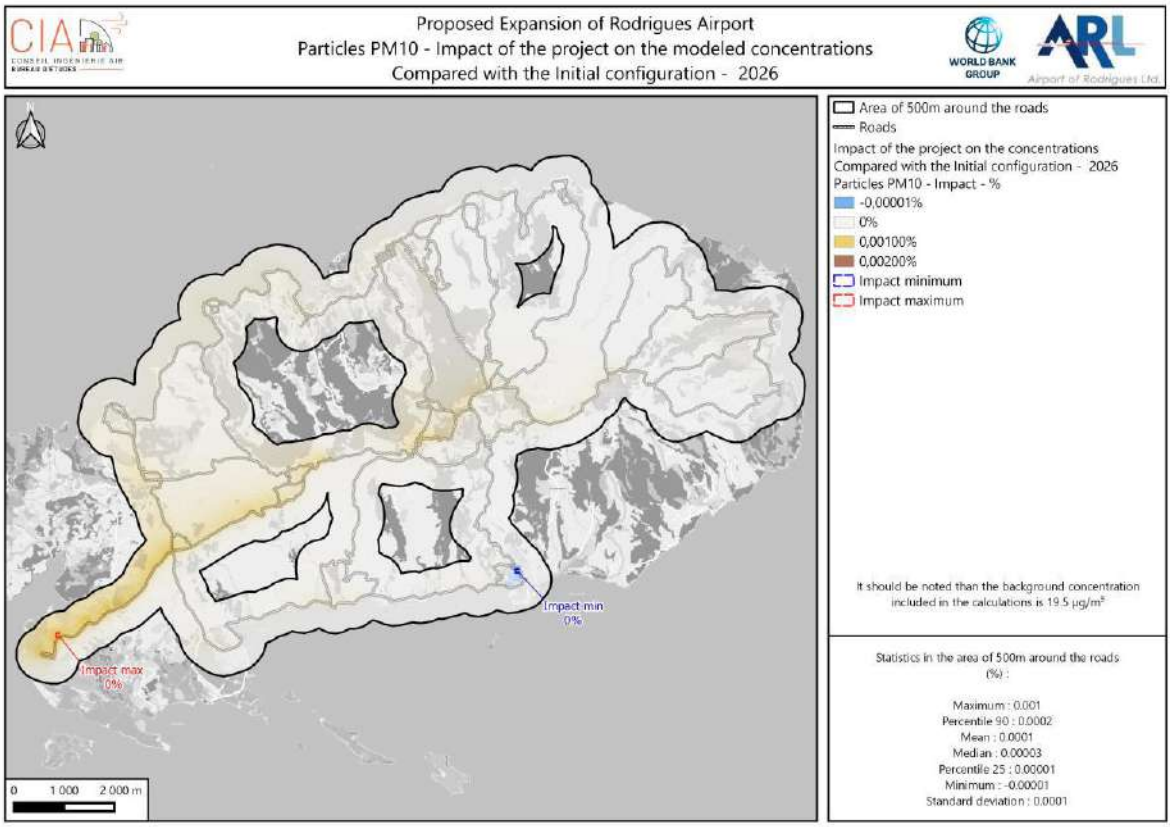


Figure 55 : Map of the impact of the project on the concentrations – Compared with the Initial configuration in 2026

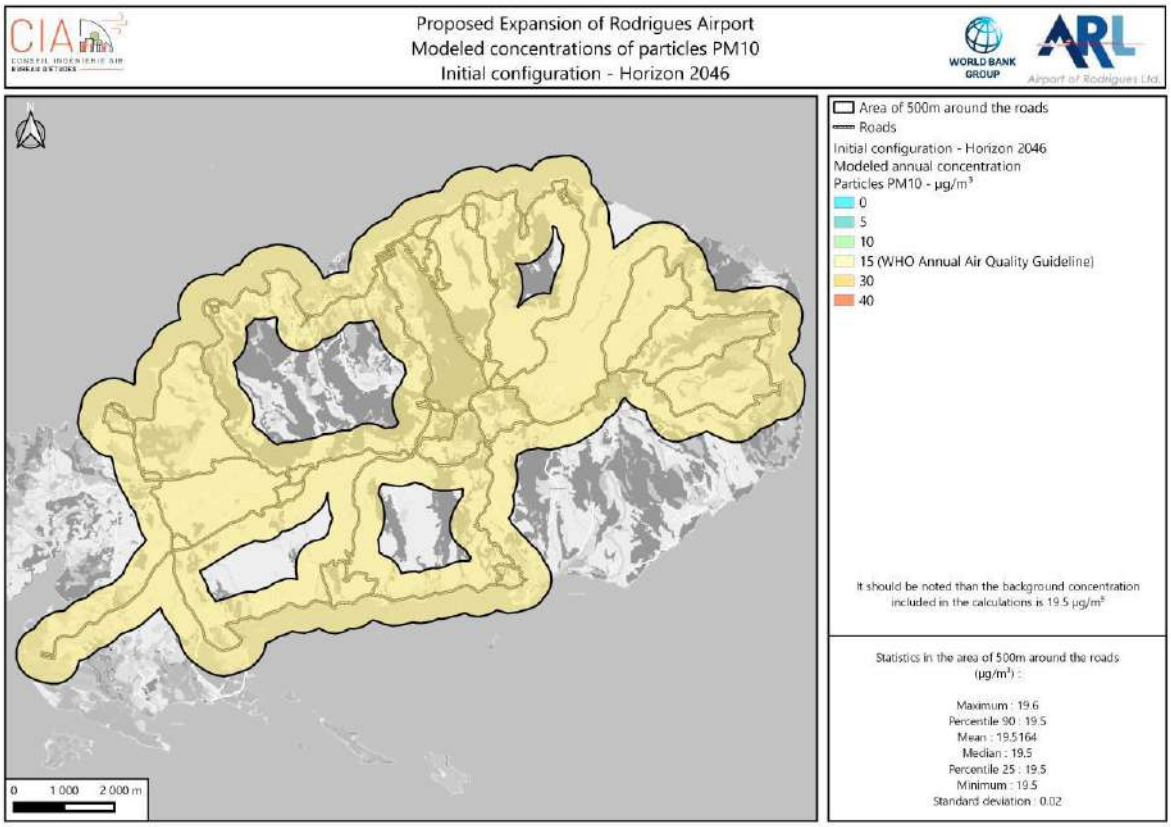


Figure 56 : Map of the modeled concentrations of PM10 at Rodrigues – Initial configuration in 2046

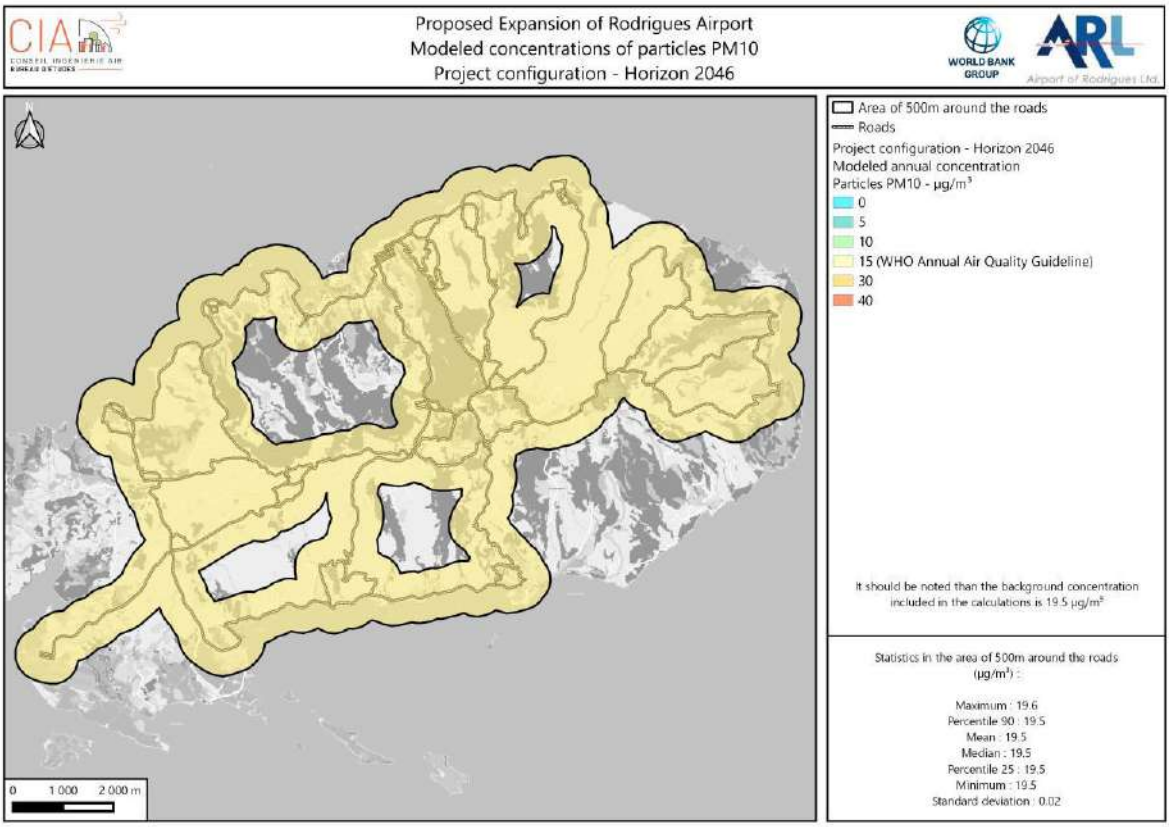


Figure 57 : Map of the modeled concentrations of PM10 at Rodrigues – Project configuration in 2046

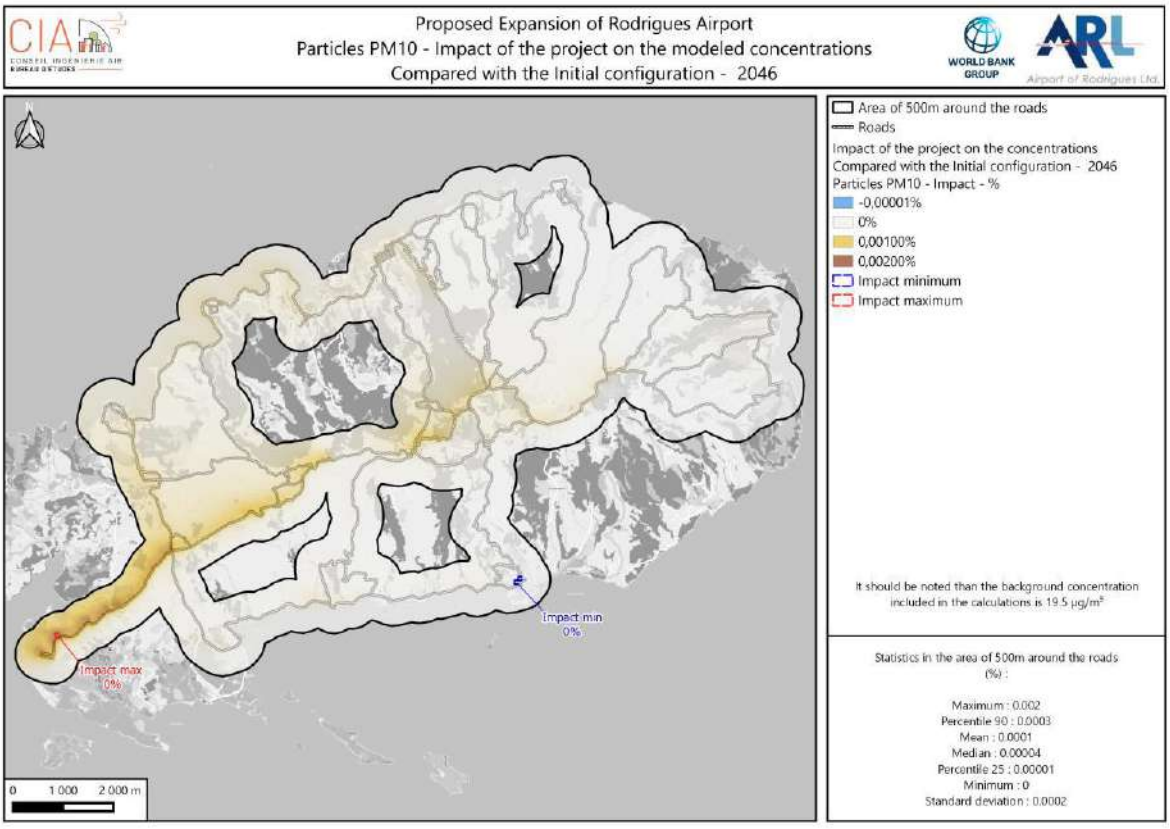


Figure 58 : Map of the impact of the project on the concentrations – Compared with the Initial configuration in 2046

5.4.1.1.3.1.3 Particles PM2.5

Table 5-14: Statistics of the modelled concentrations in the area of 500 m around the roads – Nitrogen dioxide

	2023	2026			2046		
Statistics in the area of 500 m around the roads - Unit : µg/m³	Current situation	Initial configuration	Project configuration	Project impact	Initial configuration	Project configuration	Project impact
Maximum :	10.2	10.3	10.3	0.001000	10.3	10.3	0.002
Percentile 90 :	10.2	10.2	10.2	0.000200	10.2	10.2	0.0003
Mean :	10.2	10.2064	10.2	0.000100	10.2096	10.2	0.0001
Median :	10.2	10.20	10.2	0.000030	10.20	10.2	0.00005
Percentile 25 :	10.2	10.2	10.2	0.000010	10.2	10.2	0.00001
Minimum :	10.2	10.2	10.2	-0.000010	10.2	10.2	0.0000
Standard deviation :	0.01	0.01	0.01	0.0001	0.01	0.01	0.0002

No specific spatial distribution is observed in the map below: the concentrations are close to one another, with a very low standard deviation of 0.005 µg/m³. The concentrations modeled are close to the background concentration included in the calculations (10.2 µg/m³).

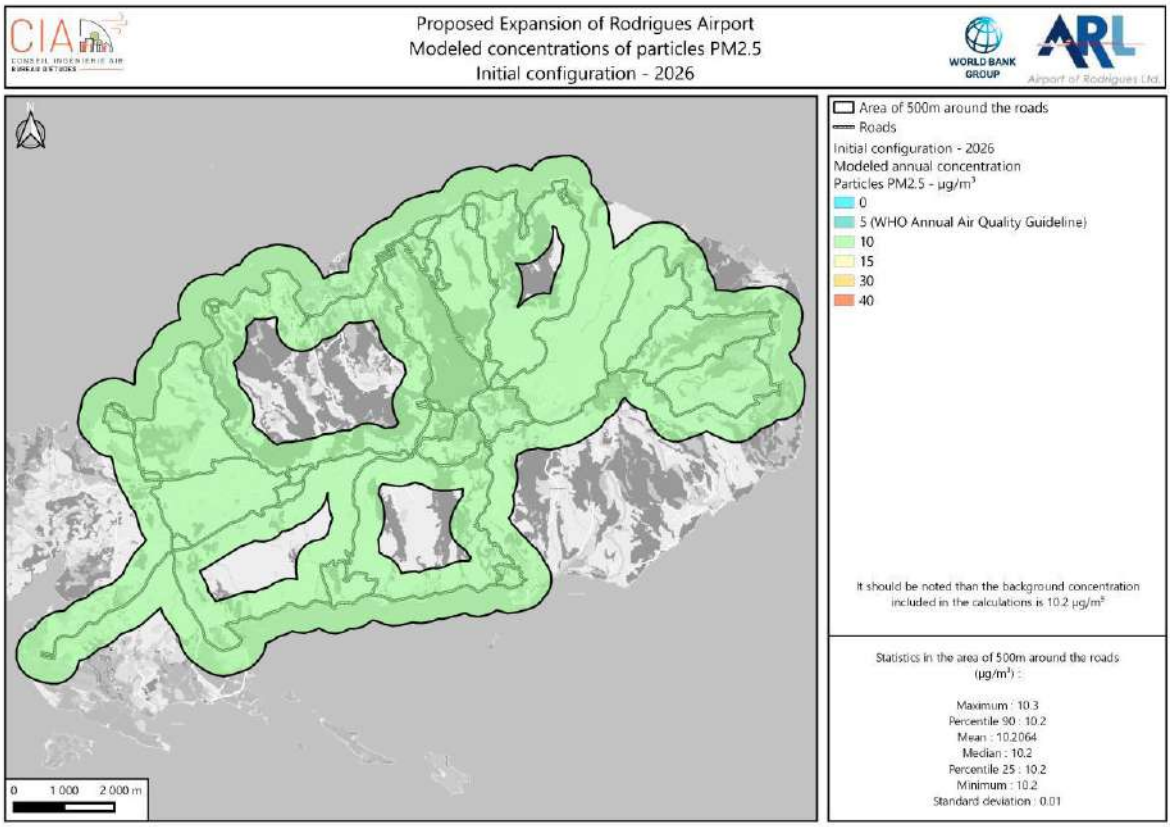


Figure 59 : Map of the modeled concentrations of PM2.5 at Rodrigues – Initial configuration in 2026

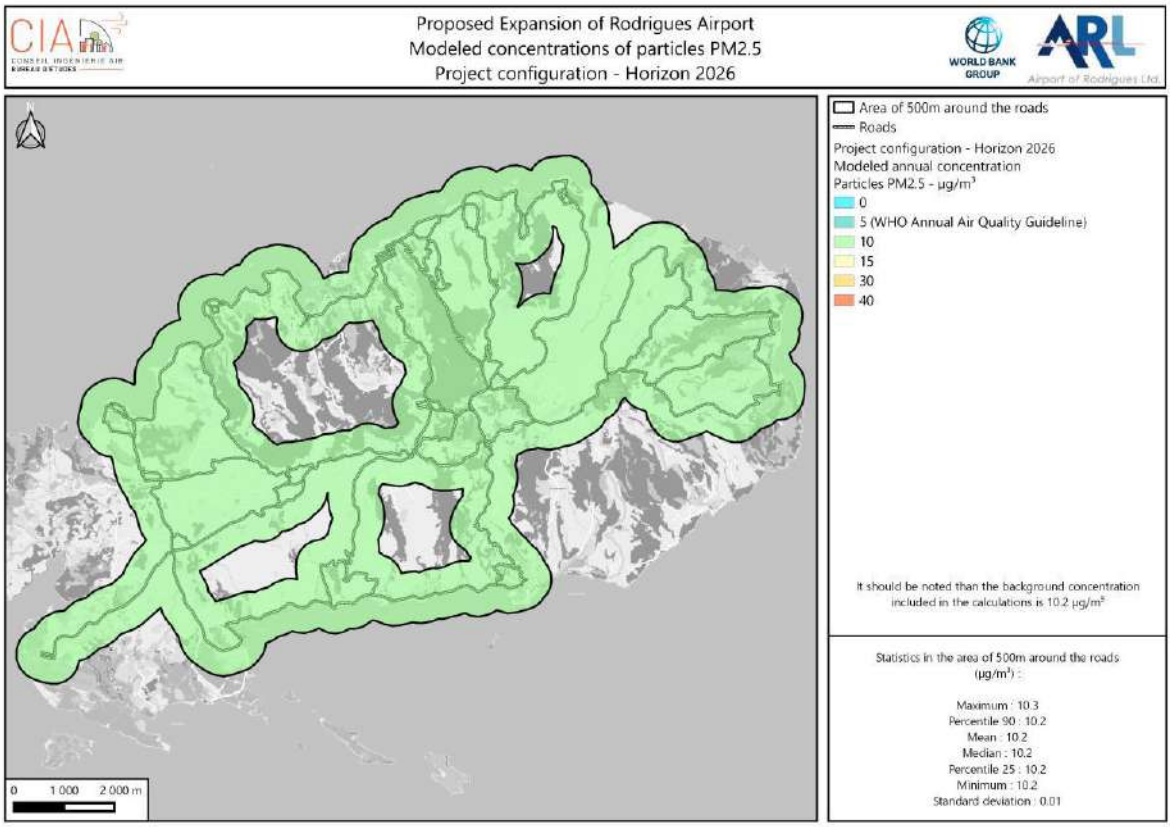


Figure 60 : Map of the modeled concentrations of PM2.5 at Rodrigues – Project configuration in 2026

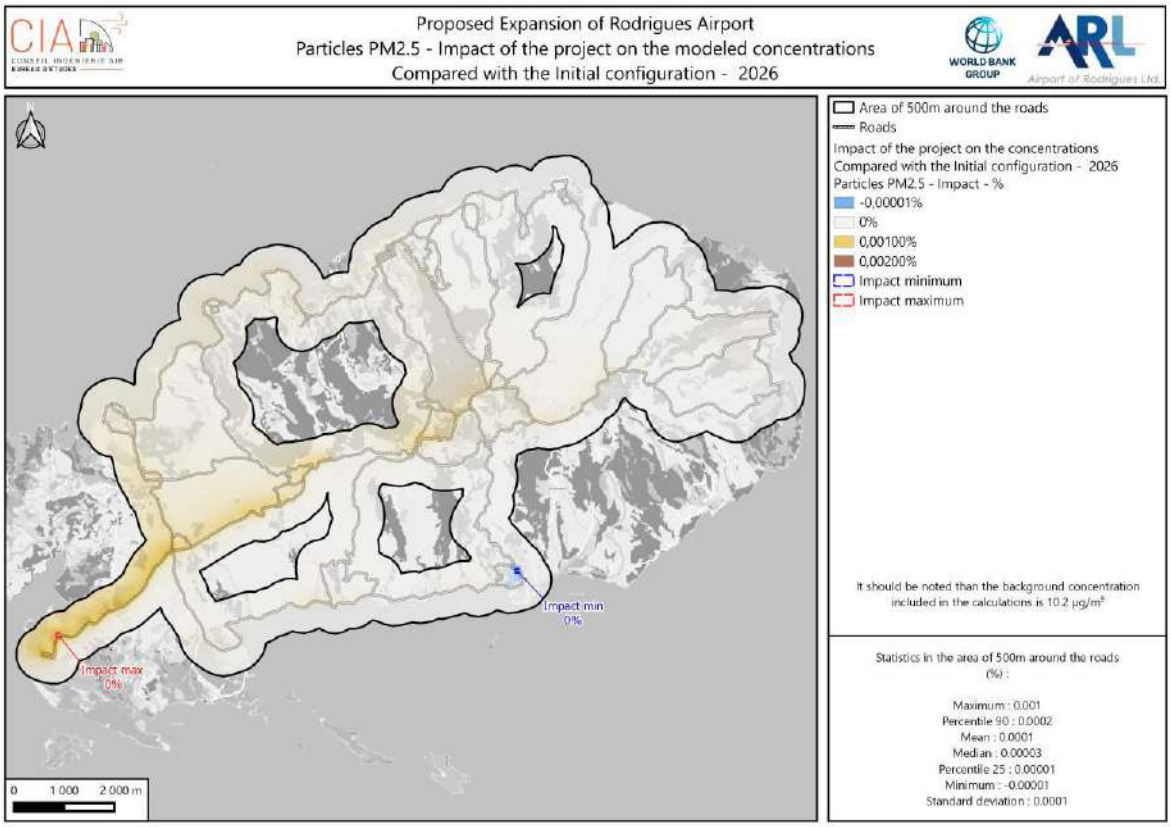


Figure 61 : Map of the impact of the project on the concentrations – Compared with the Initial configuration in 2026

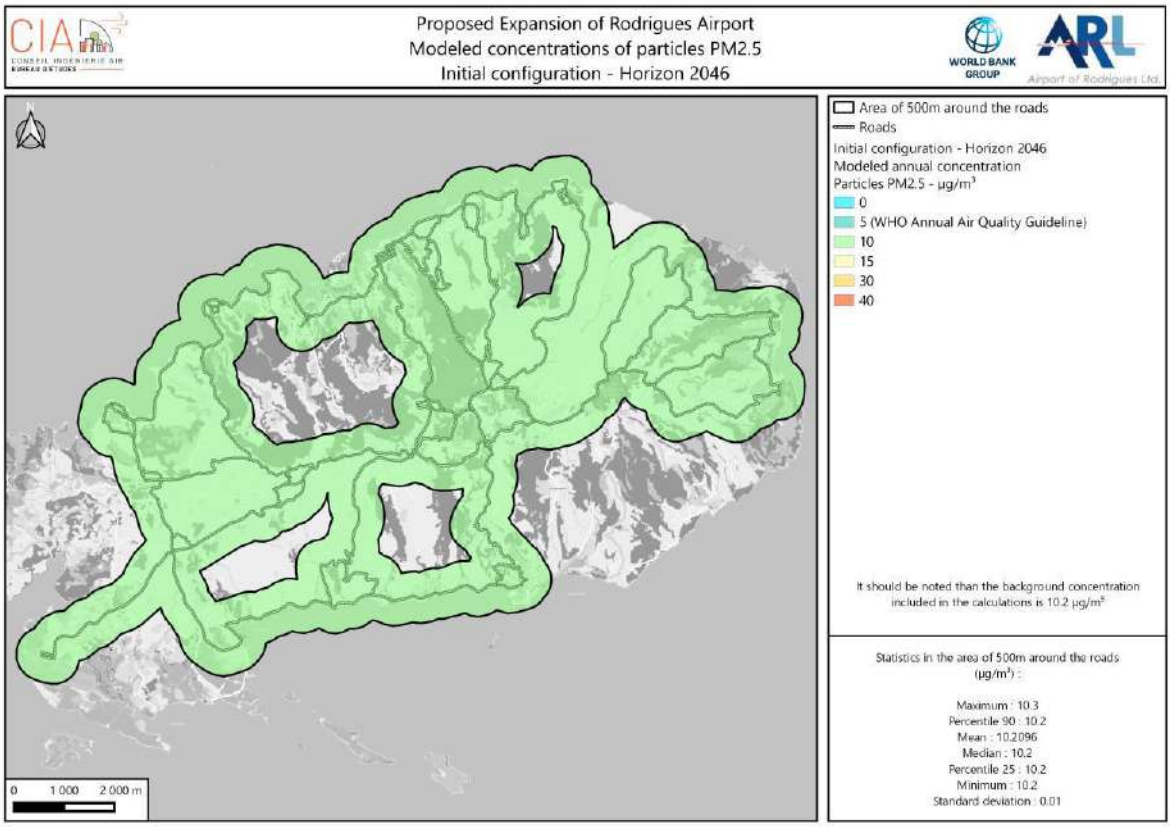


Figure 62 : Map of the modeled concentrations of PM2.5 at Rodrigues – Initial configuration in 2046

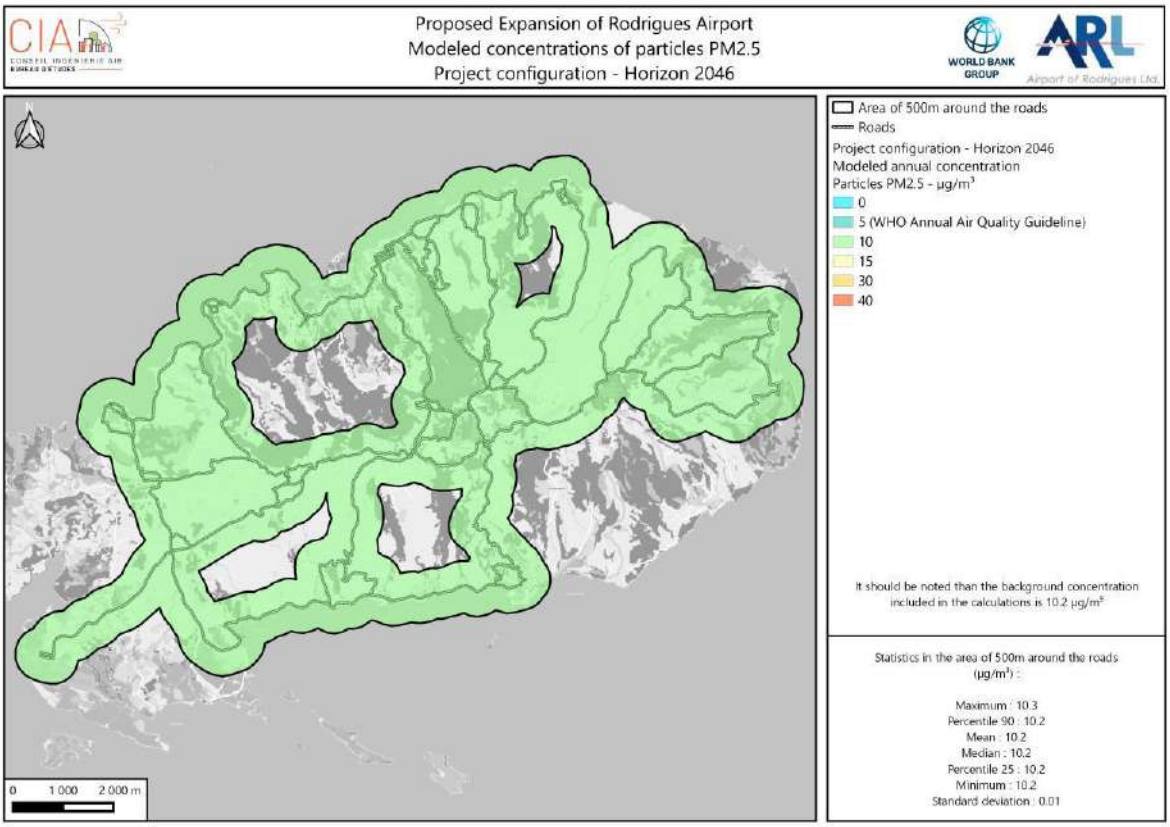


Figure 63 : Map of the modeled concentrations of PM2.5 at Rodrigues – Project configuration in 2046

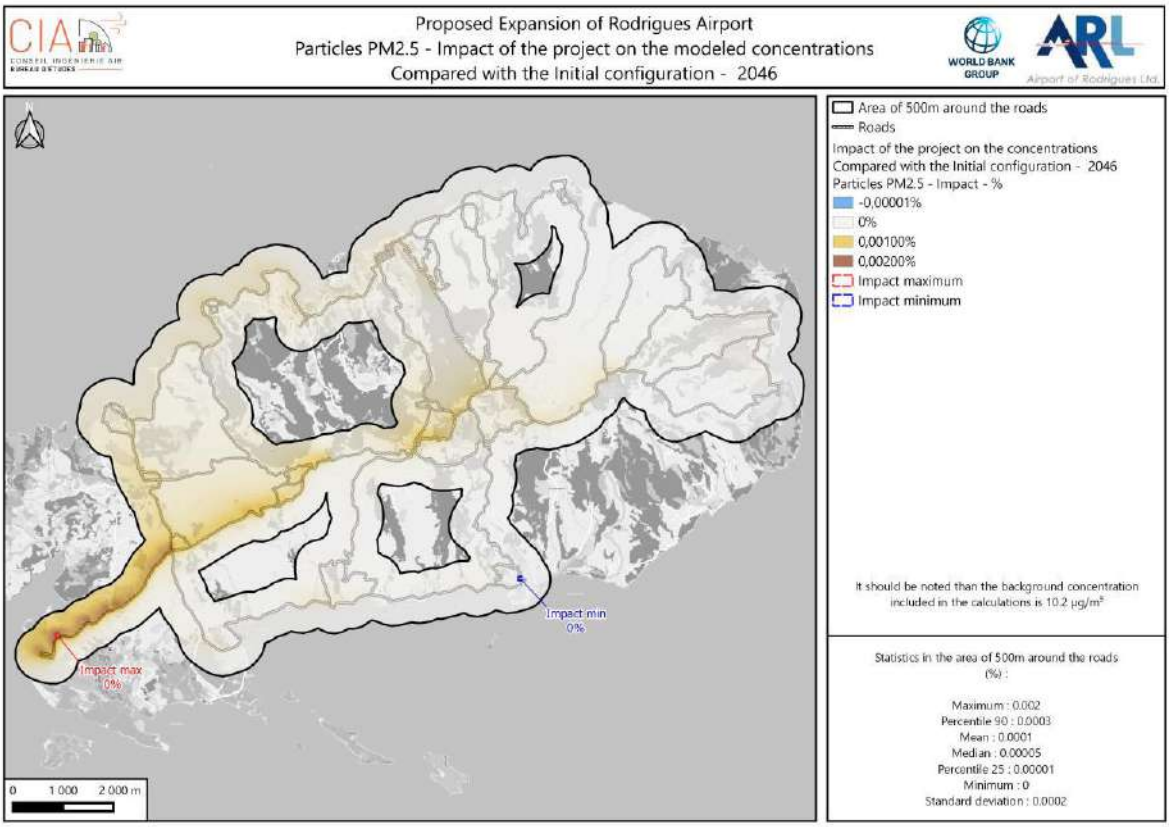


Figure 64 : Map of the impact of the project on the concentrations – Compared with the Initial configuration in 2046

5.4.1.1.4 Indicator Pollution-Population (IPP)

The Indicator Pollution Population (IPP) is calculated by multiplying the number of inhabitants of each zone by the mean concentration of nitrogen dioxide of the zone.

It allows to discriminate the areas with higher population and/or higher concentrations.

5.4.1.1.4.1 Situation in 2026

Table 5-15: Number of inhabitants by area, mean concentration in each area and Indicator Pollution Population calculated in each zone in 2026 – Initial configuration

Zone	Number of inhabitants - 2026	Mean concentration of NO_2 Initial configuration in 2026	Indicator Pollution Population of NO_2 Initial configuration in 2026
1	2050	9.47	19419
2	1578	9.50	14991
3	1526	9.50	14499
4	3680	9.53	35081
5	8411	9.49	79775
6	1198	9.41	11270
7	2921	9.43	27539
8	5400	9.52	51414
9	5190	9.52	49399
10	4072	9.52	38744
11	4018	9.44	37920
12	4104	9.42	38675
13	3854	9.41	36257
14	2758	9.41	25953

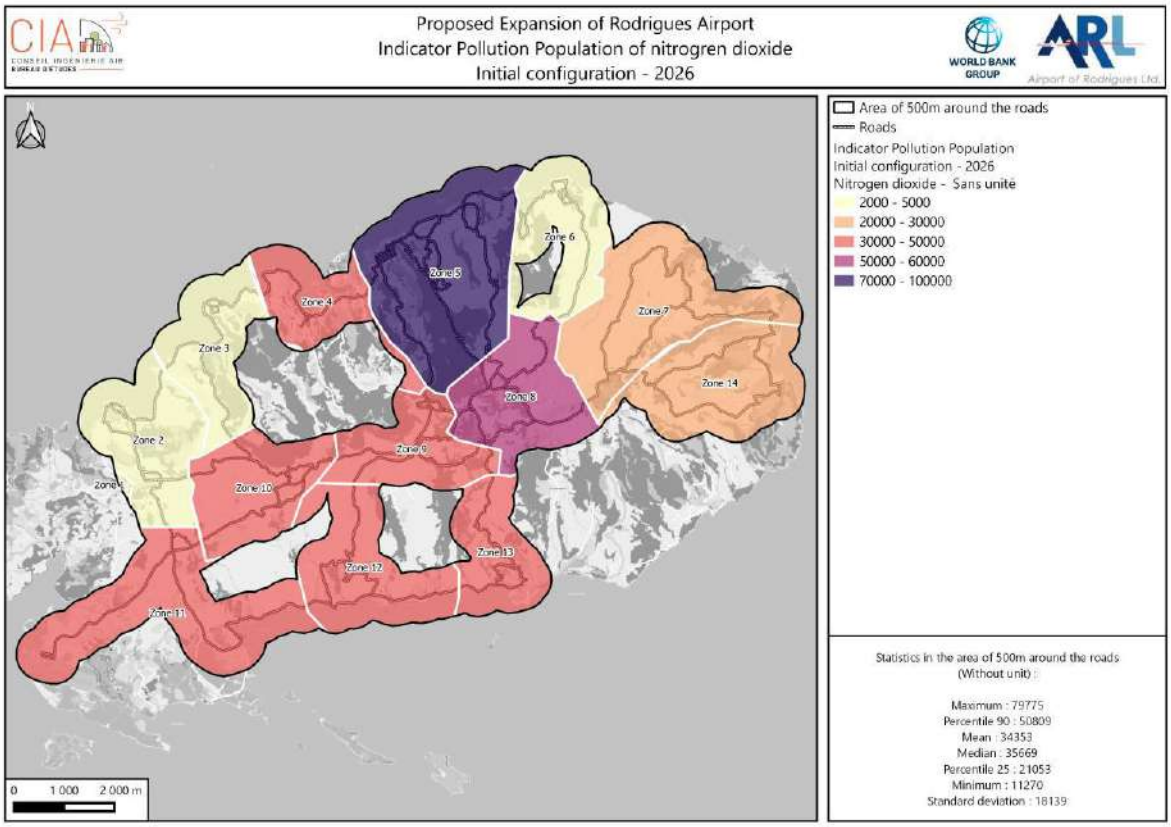


Figure 65 : Map of the Indicator Pollution Population of NO2 at Rodrigues – Initial configuration in 2026

Table 5-16: Number of inhabitants by area, mean concentration in each area and Indicator Pollution Population calculated in each zone in 2026 – Project configuration

Zone	Number of inhabitants - 2026	Mean concentration of NO_2 Project configuration in 2026	Indicator Pollution Population of NO_2 Project configuration in 2026
1	2050	9.47	19419
2	1578	9.50	14991
3	1526	9.50	14499
4	3680	9.53	35081
5	8411	9.49	79776
6	1198	9.41	11270
7	2921	9.43	27539
8	5400	9.52	51414
9	5190	9.52	49400
10	4072	9.52	38744
11	4018	9.44	37921
12	4104	9.42	38675
13	3854	9.41	36257
14	2758	9.41	25953

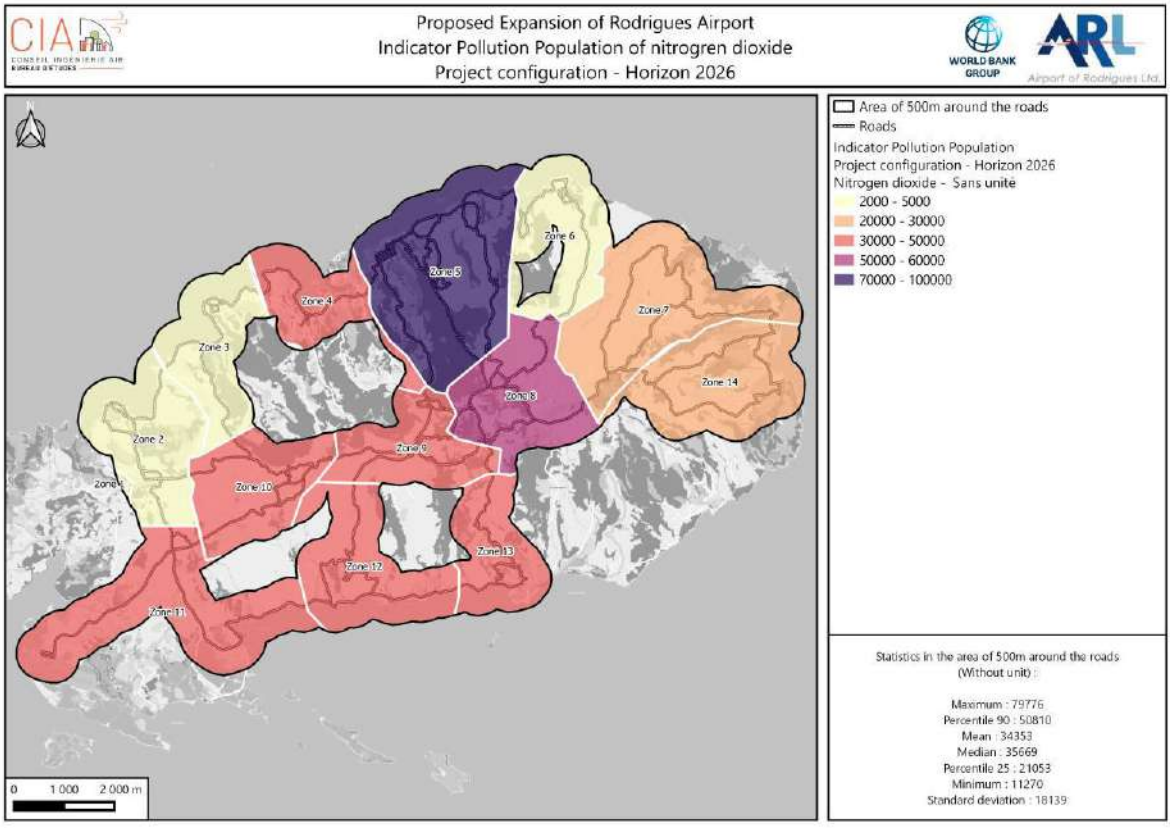


Figure 66 : Map of the Indicator Pollution Population of NO2 at Rodrigues – Project configuration in 2026

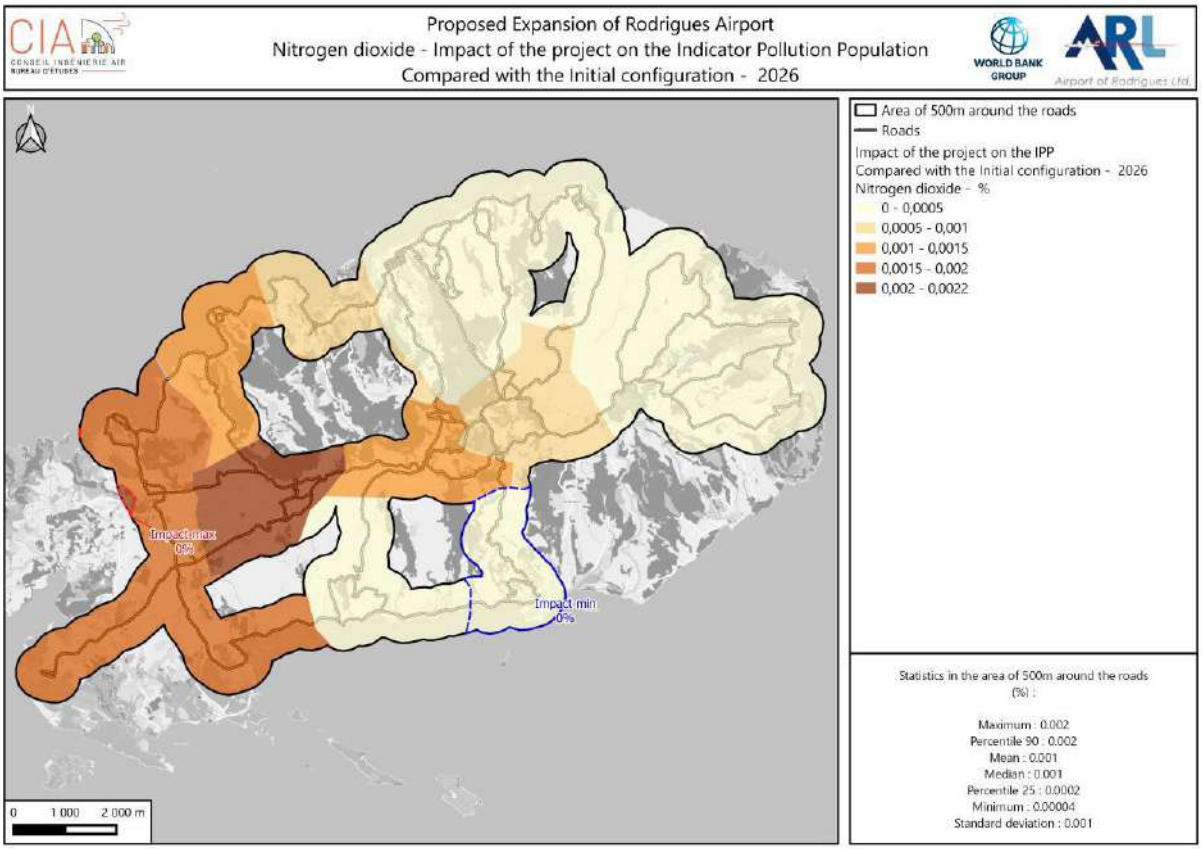


Figure 67 : Map of the impact of the project on the Indicator Pollution Population – Compared with the Initial configuration in 2026

For both situation, in 2026, the higher IPP is located in the zone 5: it's the zone with the higher number of inhabitants.

The zone 11 where the airport is located, has a low IPP compared to the zones 5, 8, 9 and 12.

As we can see on the map, the project has no impact on the population.

5.4.1.1.4.2 Situation in 2046

Table 5-17: Number of inhabitants by area, mean concentration in each area and Indicator Pollution Population calculated in each zone in 2046 – Initial configuration

Zone	Number of inhabitants - 2026	Mean concentration of NO_2 Initial configuration in 2046	Indicator Pollution Population of NO_2 Initial configuration in 2046
1	2050	9.45	31746
2	1578	9.47	24481
3	1526	9.47	23677
4	3680	9.49	57223
5	8411	9.46	130344
6	1198	9.41	18460
7	2921	9.42	45080
8	5400	9.48	83909
9	5190	9.48	80644
10	4072	9.48	63248
11	4018	9.43	62059
12	4104	9.42	63322
13	3854	9.40	59397
14	2758	9.41	42512

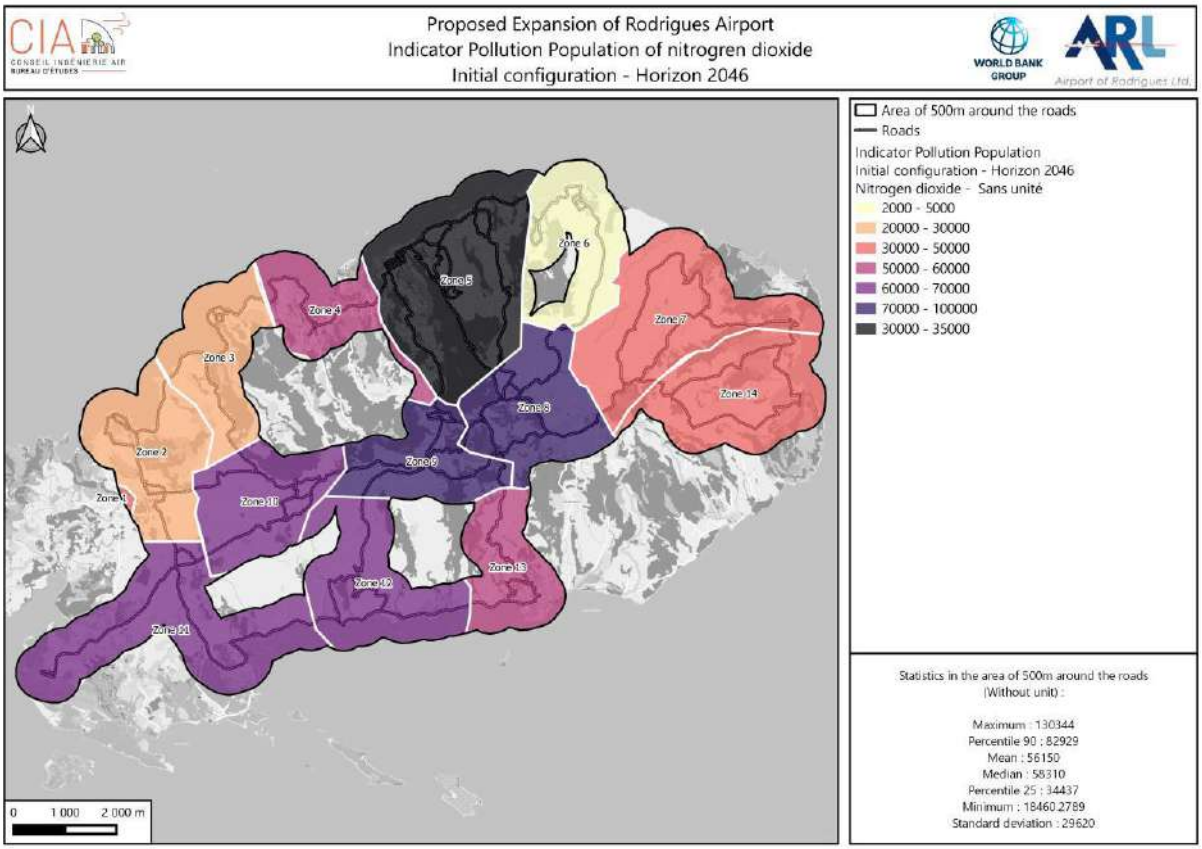


Figure 68 : Map of the Indicator Pollution Population of NO2 at Rodrigues – Initial configuration in 2046

Table 5-18: Number of inhabitants by area, mean concentration in each area and Indicator Pollution Population calculated in each zone in 2046 – Project configuration

Zone	Number of inhabitants - 2046	Mean concentration of NO_2 Project configuration in 2046	Indicator Pollution Population of NO_2 Project configuration in 2046
1	3360	9.45	31746
2	2585	9.47	24482
3	2500	9.47	23677
4	6030	9.49	57223
5	13782	9.46	130344
6	1962	9.41	18460
7	4786	9.42	45080
8	8848	9.48	83909
9	8504	9.48	80644
10	6672	9.48	63249
11	6584	9.43	62059
12	6725	9.42	63322
13	6316	9.40	59397
14	4519	9.41	42512

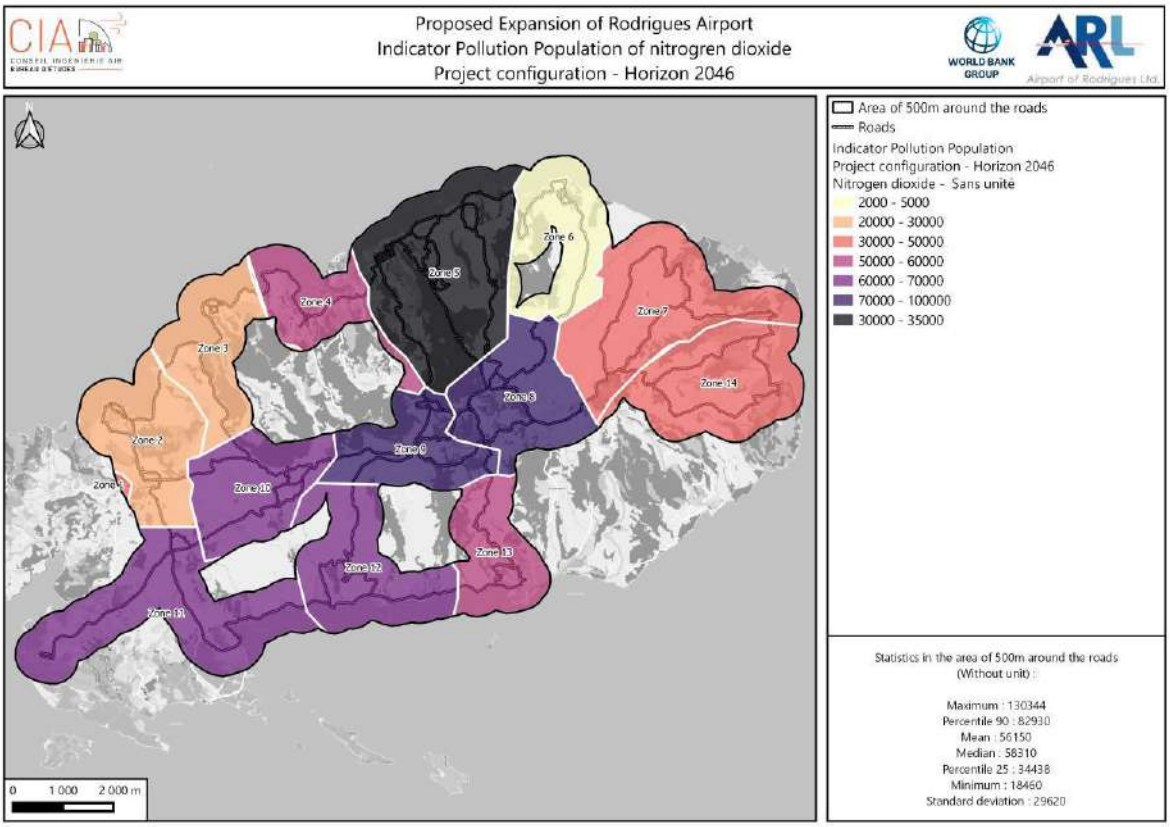


Figure 69 : Map of the Indicator Pollution Population of NO2 at Rodrigues – Project configuration in 2046

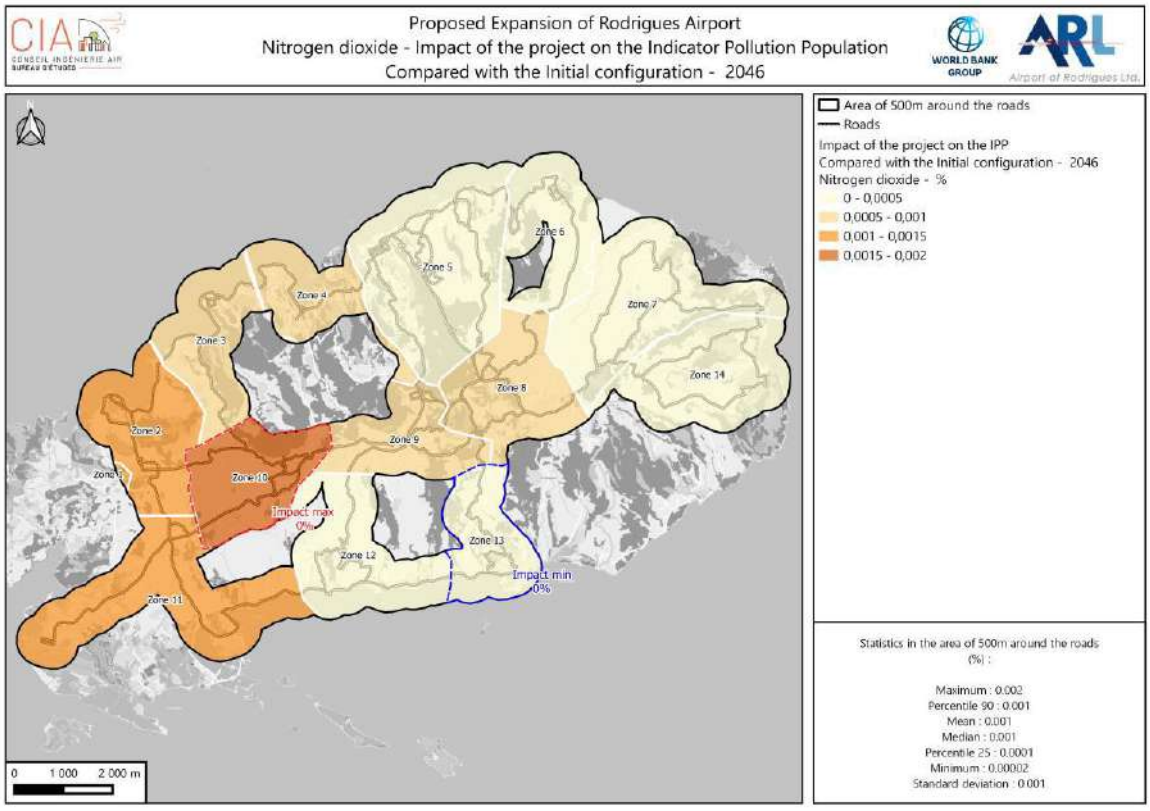


Figure 70 : Map of the impact of the project on the Indicator Pollution Population – Compared with the Initial configuration in 2046

For both situations, in 2046, the higher IPP is located in the zone 5: it's the zone with the higher number of inhabitants.

The zone 11 where the airport is located, has a low IPP compared to the zones 5, 8, 9 and 12.

As we can see on the map, the project has no impact on the population.

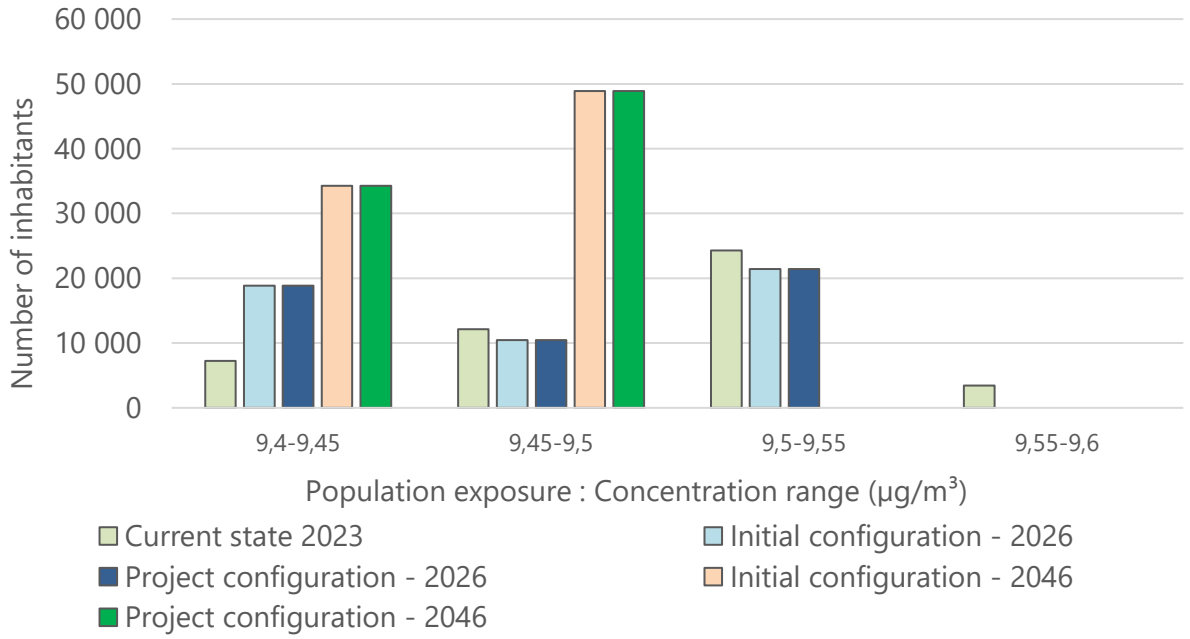


Figure 71 : Histogram showing the number of inhabitants exposed to the different concentrations

The histogram above shows the number of inhabitants exposed to the different concentration. We can see that there no change between the initial configuration and the project configuration, in 2026 and 2046.

The project as described will not have impact on the health of population, linked to the emissions of the road traffic.

5.4.1.2 Noise

5.4.1.2.1 Aircraft noise emissions

The 2046 noise levels are assessed with the baseline's methodology using the calculation tool "Impact".

Two configurations are studied: the initial configuration and the project configuration. Both are based on the same annual passengers arrivals (or departures) by 2046. However each one take into account different:

- Aircraft movements;
- Aircraft types
- Flight paths;
- Runway alignment;

5.4.1.2.1.1 Initial configuration – year 2046

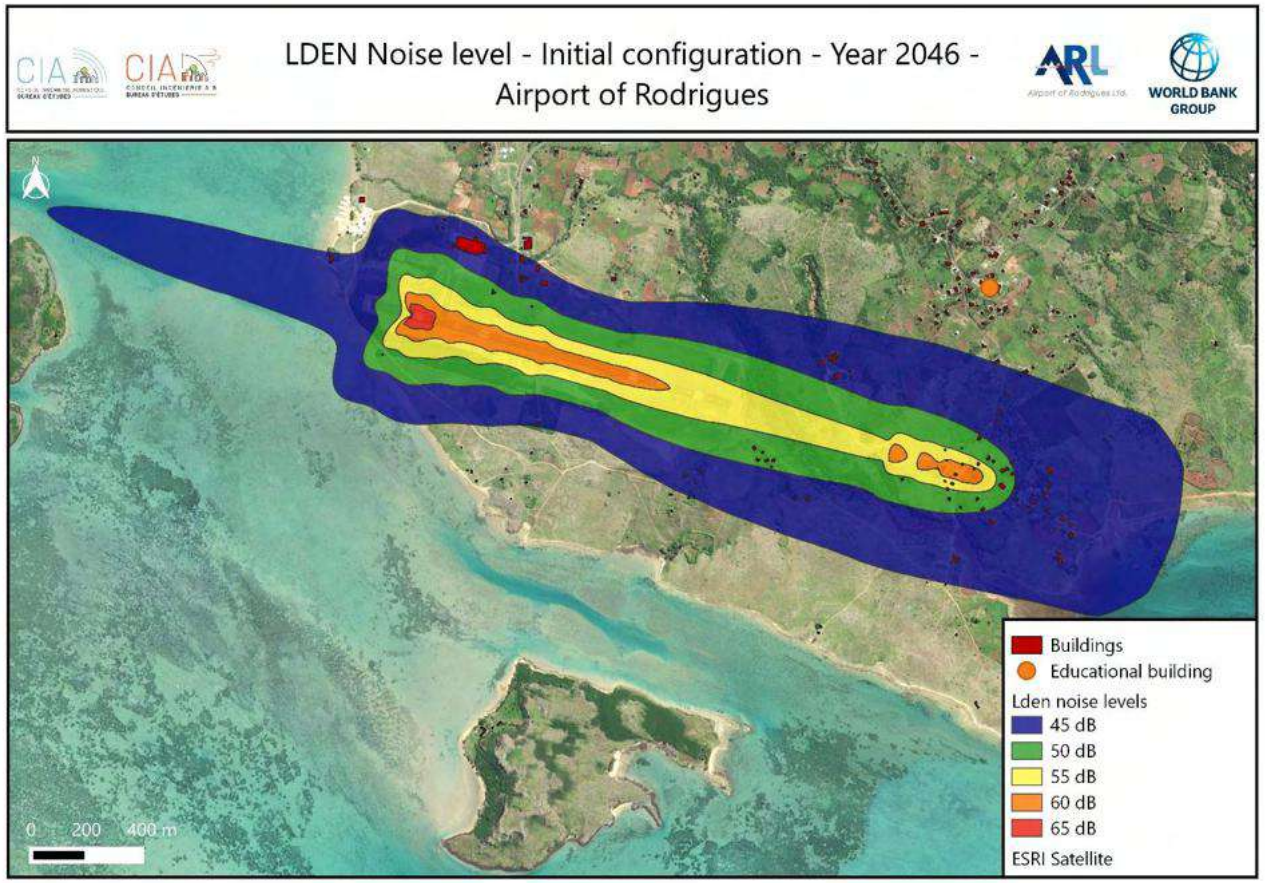
A passenger's annual increase of 4% by 2037 and 1% from 2037 is estimated. Without project, the air traffic must proportionally increases. So the population's noise level exposure also increases by 2046.

As few airplanes land on Plaine Corail Airport, and they are quite quiet, the noise curves of Lden indicator are small. No dwelling or noise-sensitive building has been identified in the footprint of the lowest noise curves that define noise exposure down to 45 dB. This confirms that populations are currently almost not exposed to airport noise.

However, it should be noted that the sensitive building pre-primary school Le Caneton is exposed to LAmax = 70dB(A) six times a day (NA65 = 6) at most.

The resulting noise contours around the airport are represented on the maps below indicating the presence of population with the buildings, thus, this maps illustrate the exposure of populations to 2046 aircraft noise with initial configuration. The ratio between the number of building and the number of buildings in the zones 11 and 1 give an approximation of the impacted population. The scale representing sound levels range from

- Lden 45 dB(A) (very low noise exposure) to 70 dB(A) (high noise exposure). The noise indicator Lden, used in European noise directives and French noise exposure plans, has been chosen because it takes into account the nuisances felt during evening and night periods ;
- LAmax 65 dB(A) (medium noise exposure) to 100 dB(A) (very high noise exposure). It indicates the daily maximum LAeq reached. The noise indicator LAmax used in French noise exposure plans has been chosen to see the maximum noise level exposure;
- NA62 : 2 to 12 (low number of events LAmax > 62 dB(A)). The NA62 indicator is hepful to contextualize the LAmax indicator. While LAmax indicates the daily maximum LAeq , NA62 indicates the daily number of events with maximum LAeq > 62 dB(A) ;
- NA65 : 2 to 10 (low number of events LAmax > 65 dB(A)). The NA65 indicator is hepful to contextualize the LAmax indicator. While LAmax indicates the daily maximum LAeq , NA65 indicates the daily number of events with maximum LAeq > 65 dB(A)



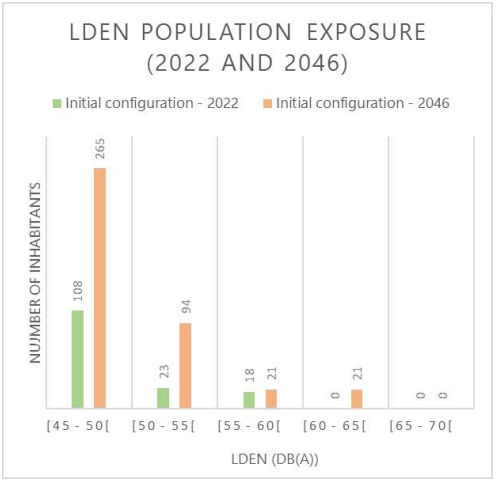
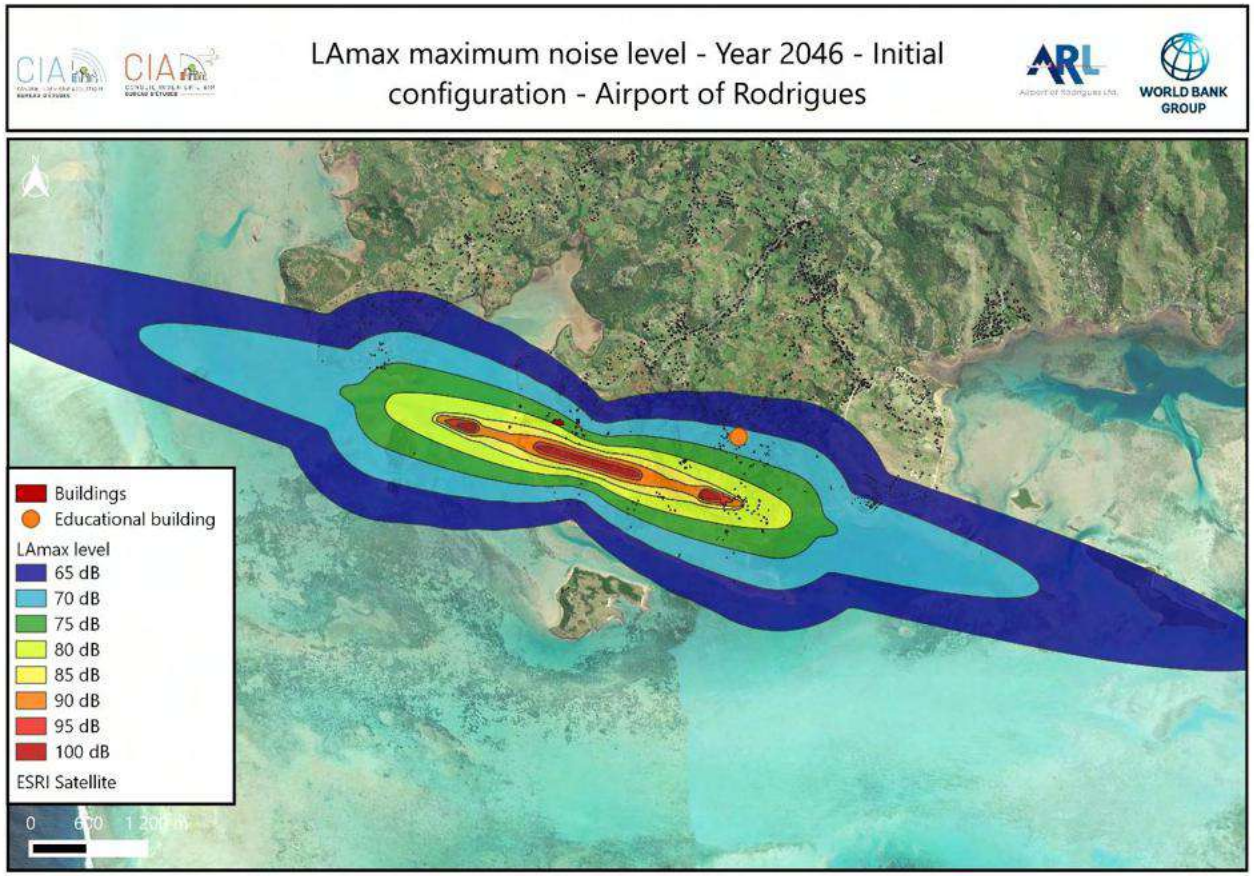


Figure 72 : Lden noise contour and population exposure - initial configuration – 2046 - Plaine Corail Airport



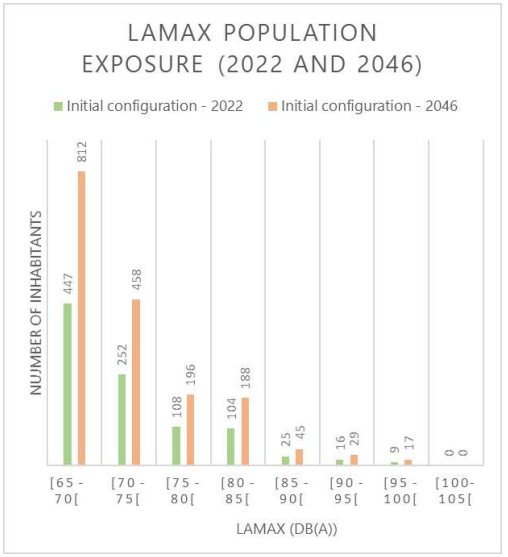
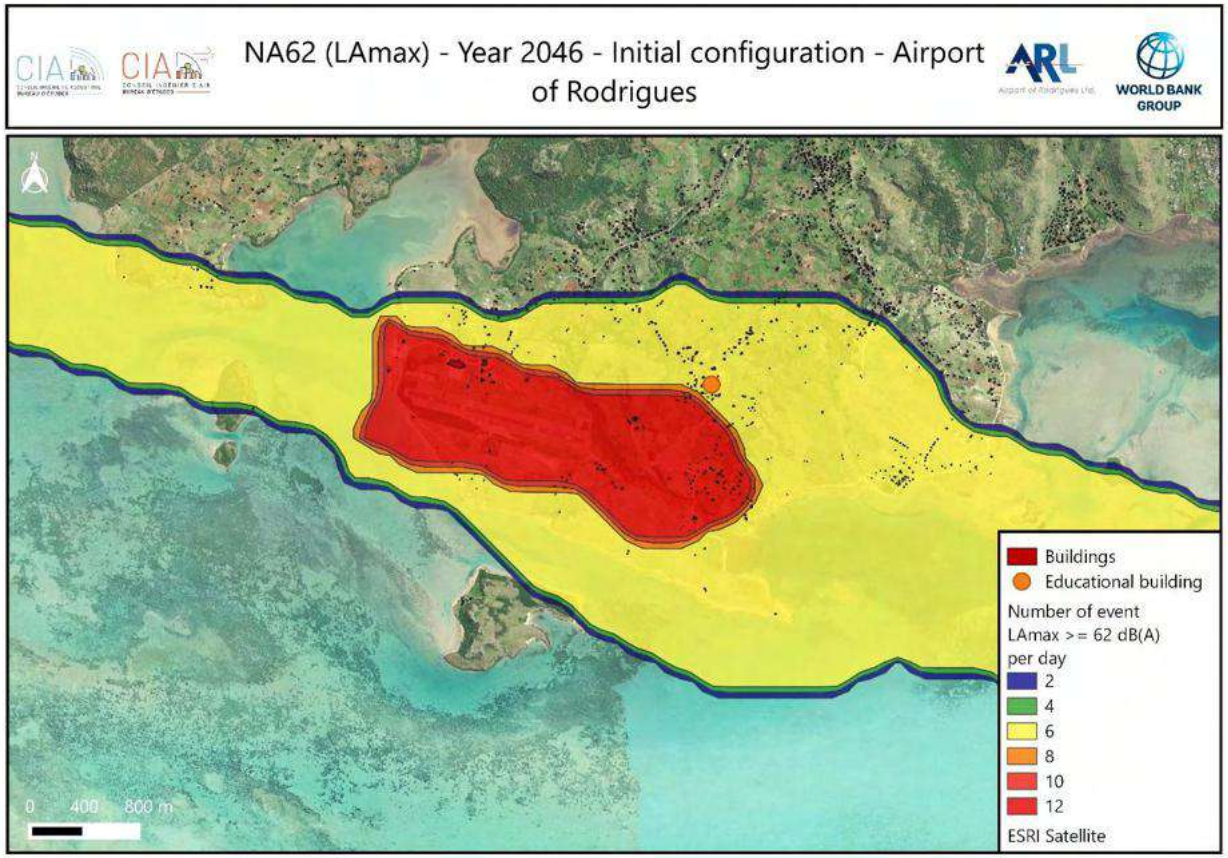


Figure 73 : LAmax noise contour and population exposure - initial configuration – 2046 - Plaine Corail Airport



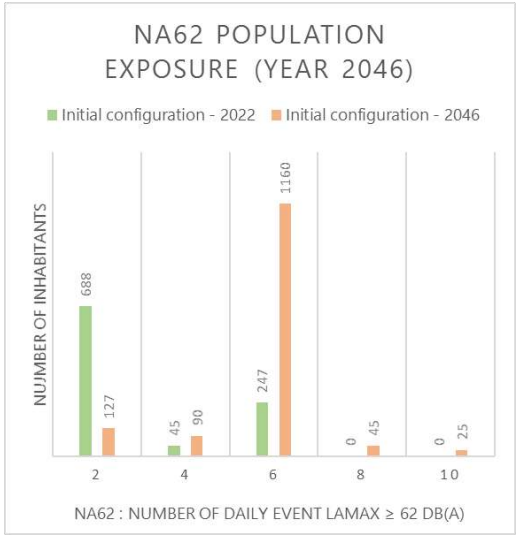
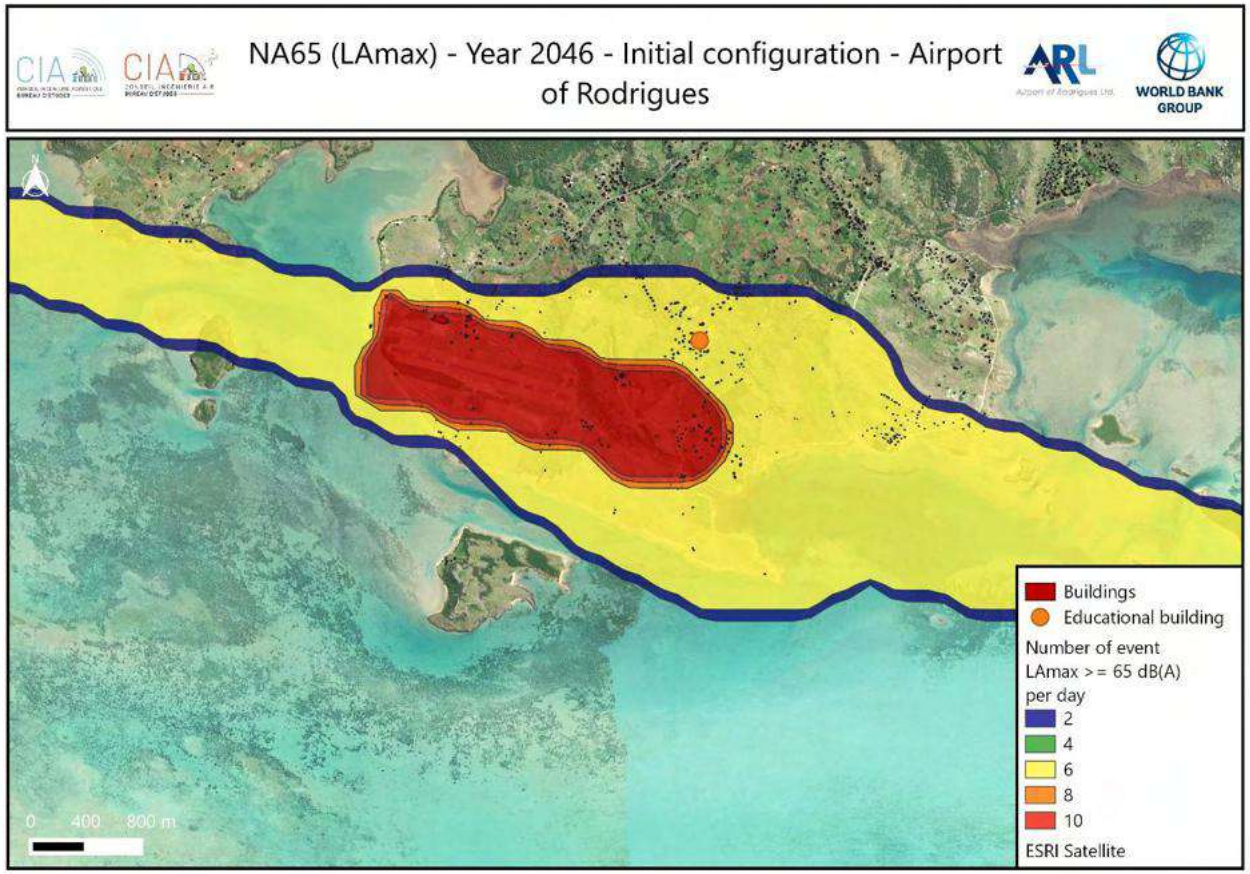


Figure 74 : Number of events LAmax > 62 dB(A) contour and population exposure - initial configuration – 2046 - Plaine Corail Airport



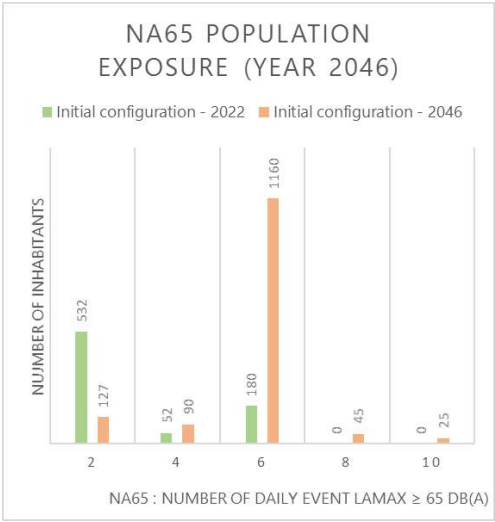


Figure 75 : Number of events LAmax > 65 dB(A) contour and population exposure - initial configuration – 2046 - Plaine Corail Airport

5.4.1.2.1.2 Project configuration – year 2046

The aim of the project is to increase the airport's capacity, both in terms of traffic and aircraft type. The platform accommodates small ATR72 aircraft with 2545 operations in 2046; in the long term, A321 NEOs and B737-900Ms will land, with approximately 1153 operations in 2046.

The A321 NEOs and B737-900Ms capacities are more than two times superior to ATR72 aircraft, therefore the project configuration enables the air traffic to be reduced. However the turbojet engine increase the noise emission. It should be noted that the new runway's angle impacts the approaches and departures paths, which enable a significant reduction of the noise level population's exposure.

In summary, with the project configuration, higher but less frequent noise levels are estimated. Moreover, the population's exposure is reduced because of new runway's angle.

The sensitive building pre-primary school Le Caneton is less exposed to aircraft noise in this configuration with LAmax < 65 dB(A).

The resulting noise contours around the airport are represented on the maps below indicating the presence of population with the buildings, thus, this maps illustrate the exposure of populations to 2046 aircraft noise with the project configuration. The ratio between the number of building and the number of buildings in the zones 11 and 1 give an approximation of the impacted population. The scale representing sound levels range from

- Lden 45 dB(A) (very low noise exposure) to 70 dB(A) (high noise exposure). The noise indicator Lden, used in European noise directives and French noise exposure plans, has been chosen because it takes into account the nuisances felt during evening and night periods ;
- LAmax 65 dB(A) (medium noise exposure) to 100 dB(A) (very high noise exposure). It indicates the daily maximum LAeq reached. The noise indicator LAmax used in French noise exposure plans has been chosen to see the maximum noise level exposure;
- NA62 : 2 to 6 (low number of events LAmax > 62 dB(A)). The NA62 indicator is helpful to contextualize the LAmax indicator. While LAmax indicates the daily maximum LAeq , NA62 indicates the daily number of events with maximum LAeq > 62 dB(A) ;
- NA65 : 2 to 6 (low number of events LAmax > 65 dB(A)). The NA65 indicator is helpful to contextualize the LAmax indicator. While LAmax indicates the daily maximum LAeq , NA65 indicates the daily number of events with maximum LAeq > 65 dB(A)

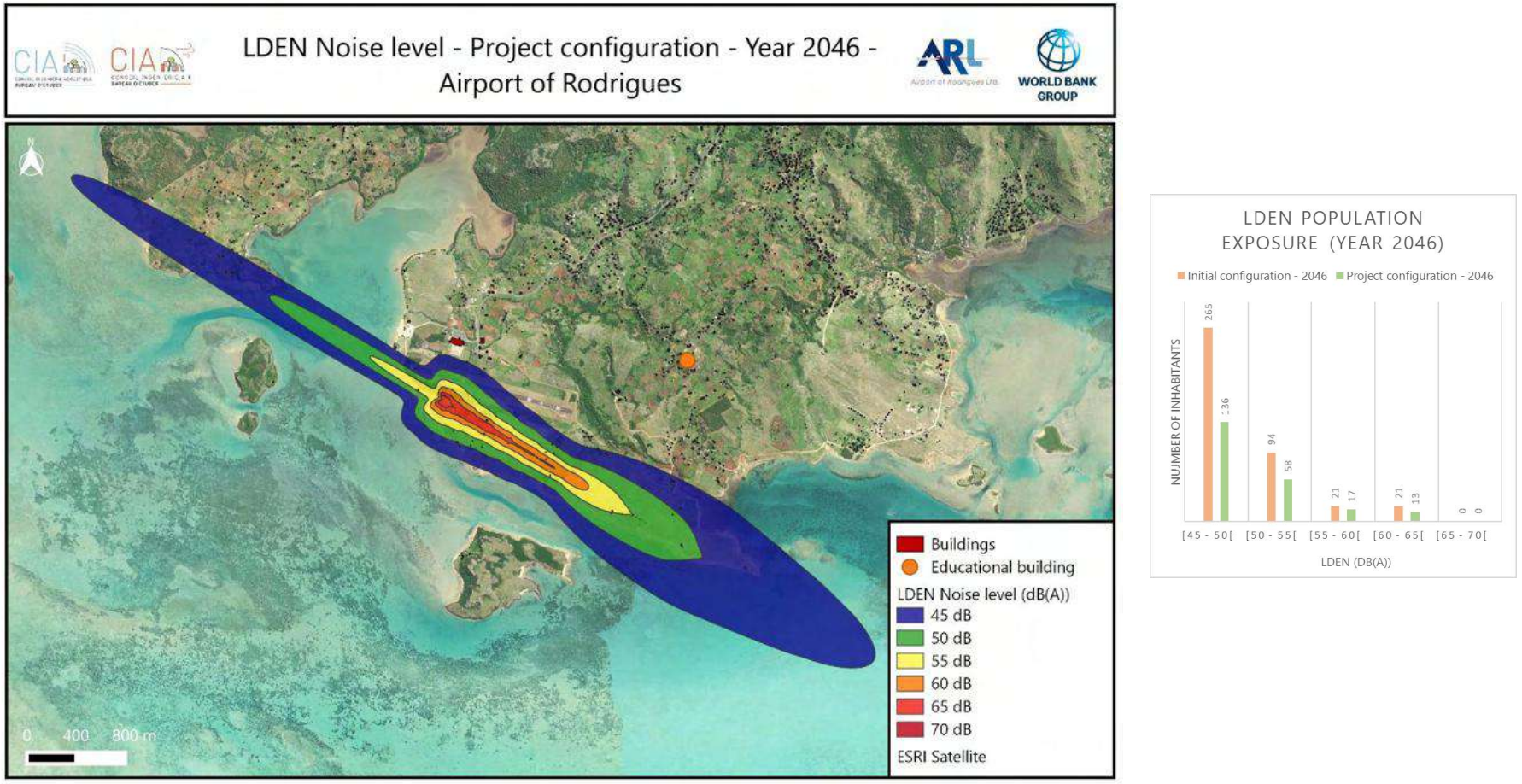
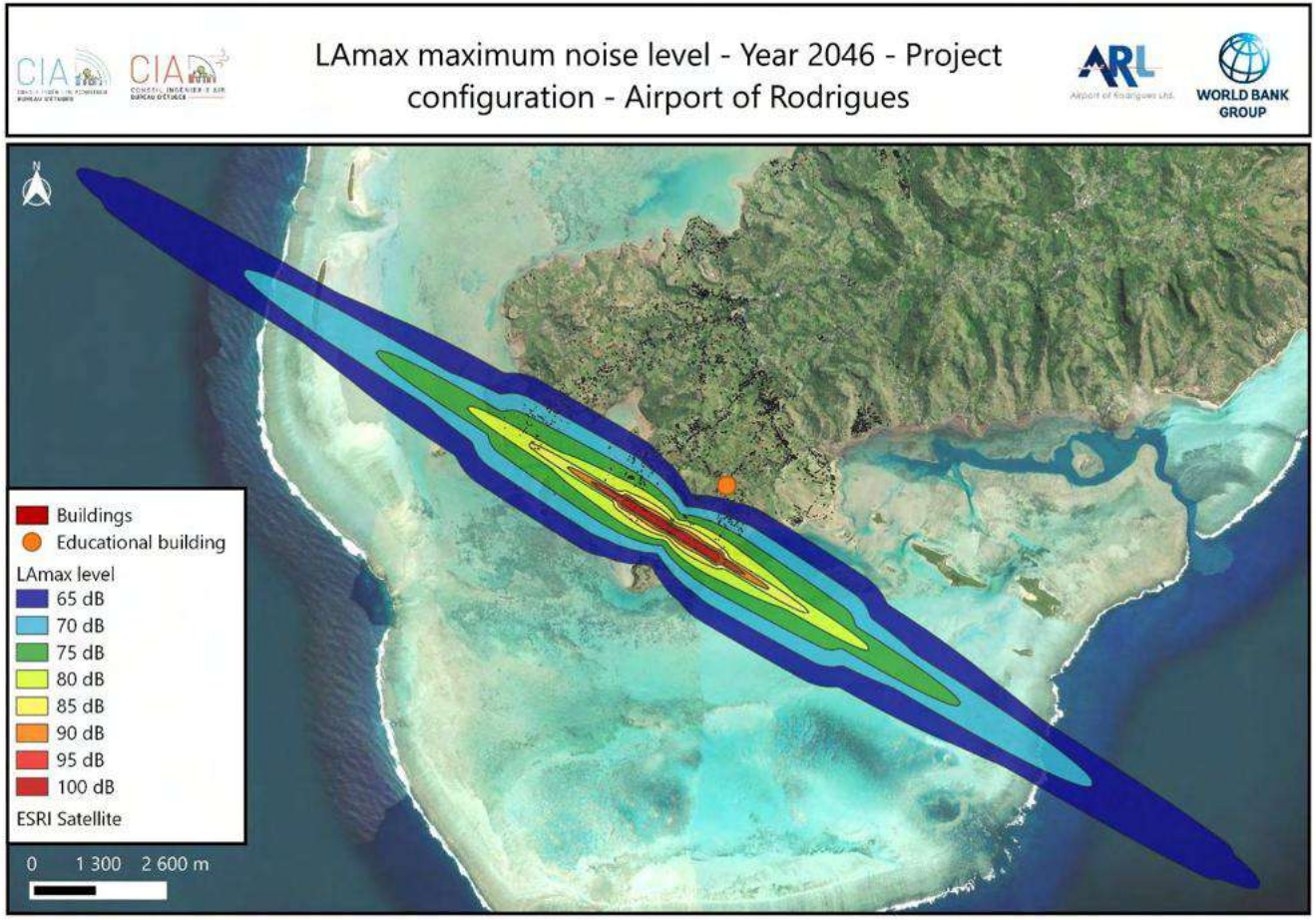


Figure 76 : Lden noise contour and population exposure - project configuration – 2046 - Plaine Corail Airport



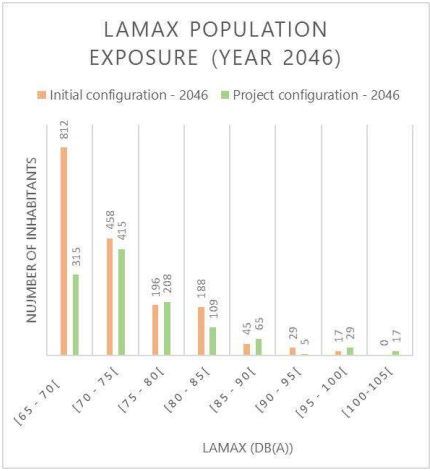
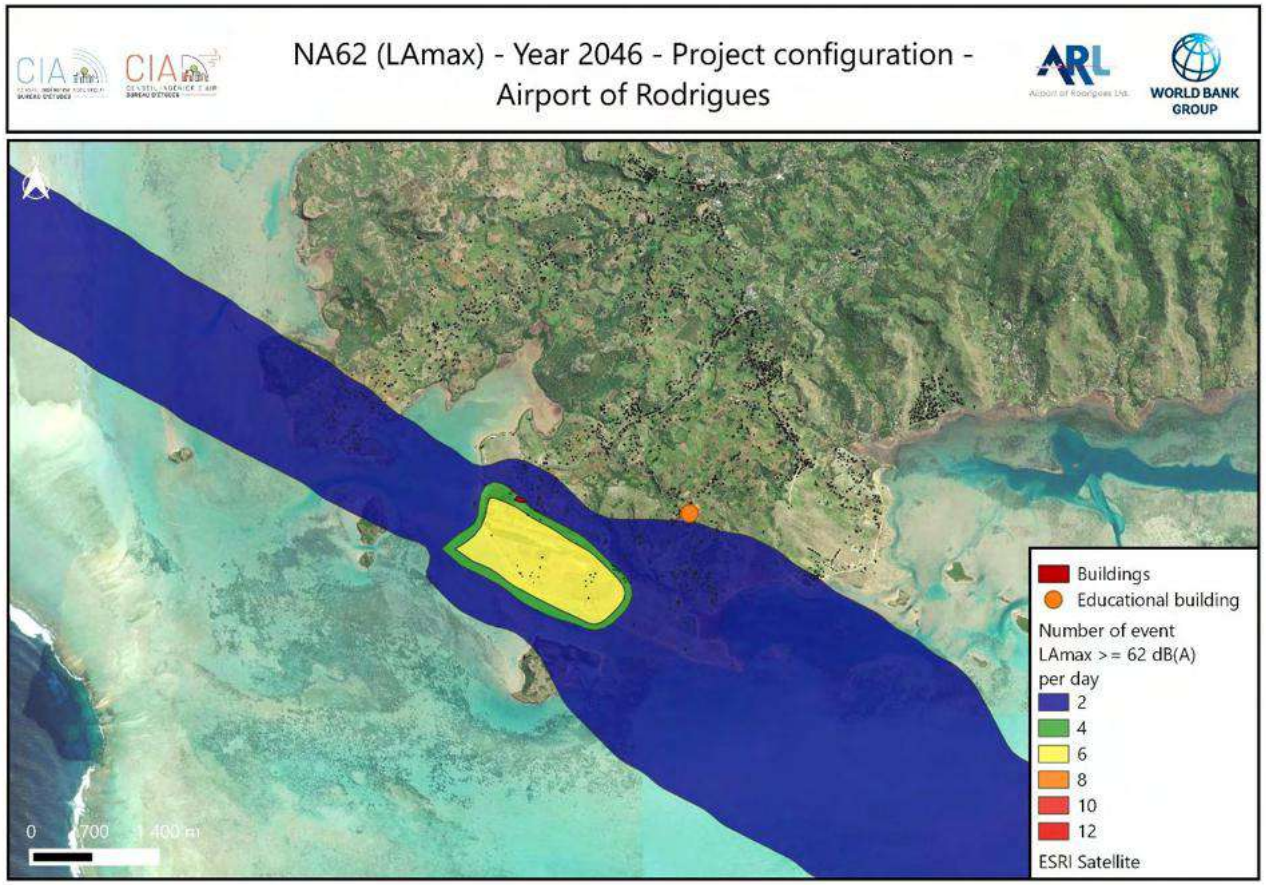


Figure 77 : LAmax noise contour and population exposure - project configuration – 2046 - Plaine Corail Airport



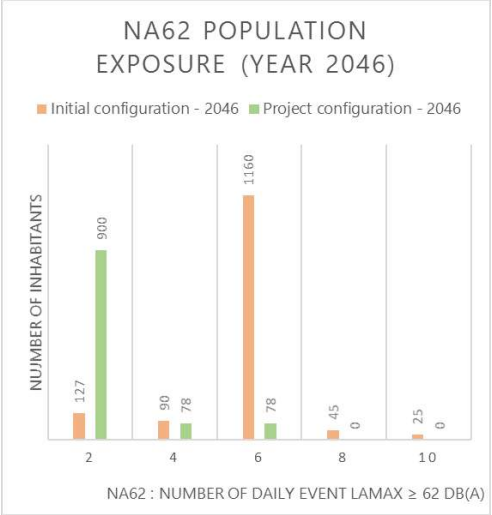
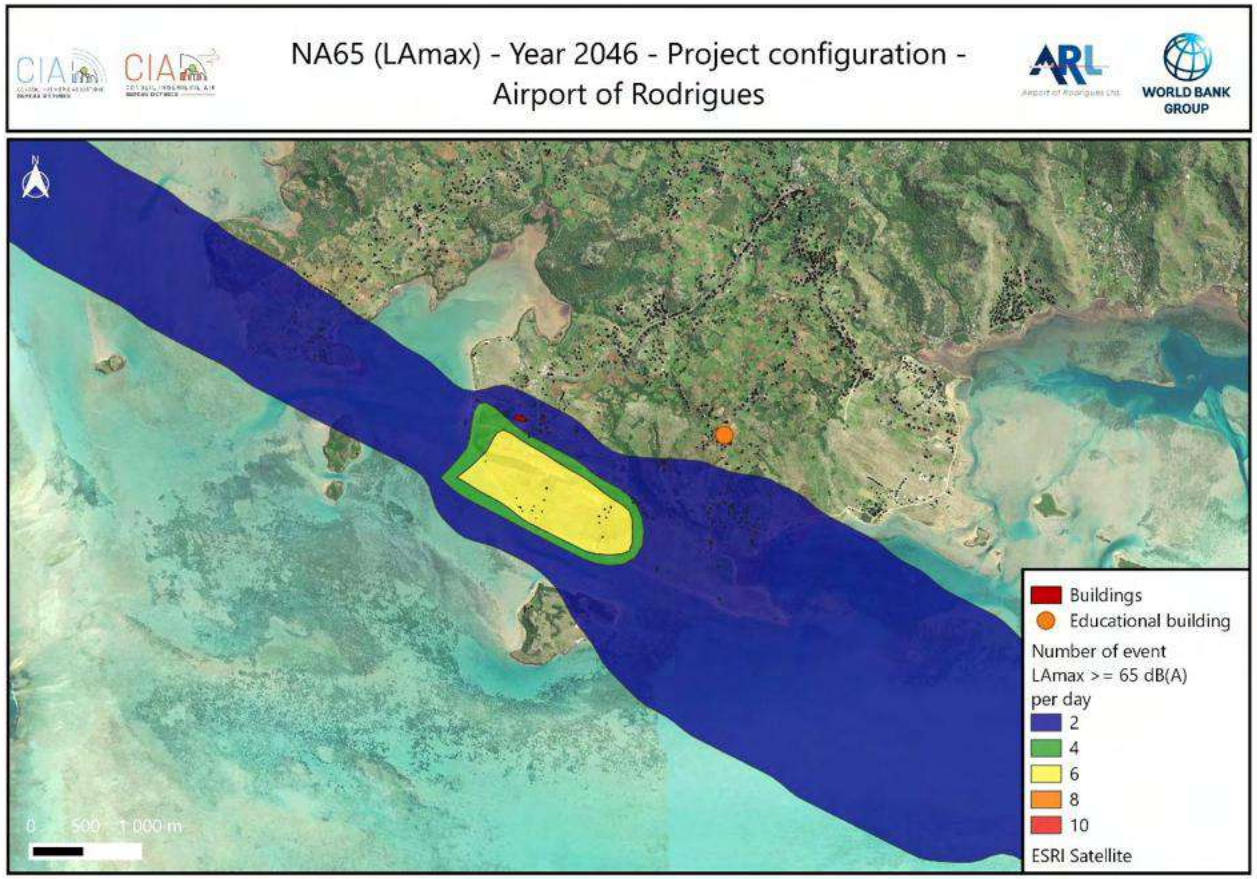


Figure 78 : Number of events LAmax > 62 dB(A) contour and population exposure – project configuration – 2046 - Plaine Corail Airport



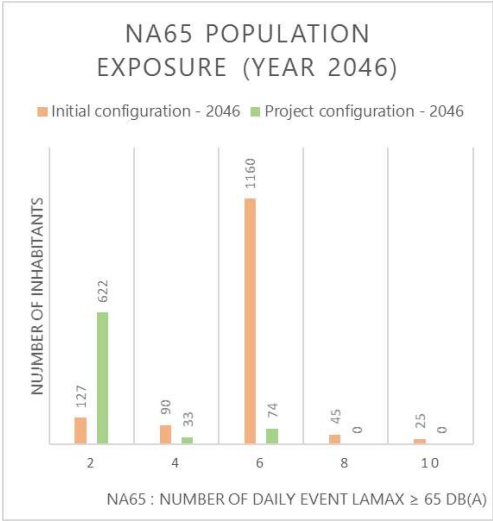


Figure 79 : Number of events LAmax > 65 dB(A) contour and population exposure - project configuration – 2046 - Plaine Corail Airport

The LDEN difference between project and initial configuration by 2046 is represented on the maps below indicating the presence of population with the buildings, thus, this maps illustrate the project's impact on exposure of populations to aircraft noise The ratio between the number of building and the number of buildings in the zones 11 and 1 give an approximation of the number of inhabitants. The project enables a reduction of the LDEN population's exposure. However it should be noted that the marine environment south of the airport is more exposed to aircraft noise.

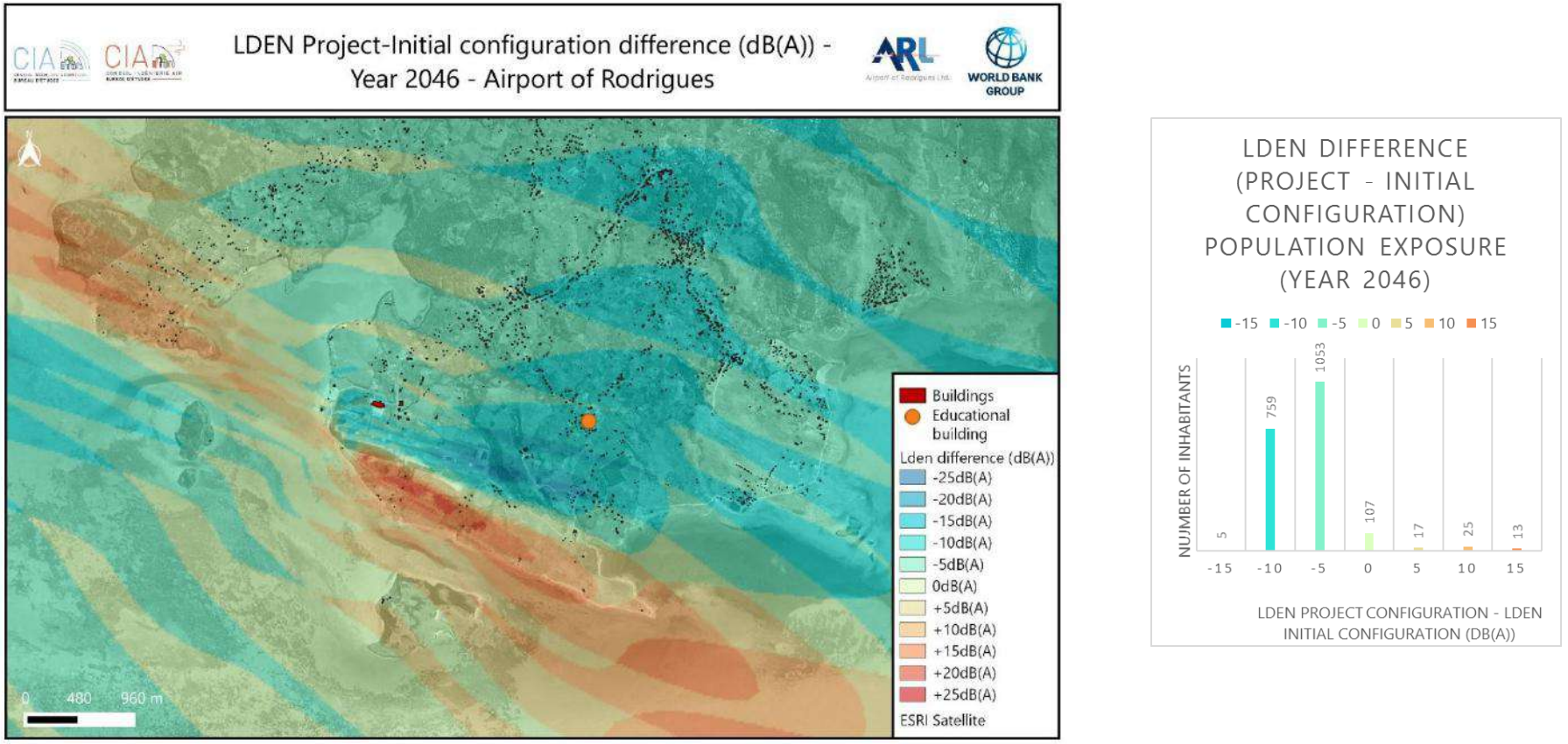


Figure 80 : Lden difference between project and initial configuration and population exposure – 2046 - Plaine Corail Airport

5.4.1.2.2 Road traffic : Calculation in future situation

From the topographic files provided, the studied site has been modeled in 3 dimensions with the Mithra SIG V5 software. The right-of-way and its geometrical characteristics were taken into account. As the project does not entail any modifications to the road infrastructure, the modelling of the variants in the future situation (with and without project) are identical to the initial state. Only the road traffic changes.

5.4.1.2.2.1 Calculation in 2026

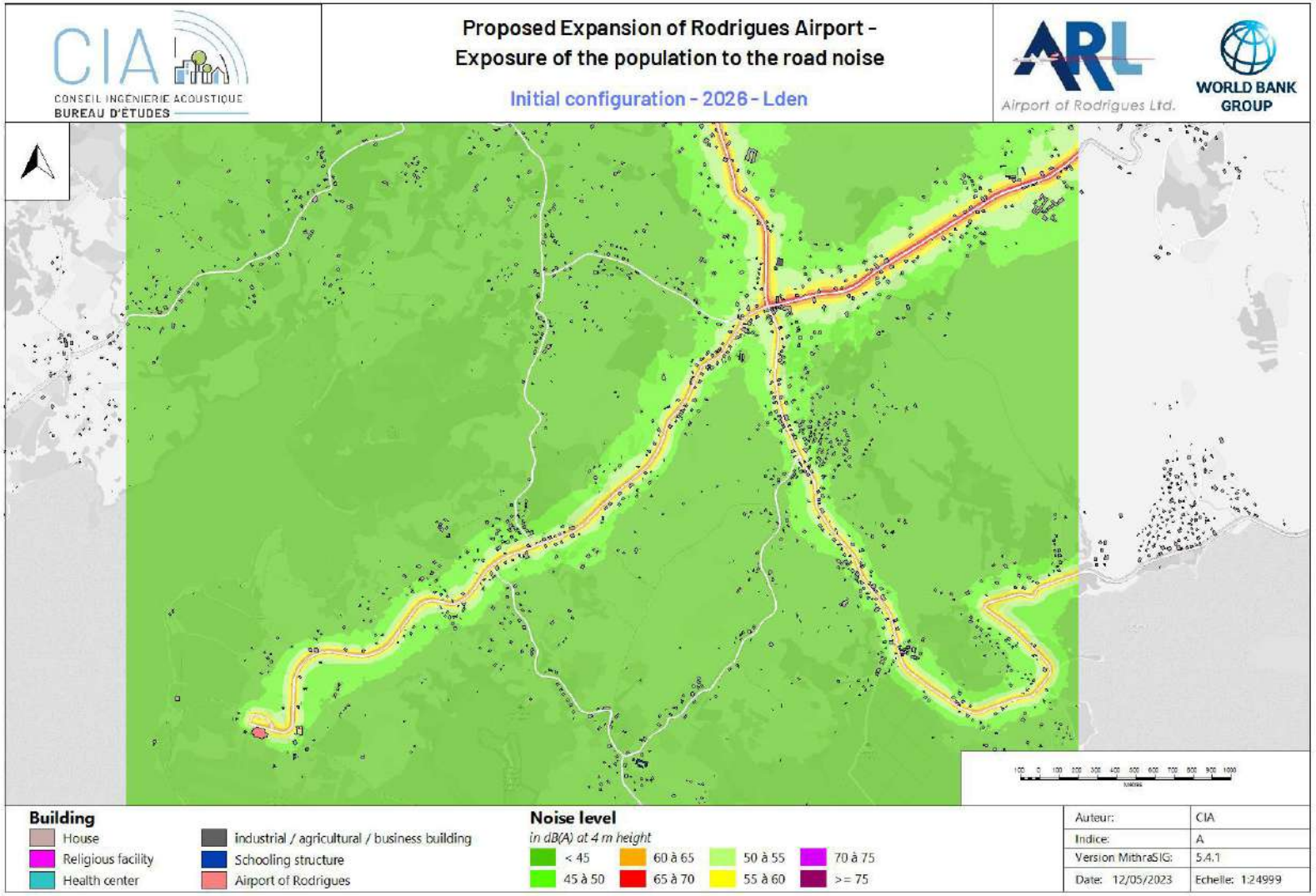
Acoustic calculations were performed on the entire studied area with and without the project to characterize the impact of noise pollution due to existing road traffic on the population, in 2026.

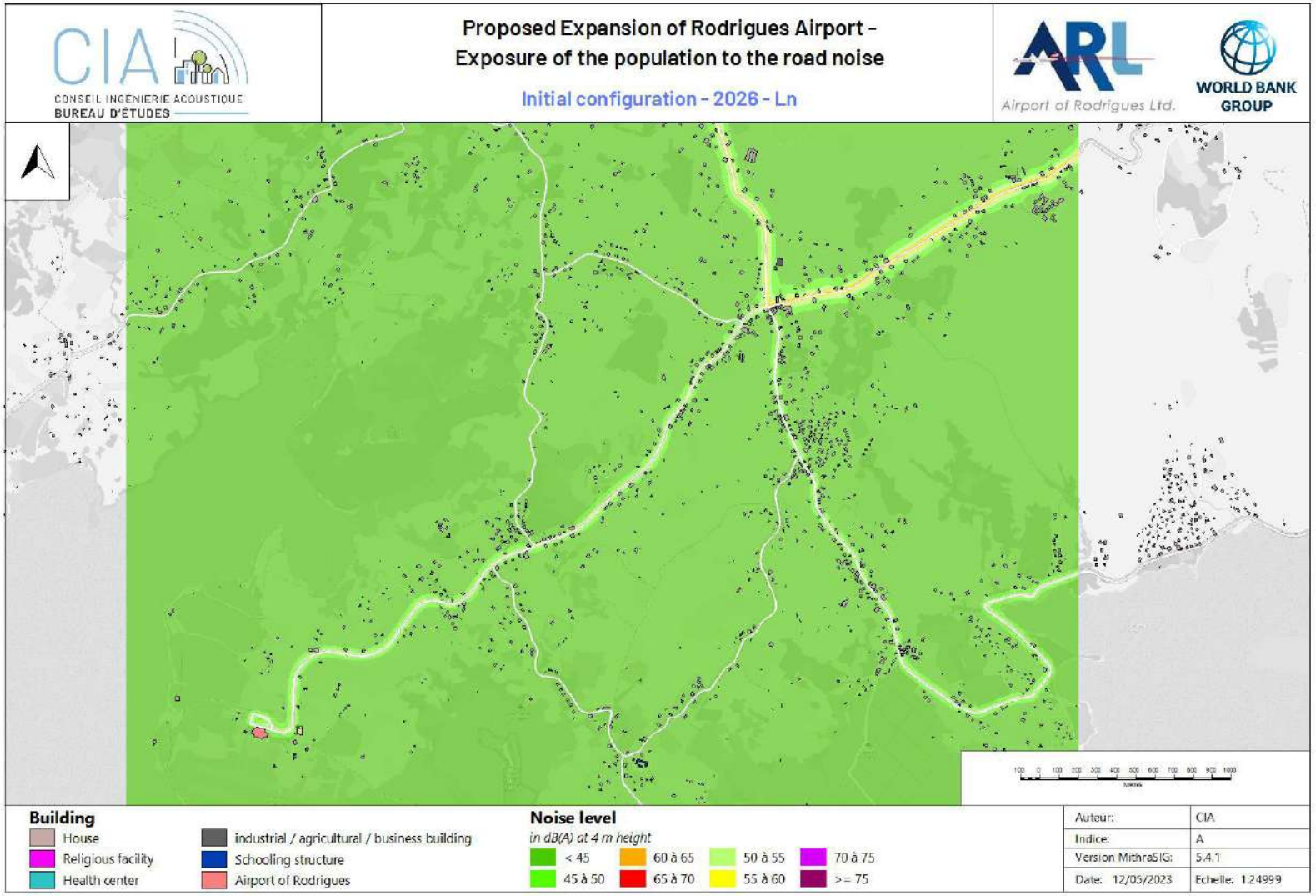
The following calculation parameters were used:

- Calculation method : NMPB 08;
- Meteorological effects: 100% favorable;
- The pavement surface considered is an R2 10-year type pavement (medium asphalt type).
- Traffic and speed:
    - AADT 2026 (traffic study – 5.1.1.3.1 Input data),
    - Speeds were considered to be regulatory (50 km/h).

Results are presented in the form of result maps, which can be broken down as follows:

- Horizontal noise map at 4 meters – Initial configuration - Lden (noise level between 45 to 75 dB(A)),
- Horizontal noise map at 4 meters – Initial configuration - Ln ((noise level between 45 to 75 dB(A)).
- Horizontal noise map at 4 meters – Project configuration - Lden (noise level between 45 to 75 dB(A)),
- Horizontal noise map at 4 meters – Project configuration - Ln ((noise level between 45 to 75 dB(A)).


CIA
CONSEIL INGENIERIE ACOUSTIQUE
BUREAU D'ETUDES
Proposed Expansion of Rodrigues Airport -
Exposure of the population to the road noise
Initial configuration - 2026 - Lden
ARL
Airport of Rodrigues Ltd.
WORLD BANK GROUP
Building
House
Religious facility
Health center
industrial / agricultural / business building
Schooling structure
Airport of Rodrigues
Noise level
in dB(A) at 4 m height
< 45
45 à 50
60 à 65
65 à 70
50 à 55
55 à 60
70 à 75
>= 75
Auteur: CIA
Indice: A
Version MithraSIG: 5.4.1
Date: 12/05/2023
Echelle: 1:24999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Initial configuration - 2026 - Ln
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Schooling structure
Airport of Rodrigues
Noise level
in dB(A) at 4 m height
< 45
45 à 50
60 à 65
65 à 70
50 à 55
55 à 60
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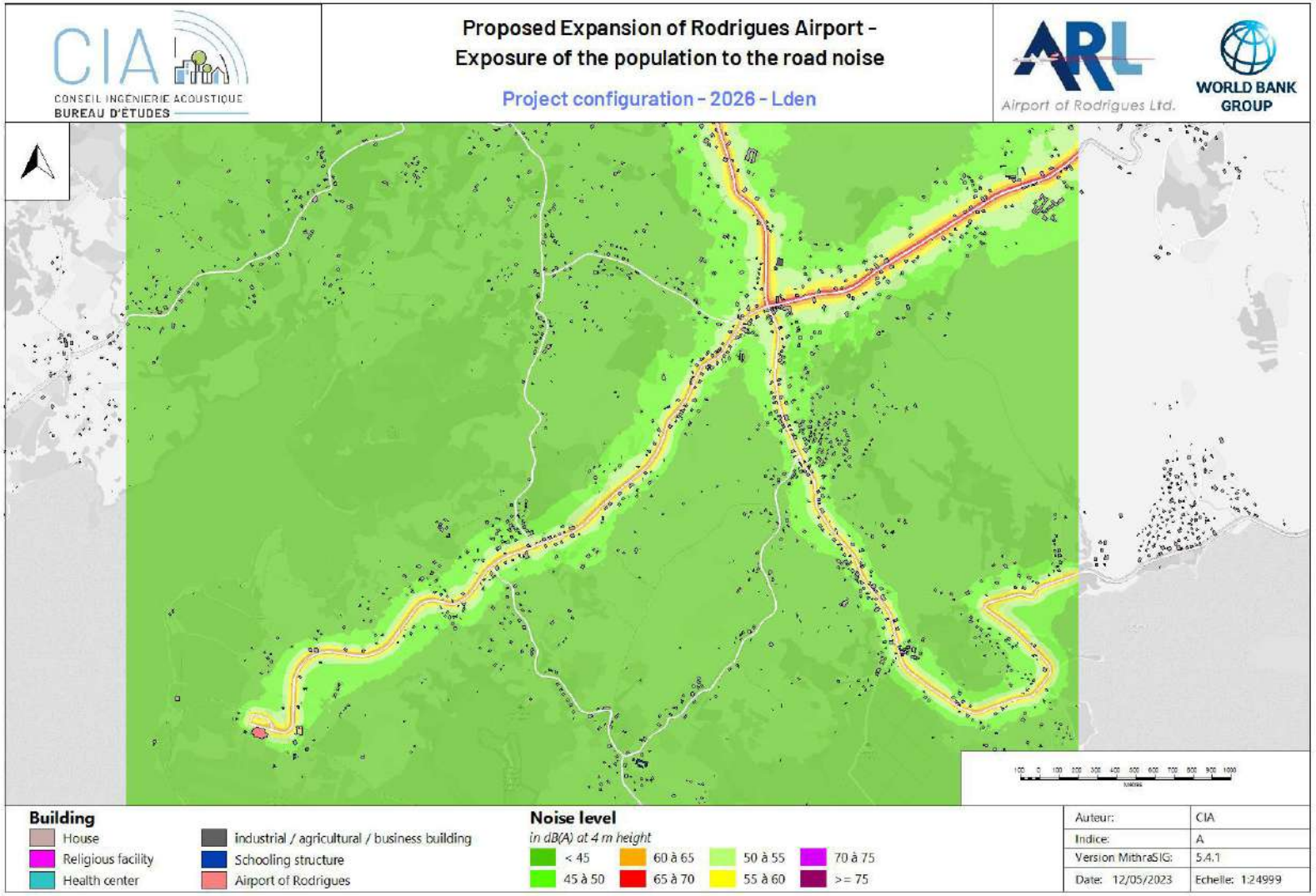
>= 75
Auteur: CIA
Indice: A
Version MithraSIG: 5.4.1
Date: 12/05/2023
Echelle: 1:24999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Noise level
in dB(A) at 4 m height
< 45
45 à 50
60 à 65
65 à 70
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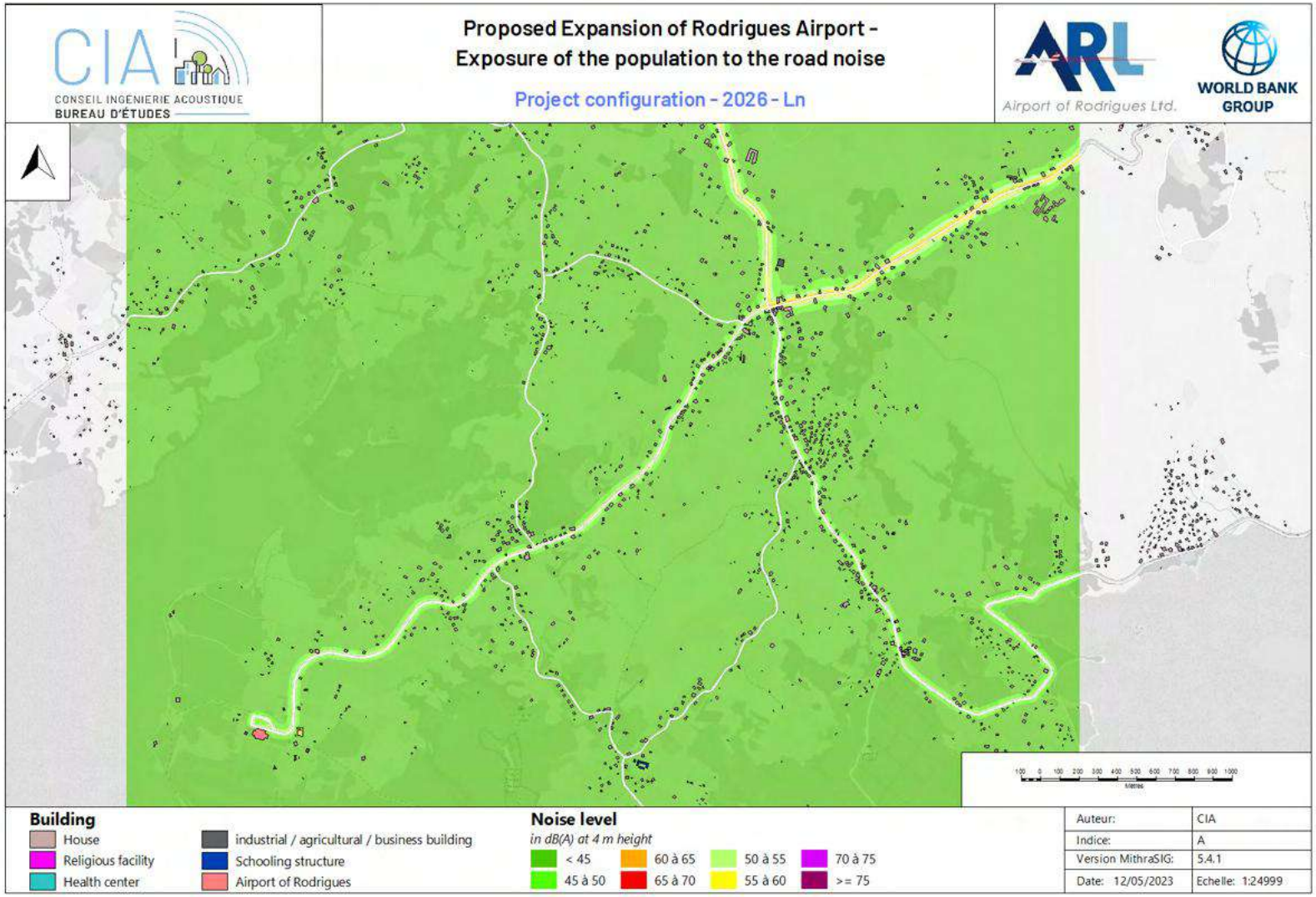
>= 75
Auteur: CIA
Indice: A
Version MithraSIG: 5.4.1
Date: 12/05/2023
Echelle: 1:24999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Proposed Expansion of Rodrigues Airport -
Exposure of the population to the road noise
Project configuration - 2026 - Ln
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Health center
industrial / agricultural / business building
Schooling structure
Airport of Rodrigues
Noise level
in dB(A) at 4 m height
< 45
45 à 50
60 à 65
65 à 70
50 à 55
55 à 60
70 à 75
>= 75
Auteur: CIA
Indice: A
Version MithraSIG: 5.4.1
Date: 12/05/2023
Echelle: 1:24999

Interpretation:

The use of noise maps at a height of 4 m allows us to estimate the noise exposure of the population in the studied area. The methodology used takes into account the exposure of the residents on the most exposed façade at a height of 4 meters. This calculation method leads to an overestimation of the noise exposure of the population. The number of inhabitants is brought back to the habitable surface of this perimeter, thus a number of persons is attributed to each building.

The tables below present a summary of the results for the dwellings exposed in the baseline situation and the situation with the project in 2026.

Table 5-19: Population noise exposure in 2026, without project

Intervals (dB)	Initial configuration - 2026 - existing buildings							
	Lden				Ln			
	Nb of homes		Nb of inhabitants		Nb of homes		Nb of inhabitants	
< 45	1371	66%	2227	43%	1798	87%	3917	75%
[45 - 50[	275	13%	957	18%	183	9%	735	14%
[50 - 55[	175	8%	816	16%	65	3%	338	7%
[55 - 60[	181	9%	761	15%	28	1%	201	4%
[60 - 65[	50	2%	274	5%	0	0%	0	0%
[65 - 70[	22	1%	156	3%	0	0%	0	0%
[70 - 75[	0	0%	0	0%	0	0%	0	0%
> 75	0	0%	0	0%	0	0%	0	0%
> Lden* 53 dB	311	15%	1387	27%				
> Ln* 45 dB					276	13%	1274	25%
Total	2074	100%	5191	100%	2074	100%	5191	100%

** WHO Recommendation*

Table 5-20: Population noise exposure in 2026, with project

Intervals (dB)	Project configuration - 2026 - existing buildings							
	Lden				Ln			
	Nb of homes		Nb of inhabitants		Nb of homes		Nb of inhabitants	
< 45	1371	66%	2227	43%	1797	87%	3910	75%
[45 - 50[	273	13%	953	18%	182	9%	736	14%
[50 - 55[	177	9%	820	16%	67	3%	344	7%
[55 - 60[	181	9%	761	15%	28	1%	201	4%
[60 - 65[	50	2%	274	5%	0	0%	0	0%
[65 - 70[	22	1%	156	3%	0	0%	0	0%
[70 - 75[	0	0%	0	0%	0	0%	0	0%
> 75	0	0%	0	0%	0	0%	0	0%
> Lden* 53 dB	312	15%	1394	27%				
> Ln* 45 dB					277	13%	1280	25%
Total	2074	100%	5191	100%	2074	100%	5191	100%

** WHO Recommendation*

Interpretation:

It is noted that 27% of the population will be exposed to noise levels above the WHO thresholds in both configurations. The project does not cause any additional noise nuisance compared to a baseline situation by 2026

Note: As the secondary roads are not very frequented, only the main road network has been considered, which may lead to a slight underestimation of the population exceeding the WHO thresholds.

5.4.1.2.2.2 Calculation in 2046

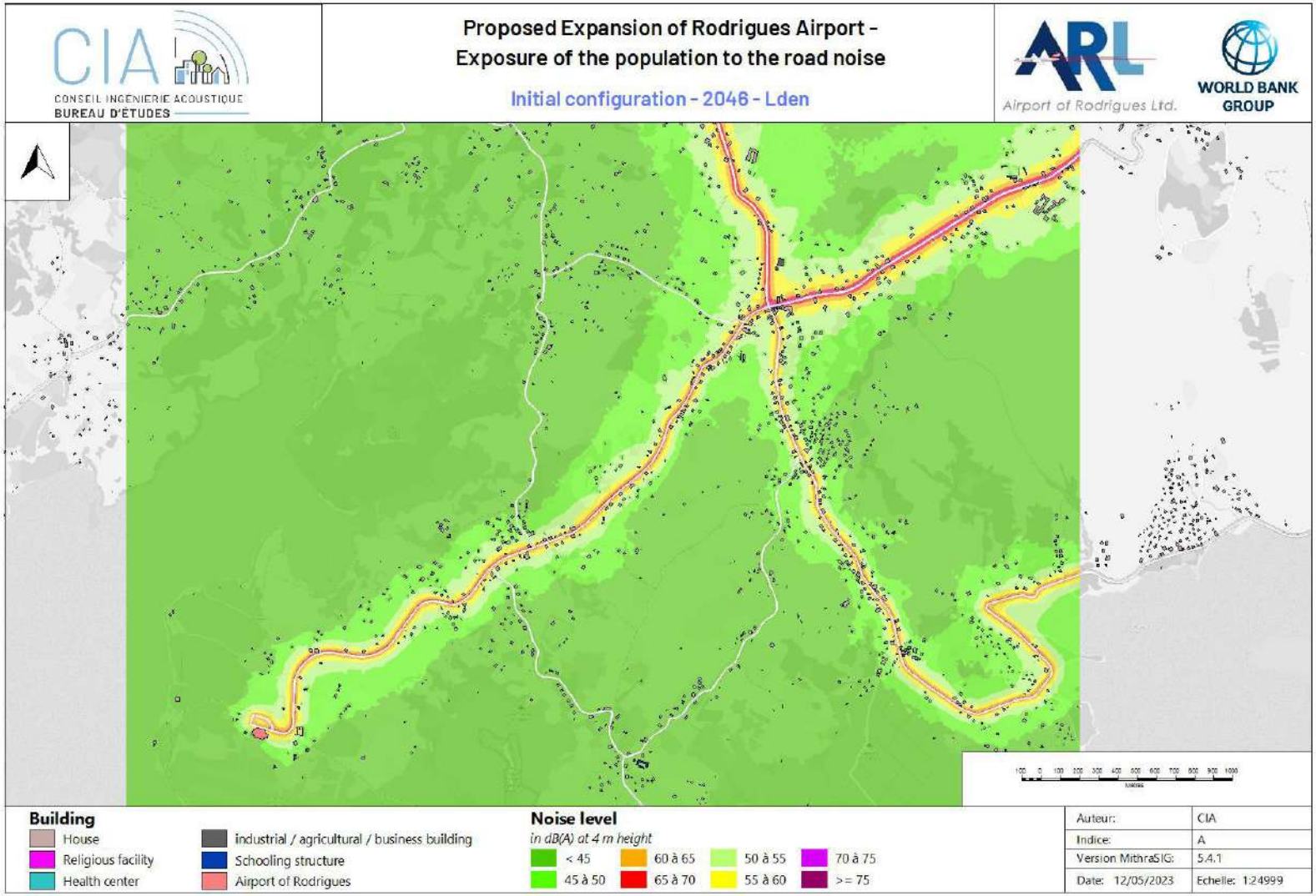
Acoustic calculations were performed on the entire studied area with and without the project to characterize the impact of noise pollution due to existing road traffic on the population, in 2046.

The following calculation parameters were used:

- Calculation method : NMPB 08;
- Meteorological effects: 100% favorable;
- The pavement surface considered is an R2 10-year type pavement (medium asphalt type).
- Traffic and speed:
    - AADT 2046 (traffic study – 5.1.1.3.1 Input data),
    - Speeds were considered to be regulatory (50 km/h).

Results are presented in the form of result maps, which can be broken down as follows:

- Horizontal noise map at 4 meters – Initial configuration - Lden (noise level between 45 to 75 dB(A)),
- Horizontal noise map at 4 meters – Initial configuration - Ln ((noise level between 45 to 75 dB(A)).
- Horizontal noise map at 4 meters – Project configuration - Lden (noise level between 45 to 75 dB(A)),
- Horizontal noise map at 4 meters – Project configuration - Ln ((noise level between 45 to 75 dB(A)).


CIA
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Airport of Rodrigues
Noise level
in dB(A) at 4 m height
< 45
45 à 50
60 à 65
65 à 70
50 à 55
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70 à 75
>= 75
Auteur: CIA
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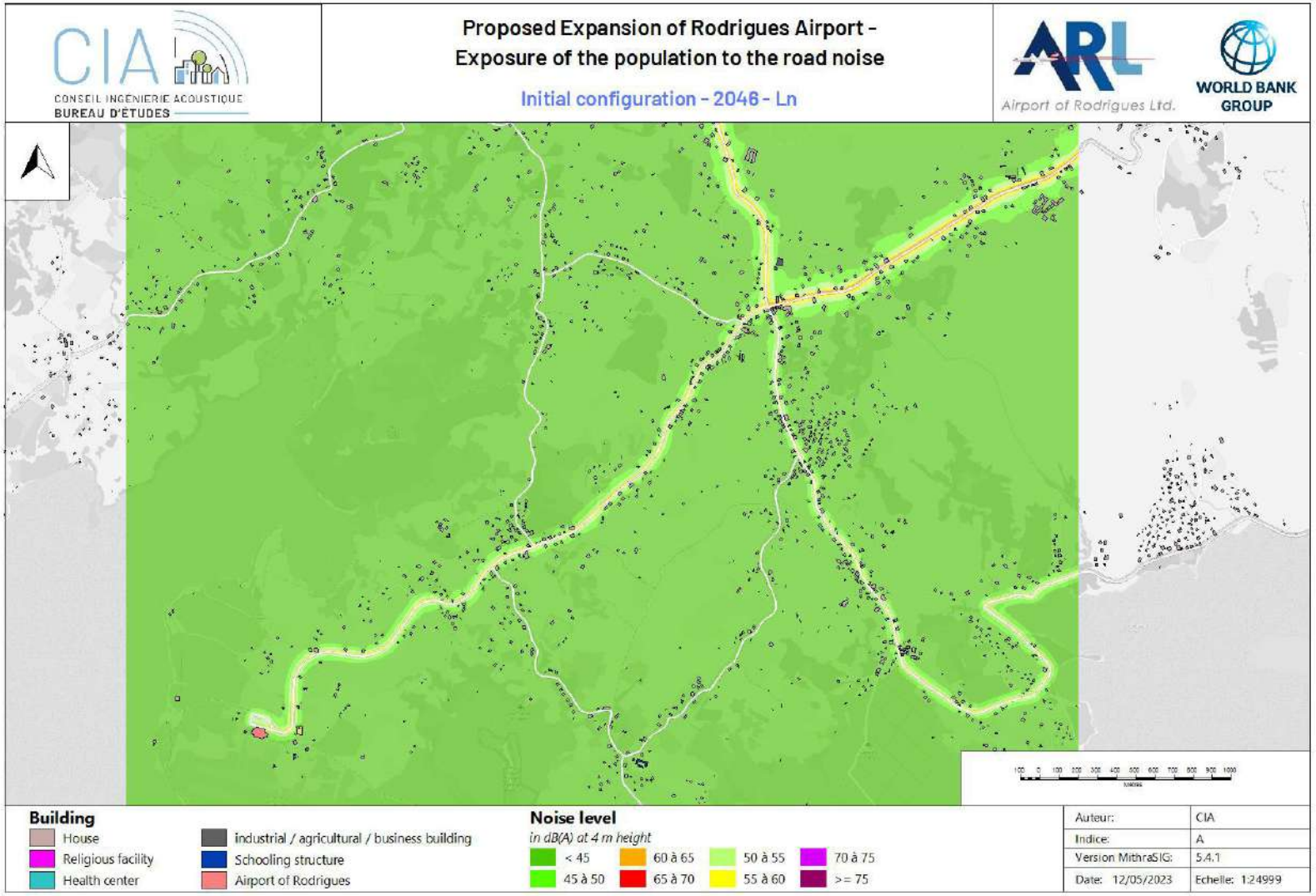
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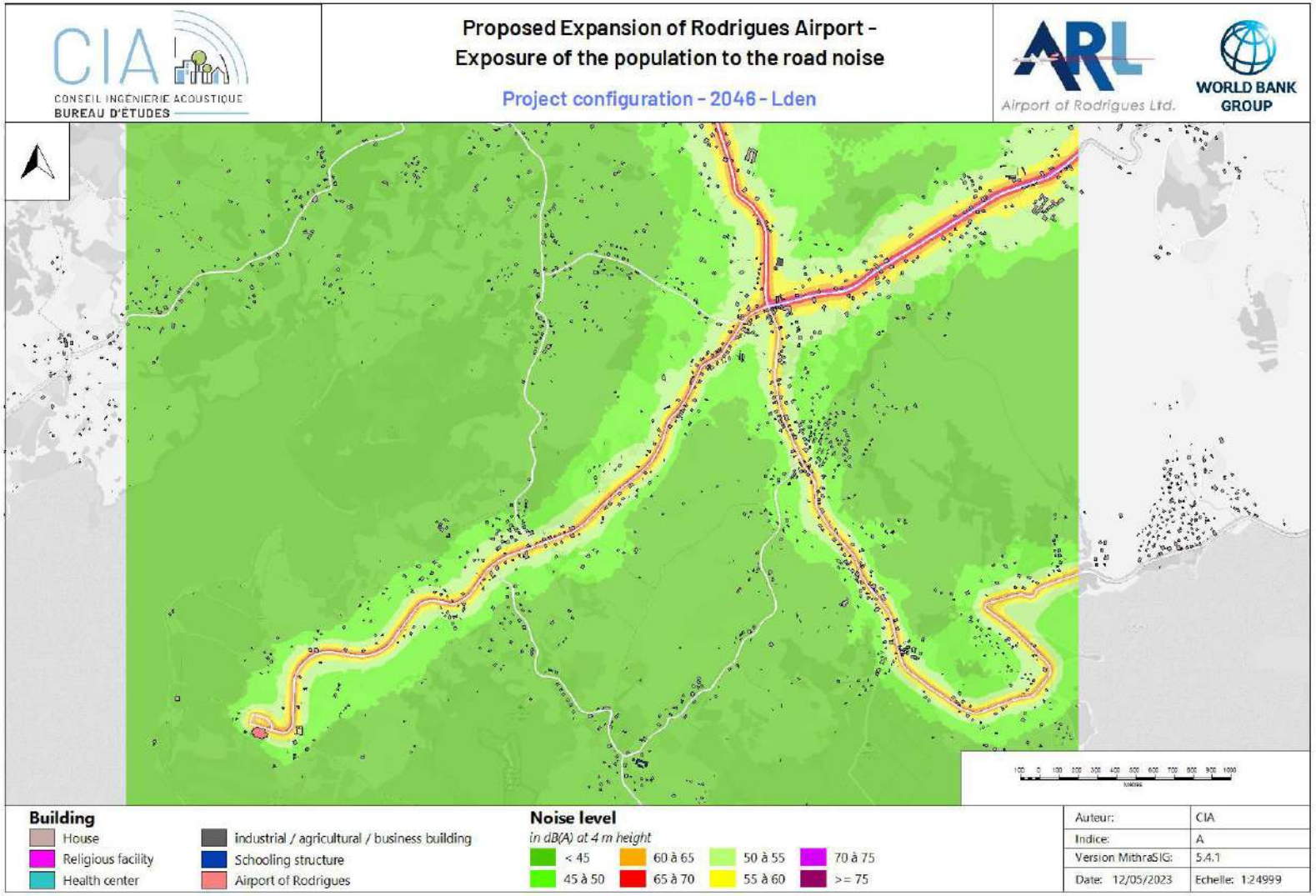
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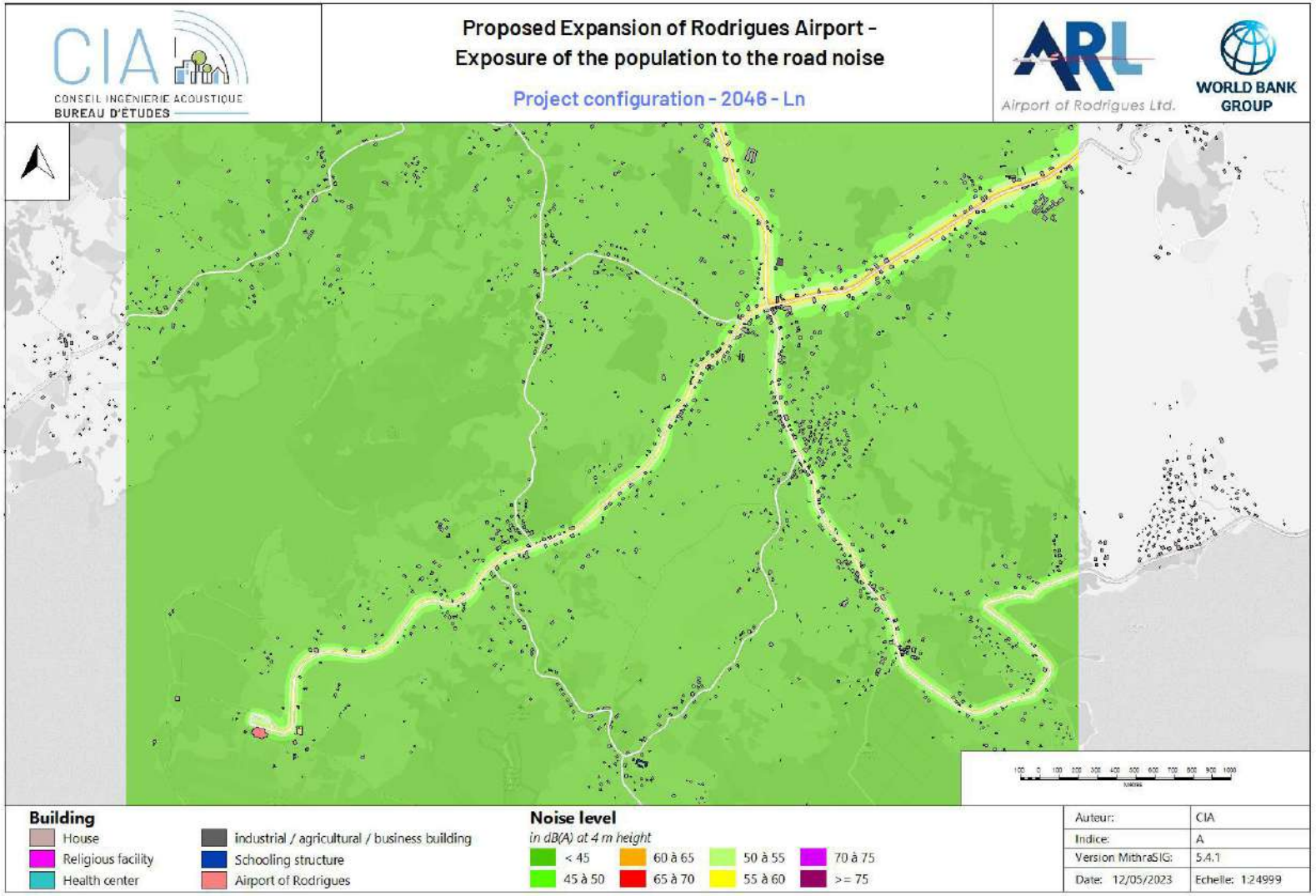
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Noise level
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45 à 50
60 à 65
65 à 70
50 à 55
55 à 60
70 à 75
>= 75
Auteur: CIA
Indice: A
Version MithraSIG: 5.4.1
Date: 12/05/2023
Echelle: 1:24999

Interpretation:

The use of noise maps at a height of 4 m allows us to estimate the noise exposure of the population in the studied area. The methodology used takes into account the exposure of the residents on the most exposed façade at a height of 4 meters. This calculation method leads to an overestimation of the noise exposure of the population. The number of inhabitants is brought back to the habitable surface of this perimeter, thus a number of persons is attributed to each building.

The tables below present a summary of the results for the dwellings exposed in the baseline situation and the situation with the project in 2046.

Table 5-21: Population noise exposure in 2046, without project

Intervals (dB)	Initial configuration - 2046 - existing buildings							
	Lden				Ln			
	Nb of homes		Nb of inhabitants		Nb of homes		Nb of inhabitants	
< 45	1180	57%	2765	33%	1724	83%	5972	70%
[45 - 50[	346	17%	1655	19%	161	8%	1004	12%
[50 - 55[	223	11%	1717	20%	136	7%	946	11%
[55 - 60[	170	8%	1044	12%	42	2%	450	5%
[60 - 65[	114	5%	895	11%	11	1%	135	2%
[65 - 70[	35	2%	353	4%	0	0%	0	0%
[70 - 75[	6	0%	78	1%	0	0%	0	0%
> 75	0	0%	0	0%	0	0%	0	0%
> Lden* 53 dB	403	19%	2925	34%				
> Ln* 45 dB					350	17%	2535	30%
Total	2074	100%	8507	100%	2074	100%	8507	100%

** WHO Recommendation*

Table 5-22: Population noise exposure in 2046, with project

Intervals (dB)	Project configuration - 2046 - existing buildings							
	Lden				Ln			
	Nb of homes		Nb of inhabitants		Nb of homes		Nb of inhabitants	
< 45	1177	57%	2753	32%	1724	83%	5972	70%
[45 - 50[	348	17%	1662	20%	160	8%	1000	12%
[50 - 55[	224	11%	1722	20%	137	7%	949	11%
[55 - 60[	170	8%	1045	12%	42	2%	451	5%
[60 - 65[	113	5%	890	10%	11	1%	135	2%
[65 - 70[	36	2%	357	4%	0	0%	0	0%
[70 - 75[	6	0%	78	1%	0	0%	0	0%
> 75	0	0%	0	0%	0	0%	0	0%
> Lden* 53 dB	405	20%	2936	35%				
> Ln* 45 dB					350	17%	2535	30%
Total	2074	100%	8507	100%	2074	100%	8507	100%

** WHO Recommendation*

Interpretation:

It is noted that 35% of the population will be exposed to noise levels above the WHO thresholds in both configurations. The project does not cause any additional noise nuisance compared to a baseline situation by 2046

Note: As the secondary roads are not very frequented, only the main road network has been considered, which may lead to a slight underestimation of the population exceeding the WHO thresholds.

5.4.1.2.3 Conclusion on the impact of the project on local residents

The project will have no impact on residents in terms of road noise emissions compared to a baseline situation. This is due to a very small increase in traffic (less than 50 vehicles/day) in 2026 and 2046. The increase in noise pollution on the population compared to the current situation is therefore explained by the increase in the number of vehicles in the future situation, and not because of the project, as shown in the histograms below:

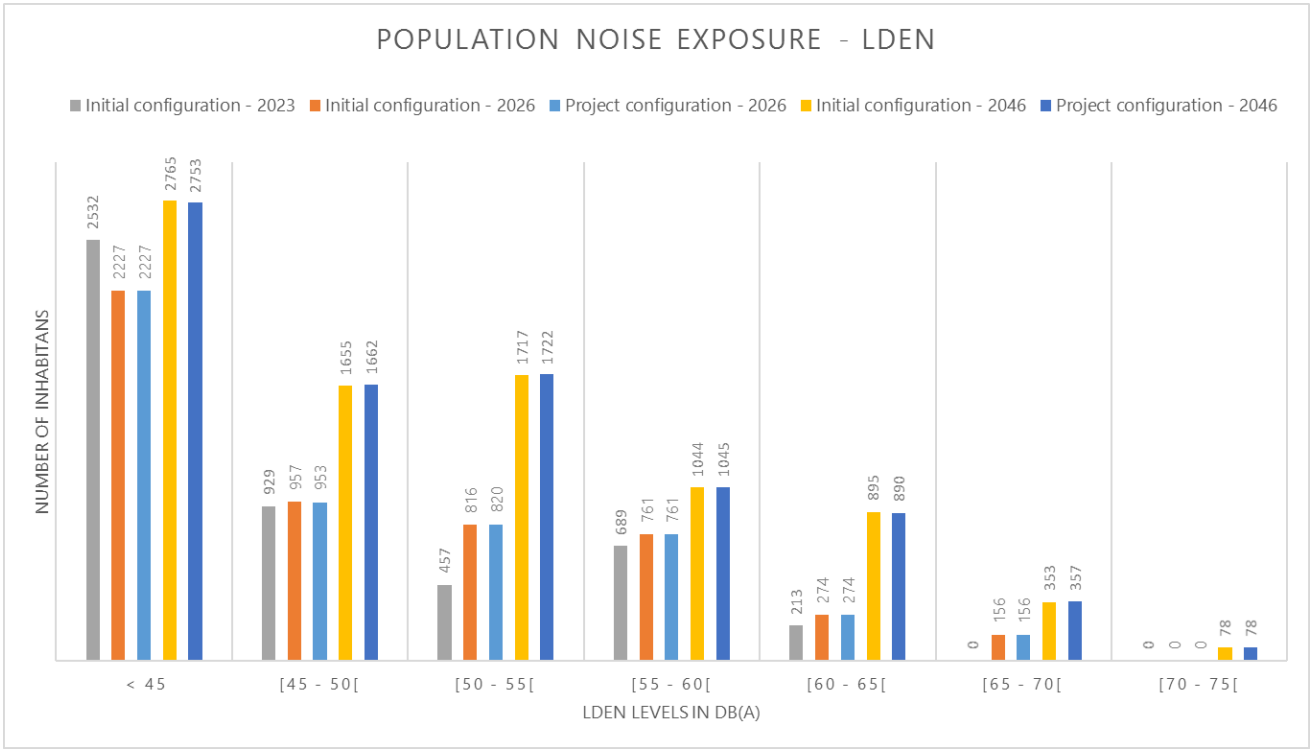


Figure 81: Population exposure to road noise - Lden

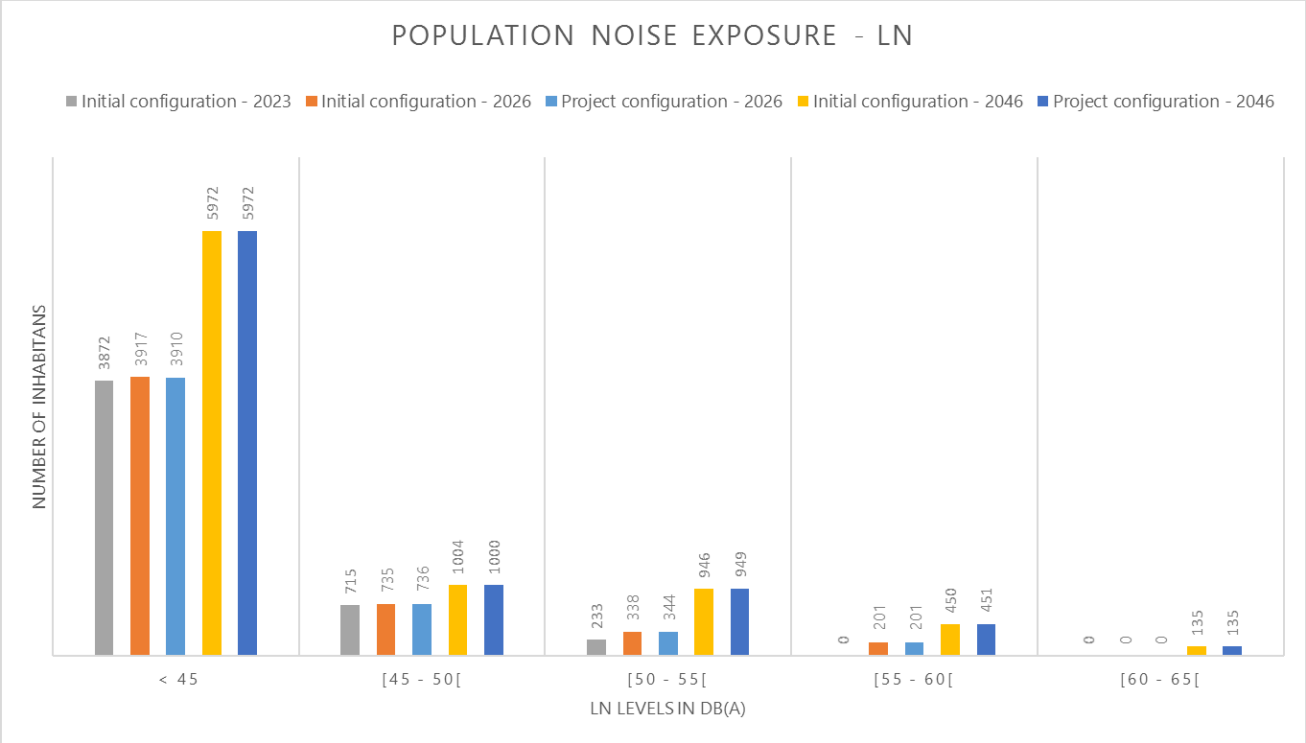


Figure 82: Population exposure to road noise - Ln

6 Mitigation Measures

6.1.1 Air quality and noise

6.1.1.1 aircraft study

The air traffic noise and pollutant emissions mainly depend on the aircraft type, the number of operation (arrival and departure) and the meteorological conditions.

It is however possible to implement certain measures to limit the population's exposure:

- Noise and pollutants exposure : Adjust approaches and departures path to avoid inhabited areas ;
- Noise exposure : Maximize operations in daily period (6h-18h) and restrict operations in night period (22h-6h) ;
- Noise exposure: It may be possible to acoustically isolate the most exposed buildings, and limit or forbid constructions in most exposed zones;
- Pollutants exposure: Replace the use of Auxiliary Power Unit during stopover of the aircraft with alternative means.

6.1.1.2 Air quality

The impact of the project being negligible, no mitigation measures are required.

Herefore, measurements could be carried out during the construction phase and at commissioning to verify compliance with air quality standards.

6.1.1.3 Noise

The impact of the project being negligible, no mitigation measures are required.

Herefore, measurements could be carried out during the construction phase and at commissioning to verify compliance with acoustic standards.

7 Conclusion: Impact of the project

7.1 Air quality

7.1.1 Road traffic: emissions of pollutants and modeled atmospheric concentrations

The concentrations modeled in the area of 500 meters around the roads are superior to the WHO Annual Air Quality Guidelines for the particles: Indeed, the background concentrations included in the calculation are already superior to those guidelines.

For the nitrogen dioxide, the WHO Annual Air Quality Guideline is respected in all the area.

The concentrations modeled are close to the background concentration included in the calculations (low standard deviation).

The impact of the project is not significant because the traffic on the roads is not changing that much.

The Indicator Pollution Population (IPP) is calculated by multiplying the number of inhabitants of each zone by the mean concentration of nitrogen dioxide of the zone. The higher IPP is located in the zone 5: it's the zone with the higher number of inhabitants. The zone 11 where the airport is located, has a low IPP compared to the zones 5, 8, 9 and 12.

The impact of the project for the inhabitants is not significant. There won't be any change for their health due to the expansion of Rodrigues Airport, as the traffic on the road is not increasing that much.

7.1.2 Air traffic

The project allows the establishment of higher capacity aircraft but the number of visitors remains the same. Thus, for most pollutants, there is a reduction in emissions. However, there is a significant increase in NOx emissions.

It should be noted that A321 NEO and B737-900Max are aircraft with lower fuel consumption compared to aircraft of the same type. As a result, their polluting emissions are reduced.

7.2 Noise

7.2.1 Road noise

The project will have no impact on residents in terms of road noise emissions compared to a baseline situation. This is due to a very small increase in traffic (less than 50 vehicles/day) in 2026 and 2046. The increase in noise pollution on the population compared to the current situation is therefore explained by the increase in the number of vehicles in the future situation, and not because of the project.

7.2.2 Air traffic

The A321 NEOs and B737-900Ms capacities are more than two times superior to ATR72 aircraft, therefore the project configuration enables the air traffic to be reduced. However the turbojet engine increase the noise emission. It should be noted that the new runway's angle impacts the approaches and departures paths, which enable a significant reduction of the noise level population's exposure.

In summary, with the project configuration, higher but less frequent noise levels are estimated Moreover, the population's exposure is reduced because of new runway's angle.

The sensitive building pre-primary school Le Caneton is less exposed to aircraft noise in this configuration with LAmax < 65 dB(A).

8 Annexes

8.1 Annex: Results of the measurements

8.1.1 air pollutants

TERA environnement

RAPPORT D'ESSAIS

Accréditation 1-5598, portée disponible sur cofrac.fr

cofrac ESSAIS

Affaire N° 23AF11520 Commande N° BPA 23DE33605_V2

Présentation générale

Affaire N°	23AF11520	**Version du rapport :**	0
Client :	CONSEIL INGENIERIE AIR CIA	**Référence client :**	
Adresse :	263 Av. St Antoine, 13015 Marseille		
Commande client :	BPA 23DE33605_V2	**Devis client :**	23DE33605_V2
Date de fin des prélèvements :	16/03/2023		
Date de réception des échantillons :	24/03/2023 12:26:00	**Rapport transmis le :**	06/04/2023
Réserves éventuelles :			

Les résultats ne se rapportent qu'aux objets soumis à l'essai. TERA Environnement n'est pas responsable des informations transmises par le client et se dégage de toute responsabilité relative aux durées, températures, volumes de prélèvement ou emplacements notamment. Les concentrations calculées ne sont donc jamais portées par l'accréditation et sont sujettes à caution. Pour les prélèvements passifs, si la température d'exposition n'est pas renseignée, elle sera considérée à 20°C par défaut. Les résultats s'appliquent aux échantillons tels qu'ils ont été reçus.
Les milieux sont spécifiés ainsi : AIA=Air ambiant / ALT=Air des Lieux de Travail / AGA=Gaz des sols -Emission-Air des lieux de travail / AEX=Air à l'émission / GDS=Gaz contenus dans les sols / Eau=Eaux / QAI = Qualité de l'air intérieur / HTS= Hautes technologies - Santé / LAR=LABREF3O-ERP / DIV=Divers / SUR=Conta de surface / ADBLUE / CAP=Location de capteurs
Dans la suite du rapport, seuls les paramètres notés avec un (c) sont couverts par l'accréditation cofrac essais .

Présentation des échantillons - Nombre total d'échantillons : 15

Paramètres à analyser	Milieu	Références échantillons	Emplacement client	Température d'exposition	Exposition(min)
Indice COVs comme défini dans le guide HQE	AIA	RAD 145 - B613W	3	20°C	1470
Indice COVs comme défini dans le guide HQE	AIA	RAD 145 - B604W	4	20°C	1400
Indice COVs comme défini dans le guide HQE	AIA	RAD 145 - B607W	2	20°C	1680
Indice COVs comme défini dans le guide HQE	AIA	RAD 145 - B610W	1	20°C	1590
Indice COVs comme défini dans le guide HQE	AIA	RAD 145 - BLANC 438	BLANC	20°C	
NO2 et SO2 sur support passif	AIA	RAD 166 - B614W	3	20°C	1470
NO2 et SO2 sur support passif	AIA	RAD 166 - B606W	4	20°C	1400
NO2 et SO2 sur support passif	AIA	RAD 166 - B608W	2	20°C	1680
NO2 et SO2 sur support passif	AIA	RAD 166 - B612W	1	20°C	1590
NO2 et SO2 sur support passif	AIA	RAD 166 - BLANC	BLANC	20°C	
Ozone (O3)	AIA	RAD 172 - B615W	3	20°C	1470
Ozone (O3)	AIA	RAD 172 - B605W	4	20°C	1400
Ozone (O3)	AIA	RAD 172 - B609W	2	20°C	1680
Ozone (O3)	AIA	RAD 172 - B611W	1	20°C	1590
Ozone (O3)	AIA	RAD 172 - BLANC	BLANC	20°C	

TERA environnement

RAPPORT D'ESSAIS

Accréditation 1-5598, portée disponible sur cofrac.fr

cofrac ESSAIS

Affaire N° 23AF11520 Commande N° BPA 23DE33605_V2

Rad code 166 pour NO2/SO2/HF ***Numéro de lot : 22309I09*** ***Lieu de réalisation des essais : Crolles*** ***Date d'essais : 27/03/2023***

Résultat en µg

Composés	No CAS	rad 166 - B614W	rad 166 - B606W	rad 166 - B608W	rad 166 - B612W	rad 166 - blanc
Dioxyde d'azote (NO2)(c)	10102-44-0	<1.0	<1.0	<1.0	<1.0	<1.0
Dioxyde de Soufre (SO2)	7446-09-5	<0.30	1.7	<0.30	<0.30	<0.30

Les incertitudes sont présentées en annexe de ce rapport.

Rad code 166 pour NO2/SO2/HF

Résultat en µg/m³

Composés	No CAS	rad 166 - B614W	rad 166 - B606W	rad 166 - B608W	rad 166 - B612W	rad 166 - blanc
Dioxyde d'azote (NO2)	10102-44-0	<10.2	<10.7	<8.9	<9.4	-
Dioxyde de Soufre (SO2)	7446-09-5	<1.1	7.00	<1.0	<1.1	-

Rad code 172 pour Ozone ***Numéro de lot : 23010A12*** ***Lieu de réalisation des essais : Crolles*** ***Date d'essais : 27/03/2023***

Résultat en µg

Composés	No CAS	rad 172 - B615W	rad 172 - B605W	rad 172 - B609W	rad 172 - B611W	rad 172 - blanc
Ozone (O3)	10028-15-6	<0.50	<0.50	<0.50	<0.50	<0.50

Les incertitudes sont présentées en annexe de ce rapport.

Rad code 172 pour Ozone

Résultat en µg/m³

Composés	No CAS	rad 172 - B615W	rad 172 - B605W	rad 172 - B609W	rad 172 - B611W	rad 172 - blanc
Ozone (O3)	10028-15-6	<13.8	<14.5	<12.1	<12.8	-

Rad code 145 pour COVs **Numéro de lot : -** **Lieu de réalisation des essais : Crolles** **Date d'essais : 28/03/2023**

Masses en ng / support

Composés	N°CAS	RAD145 B613W	RAD145 438 BLC	RAD145 B604W	RAD145 B607W	RAD145 B610W
Indice COV	-	3391	176	3323	3922	2871

Rad code 145 pour COVs

Résultats en µg/m3

Composés	N°CAS	RAD145 B613W	RAD145 438 BLC	RAD145 B604W	RAD145 B607W	RAD145 B610W
Indice COV	-	78.8	-	81.1	79.8	61.7

TERA environnement

RAPPORT D'ESSAIS

Accréditation 1-5598, portée disponible sur cofrac.fr

cofrac ESSAIS

Affaire N° 23AF11520 Commande N° BPA 23DE33605_V2

Annexe

Composés	Supports	Norme	Technique analytique	Incertitude basse %	Incertitude haute %	LQ	Unité
Indice COVs comme défini dans le guide HQE	Rad code 145 COVs basse LQ	NF EN ISO 16017-2	ATDGCMS C	30	30	5	ng
Dioxyde d'azote (NO2)	Rad code 166 pour NO2/SO2/HF	NF EN 16339	CICD	30	19	1	µg
Dioxyde de Soufre (SO2)	Rad code 166 pour NO2/SO2/HF	Méthode interne MO.LAB.842	CICD	20	20	0,3	µg
Ozone (O3)	Rad code 172 pour Ozone	Méthode interne MO.LAB.707	SPECTRO	25	25	0,5	µg

	Approbation	
Nom(s)	Fiona PELLETIER	Aurélie GAILLA
Visa(s)		

FIN DU RAPPORT

8.1.2 Acoustics data processing

Global measured noise level – pf1

Fichier	PF1	
Lieu	*** ***	
Type de données	Leq	
Pondération	A	
Unité	dB	
Début	15/03/2023 14:00:00	
Fin	16/03/2023 14:00:00	
Période	Rodrigues Jour	
Tranches horaires	Rodrigues Jour 07:00 18:00 K = 0 dBA	
Source	Ld dB	L50 dB
Résiduel	55,2	42,6
Période	Rodrigues soirée	
Tranches horaires	Rodrigues soirée 18:00 21:00 K = 0 dBA	
Source	Soir dB	L50 dB
Résiduel	51,8	43,1
Période	Rodrigues Nuit	
Tranches horaires	Rodrigues Nuit 21:00 07:00 K = 0 dBA	
Source	Ln dB	L50 dB
Résiduel	50,6	45,9

Global measured noise level – pf2

Fichier	PF2	
Lieu	*** ***	
Type de données	Leq	
Pondération	A	
Unité	dB	
Début	15/03/2023 15:00:00	
Fin	16/03/2023 15:00:00	
Période	Rodrigues Jour	
Tranches horaires	Rodrigues Jour 07:00 18:00 K = 0 dBA	
Source	Ld dB	L50 dB
Résiduel	56,2	48,7
Période	Rodrigues soirée	
Tranches horaires	Rodrigues soirée 18:00 21:00 K = 0 dBA	
Source	Soir dB	L50 dB
Résiduel	51,7	44,3
Période	Rodrigues Nuit	
Tranches horaires	Rodrigues Nuit 21:00 07:00 K = 0 dBA	
Source	Ln dB	L50 dB
Résiduel	49,0	43,0

Global measured noise level – pf3

Fichier	PF3	
Lieu	*** ***	
Type de données	Leq	
Pondération	A	
Unité	dB	
Début	14/03/2023 11:00:00	
Fin	15/03/2023 11:00:00	
Période	Rodrigues Jour (Ld)	
Tranches horaires	Rodrigues Jour 07:00 18:00 K = 0 dBA	
	Ld dB	L50 dB
Niveau	55,8	51,3
Période	Rodrigues soirée (Soir)	
Tranches horaires	Rodrigues soirée 18:00 21:00 K = 0 dBA	
	Soir dB	L50 dB
Niveau	50,6	46,3
Période	Rodrigues Nuit (Ln)	
Tranches horaires	Rodrigues Nuit 21:00 07:00 K = 0 dBA	
	Ln dB	L50 dB
Niveau	48,1	42,6

Global measured noise level – pf4

Fichier	PF4	
Lieu	*** ***	
Type de données	Leq	
Pondération	A	
Unité	dB	
Début	14/03/2023 12:00:00	
Fin	15/03/2023 11:55:00	
Période	Rodrigues Jour (Ld)	
Tranches horaires	Rodrigues Jour 07:00 18:00 K = 0 dBA	
	Ld dB	L50 dB
Niveau	63,8	54,5
Période	Rodrigues soirée (Soir)	
Tranches horaires	Rodrigues soirée 18:00 21:00 K = 0 dBA	
	Soir dB	L50 dB
Niveau	58,4	52,8
Période	Rodrigues Nuit (Ln)	
Tranches horaires	Rodrigues Nuit 21:00 07:00 K = 0 dBA	
	Ln dB	L50 dB
Niveau	56,1	49,3

Measured flight-over contribution – pf1

Fichier	PF1			
Lieu	*** ***			
Type de données	Leq			
Pondération	A			
Unité	dB			
Début	15/03/2023 14:00:00			
Fin	16/03/2023 14:00:00			
Période	Rodrigues Jour			
Tranches horaires	Rodrigues Jour 07:00 18:00 K = 0 dBA			
Source	Ld dB	Leq (partiel) dB	Nb	L50 dB
Avion	55,7	30,1	3	53,5
Période	Rodrigues soirée			
Tranches horaires	Rodrigues soirée 18:00 21:00 K = 0 dBA			
Source	Soir dB	Leq (partiel) dB	Nb	L50 dB
Avion			0	
Période	Rodrigues Nuit			
Tranches horaires	Rodrigues Nuit 21:00 07:00 K = 0 dBA			
Source	Ln dB	Leq (partiel) dB	Nb	L50 dB
Avion			0	

Measured flight-over contribution – pf3

Fichier	PF3			
Lieu	*** ***			
Type de données	Leq			
Pondération	A			
Unité	dB			
Début	14/03/2023 11:00:00			
Fin	15/03/2023 11:00:00			
Période	Rodrigues Jour			
Tranches horaires	Rodrigues Jour 07:00 18:00 K = 0 dBA			
Source	Ld dB	Leq (partiel) dB	Nb	L50 dB
Avion	67,8	44,7	4	58,6
Période	Rodrigues soirée			
Tranches horaires	Rodrigues soirée 18:00 21:00 K = 0 dBA			
Source	Soir dB	Leq (partiel) dB	Nb	L50 dB
Avion			0	
Période	Rodrigues Nuit			
Tranches horaires	Rodrigues Nuit 21:00 07:00 K = 0 dBA			
Source	Ln dB	Leq (partiel) dB	Nb	L50 dB
Avion	64,2	35,8	1	55,2

Measured flight-over contribution – pf4

Fichier	PF4			
Lieu	*** ***			
Type de données	Leq			
Pondération	A			
Unité	dB			
Début	14/03/2023 12:00:00			
Fin	15/03/2023 11:55:00			
Période	Rodrigues Jour			
Tranches horaires	Rodrigues Jour 07:00 18:00 K = 0 dBA			
Source	Ld dB	Leq (partiel) dB	Nb	L50 dB
Avion	67,2	43,4	4	60,3
Période	Rodrigues soirée			
Tranches horaires	Rodrigues soirée 18:00 21:00 K = 0 dBA			
Source	Soir dB	Leq (partiel) dB	Nb	L50 dB
Avion			0	
Période	Rodrigues Nuit			
Tranches horaires	Rodrigues Nuit 21:00 07:00 K = 0 dBA			
Source	Ln dB	Leq (partiel) dB	Nb	L50 dB
Avion	66,8	37,6	1	59,4

Fichier	PF1					
Périodes	1h					
Début	15/03/2023 14:00:00					
Fin	16/03/2023 14:00:00					
Lieu	*** ***					
Pondération	A					
Type de données	Leq					
Unité	dB					
Début période	Leq	L90	L50	L10	L5	L1
15/03/2023 14:00:00	48,6	39,7	42,7	47,4	49,7	57,7
15/03/2023 15:00:00	59,6	41,2	51,9	64,3	65,9	68,3
15/03/2023 16:00:00	59,9	42,8	54,3	63,9	65,7	68,8
15/03/2023 17:00:00	48,6	38,8	42,5	49,3	52,1	60,8
15/03/2023 18:00:00	51,8	36,0	43,2	53,9	56,7	62,8
15/03/2023 19:00:00	49,3	36,5	40,8	44,0	44,9	50,9
15/03/2023 20:00:00	53,4	40,6	44,6	46,5	47,0	68,3
15/03/2023 21:00:00	45,1	40,2	45,0	46,9	48,8	50,0
15/03/2023 22:00:00	45,5	41,2	45,1	47,2	47,8	50,2
15/03/2023 23:00:00	46,4	42,1	46,7	47,9	48,2	48,7
16/03/2023 00:00:00	51,6	45,4	46,4	51,2	51,5	53,4
16/03/2023 01:00:00	49,7	48,9	49,6	50,2	50,5	51,0
16/03/2023 02:00:00	50,0	48,7	50,1	50,6	50,8	51,2
16/03/2023 03:00:00	44,6	36,9	45,1	45,8	46,0	46,8
16/03/2023 04:00:00	42,5	40,3	42,3	43,6	44,5	46,5
16/03/2023 05:00:00	52,1	40,4	46,0	52,8	56,0	62,2
16/03/2023 06:00:00	57,0	38,9	44,5	59,9	62,9	67,2
16/03/2023 07:00:00	52,0	37,7	41,1	47,0	50,1	62,3
16/03/2023 08:00:00	53,4	37,9	42,0	57,7	60,1	62,5
16/03/2023 09:00:00	56,1	39,4	49,2	59,2	61,3	65,4
16/03/2023 10:00:00	49,1	37,7	42,1	50,5	53,1	58,2
16/03/2023 11:00:00	58,1	38,2	42,2	49,8	57,6	69,1
16/03/2023 12:00:00	43,9	35,2	39,5	45,2	48,9	55,1
16/03/2023 13:00:00	49,9	35,9	39,4	44,9	49,2	62,4
Période totale	53,4	38,4	44,4	52,6	58,4	65,2

Fichier	PF2					
Périodes	1h					
Début	15/03/2023 15:00:00					
Fin	16/03/2023 15:00:00					
Lieu	*** ***					
Pondération	A					
Type de données	Leq					
Unité	dB					
Début période	Leq	L90	L50	L10	L5	L1
15/03/2023 15:00:00	79,4	46,5	54,7	65,6	70,0	94,6
15/03/2023 16:00:00	63,1	43,2	50,7	61,6	64,9	75,8
15/03/2023 17:00:00	56,3	42,2	48,1	58,3	61,4	69,1
15/03/2023 18:00:00	52,6	37,7	47,0	56,4	58,3	62,6
15/03/2023 19:00:00	52,7	37,3	48,6	56,4	57,9	60,6
15/03/2023 20:00:00	48,6	33,9	38,7	52,7	55,6	60,1
15/03/2023 21:00:00	47,9	31,1	42,9	51,1	52,8	59,0
15/03/2023 22:00:00	45,5	42,0	42,8	45,1	49,0	56,6
15/03/2023 23:00:00	47,2	42,0	42,7	46,4	51,1	59,5
16/03/2023 00:00:00	47,4	34,5	44,8	47,3	51,0	57,3
16/03/2023 01:00:00	43,9	41,4	42,6	43,2	43,9	53,4
16/03/2023 02:00:00	45,9	42,4	42,9	46,4	49,8	56,8
16/03/2023 03:00:00	43,9	41,8	42,8	44,1	45,3	53,0
16/03/2023 04:00:00	46,1	42,9	43,6	46,7	51,9	56,0
16/03/2023 05:00:00	51,7	35,2	45,7	56,0	57,5	61,3
16/03/2023 06:00:00	55,4	42,2	48,7	57,4	60,4	67,5
16/03/2023 07:00:00	56,4	43,0	49,6	59,2	62,2	67,4
16/03/2023 08:00:00	54,4	42,2	49,1	57,7	60,2	64,8
16/03/2023 09:00:00	53,9	42,0	48,8	57,8	59,7	63,7
16/03/2023 10:00:00	56,1	42,1	48,9	58,6	61,5	68,4
16/03/2023 11:00:00	54,1	39,8	46,5	57,5	59,6	65,5
16/03/2023 12:00:00	50,5	39,6	44,4	53,4	56,4	61,6
16/03/2023 13:00:00	56,4	40,1	46,8	57,0	60,1	70,0
16/03/2023 14:00:00	55,5	42,9	50,2	58,6	60,7	65,4
Période totale	65,9	39,8	45,1	56,5	59,4	66,3

Fichier	PF3					
Périodes	1h					
Début	14/03/2023 11:00:00					
Fin	15/03/2023 11:00:00					
Lieu	*** ***					
Pondération	A					
Type de données	Leq					
Unité	dB					
Début période	Leq	L90	L50	L10	L5	L1
14/03/2023 11:00:00	52,6	48,0	51,4	55,2	56,4	58,8
14/03/2023 12:00:00	54,9	48,8	53,1	57,7	59,0	63,2
14/03/2023 13:00:00	52,1	47,0	50,2	53,7	55,3	58,4
14/03/2023 14:00:00	53,4	48,1	51,2	55,9	57,9	61,6
14/03/2023 15:00:00	56,2	48,4	51,5	56,5	59,7	65,7
14/03/2023 16:00:00	51,2	46,9	50,0	53,6	54,7	56,9
14/03/2023 17:00:00	57,5	47,1	50,3	58,9	65,2	69,7
14/03/2023 18:00:00	53,5	44,2	47,5	53,5	55,6	67,0
14/03/2023 19:00:00	48,6	43,6	46,2	50,8	52,5	56,9
14/03/2023 20:00:00	47,0	42,4	45,2	49,0	50,5	54,6
14/03/2023 21:00:00	46,9	41,4	45,0	48,7	50,4	55,4
14/03/2023 22:00:00	48,0	40,4	42,6	46,0	47,5	55,2
14/03/2023 23:00:00	43,9	39,7	42,4	45,9	47,2	50,9
15/03/2023 00:00:00	47,4	41,7	43,9	47,7	49,7	55,4
15/03/2023 01:00:00	43,8	38,9	41,7	45,8	47,9	52,1
15/03/2023 02:00:00	41,5	37,1	39,6	43,3	45,3	49,9
15/03/2023 03:00:00	41,5	36,9	39,1	43,0	44,8	49,9
15/03/2023 04:00:00	40,9	36,3	38,9	43,7	45,1	48,8
15/03/2023 05:00:00	52,3	38,4	47,3	54,7	58,6	62,9
15/03/2023 06:00:00	53,4	43,9	49,4	56,8	58,7	62,1
15/03/2023 07:00:00	57,7	44,5	50,8	61,9	64,5	68,3
15/03/2023 08:00:00	57,6	46,7	53,7	61,5	63,6	66,5
15/03/2023 09:00:00	56,2	46,6	51,3	59,6	61,7	65,6
15/03/2023 10:00:00	58,1	47,3	52,5	59,2	61,3	68,8
Période totale	53,4	39,9	47,7	55,4	58,2	64,4

Fichier	PF4					
Périodes	1h					
Début	14/03/2023 12:00:00					
Fin	15/03/2023 12:00:00					
Lieu	*** ***					
Pondération	A					
Type de données	Leq					
Unité	dB					
Début période	Leq	L90	L50	L10	L5	L1
14/03/2023 12:00:00	62,1	51,1	54,5	66,4	68,6	72,2
14/03/2023 13:00:00	61,5	50,6	55,2	64,4	66,4	71,7
14/03/2023 14:00:00	59,5	51,1	53,7	61,0	64,4	70,1
14/03/2023 15:00:00	64,2	52,5	55,7	65,9	69,6	77,4
14/03/2023 16:00:00	70,9	53,1	58,5	75,8	78,9	82,1
14/03/2023 17:00:00	58,7	52,7	55,1	61,2	63,8	68,6
14/03/2023 18:00:00	59,1	51,8	54,0	58,9	62,6	71,9
14/03/2023 19:00:00	60,4	51,3	53,2	55,6	57,8	75,6
14/03/2023 20:00:00	51,9	49,6	51,3	53,2	54,0	56,1
14/03/2023 21:00:00	53,7	49,7	51,5	53,6	54,2	58,5
14/03/2023 22:00:00	52,5	48,1	50,4	52,7	53,4	56,1
14/03/2023 23:00:00	55,1	48,4	50,1	52,0	52,9	69,7
15/03/2023 00:00:00	50,4	48,4	50,0	51,8	52,3	53,3
15/03/2023 01:00:00	48,5	45,8	47,8	50,5	51,2	52,6
15/03/2023 02:00:00	47,2	44,9	46,9	48,8	49,3	50,2
15/03/2023 03:00:00	48,2	45,7	47,7	49,6	50,4	52,1
15/03/2023 04:00:00	47,4	44,0	45,8	48,1	49,3	57,0
15/03/2023 05:00:00	60,2	45,9	49,4	62,9	67,2	71,7
15/03/2023 06:00:00	63,0	49,3	53,3	64,8	68,1	73,6
15/03/2023 07:00:00	60,2	48,0	52,3	61,5	64,0	71,5
15/03/2023 08:00:00	61,2	47,8	52,9	64,9	67,0	73,4
15/03/2023 09:00:00	61,9	49,7	55,3	65,3	67,0	72,7
15/03/2023 10:00:00	63,2	49,2	52,8	66,7	68,7	75,8
15/03/2023 11:00:00	68,1	48,8	52,4	63,2	65,4	70,7
Période totale	62,0	47,0	52,0	62,0	65,9	73,6

Fichier	PR5					
Périodes	2m					
Début	15/03/2023 09:35:00					
Fin	15/03/2023 10:21:00					
Lieu	*** ***					
Pondération	A					
Type de données	Leq					
Unité	dB					
Début période	Leq	L90	L50	L10	L5	L1
15/03/2023 09:35:00	66,3	44,1	48,9	71,3	74,2	78,6
15/03/2023 09:37:00	52,5	47,0	49,4	54,3	56,5	62,6
15/03/2023 09:39:00	60,5	44,4	47,2	58,9	67,5	72,6
15/03/2023 09:41:00	61,8	45,4	52,4	64,9	67,8	73,8
15/03/2023 09:43:00	59,7	48,5	51,2	58,6	65,6	72,9
15/03/2023 09:45:00	61,9	45,4	49,5	64,1	68,2	75,8
15/03/2023 09:47:00	60,2	46,1	49,3	60,2	65,4	73,9
15/03/2023 09:49:00	56,5	43,9	45,7	52,1	56,6	70,3
15/03/2023 09:51:00	56,4	44,3	47,4	56,8	61,0	67,9
15/03/2023 09:53:00	56,8	42,7	47,4	58,5	62,3	68,5
15/03/2023 09:55:00	52,1	44,8	47,9	52,5	53,9	62,4
15/03/2023 09:57:00	54,3	45,5	47,9	53,8	57,9	67,4
15/03/2023 09:59:00	61,8	46,1	50,6	64,2	70,0	74,3
15/03/2023 10:01:00	53,9	44,5	46,8	53,0	59,1	63,6
15/03/2023 10:03:00	62,0	48,8	52,4	60,9	64,4	68,8
15/03/2023 10:05:00	59,0	48,7	51,2	57,4	59,9	65,3
15/03/2023 10:07:00	56,4	50,1	51,9	58,6	62,7	68,5
15/03/2023 10:09:00	62,6	50,7	54,0	63,1	70,3	74,8
15/03/2023 10:11:00	68,5	57,6	63,0	72,3	75,5	77,4
15/03/2023 10:13:00	65,5	56,9	59,3	64,1	70,1	75,6
15/03/2023 10:15:00	53,6	50,2	52,7	56,1	56,9	58,4
15/03/2023 10:17:00	53,0	46,7	49,5	56,3	59,9	62,2
15/03/2023 10:19:00	54,3	45,8	49,2	55,2	58,9	66,1
Période totale	61,2	45,4	50,5	61,2	66,2	74,2

Fichier	PR6					
Périodes	1m					
Début	15/03/2023 10:46:00					
Fin	15/03/2023 11:00:00					
Lieu	*** ***					
Pondération	A					
Type de données	Leq					
Unité	dB					
Début période	Leq	L90	L50	L10	L5	L1
15/03/2023 10:46:00	51,1	41,2	43,3	51,4	59,5	64,2
15/03/2023 10:47:00	54,1	43,1	44,6	55,2	59,4	69,2
15/03/2023 10:48:00	59,1	45,3	50,3	63,1	68,4	69,1
15/03/2023 10:49:00	45,0	41,2	43,1	45,9	49,1	56,1
15/03/2023 10:50:00	48,6	44,0	46,7	51,2	54,8	57,4
15/03/2023 10:51:00	46,9	44,2	45,2	48,1	49,4	57,6
15/03/2023 10:52:00	49,0	43,2	47,2	52,1	53,5	58,2
15/03/2023 10:53:00	47,4	44,2	45,8	50,4	51,0	54,8
15/03/2023 10:54:00	45,9	41,9	43,7	46,5	47,8	58,7
15/03/2023 10:55:00	47,2	41,9	45,4	48,8	50,7	56,4
15/03/2023 10:56:00	45,4	40,7	43,1	48,5	49,2	54,1
15/03/2023 10:57:00	46,0	41,6	43,6	49,4	51,3	53,5
15/03/2023 10:58:00	48,1	42,6	45,5	51,0	51,5	59,5
15/03/2023 10:59:00	46,8	42,4	44,9	50,3	51,5	52,5
Période totale	51,0	41,9	45,0	51,0	54,1	63,2

8.2 Annex: Measurement methods used in the campaign

8.2.1 Air pollutants measurements

8.2.1.1 Gaseous pollutants

The nitrogen dioxide, the ozone, the sulphur dioxide and the total Volatile Organic Compounds (VOC) have been sampled on radiello tubes, for a 24 hour period.

The tubes are are placed in a shelter between 2 and 3 meters above the ground.

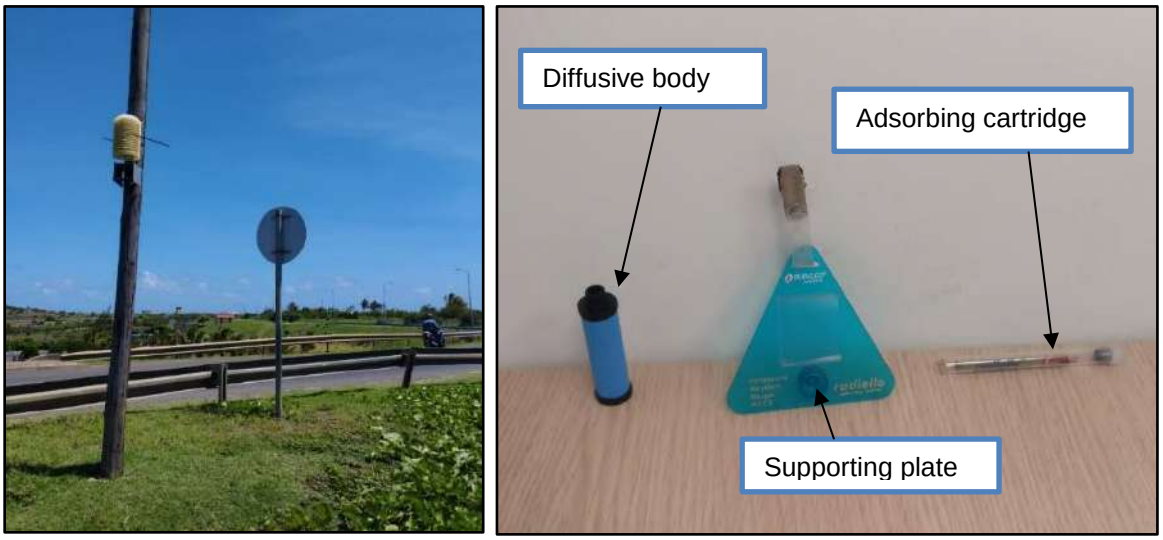


Figure 83: Components and installation of the radiello tubes

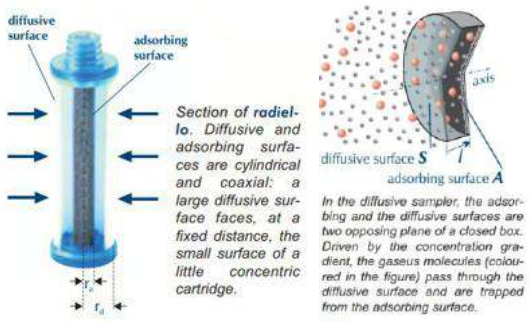


Figure 84: Working principle of the radiello tubes – Source Manuale radiello

The detailed principle of sampling is explained in the user manual 2019 Radiello (https://www.restek.com/globalassets/pim-media/instruction-sheets/radiello-manual.pdf).

Those samples have been sent to the laboratory TERA Environnement for analysis.

Table 8-1: Method of analysis used by TERA environnement for the tubes Radiello

Composés	Supports	Norme	Technique analytique	Incertitude basse %	Incertitude haute %	LQ	Unité
Indice COVs comme défini dans le guide HQE	Rad code 145 COVs basse LQ	NF EN ISO 16017-2	ATDGCMS C	30	30	5	ng
Dioxyde d'azote (NO2)	Rad code 166 pour NO2/SO2/HF	NF EN 16339	CICD	30	19	1	µg
Dioxyde de Soufre (SO2)	Rad code 166 pour NO2/SO2/HF	Méthode interne MO.LAB.842	CICD	20	20	0,3	µg
Ozone (O3)	Rad code 172 pour Ozone	Méthode interne MO.LAB.707	SPECTRO	25	25	0,5	µg

8.2.1.2 Particles: Outdoor air quality meter NEMO

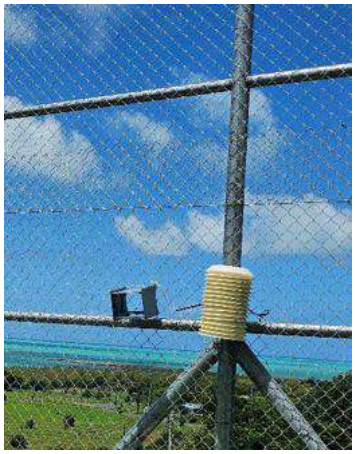


Figure 85: NEMo outdoor microsensor ambient air monitoring

For ten years, Ethera has been committed to designing air quality analysing devices and putting its unique know-how in France at the service of the development of sensors dedicated to outdoor air quality, to characterize and integrate into functional and autonomous units – the NEMo range.

The NEMo Outdoor station allows continuous measurement of various parameters such as:

- NO_2 / O_3
- PM1/2.5/10
- NH_3
- H_2S
- SO_2
- CO

It is designed to operate in complete autonomy on solar panel or power supply. This station is connected with several wireless means of communication: Sigfox, LoRa or LTE-M.

The microsensors lack of exactitude for the gaseous pollutants compared to the measurements methods of reference. That's why in this study, it is only used to measure the particles.

This microsensor has been tested by the « AirLab Microcapteurs 2021 Challenge » and is well rated for the outdoor measurement of particles (4.5/5).

Figure 86: Evaluation of the outdoor NEMo microsensor – AirLab Challenge Microcapteurs 2021

8.2.2 Acoustic's measurements material

- The measurements were made with Class 1 equipment in accordance with the NFS 31-009 standard for precision sound level meters.

Sonometers

- 4 Svantek Class 1 Svan 971 sound meters (PF1, PF2, PF3 and PF4 measurements)

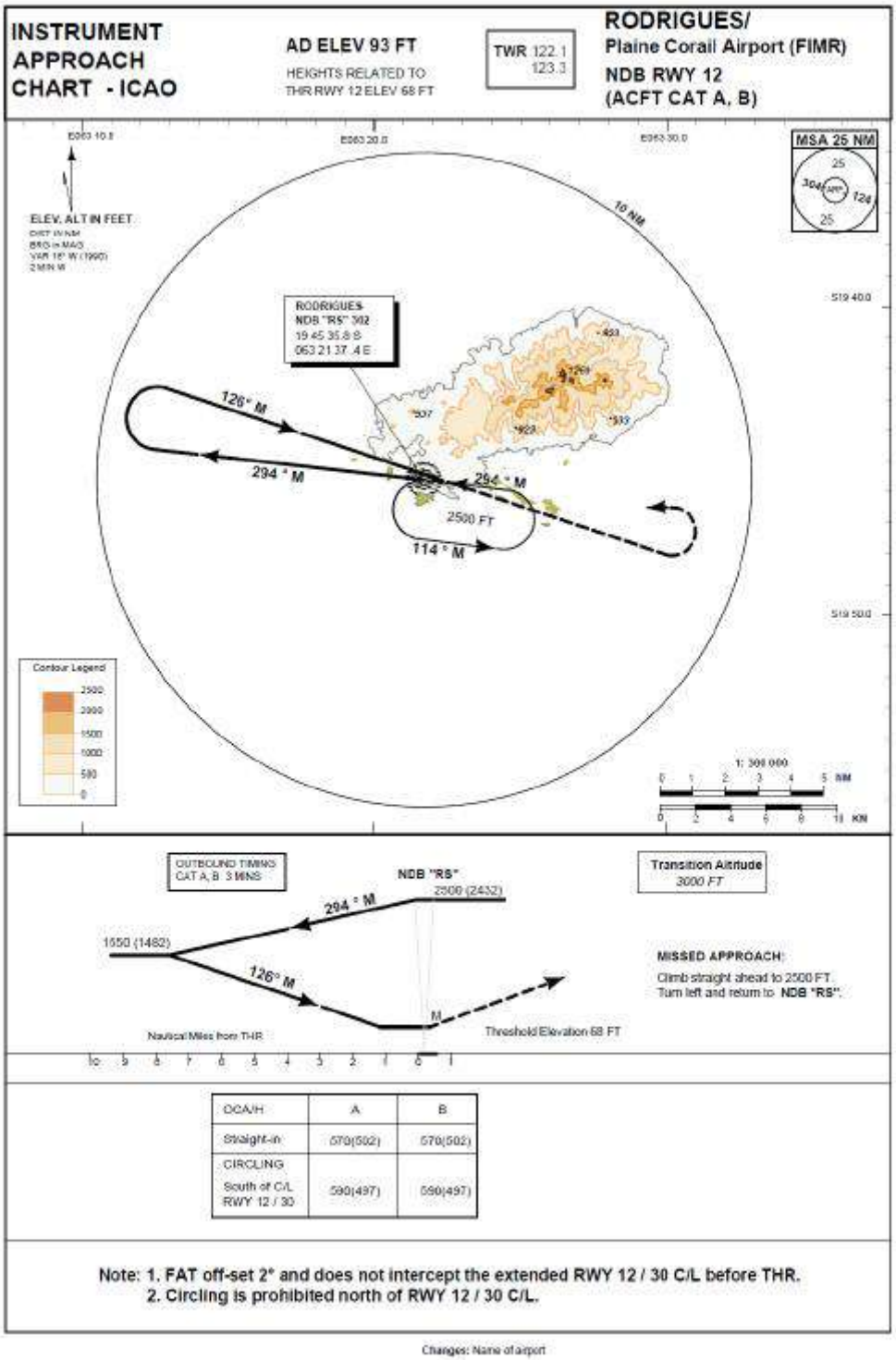
Calibrator

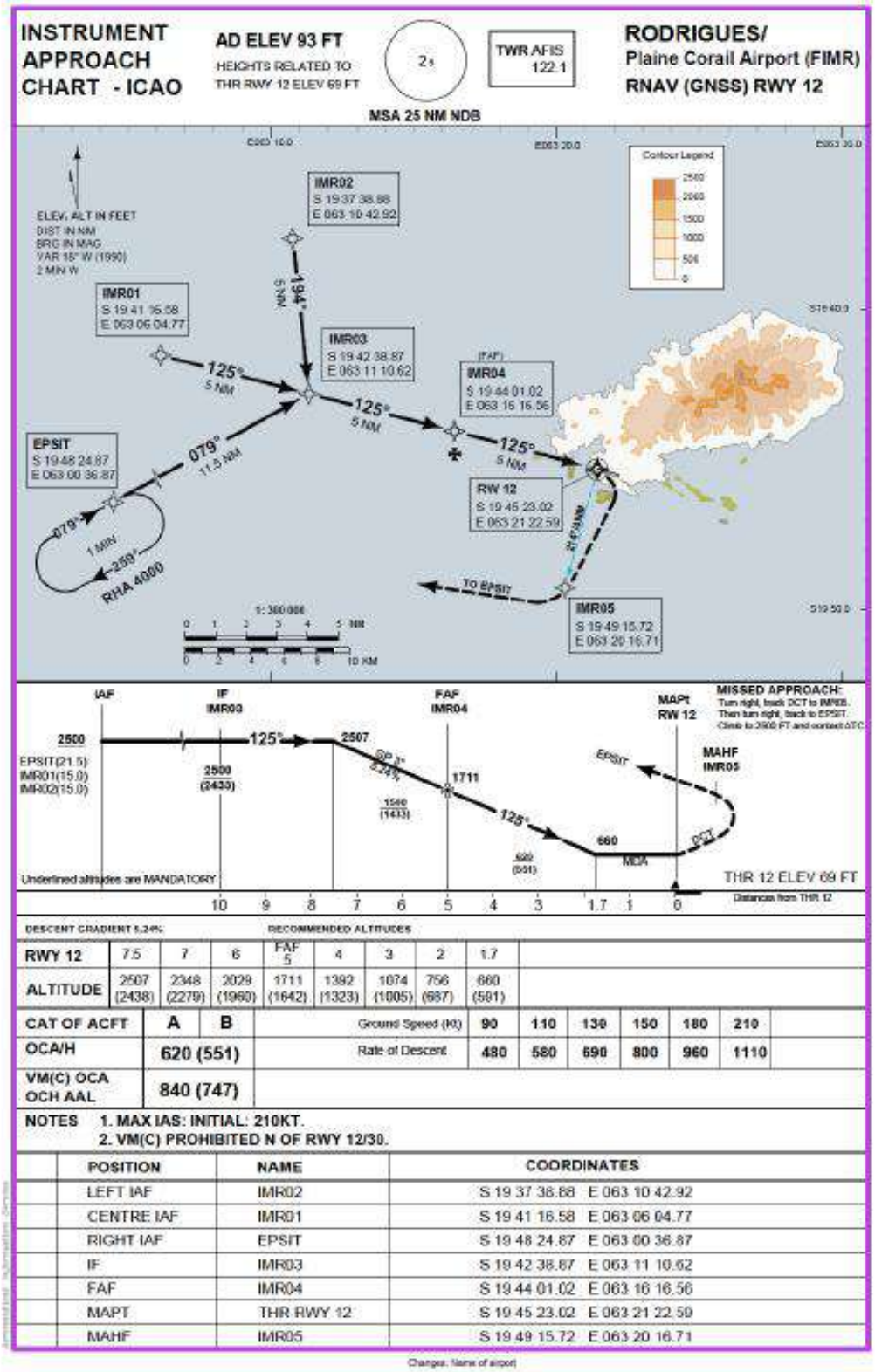
- Class 1 calibrator from Cirrus.

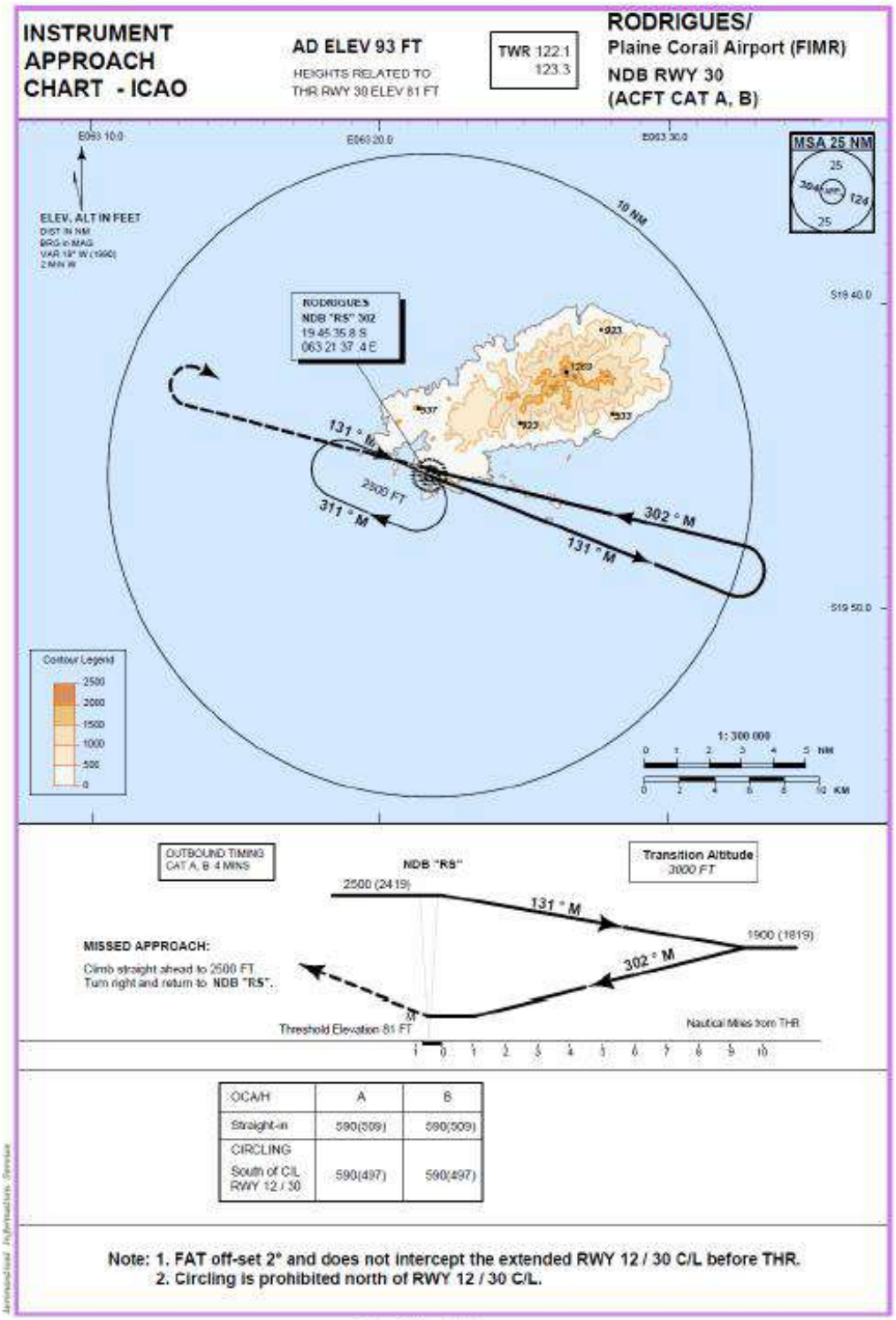
Processing softwares

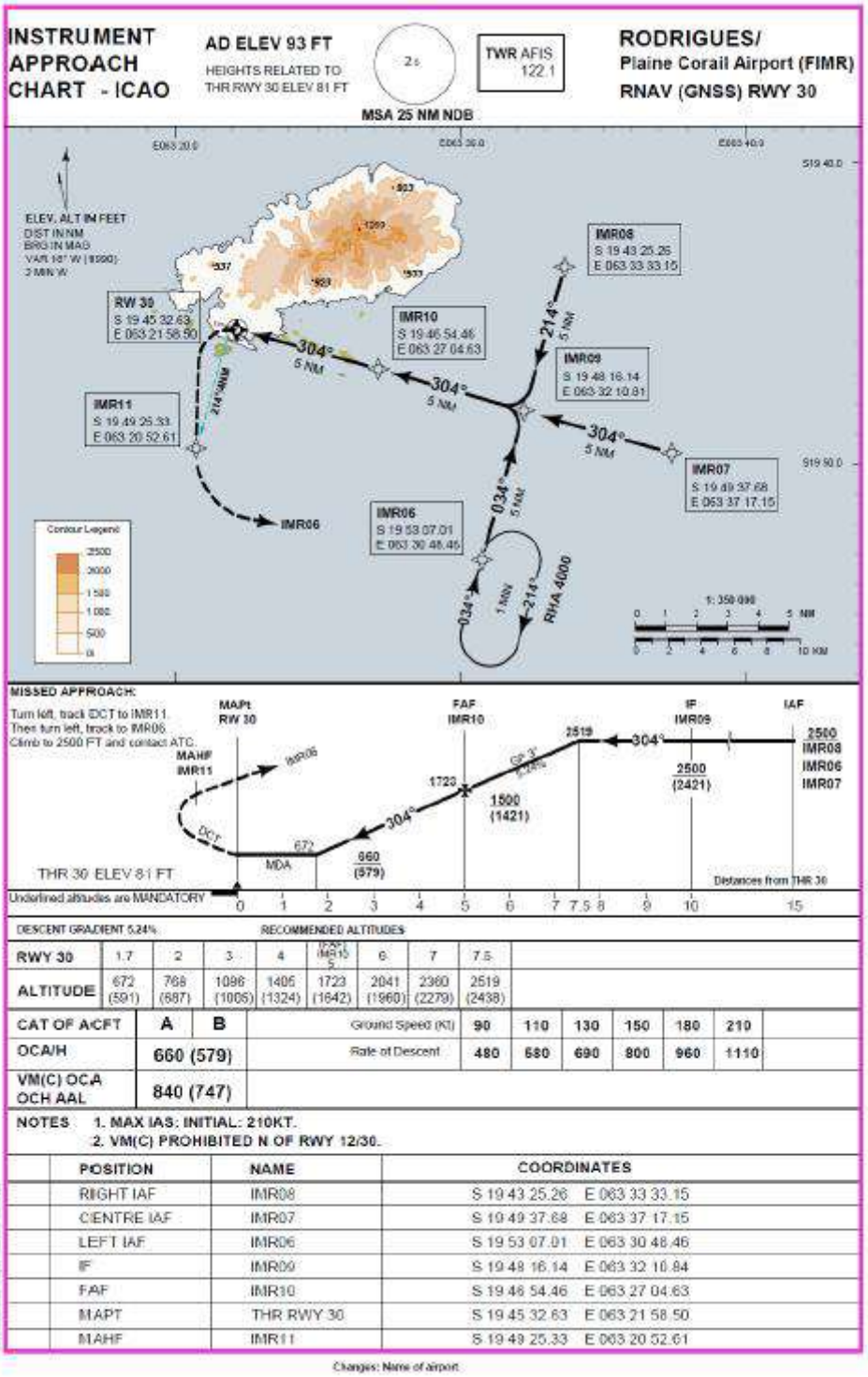
- dBTrait from 01dB. ;
- SvanPC++ from Svantek.

8.3 Annex: Plaine Corail airport's approaches

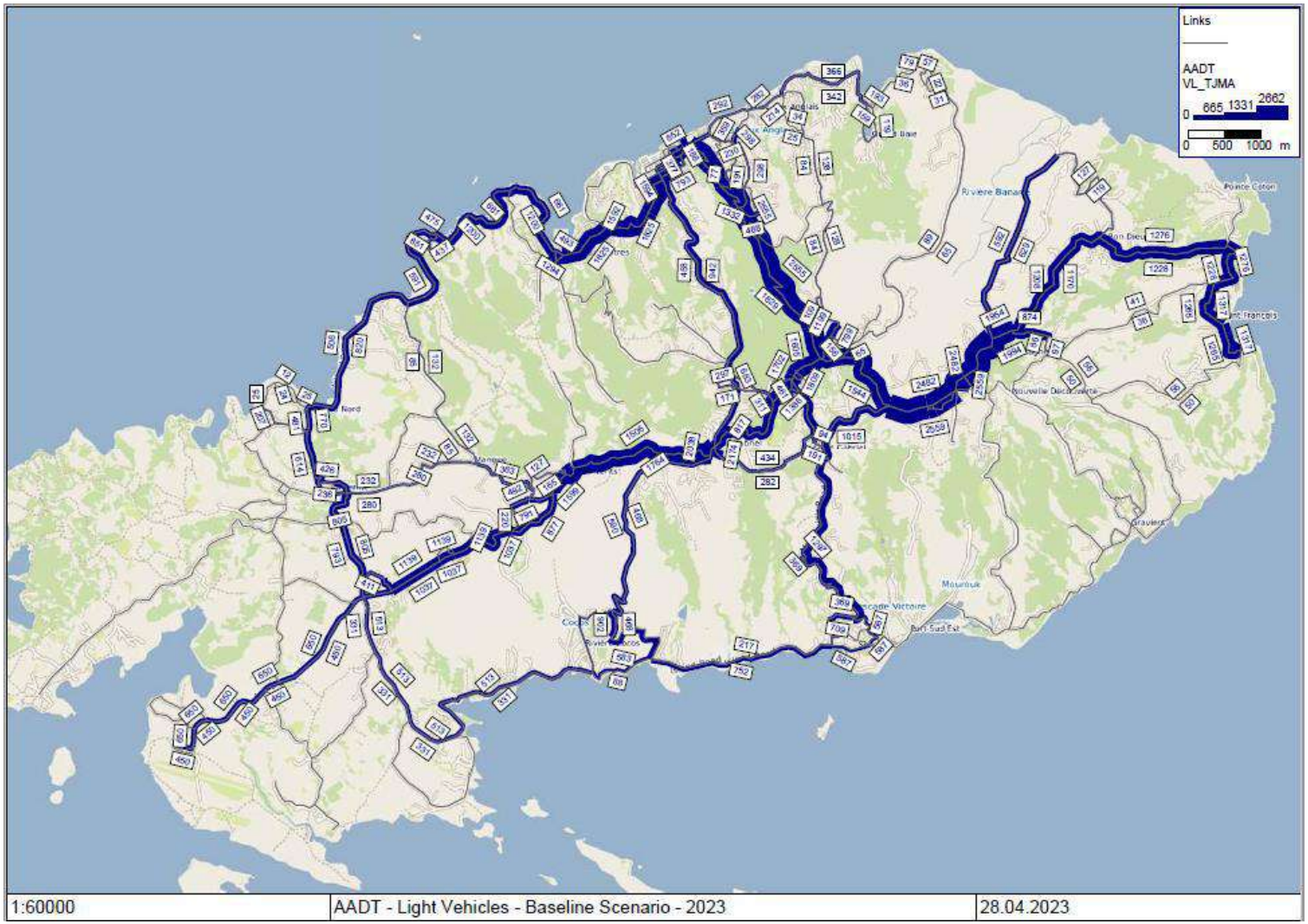


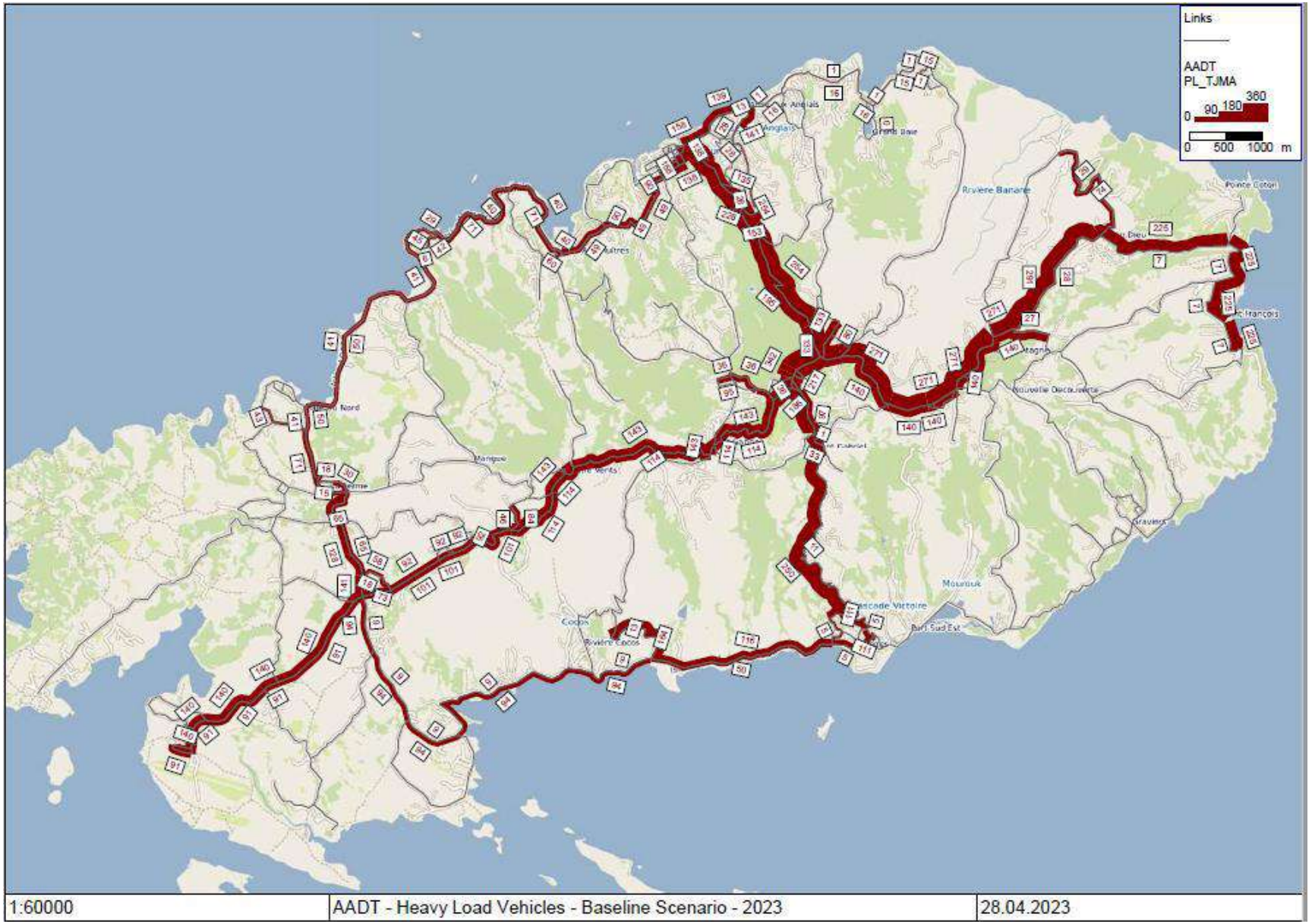

INSTRUMENT APPROACH CHART - ICAO
AD ELEV 93 FT
HEIGHTS RELATED TO THR RWY 12 ELEV 69 FT
TWR AFIS 122.1
RODRIGUES/
Plaine Corail Airport (FIMR)
RNAV (GNSS) RWY 12
MSA 25 NM NDB
IMR02 S 19 37 38.88 E 063 10 42.92
IMR01 S 19 41 16.58 E 063 06 04.77
IMR03 S 19 42 38.87 E 063 11 10.62
IMR04 S 19 44 01.02 E 063 16 16.56
EPSIT S 19 48 24.87 E 063 00 36.87
RW 12 S 19 45 23.02 E 063 21 22.59
IMR05 S 19 49 15.72 E 063 20 16.71
ELEV. ALT IN FEET
DIST IN NM
BRG IN MAG
VAR 15° W (1990)
2 MIN W
Contour Legend
194°
5 NM
125°
5 NM
125°
5 NM
125°
5 NM
079°
11.5 NM
079°
1 MIN
259°
RHA 4000
TO EPSIT
1: 360 000
IAF
IF IMR03
FAF IMR04
MAPt RW 12
MAHF IMR05
MISSED APPROACH:
Turn right, track DCT to IMR05.
Then turn right, track to EPSIT.
Climb to 2500 FT and contact ATC.
2500
EPSIT(21.5)
IMR01(15.0)
IMR02(15.0)
2500 (2433)
125°
2507
GP 3° 5.24%
1711
1566 (1433)
125°
680
MDA
DCT
EPSIT
Underlined altitudes are MANDATORY
THR 12 ELEV 69 FT
Distance from THR 12
10 9 8 7 6 5 4 3 1.7 1 0
DESCENT GRADIENT 5.24%
RECOMMENDED ALTITUDES
RWY 12 | 7.5 | 7 | 6 | FAF 5 | 4 | 3 | 2 | 1.7
ALTITUDE | 2507 (2438) | 2348 (2279) | 2029 (1960) | 1711 (1642) | 1392 (1323) | 1074 (1005) | 756 (687) | 660 (591)
CAT OF ACFT | A | B
OCA/H | 620 (551)
VM(C) OCA OCH AAL | 840 (747)
Ground Speed (Kt) | 90 | 110 | 130 | 150 | 180 | 210
Rate of Descent | 480 | 580 | 690 | 800 | 960 | 1110
NOTES 1. MAX IAS: INITIAL: 210KT.
2. VM(C) PROHIBITED N OF RWY 12/30.
POSITION | NAME | COORDINATES
LEFT IAF | IMR02 | S 19 37 38.88 E 063 10 42.92
CENTRE IAF | IMR01 | S 19 41 16.58 E 063 06 04.77
RIGHT IAF | EPSIT | S 19 48 24.87 E 063 00 36.87
IF | IMR03 | S 19 42 38.87 E 063 11 10.62
FAF | IMR04 | S 19 44 01.02 E 063 16 16.56
MAPT | THR RWY 12 | S 19 45 23.02 E 063 21 22.59
MAHF | IMR05 | S 19 49 15.72 E 063 20 16.71


INSTRUMENT APPROACH CHART - ICAO
AD ELEV 93 FT
HEIGHTS RELATED TO THR RWY 30 ELEV 81 FT
TWR 122.1 123.3
RODRIGUES/
Plaine Corail Airport (FIMR)
NDB RWY 30
(ACFT CAT A, B)
MSA 25 NM
ELEV, ALT IN FEET
RODRIGUES
NDB "RS" 302
19 45 35.8 S
063 21 37 .4 E
10 NM
131 ° M
311 ° M
2500 FT
302 ° M
131 ° M
Contour Legend
2500
2000
1500
1000
500
0
1: 300 000
OUTBOUND TIMING
CAT A, B 4 MINS
NDB "RS"
Transition Altitude
3000 FT
2500 (2419)
131 ° M
1500 (1819)
302 ° M
MISSED APPROACH:
Climb straight ahead to 2500 FT
Turn right and return to NDB "RS".
Threshold Elevation 81 FT
Nautical Miles from THR
OCA/H | A | B
Straight-in | 590(509) | 590(509)
CIRCLING South of C/L RWY 12 / 30 | 590(497) | 590(497)
Note: 1. FAT off-set 2° and does not intercept the extended RWY 12 / 30 C/L before THR.
2. Circling is prohibited north of RWY 12 / 30 C/L.
Changes: Name of airport


INSTRUMENT APPROACH CHART - ICAO
AD ELEV 93 FT
HEIGHTS RELATED TO THR RWY 30 ELEV 81 FT
TWR AFIS 122.1
MSA 25 NM NDB
RODRIGUES/
Plaine Corail Airport (FIMR)
RNAV (GNSS) RWY 30
ELEV, ALT IN FEET
DIST IN NM
BRG IN MAG
VAR 16° W (2020)
3 MIN W
RW 30
S 19 45 32.63
E 063 21 58.50
IMR08
S 19 43 25.26
E 063 33 33.15
IMR10
S 19 46 54.46
E 063 27 04.63
IMR09
S 19 48 16.14
E 063 32 10.81
IMR11
S 19 49 25.33
E 063 20 52.61
IMR07
S 19 49 37.68
E 063 37 17.15
IMR06
S 19 53 07.01
E 063 30 48.46
304°
5 NM
214°
034°
1 MIN
RHA 4000
Contour Legend
2500
2000
1 500
1 000
500
0
1: 350 000
MISSED APPROACH:
Turn left, track DCT to IMR11.
Then turn left, track to IMR06.
Climb to 2500 FT and contact ATC.
MAPt
RW 30
FAF
IMR10
IF
IMR09
IAF
2500
IMR08
IMR06
IMR07
MAHF
IMR11
DCT
672
MDA
660
(579)
1723
1500
(1421)
2519
2500
(2421)
THR 30 ELEV 81 FT
Distances from THR 30
Underlined altitudes are MANDATORY
0 1 2 3 4 5 6 7 7.5 8 9 10 15
DESCENT GRADIENT 5.24%
RECOMMENDED ALTITUDES
RWY 30 | 1.7 | 2 | 3 | 4 | (FAF IMR10) 5 | 6 | 7 | 7.5
ALTITUDE | 672 (591) | 768 (687) | 1096 (1005) | 1406 (1324) | 1723 (1642) | 2041 (1960) | 2360 (2279) | 2519 (2438)
CAT OF A/CFT | A | B
OCA/H | 660 (579)
VM(C) OCA OCH AAL | 840 (747)
Ground Speed (KT) | 90 | 110 | 130 | 150 | 180 | 210
Rate of Descent | 480 | 680 | 690 | 800 | 960 | 1110
NOTES 1. MAX IAS: INITIAL: 210KT.
2. VM(C) PROHIBITED N OF RWY 12/30.
POSITION | NAME | COORDINATES
RIGHT IAF | IMR08 | S 19 43 25.26 E 063 33 33.15
CENTRE IAF | IMR07 | S 19 49 37.68 E 063 37 17.15
LEFT IAF | IMR06 | S 19 53 07.01 E 063 30 48.46
IF | IMR09 | S 19 48 16.14 E 063 32 10.84
FAF | IMR10 | S 19 46 54.46 E 063 27 04.63
MAPT | THR RWY 30 | S 19 45 32.63 E 063 21 58.50
MAHF | IMR11 | S 19 49 25.33 E 063 20 52.61
Changes: Name of airport

8.4 Annex: Road traffic at Rodrigues – Light vehicles and Heavy goods vehicles

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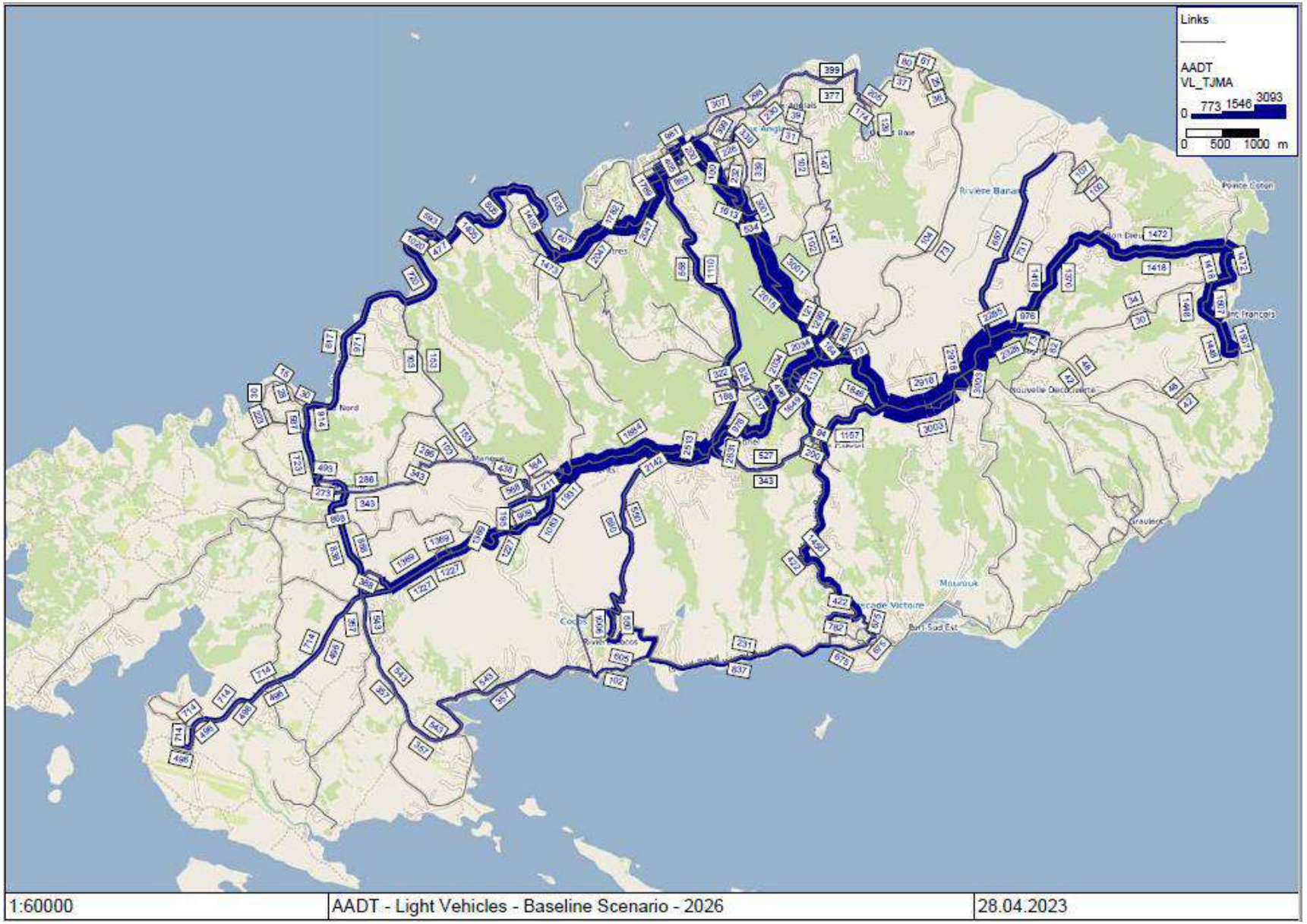
1:60000
AADT - Heavy Load Vehicles - Baseline Scenario - 2023
28.04.2023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VL_TJMA
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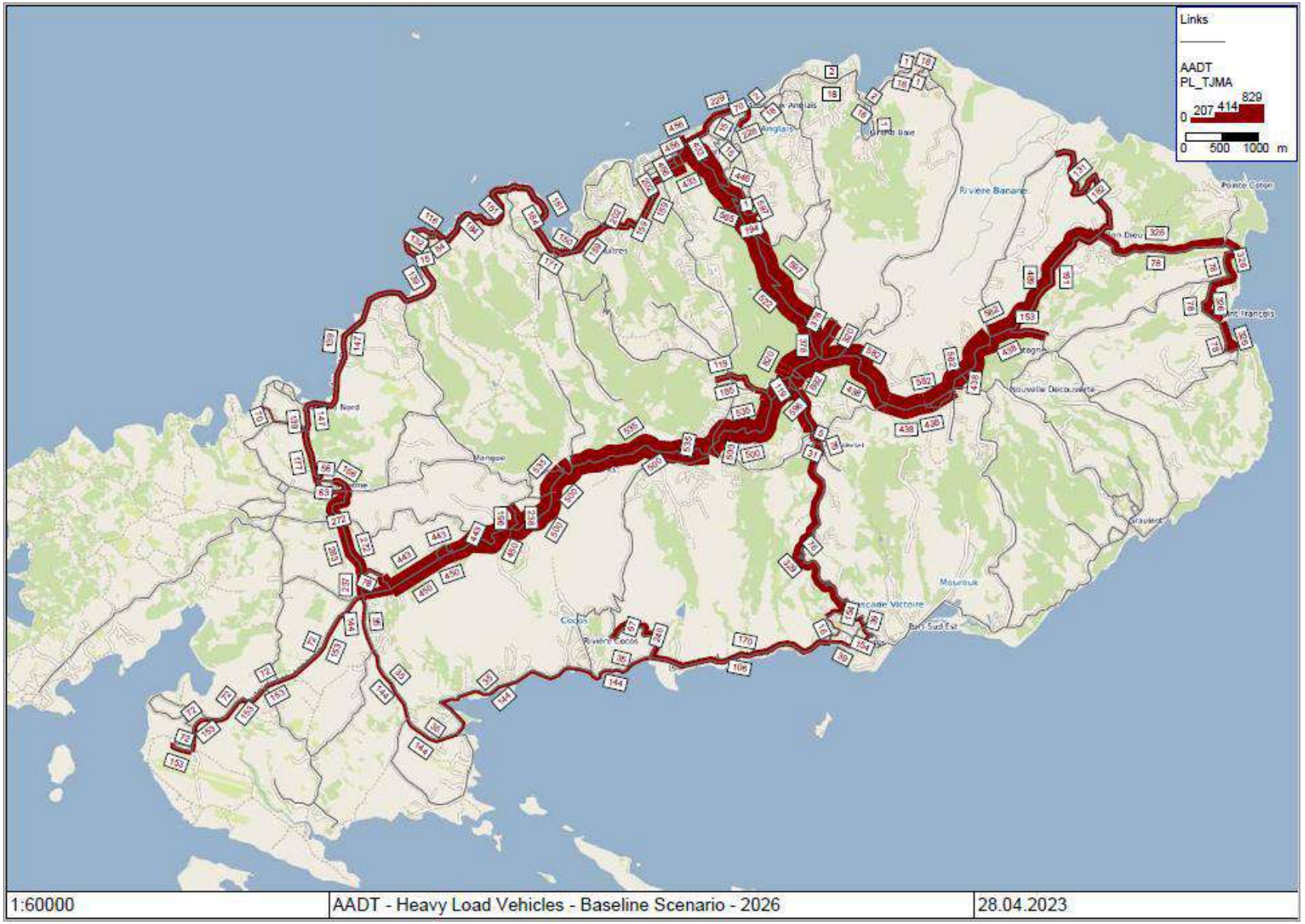
AADT - Light Vehicles - Baseline Scenario - 2026
28.04.2023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207
414
829
0
500
1000 m
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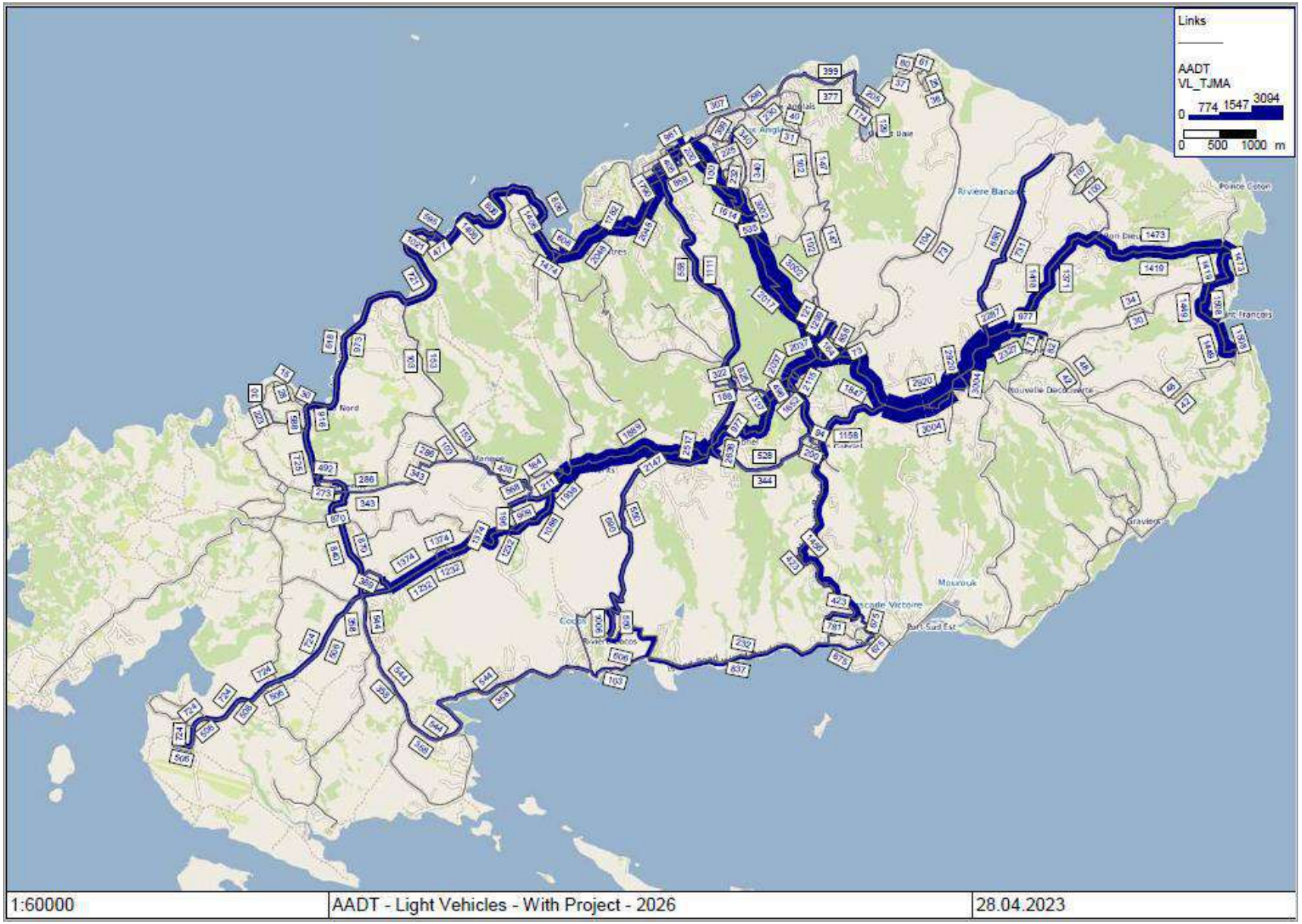
AADT - Heavy Load Vehicles - Baseline Scenario - 2026
28.04.2023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VL_TJMA
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1547
3094
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1000 m
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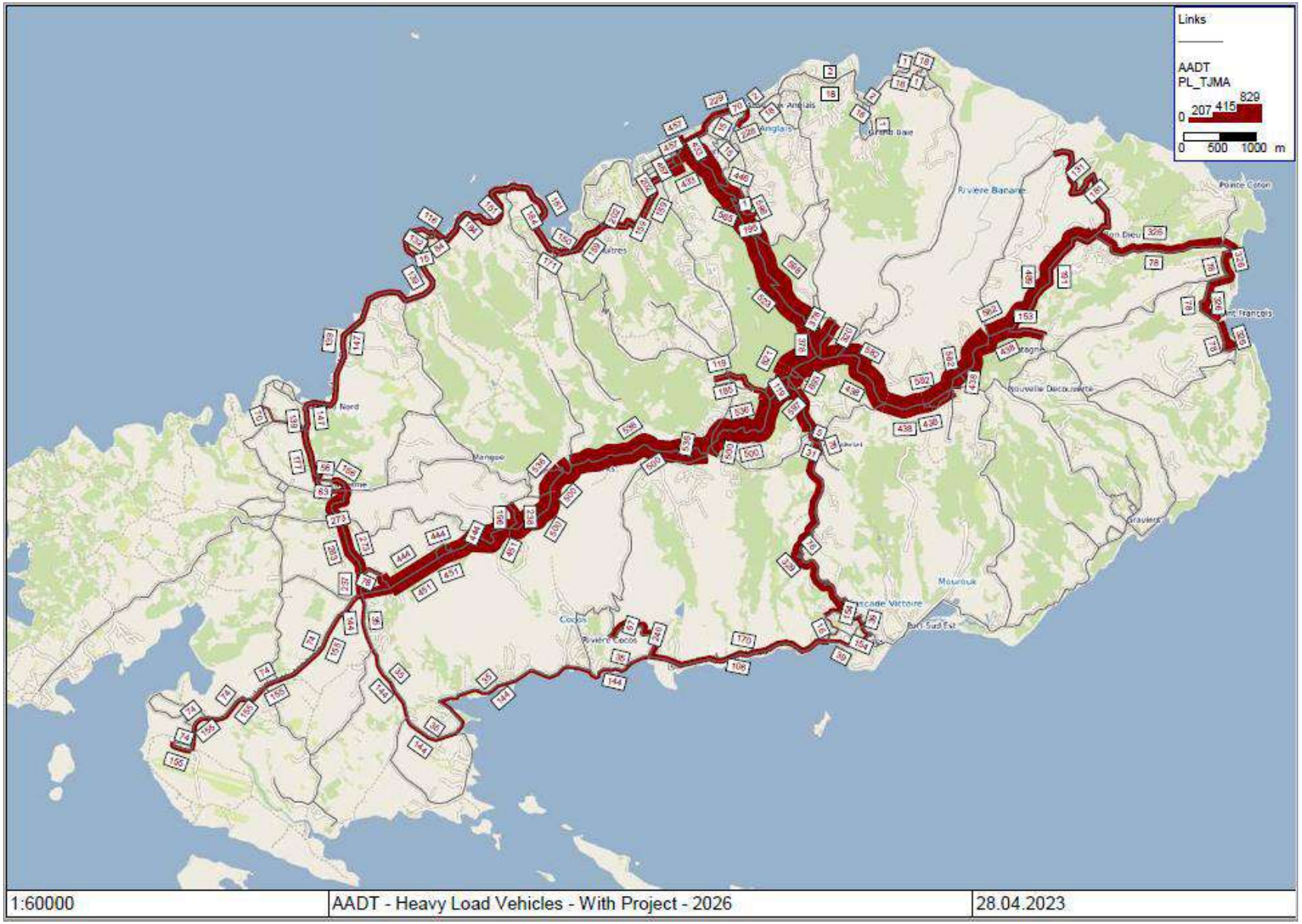
AADT - Light Vehicles - With Project - 2026
28.04.2023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PL_TJMA
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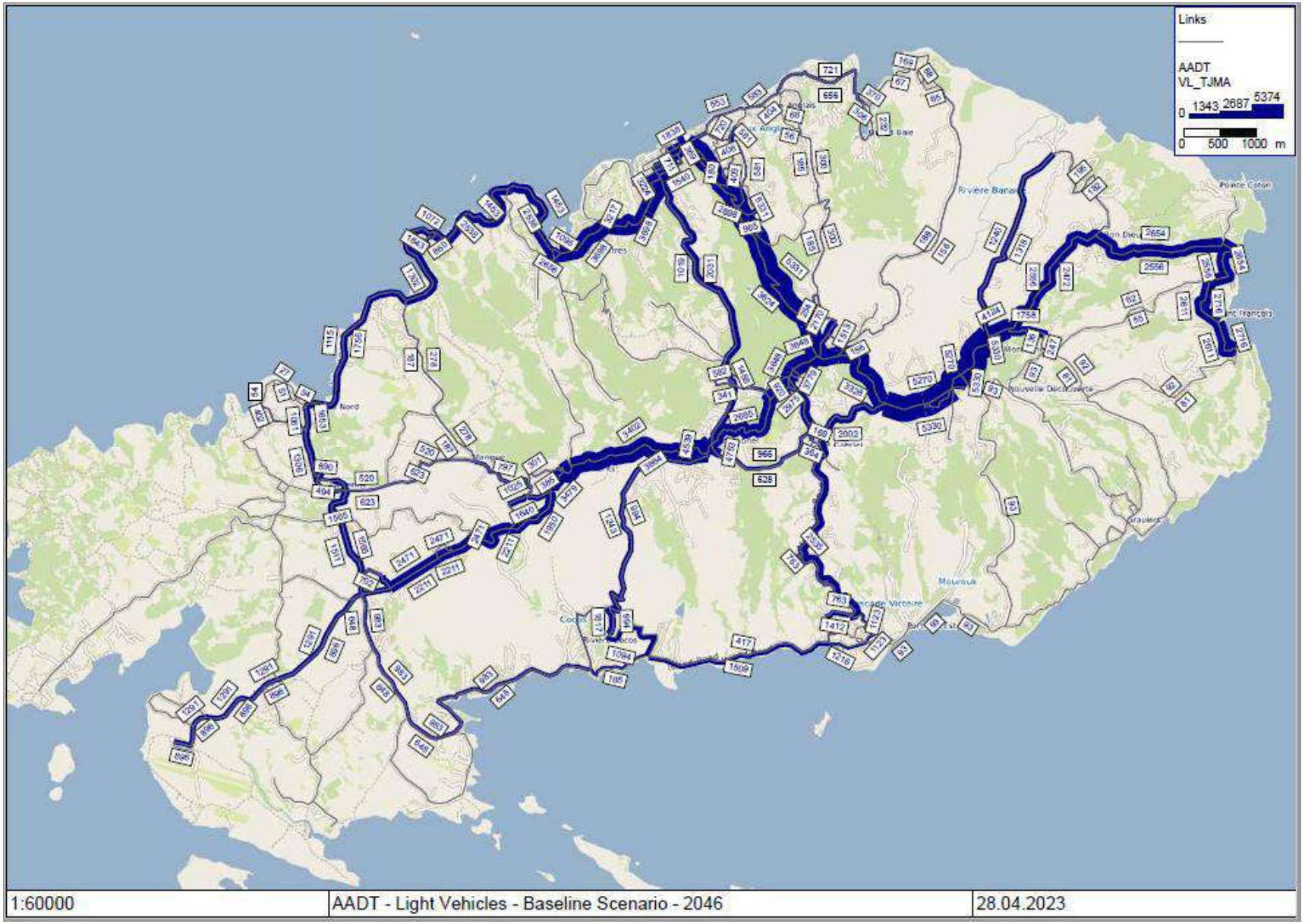
207
415
829
0
500
1000 m
1:60000
AADT - Heavy Load Vehicles - With Project - 2026
28.04.2023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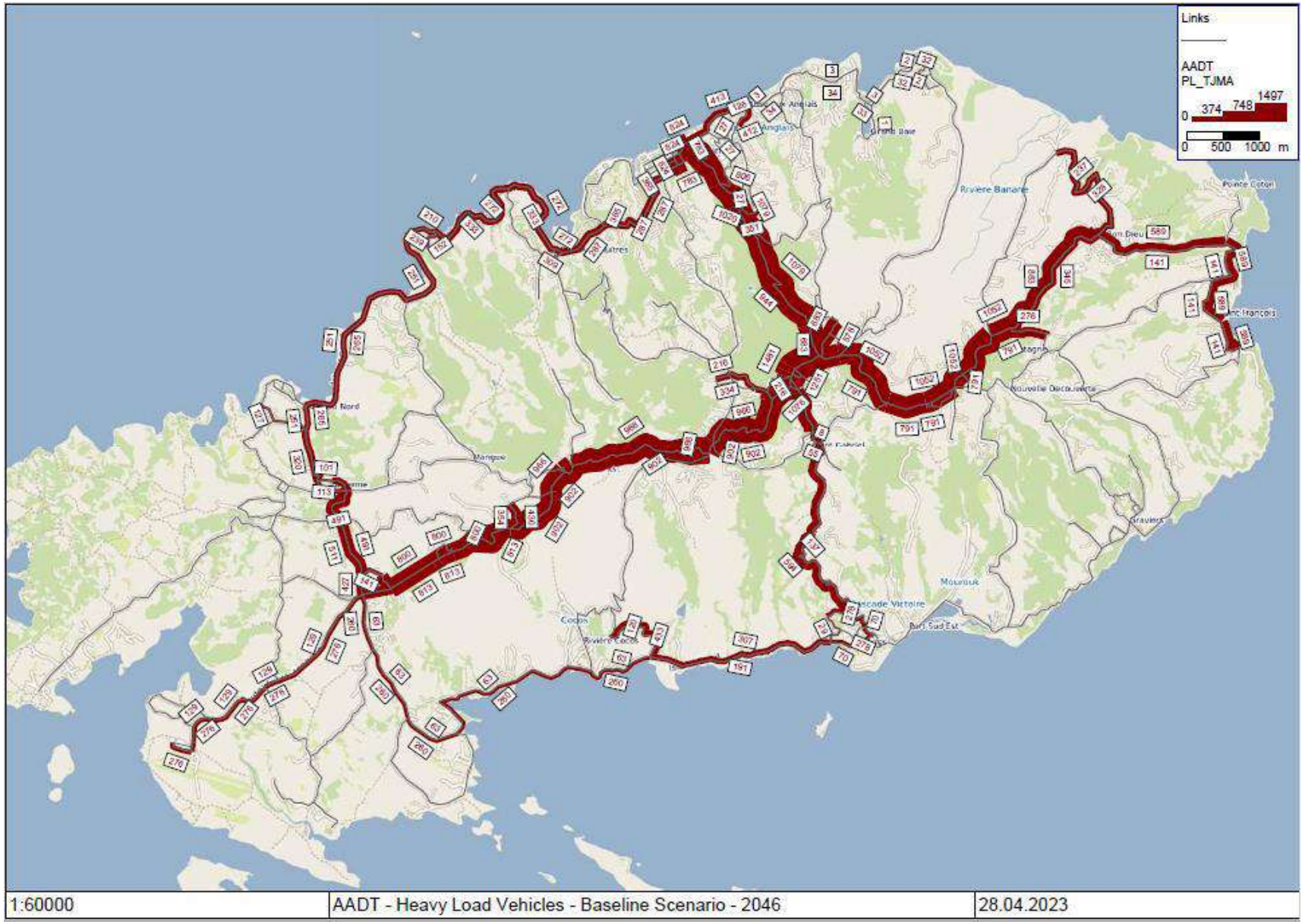
AADT - Light Vehicles - Baseline Scenario - 2046
28.04.2023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AADT
PL_TJMA
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374
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1497
0
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1000 m
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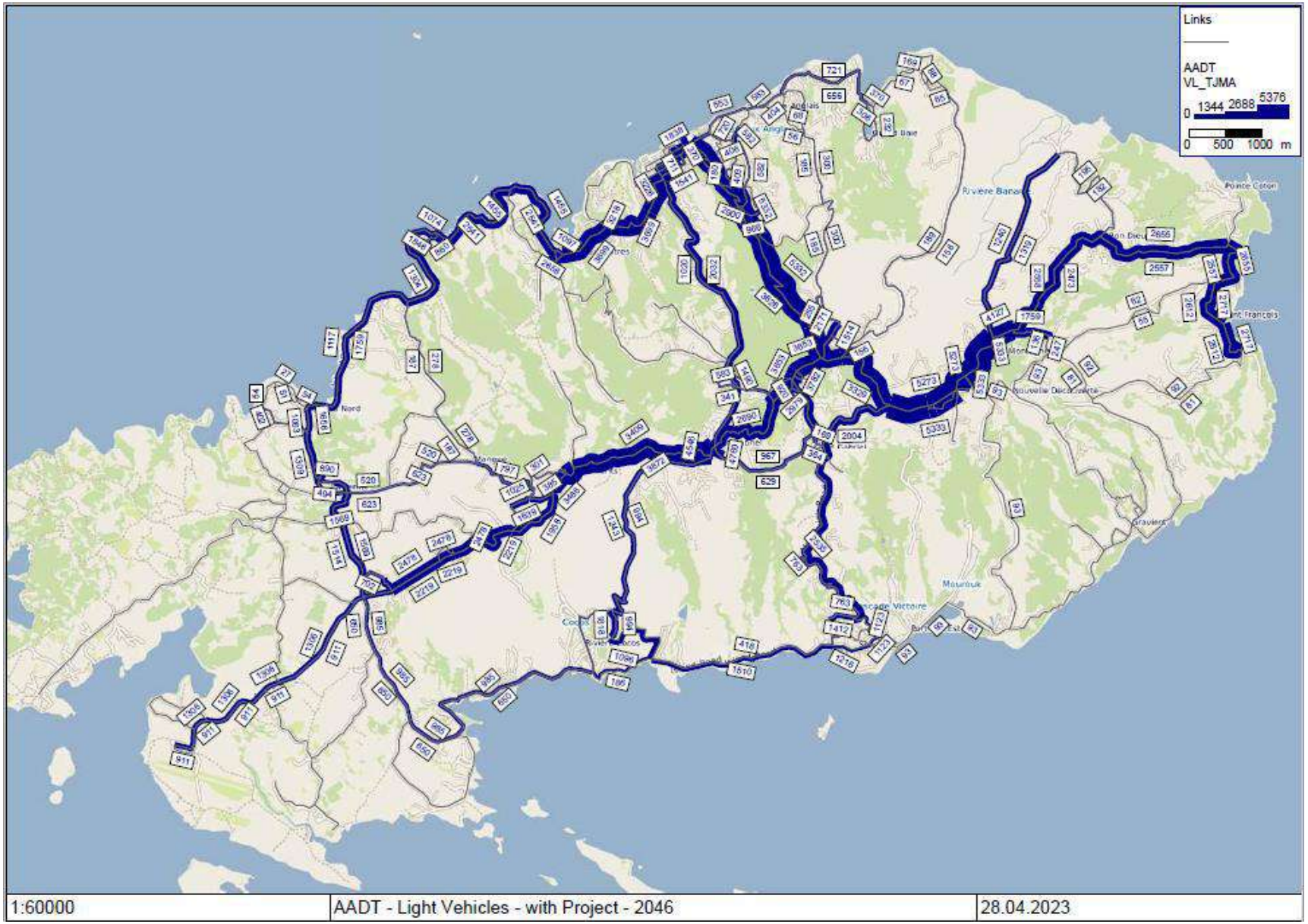
AADT - Heavy Load Vehicles - Baseline Scenario - 2046
28.04.2023


Links
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VL_TJMA
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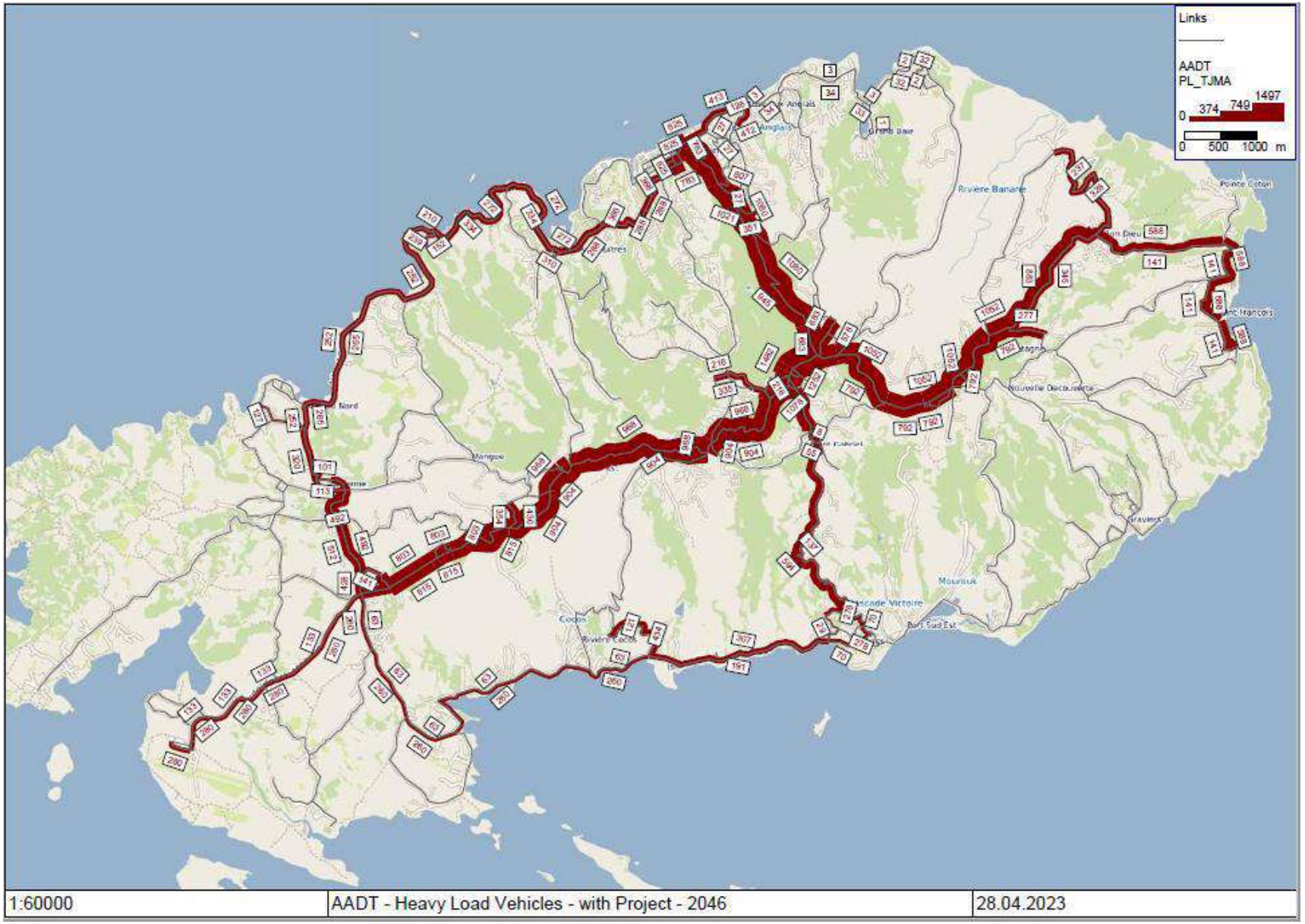
AADT - Light Vehicles - with Project - 2046
28.04.2023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AADT
PL_TJMA
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0
374
749
0
500
1000 m
1:60000
AADT - Heavy Load Vehicles - with Project - 2046
28.04.2023