PA/01398/23: AMENDMENTS TO APPROVED TOWNSQUARE DEVELOPMENT, SLIEMA

AIR QUALITY STUDY UPDATE

Version 2: October 2023

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Quality Assurance

PA/01398/23: Amendments to Approved Townsquare Development, Sliema
Air Quality Study Update
October 2023

Report for: **ST Property Investments Ltd**

Revision Schedule

Rev	Date	Details	Written by:	Checked by:	Approved by:
00	August 2023	Submitted to ERA	**Tiziana Agius** Consultant	**Rachel Xuereb** Director	**Adrian Mallia** Managing Director
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Kappara Business Centre
113 Triq Birkirkara
San Gwann SGN 4197
MALTA

Tel.: 21378172

Email: mgmt@adi.com.mt
Web: www.adi-associates.com

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AIR QUALITY STUDY UPDATE

INTRODUCTION

1. This Air Quality Study Update has been requested by the Environment & Resources Authority (ERA) in order to address the potential impacts of air emissions from the operational aspects of the proposed changes to the approved Sliema Townsquare development. This development is hereinafter referred to as 'the Scheme'.

2. The Scheme entitled '*Amendments to PA 1191/05 including: increase in number of apartments from 159 to 234; reconfiguration of parking levels to increase number of parking spaces from 600+ to 850+; introduction of a green parking area for alternative mode of transport including cycling, scooters, and taxis; removal of vehicular access to the car park from Hughes Hallet street level; introduction of hotel (Class 3B) to also serve apartments (Class 1); addition of amenities level within double height level in tower; conversion of recessed level of tower into full floor and conversion of second recessed level of tower housing core into recessed level; removal of the Pavilion building; introduction of office levels within double height areas in lower buildings; internal reconfiguration of office spaces; internal reconfiguration and subdivision of retail and food and beverage outlets, increasing the total number of Class 4B units, changing the use of Class 4C outlets to Class 4D and increasing the number of Class 4D units; inclusion of external areas to cater for the use of tables and chairs.*' is the subject of development application number PA/01398/23. The location of the Scheme site is shown in **Figure 1**.

3. The project is proposed by ST Property Investments Ltd, hereinafter referred to as 'the Applicant'.

4. The key issue for the assessment is:

> **Key Issue:**
>
> - **Effects of air emissions arising from operation of the Scheme on sensitive receptors**

Objectives of the Assessment

5. The objectives of the air quality study update are to:

- Quantify the expected air emissions from traffic resulting from operation of the Scheme, and assess their impact on air quality;
- Assess cumulative impacts from developments in the area; and
- Propose mitigation measures to reduce the impact, if any, of traffic emissions resulting from operation of the Scheme.

Figure 1: Location of the Scheme site and baseline monitoring locations

6. The air quality assessment focuses on the potential impacts on air quality as a result of vehicular traffic arising from the operation of the Scheme. The 2018 EIA Update Report for PA/01191/05 estimated that the Annual Average Daily Traffic (AADT) generated was 2,526. A Transport Impact Assessment Update was prepared for the current Scheme. Taking account of the new proposed land uses, the TIA estimated that the AADT from the Scheme is 3,188 - an increase in AADT of 662 vehicles.

7. Construction road traffic has been scoped out of this assessment since this was not requested by ERA (see below).

Legislation and Guidance

8. Guidance on air quality related to traffic emissions in the Maltese context is available in the following national legislation:

- **S.L. 549.59**: *Ambient Air Quality Regulations*.

9. For PM_{10}, the legislation sets an annual limit value of 40 $\mu g/m^3$, and a daily limit value of 50 $\mu g/m^3$ not to be exceeded more than 35 times in a calendar year.

10. The annual mean limit for NO_2 is 40 $\mu g/m^3$, whereas maximum hourly concentrations of NO_2 must not exceed 200 $\mu g/m^3$ – this value cannot be exceeded more than 18 times annually.

ASSESSMENT METHODOLOGY

Terms of Reference

11. Since this is an update to a previous Air Quality Study carried out for development application PA/01191/05 no formal Terms of Reference have been issued by the Environment and Resources Authority (ERA). ERA requested the following:

With respect to Air Quality, in view of the increase in traffic generation due to the proposed changes to the proposed development, the updating of the Air Quality study is deemed necessary, to assess the effects of the said envisaged increase in operational traffic on air quality.

Traffic Data

12. The traffic figures used in this assessment are shown in **Table 1**; the corresponding road links and sensitive receptors are labelled in **Figure 2**. **Figure 2** shows the distribution of traffic from the Scheme and identifies the Area of Study. The Area of Study was selected taking into account the distribution of traffic from the Scheme, and includes the sensitive receptors located on the roads where the increase in AADT due to the Scheme is the highest. The same sensitive receptors that were considered in the 2018 EIA Update Report for PA/01191/05 were selected.

13. The years considered were the base year of operation (year 2028), and the base year of operation plus five years (year 2033). Both years' (base year, and base year + five years) traffic data have been used, since even though traffic flows are predicted to be greater after five years of operation, traffic levels in the base year may have a higher impact on air quality given that emissions from vehicles are reducing with time.

14. The traffic generated by major developments that are approved but not yet operational, and affecting the roads in the Area of Study has been included in the baseline scenario. The following approved development projects are included in the baseline scenario:

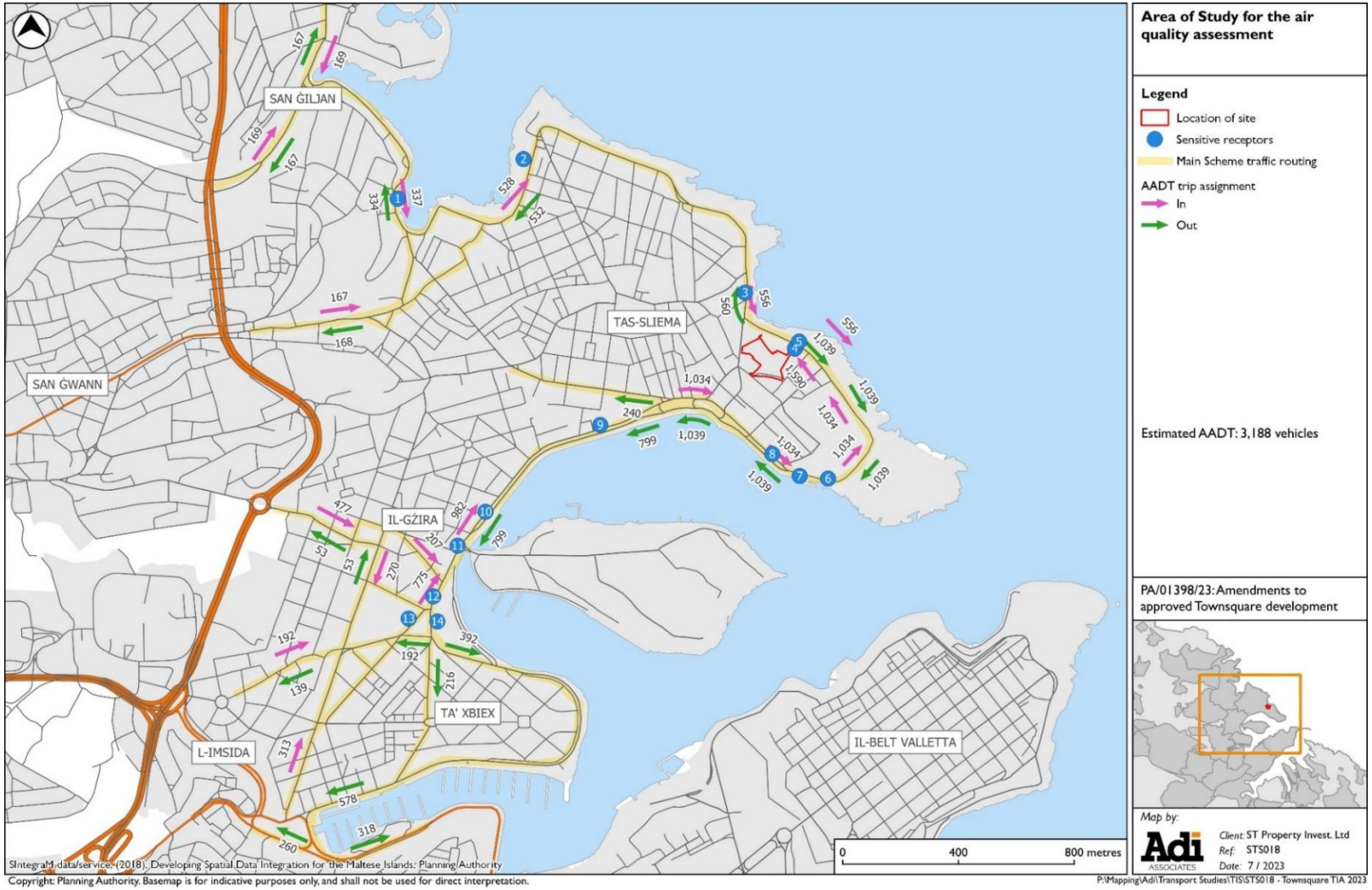
- Metropolis high-rise in Il-Gżira;
- Office development with retail component in Il-Gżira;
- ST Tower in Ta' Xbiex;
- The demolition and extension of the existing Fortina hotel development; and
- Manoel Island redevelopment.

Table 1: Predicted traffic growth

Ref. (Figure 2)	Road link	Committed traffic	AADT (Base year) 2028			AADT (Base year + 5 years) 2033			% Heavy vehicles	Average vehicle speed (km/h)
			Scheme traffic	Baseline (Network + Committed)	Baseline + Scheme	Scheme traffic	Baseline (Network + Committed)	Baseline + Scheme		
1	Triq Censu Tabone (Neptunes waterpolo pitch)	3,075	547	20,349	20,896	671	20,349	21,901	9.7%	30.0
2	Triq it-Torri (Independence garden)	3,075	864	23,763	24,627	1,060	23,763	25,879	9.7%	30.0
3a	Triq it-Torri (N of Pjazzetta junction)	3,075	910	16,558	17,468	1,116	16,558	18,362	7.0%	31.9
3b	Triq it-Torri (S of Pjazzetta junction)	1,141	0	7,232	7,232	0	7,232	7,542	7.0%	31.9
4	Ix-Xatt ta' Qui-Si-Sana (west of STS access)	1,904	910	12,388	13,298	1,116	12,388	14,039	8.8%	32.7
5	Ix-Xatt ta' Qui-Si-Sana (east of STS access)	1,904	2,597	12,388	14,985	3,185	12,388	16,108	8.8%	32.7
6	Ix-Xatt ta' Tigne' (east of Fortina)	2,667	1,691	13,331	15,022	2,073	13,331	15,947	6.8%	29.8
7	Ix-Xatt ta' Tigne' (west of Fortina)	2,912	1,691	13,576	15,267	2,073	13,576	16,192	6.8%	29.8
8	Ix-Xatt ta' Tigne' (Sliema Ferries up to Triq Censu Xerri)	2,912	1,691	20,366	22,057	2,073	20,366	23,329	6.8%	29.8
9	Ix-Xatt (between Triq Bouverie and Sliema Ferries)	3,997	1,495	30,981	32,476	1,833	30,981	34,190	8.0%	40.4
10	Triq ix-Xatt (between Manoel island and Triq Ponsonby)	3,997	1,453	32,608	34,061	1,781	32,608	35,849	8.0%	40.4
11a	Triq ix-Xatt (south of Manoel Island)	5,146	1,453	33,521	34,974	1,781	33,521	36,749	8.0%	40.4
11b	Triq ix-Xatt (Manoel Island arm)	3,827	0	7,245	7,245	0	7,245	7,420	5.1%	30.0
12	Triq ix-Xatt (between Triq il-Gzira and Triq San Gorg)	4,651	1,285	31,746	33,031	1,554	31,746	34,682	8.0%	40.4
13	Triq L-Imsida	2,294	633	15,194	15,827	775	15,194	16,627	6.7%	30.5
14	Triq ix-Xatt (between Triq San Gorg and Triq Il-Gnien)	2,483	652	18,698	19,350	799	18,698	20,324	5.3%	30.0
		Scheme AADT:		2,603 [1]			3,188 [2]			

[1] This AADT is based on the first year of operation, where it is assumed that the offices and the residences are at 50% occupancy.
[2] This AADT is based on the fifth year of operation, where it is assumed that the offices and the residences are at full occupancy.

Figure 2: Area of Study and air sensitive receptors



Baseline Air Quality Study

15. Knowledge of the current baseline air quality is principally required in order to calibrate the air dispersion model (as requested by ERA); dispersion modelling is used to predict future air quality at the Scheme and at the nearest sensitive receptors, both without and with the Scheme.

16. Baseline monitoring was carried out in 2018, as part of the Air Quality Study for the EIA Update Report for PA/01191/05. ERA agreed that this baseline monitoring can be used for this Update Report as long as it takes into consideration the increase in traffic over the years.

17. Monitoring in 2018 was carried out for a period of six weeks, on the following days:

- NO_2: From 20th September to 2nd November 2018; and
- PM_{10}: From 20th September to 24th November 2018.[3]

18. NO_2 was measured using Passam NO_2 passive diffusion monitoring tubes. The equivalence of Passam tubes to the standard chemiluminescence test according to EN 14211:2012 was demonstrated by Pfeffer et al. (2010)[4]. The tubes were supplied by Passam ag, a laboratory accredited to ISO/IEC 17025:2017, and later returned for analysis. The analysis is specifically accredited.

19. Measurement of PM_{10} was carried out in accordance with the reference method EN 12341: 2014. Sampling was carried out using a low-volume sampler equipped with a size selective inlet and drawing in ambient air with a constant flow rate of 2.3 m^3/h over a period of 24 hours per sample. The sampler is a reference sampler for PM_{10} according to EN 12341. Samples were collected on pre-weighed quartz fibre filters supplied by a laboratory accredited to both EN ISO IEC 17025 and EN 12341:2014. After sampling, the filters were conditioned and weighed at the same accredited laboratory. Selected filters were also tested for sodium (Na) and chloride (Cl) using methods UNI EN 14902 2005/EC:2008 and UNI EN ISO 10304-1:2009 and respectively.

[3] There were two interruptions in the electricity supply over the monitoring period, hence the six weeks of data were collected over a longer timeframe. There was also one Saharan dust episode on the days monitored; data from this day was excluded, since in accordance with Directive 2008/50/EC, the Ambient Air Quality Directive, exceedances of air quality limit values are not counted if they are attributable to natural events.
[4] Pfeffer et al. (2010). Calibration of diffusive samplers for nitrogen dioxide using the reference method – Evaluation of measurement uncertainty. *Gefahrstoffe- Reinhaltung der Luft*, 11-12, 500-506.

Modelling

Dispersion Model

20. BREEZE Roads was used to model emissions of NO_x and PM_{10} from traffic under both baseline conditions and conditions when the Scheme will be operational. The years 2028 (base year of operation) and 2033 were used as the reference years.

21. BREEZE Roads was developed in the US and is used extensively in the UK and other countries. It is an air dispersion modelling suite that predicts air quality impacts of a number of pollutants including NO_x and PM. It is specifically designed to model pollutant concentrations that are emitted from moving and idling motor vehicles at or alongside roadways and roadway intersections.

Background Values

22. Urban background values are required since BREEZE Roads only predicts impacts on air quality occurring due to the emissions from traffic. These traffic emissions then need to be added to background air quality levels to predict the overall level of emissions.

23. This Air Quality Update utilises the same background values as the previous study carried out in 2018. This includes:

- NO_2: Value obtained from ERA's urban background monitoring station at Żejtun;
- PM_{10}: Value obtained from ERA's monitoring station at Msida (a traffic site), deconvoluted by ERA into its constituent concentration ranges using the method described by Gomez Losada *et al*., (2015) and Gomez Losada *et al*., (2016) in order to obtain background values.

24. The background is assumed to remain constant throughout the years modelled.

Traffic Emission Factors

25. Emission factors are required to predict emissions from future vehicle fleet compositions. It is assumed that vehicle emission rates are similar to those in the UK and hence the same emission factors were used. These factors are based on a toolkit published by Defra[5] that mirrors the past and present vehicle fleet in the UK. The factors were however, adjusted in line with the age distribution of Maltese fleet compared to the UK fleet.

26. The UK average vehicle age is 8 years, compared to Malta's 15 years.[6] This suggests

[5] The toolkit makes use of emission factors published by the UK Department for Transport (derived from actual vehicle emissions) together with information on fleet composition on different road types. The toolkit is developed by the Highways Agency, AEA, Bureau Veritas and air quality consultants, together with contributions from CERC.

[6] NSO (2020), *Transport Statistics 2019* https://nso.gov.mt/en/nso/Media/Salient-Points-of-Publications/Documents/2021/Transport%20Statistics%202020/Transport_Statistics-2020.pdf. Table 3.2.18.

that currently, the Maltese emission factors are 7 years behind those of the UK. Therefore, the emission factors of the current fleet (2023) are assumed to be equivalent to the UK emission factors of 2016.

27. The dispersion model assumed an average vehicle age of fifteen years, therefore assuming that the current average vehicle age in Malta remains constant; again, this is a conservative approach.

28. The percentage of the predicted concentration of NO_x that is in the form of NO_2 was estimated using UK guidance[7] that takes account of the prevailing background pollutant concentrations.

29. In respect of PM_{10} emissions, the emission factors used also include a contribution from brake and tyre wear. Incorporating the findings of a local study conducted by Scerri *et al.*, 2023[8], the emission factors used in the modelling were adjusted to account for resuspension. To account for resuspension, an emission factor of 0.05 g/veh-km was added, assuming that all the "road dust/crustal" is resuspended PM_{10} due to traffic movement[9].

Meteorological Data

30. Meteorological data used in the 2018 study was obtained from the Malta International Airport.

Sensitive Receptors

31. The principal air sensitive receptors in the Area of Study, taking into account the applicability of air quality objectives (as per UK guidance[10]) are shown in **Table 2** and **Figure 2**.

Table 2: Air sensitive receptors

Point ref. (Figure 2)	Receptor type
1	Triq Censu Tabone (Neptunes waterpolo pitch)
2	Triq it-Torri (Independence Garden)
3	Triq it-Torri (Pjazzetta junction)
4	Ix-Xatt ta' Qui-Si-Sana (west of STS access)
5	Ix-Xatt ta' Qui-Si-Sana (east of STS access)
6	Ix-Xatt ta' Tigne' (east of Fortina)

[7] Defra. *Local Air Quality Management (LAQM) Support.* http://laqm.defra.gov.uk/.
[8] Scerri, M.M., Weinbruch, S., Delmaire, G., Mercieca, N., Nolle, M., Prati, P. and Massabò, D., 2023. Exhaust and non-exhaust contributions from road transport to PM10 at a Southern European traffic site. *Environmental Pollution*, *316*, p.120569.
[9] The revised emission factor of 0.05 g/veh-km was established through a series of discussions with ERA in October 2023 (confirmation email dated 5th October 2023 from Mr Yves De Blick).
[10] Defra (2018) *Local Air Quality Management Technical Guidance LAQM.TG16* https://laqm.defra.gov.uk/documents/LAQM-TG16-February-18-v1.pdf (Box 1.1).

Point ref. (Figure 2)	Receptor type
7	Ix-Xatt ta' Tigne' (west of Fortina)
8	Ix-Xatt ta' Tigne' (Sliema Ferries up to Triq Censu Xerri)
9	Ix-Xatt (between Triq Bouverie and Sliema Ferries)
10	Triq ix-Xatt (between Manoel island and Triq Ponsonby)
11	Triq ix-Xatt (Manoel Island)
12	Triq ix-Xatt (between Triq il-Gzira and Triq San Gorg)
13	Triq L-Imsida
14	Triq ix-Xatt (between Triq San Gorg and Triq Il-Gnien)

Model Calibration

32. The model was calibrated against the monitoring data, in accordance with ERA guidance. This aims to ensure that the resulting total concentration (road traffic plus background) matches the measured concentration at a location that is similar to where predictions are being made.

33. Provided that the model calibration factor used is appropriate for the location of the development, and for future years, this method will provide reliable estimates of the impacts on air quality from the Scheme and reduce uncertainties.

BASELINE AIR QUALITY

Monitoring Data

34. The results of the monitoring over the six-week period (2018) yielded an average of:

- NO_2: 23.1 µg/m^3; and
- PM_{10}: 40 µg/m^3.

35. Using the 2018 scaling factors provided by ERA[11], the following annual averages were calculated:

- NO_2: 21.0 µg/m^3; and
- PM_{10}: 40 µg/m^3.

36. By comparison, the annual limit value for NO_2 and PM_{10} is 40 µg/m^3. Therefore, the measured data indicates that the monitoring location is compliant with the annual limit values for NO_2 and PM_{10}.

37. For NO_2 it is assumed that if the annual mean limit value is not exceeded then the short-term limit value, which allows for 18 exceedances of 200 µg/m^3 as an hourly mean, will also be achieved. Therefore, since the annual mean limit value is not

[11] Mark Scerri (ERA), 29th November 2018. NO_2 factor: 0.91; PM_{10} factor: 1.

exceeded, it is assumed that the allowed number of hourly exceedances is not exceeded either.

38. To predict whether the allowed number of daily exceedances of the PM_{10} limit value is exceeded, an equation provided by ERA[12] was used. This gives a calculated 90.4th percentile of 58 ± 3 µg/m^3, which indicates that at the monitoring location under baseline conditions, the 35 allowed number of exceedances are already exceeded. It is noted that some of the exceedances at the monitoring site could be due to sea spray. Being a natural source, exceedances due to sea spray are not considered as exceedances for the purposes of assessing compliance with legislation. Measurements of sodium (Na) and chloride (Cl) in selected PM_{10} filters indicate an average sea spray concentration of around 3 µg/m^3; however, no deduction for sea spray has been made in this assessment, and this is a conservative approach.

39. Data from ERA's NO_2 diffusion tubes in the Area of Study (SLM4) is presented in **Table 3**; this baseline data has also been used for calibration of the dispersion model. This data again was used in the 2018 Study as it informs the baseline.

Table 3: ERA NO2 diffusion tube data

Code (Figure 1)	NO_2 annual average (µg/m^3)[13]
SLM4	25.5

Background Data

40. The background values used in the dispersion model (obtained as explained above) were as follows:

- NO_2: 14.5 µg/m^3; and
- PM_{10}: 21 µg/m^3.

41. The background values are compliant with the annual and hourly limits for NO_2, and the annual and daily limits for PM_{10}.

Model Calibration

42. The outputs of the dispersion model were added to the background values, and the results calibrated against the baseline monitoring data.

43. A calibration factor of 2.4 was used for NO_2 and PM_{10}. It is common practice in the

[12] PCT = (1.46 × CAA) + 0.03, where:
- PCT = 90.4th percentile of the daily PM_{10} averages (an indicator of the number of exceedances of the PM_{10} daily limit value); and
- CAA = Annual PM_{10} average.

[13] At the time of the 2018 Study, the most recent data for this monitoring point was from 31st August 2017 to 25th August 2018.

UK to assume that the factors that give rise to model under-prediction of NO_2 also apply to PM_{10}. However, using a calibration factor of 2.4 for PM_{10} gave a shortfall of 17.1 µg/m^3; therefore, this amount was also added to all PM_{10} predictions.

44. The output of the calibrated model is identical to the measured data for PM_{10} and is within the 20% threshold stipulated by ERA for NO_2, as shown in **Table 4.**

Table 4: Comparison of calibrated model with measured data

Parameter	Measured concentration (µg/m^3)	Predicted concentration (µg/m^3)	Difference
NO_2: **MP1**	21	22.8	8.57%
NO_2: **SLM5**	25.5	23.32	-8.55%
PM_{10}	40	40	0%

DETERMINING IMPACT SIGNIFICANCE

45. The significance criteria in **Table 5** and **Table 6** were used to assess the significance of impacts arising from traffic generated by the Scheme on air quality[14].

Table 5: Criteria of significance: NO_2 / PM_{10} annual levels

Baseline annual levels of NO_2/PM_{10}	Change in annual NO_2/PM_{10} levels due to Scheme			
	≤0.4 µg/m^3	≥0.8 to <2 µg/m^3	≥2.4 to <4.0 µg/m^3	>4.0 µg/m^3
≥44 µg/m^3	Moderate	Substantial	Substantial	Substantial
41.2 to 43.6 µg/m^3	Moderate	Moderate	Substantial	Substantial
38.0 to 40.8 µg/m^3	Slight	Moderate	Moderate	Substantial
30.4 to 37.6 µg/m^3	Negligible	Slight	Moderate	Moderate
≤30 µg/m^3	Negligible	Negligible	Slight	Moderate

Table 6: Criteria of significance: PM_{10} daily limit exceedances

Baseline PCT[15]		Change in PCT due to Scheme		
	≤0.5 µg/m^3	1.0 to 2.5 µg/m^3	3.0 to 5.0 µg/m^3	>5.0 µg/m^3
≥55 µg/m^3	Moderate	Substantial	Substantial	Substantial
51.5 to 54.5 µg/m^3	Moderate	Moderate	Substantial	Substantial

[14] In additional to these criteria, ERA also provided the recently updated Significance Criteria Tool V1.2 which was used to verify the significance of impacts (Email dated 28th July 2023 by Nolle Michael).
[15] PCT: 90.4th percentile of the daily PM_{10} averages.

Baseline PCT[15]		Change in PCT due to Scheme		
	≤0.5 µg/m³	1.0 to 2.5 µg/m³	3.0 to 5.0 µg/m³	>5.0 µg/m³
47.5 to 51.0 µg/m³	Slight	Moderate	Moderate	Substantial
38.0 to 47.0 µg/m³	Negligible	Slight	Moderate	Moderate
≤37.5 µg/m³	Negligible	Negligible	Slight	Moderate

ASSESSMENT OF IMPACTS

46. **Table 7** to **Table 9** compare the predicted air quality in 2028 and 2033 at the sensitive receptors in the baseline scenario to the air quality with the Scheme.

47. The data in these tables is based on the calibrated model and includes background air quality levels. The output of the dispersion model is presented in **Appendix 1**.

48. The results show that the impact from Scheme traffic on NO_2 annual ambient air concentrations, using the significance criteria provided by ERA, is negligible at all the sensitive receptors in both the base year scenario and in the base year + 5 years scenario.

49. The annual mean limit value of 40 µg/m³ for NO_2 is complied with at all receptors in the base year, as well as the base year + 5 years scenario. This suggests that at these receptors the short-term limit value, which allows for 18 exceedances of 200 µg/m³ as an hourly mean, will also be achieved.

50. With respect to PM_{10} ambient air concentrations, the model shows that the impact from Scheme traffic on the PM_{10} annual average concentrations ranges from negligible to slight in both years considered.

51. The model shows that the impact from Scheme traffic on the number of exceedances of the PM_{10} daily average limit value is negligible to moderate in both years considered.

52. The model also predicts that the PM_{10} daily limit values will be exceeded at all receptors considered, even in the baseline (without Scheme) scenarios. The PM_{10} annual limit value will be exceeded at receptors 1, 2, 4, 5, 8, 9, 10, 11, 12 even in the baseline (without Scheme) scenario.

53. Contour plots are presented in **Figure 3** and **Figure 4**, to compare the predicted air quality in 2028 and 2033 in the baseline scenario to the air quality with the Scheme.

Table 7: Predicted NO_2 annual average concentrations ($\mu g/m^3$) [16]

Year:	2028 (base year of operation)				2033 (base year + 5 years)			
Receptor	**Baseline**	**Baseline plus Scheme**	**Change as a result of Scheme**	**Impact**	**Baseline**	**Baseline plus Scheme**	**Change as a result of Scheme**	**Impact**
1) Triq Censu Tabone (Neptunes waterpolo pitch)	22.31	22.44	0.13	Negligible	20.21	20.30	0.10	Negligible
2) Triq it-Torri (Independence garden)	21.96	22.13	0.17	Negligible	19.99	20.11	0.12	Negligible
3) Triq it-Torri (Pjazzetta junction)	19.22	19.35	0.13	Negligible	18.34	18.43	0.09	Negligible
4) Ix-Xatt ta' Qui-Si-Sana (west of STS access)	20.49	21.04	0.55	Negligible	19.10	19.50	0.40	Negligible
5) Ix-Xatt ta' Qui-Si-Sana (east of STS access)	20.63	21.21	0.58	Negligible	19.19	19.60	0.42	Negligible
6) Ix-Xatt ta' Tigne' (east of Fortina)	19.67	19.94	0.27	Negligible	18.62	18.81	0.20	Negligible
7) Ix-Xatt ta' Tigne' (west of Fortina)	20.33	20.64	0.31	Negligible	19.03	19.26	0.23	Negligible
8) Ix-Xatt ta' Tigne' (Sliema Ferries up to Triq Censu Xerri)	21.76	22.10	0.34	Negligible	19.93	20.18	0.26	Negligible
9) Ix-Xatt (between Triq Bouverie and Sliema Ferries)	21.57	21.77	0.20	Negligible	19.79	19.93	0.15	Negligible
10) Triq ix-Xatt (between Manoel island and Triq Ponsonby)	21.02	21.19	0.16	Negligible	19.45	19.56	0.12	Negligible
11) Triq ix-Xatt (Manoel Island)	21.62	21.80	0.17	Negligible	19.82	19.95	0.13	Negligible
12) Triq ix-Xatt (between Triq il-Gzira and Triq San Gorg)	20.98	21.12	0.15	Negligible	19.42	19.52	0.11	Negligible
13) Triq L-Imsida	19.20	19.28	0.08	Negligible	18.33	18.40	0.06	Negligible
14) Triq ix-Xatt (between Triq San Gorg and Triq Il-Gnien)	20.05	20.16	0.11	Negligible	18.88	18.95	0.08	Negligible

[16] Any discrepancies observed when deducting the *Baseline plus Scheme* values from the *Baseline* values are due to rounded figures having been presented in these Tables. However, the change in air quality is calculated using the original unrounded figures.

Table 8: Predicted PM_{10} annual average concentrations ($\mu g/m^3$) [17]

Year:	2028 (base year of operation)				2033 (base year + 5 years)			
Receptor	**Baseline**	**Baseline plus Scheme**	**Change as a result of Scheme**	**Impact**	**Baseline**	**Baseline plus Scheme**	**Change as a result of Scheme**	**Impact**
1) Triq Censu Tabone (Neptunes waterpolo pitch)	41.27	41.36	0.09	Negligible	41.39	41.49	0.11	Negligible
2) Triq it-Torri (Independence garden)	41.04	41.15	0.11	Negligible	41.15	41.28	0.13	Negligible
3) Triq it-Torri (Pjazzetta junction)	39.43	39.51	0.08	Negligible	39.46	39.56	0.10	Negligible
4) Ix-Xatt ta' Qui-Si-Sana (west of STS access)	40.24	40.61	0.37	Slight	40.30	40.75	0.45	Slight
5) Ix-Xatt ta' Qui-Si-Sana (east of STS access)	40.33	40.72	0.39	Slight	40.39	40.87	0.48	Slight
6) Ix-Xatt ta' Tigne' (east of Fortina)	39.70	39.87	0.18	Negligible	39.73	39.94	0.21	Slight
7) Ix-Xatt ta' Tigne' (west of Fortina)	40.14	40.34	0.21	Slight	40.18	40.43	0.25	Slight
8) Ix-Xatt ta' Tigne' (Sliema Ferries up to Triq Censu Xerri)	41.11	41.36	0.24	Slight	41.18	41.48	0.29	Moderate
9) Ix-Xatt (between Triq Bouverie and Sliema Ferries)	41.31	41.47	0.16	Negligible	41.41	41.60	0.19	Negligible
10) Triq ix-Xatt (between Manoel island and Triq Ponsonby)	40.90	41.02	0.12	Negligible	40.98	41.14	0.15	Negligible
11) Triq ix-Xatt (Manoel Island)	41.36	41.50	0.14	Negligible	41.45	41.62	0.17	Negligible
12) Triq ix-Xatt (between Triq il-Gzira and Triq San Gorg)	40.84	40.95	0.11	Negligible	40.92	41.05	0.13	Negligible
13) Triq L-Imsida	39.41	39.46	0.05	Negligible	39.46	39.52	0.07	Negligible
14) Triq ix-Xatt (between Triq San Gorg and Triq Il-Gnien)	40.00	40.07	0.07	Negligible	40.06	40.14	0.09	Negligible

[17] Exceedances of the limit values are in red.

Table 9: Predicted PM_{10} 90.4th percentile of daily PM_{10} levels [18]

Year:	2028 (base year of operation)				2033 (base year + 5 years)			
Receptor	**Baseline**	**Baseline plus Scheme**	**Change as a result of Scheme**	**Impact**	**Baseline**	**Baseline plus Scheme**	**Change as a result of Scheme**	**Impact**
1) Triq Censu Tabone (Neptunes waterpolo pitch)	60.28	60.41	0.13	Negligible	60.45	60.61	0.16	Negligible
2) Triq it-Torri (Independence garden)	59.95	60.11	0.16	Negligible	60.11	60.30	0.19	Negligible
3) Triq it-Torri (Pjazzetta junction)	57.60	57.72	0.12	Negligible	57.65	57.79	0.14	Negligible
4) Ix-Xatt ta' Qui-Si-Sana (west of STS access)	58.78	59.32	0.54	Moderate	58.87	59.52	0.66	Moderate
5) Ix-Xatt ta' Qui-Si-Sana (east of STS access)	58.91	59.48	0.57	Moderate	59.01	59.70	0.69	Moderate
6) Ix-Xatt ta' Tigne' (east of Fortina)	57.99	58.25	0.26	Moderate	58.04	58.35	0.31	Moderate
7) Ix-Xatt ta' Tigne' (west of Fortina)	58.63	58.93	0.30	Moderate	58.69	59.06	0.36	Moderate
8) Ix-Xatt ta' Tigne' (Sliema Ferries up to Triq Censu Xerri)	60.06	60.41	0.36	Moderate	60.16	60.59	0.43	Moderate
9) Ix-Xatt (between Triq Bouverie and Sliema Ferries)	60.35	60.58	0.23	Negligible	60.49	60.77	0.28	Moderate
10) Triq ix-Xatt (between Manoel island and Triq Ponsonby)	59.74	59.92	0.18	Negligible	59.87	60.09	0.22	Negligible
11) Triq ix-Xatt (Manoel Island)	60.41	60.61	0.20	Negligible	60.55	60.79	0.24	Negligible
12) Triq ix-Xatt (between Triq il-Gzira and Triq San Gorg)	59.66	59.82	0.16	Negligible	59.77	59.97	0.20	Negligible
13) Triq L-Imsida	57.57	57.65	0.08	Negligible	57.63	57.73	0.10	Negligible
14) Triq ix-Xatt (between Triq San Gorg and Triq Il-Gnien)	58.42	58.53	0.11	Negligible	58.51	58.64	0.13	Negligible

[18] Using the equation provided by ERA: PCT = (1.46×CAA) + 0.03. Any discrepancies noted when applying this formula to the PM_{10} annual average results are due to rounded figures having been presented in Table 9. However, the calculation is carried out using the original unrounded figures.

Figure 3: Contour plots - NO2 annual average

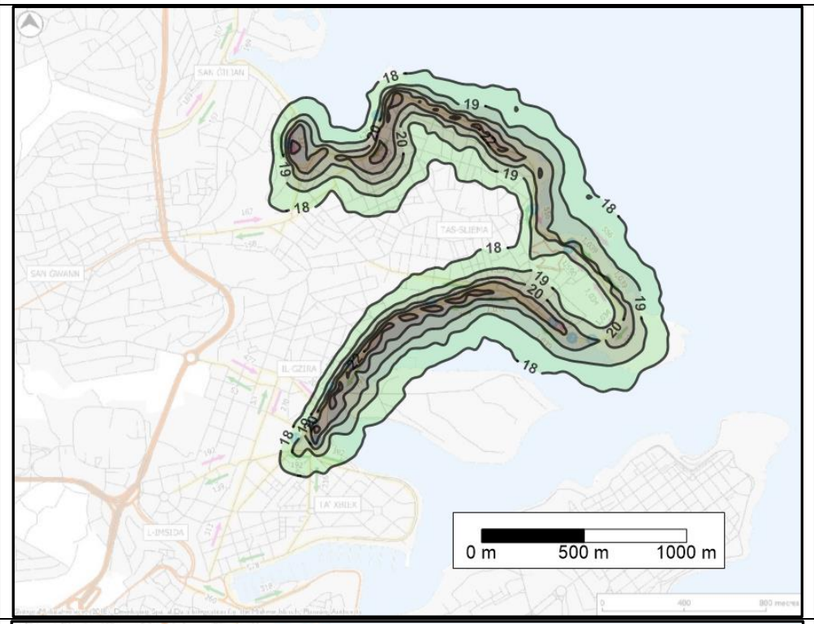
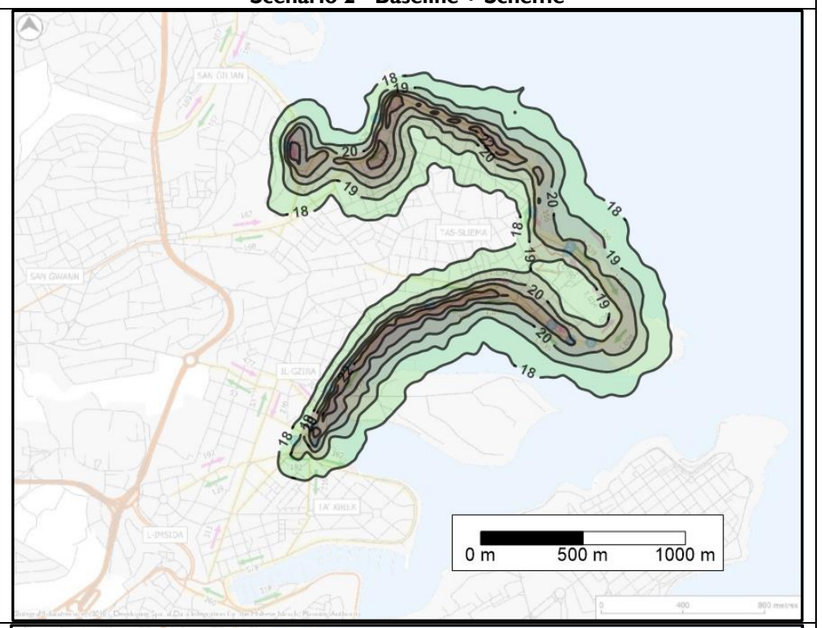
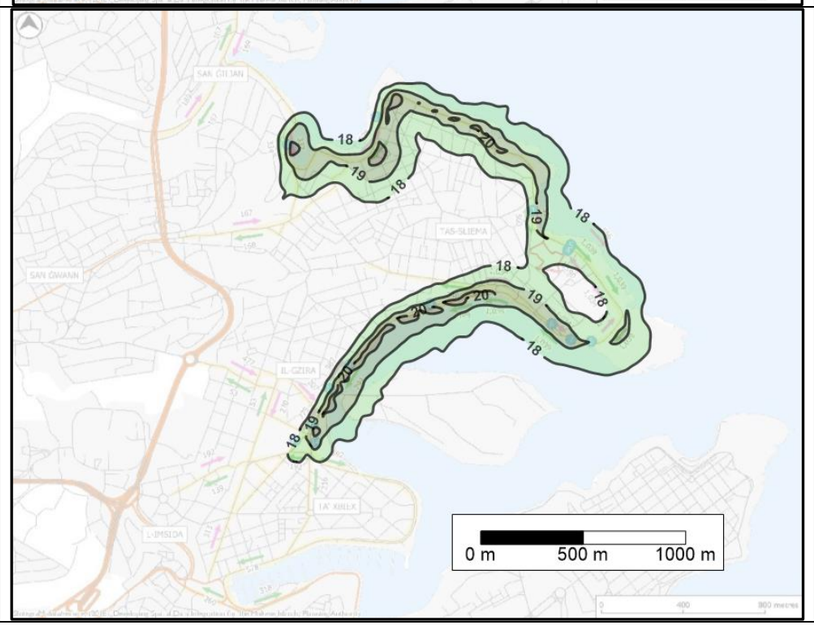
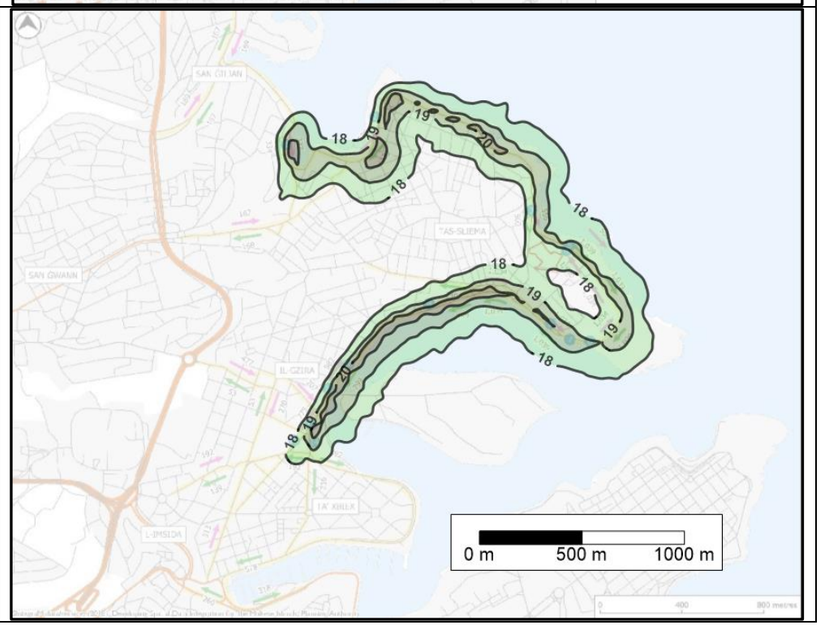
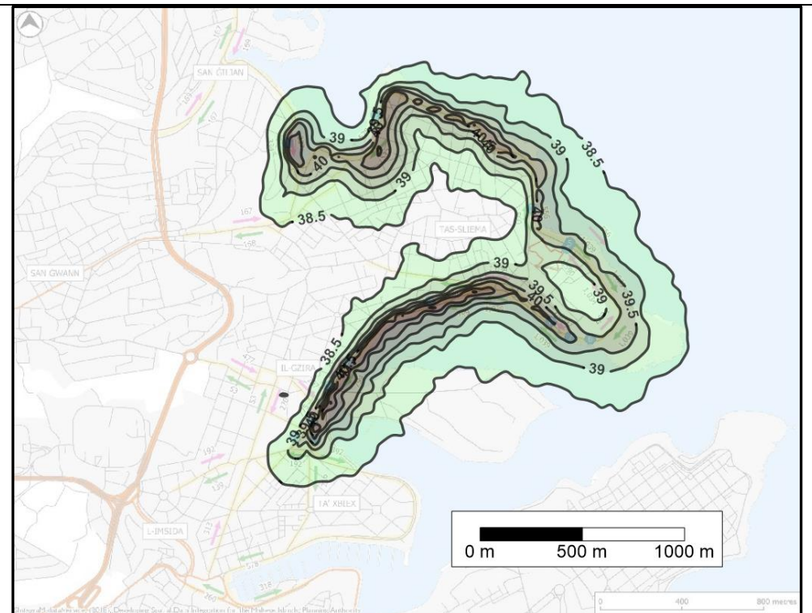
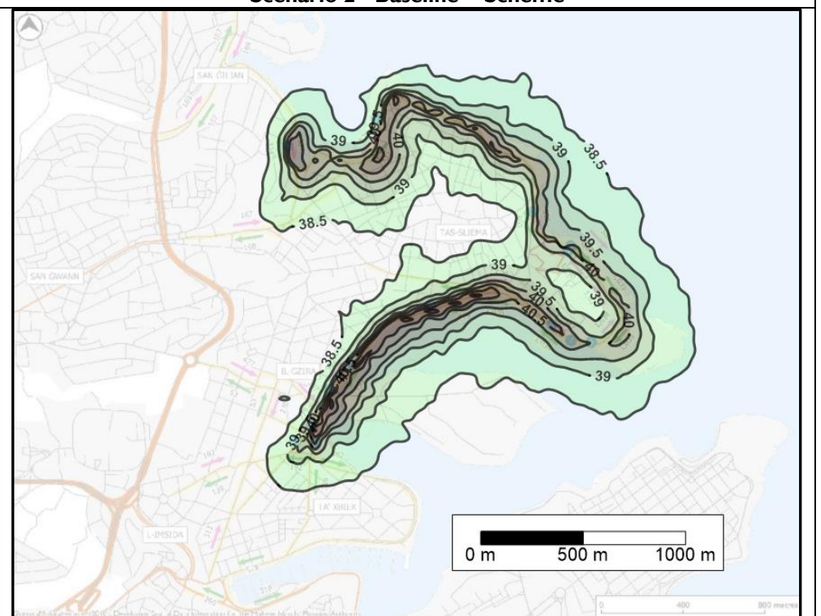
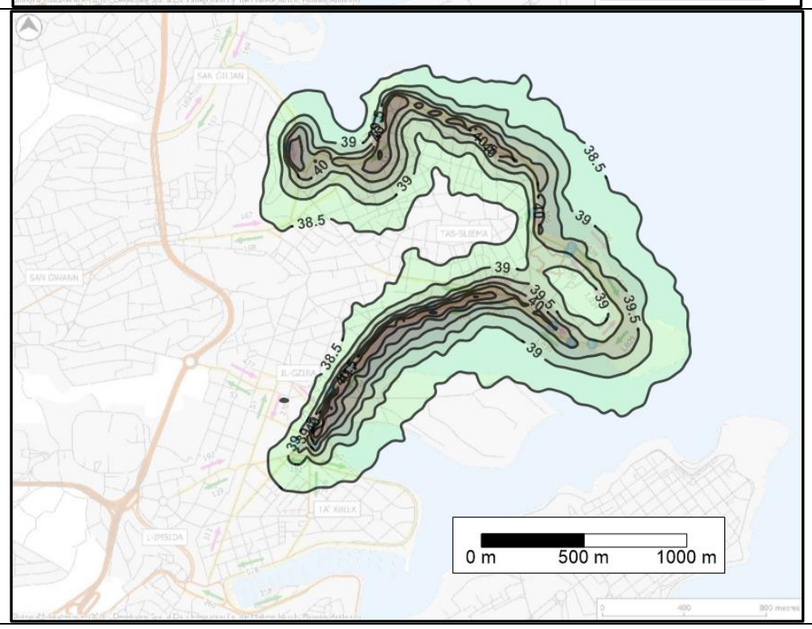
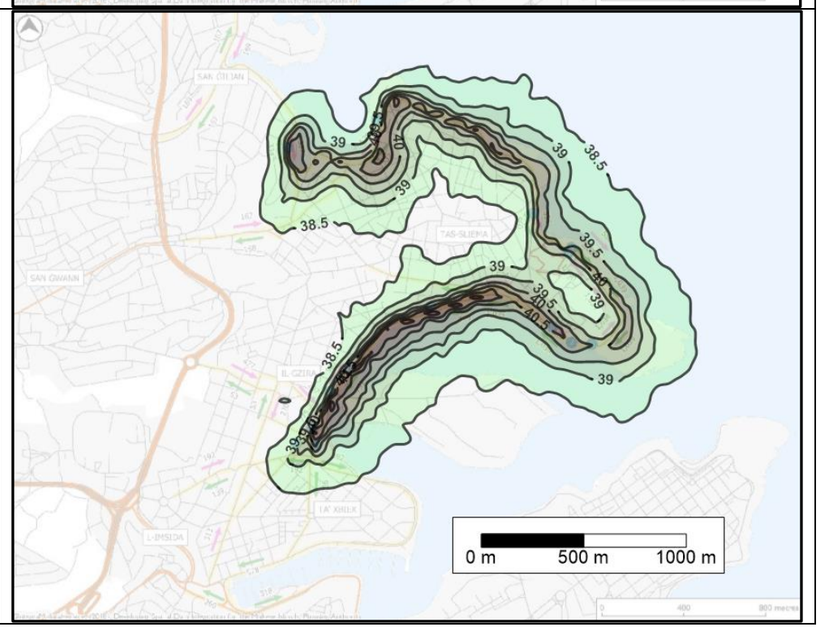
Year	Scenario 1 - Baseline	Scenario 2 - Baseline + Scheme
2028		
2033		

Figure 4: Contour plots – PM10 annual average

Year	Scenario 1 - Baseline	Scenario 2 - Baseline + Scheme
2028		
2033		

MITIGATION

54. A Green Transport Plan has been prepared for the Scheme, which comprises a number of measures and a financial commitment towards their implementation for an overall aim to shift the mode of travel of site employees and visitors away from single occupancy passenger cars. The measures include:

- The setting up of a Green Transport Plan Sub-Committee, including a Transport Coordinator;
- Promoting the use of public transportation, including through an information campaign and subsidising public transport expenses incurred by management and staff;
- Establishing A *Guaranteed Emergency Ride Home Policy* where the employer will offer to finance or part-finance a trip home in the event of a family emergency or unforeseen problems when staff use alternative means to go to work;
- Providing financial incentives for staff to use alternative modes of travel;
- Provision of shower and changing facilities for employees who walk or cycle to work, as well as safe bicycle racks;
- Establishing a car-sharing database and online tool to promote carpooling amongst employees, with dedicated parking for carpooling employees;
- Installation of electrical charging points;
- Organizing collective private transport service for employees; and
- Considering flexi-time and working from home policies for staff.

55. It is anticipated that the measures in this Plan will be beneficial from an air quality perspective; impacts are quantified below.

Impact Assessment following implementation of the GTP

56. **Table 10** shows how the AADT is reduced as a result of the implementation of the GTP. It is noted that the GTP targets are not applied to residents, shoppers and visitors since the applicable measures are limited. The targets are therefore applied to office workers and other employees in the various retail and F&B outlets, and the hotel.

57. **Table 11** to **Table 13** show the impact assessment following the implementation of the Green Transport Plan. The tables were computed following a reduction in AADT as a result of the implementation of GTP measures and the targets described in the GTP.

Table 10: The AADT before and after the implementation of the Green Transport Plan.

Ref. (Figure 2)	Road link	Committed traffic	AADT (Base year + 5 years) 2033			AADT (Base year + 5 years) 2033 (Implementation of the GTP)			% Heavy vehicles	Average vehicle speed (km/h)
			Scheme traffic	Baseline (Network + Committed)	Baseline + Scheme	Scheme traffic	Baseline (Network + Committed)	Baseline + Scheme		
1	Triq Censu Tabone (Neptunes waterpolo pitch)	3,075	671	20,349	21,901	655	21,230	21,885	9.7%	30.0
2	Triq it-Torri (Independence garden)	3,075	1,060	23,763	25,879	1,034	24,819	25,853	9.7%	30.0
3a	Triq it-Torri (N of Pjazzetta junction)	3,075	1,116	16,558	18,362	1,088	17,246	18,334	7.0%	31.9
3b	Triq it-Torri (S of Pjazzetta junction)	1,141	0	7,232	7,542	0	7,542	7,542	7.0%	31.9
4	Ix-Xatt ta' Qui-Si-Sana (west of STS access)	1,904	1,116	12,388	14,039	1,088	12,923	14,011	8.8%	32.7
5	Ix-Xatt ta' Qui-Si-Sana (east of STS access)	1,904	3,185	12,388	16,108	3,106	12,923	16,029	8.8%	32.7
6	Ix-Xatt ta' Tigne' (east of Fortina)	2,667	2,073	13,331	15,947	2,022	13,874	15,896	6.8%	29.8
7	Ix-Xatt ta' Tigne' (west of Fortina)	2,912	2,073	13,576	16,192	2,022	14,119	16,141	6.8%	29.8
8	Ix-Xatt ta' Tigne' (Sliema Ferries up to Triq Censu Xerri)	2,912	2,073	20,366	23,329	2,022	21,256	23,278	6.8%	29.8
9	Ix-Xatt (between Triq Bouverie and Sliema Ferries)	3,997	1,833	30,981	34,190	1,788	32,357	34,145	8.0%	40.4
10	Triq ix-Xatt (between Manoel island and Triq Ponsonby)	3,997	1,781	32,608	35,849	1,738	34,068	35,806	8.0%	40.4
11a	Triq ix-Xatt (south of Manoel Island)	5,146	1,781	33,521	36,749	1,738	34,968	36,706	8.0%	40.4
11b	Triq ix-Xatt (Manoel Island arm)	3,827	0	7,245	7,420	0	7,420	7,420	5.1%	30.0
12	Triq ix-Xatt (between Triq il-Gzira and Triq San Gorg)	4,651	1,554	31,746	34,682	1,536	33,128	34,664	8.0%	40.4
13	Triq L-Imsida	2,294	775	15,194	16,627	757	15,852	16,609	6.7%	30.5
14	Triq ix-Xatt (between Triq San Gorg and Triq Il-Gnien)	2,483	799	18,698	20,324	779	19,525	20,304	5.3%	30.0
		Scheme AADT:		3,188 [19]			3,112			

[19] This AADT is based on the fifth year of operation, where it is assumed that the offices and the residences are at full occupancy.

RESIDUAL IMPACTS

58. Although the implementation of a Green Transport Plan is likely to have positive impacts on air quality, the residual impact on air quality remains the same so the residual impact remains unchanged.

59. Impacts on air quality are summarised in **Table 14**.

Table 11: Predicted NO2 annual average concentrations following GTP implementation (µg/m3)

Year:	2028 (base year of operation)				2033 (base year + 5 years)			
Receptor	**Baseline**	**Baseline plus Scheme**	**Change as a result of Scheme**	**Impact**	**Baseline**	**Baseline plus Scheme**	**Change as a result of Scheme**	**Impact**
1) Triq Censu Tabone (Neptunes waterpolo pitch)	22.31	22.44	0.13	Negligible	20.21	20.30	0.10	Negligible
2) Triq it-Torri (Independence garden)	21.96	22.13	0.17	Negligible	19.99	20.11	0.12	Negligible
3) Triq it-Torri (Pjazzetta junction)	19.22	19.35	0.13	Negligible	18.34	18.43	0.09	Negligible
4) Ix-Xatt ta' Qui-Si-Sana (west of STS access)	20.49	21.04	0.55	Negligible	19.10	19.50	0.40	Negligible
5) Ix-Xatt ta' Qui-Si-Sana (east of STS access)	20.63	21.21	0.58	Negligible	19.19	19.60	0.42	Negligible
6) Ix-Xatt ta' Tigne' (east of Fortina)	19.67	19.94	0.27	Negligible	18.62	18.81	0.20	Negligible
7) Ix-Xatt ta' Tigne' (west of Fortina)	20.33	20.64	0.31	Negligible	19.03	19.26	0.23	Negligible
8) Ix-Xatt ta' Tigne' (Sliema Ferries up to Triq Censu Xerri)	21.76	22.10	0.34	Negligible	19.93	20.18	0.26	Negligible
9) Ix-Xatt (between Triq Bouverie and Sliema Ferries)	21.57	21.77	0.20	Negligible	19.79	19.93	0.15	Negligible
10) Triq ix-Xatt (between Manoel island and Triq Ponsonby)	21.02	21.19	0.16	Negligible	19.45	19.56	0.12	Negligible
11) Triq ix-Xatt (Manoel Island)	21.62	21.80	0.17	Negligible	19.82	19.95	0.13	Negligible
12) Triq ix-Xatt (between Triq il-Gzira and Triq San Gorg)	20.98	21.12	0.15	Negligible	19.42	19.52	0.11	Negligible
13) Triq L-Imsida	19.20	19.28	0.08	Negligible	18.33	18.40	0.06	Negligible
14) Triq ix-Xatt (between Triq San Gorg and Triq Il-Gnien)	20.05	20.16	0.11	Negligible	18.88	18.95	0.08	Negligible

Table 12: Predicted PM_{10} annual average concentrations following GTP implementation ($\mu g/m^3$) [20]

Year:	2028 (base year of operation)				2033 (base year + 5 years)			
Receptor	**Baseline**	**Baseline plus Scheme**	**Change as a result of Scheme**	**Impact**	**Baseline**	**Baseline plus Scheme**	**Change as a result of Scheme**	**Impact**
1) Triq Censu Tabone (Neptunes waterpolo pitch)	41.27	41.36	0.09	Negligible	41.39	41.49	0.11	Negligible
2) Triq it-Torri (Independence garden)	41.04	41.15	0.11	Negligible	41.15	41.28	0.13	Negligible
3) Triq it-Torri (Pjazzetta junction)	39.43	39.51	0.08	Negligible	39.46	39.56	0.10	Negligible
4) Ix-Xatt ta' Qui-Si-Sana (west of STS access)	40.24	40.61	0.37	Slight	40.30	40.74	0.44	Slight
5) Ix-Xatt ta' Qui-Si-Sana (east of STS access)	40.33	40.72	0.39	Slight	40.39	40.86	0.46	Slight
6) Ix-Xatt ta' Tigne' (east of Fortina)	39.70	39.87	0.18	Negligible	39.73	39.94	0.21	Slight
7) Ix-Xatt ta' Tigne' (west of Fortina)	40.14	40.34	0.21	Slight	40.18	40.42	0.24	Slight
8) Ix-Xatt ta' Tigne' (Sliema Ferries up to Triq Censu Xerri)	41.11	41.36	0.24	Slight	41.18	41.47	0.29	Moderate
9) Ix-Xatt (between Triq Bouverie and Sliema Ferries)	41.31	41.47	0.16	Negligible	41.41	41.60	0.19	Negligible
10) Triq ix-Xatt (between Manoel island and Triq Ponsonby)	40.90	41.02	0.12	Negligible	40.98	41.13	0.15	Negligible
11) Triq ix-Xatt (Manoel Island)	41.36	41.50	0.14	Negligible	41.45	41.61	0.16	Negligible
12) Triq ix-Xatt (between Triq il-Gzira and Triq San Gorg)	40.84	40.95	0.11	Negligible	40.92	41.05	0.13	Negligible
13) Triq L-Imsida	39.41	39.46	0.05	Negligible	39.46	39.52	0.07	Negligible
14) Triq ix-Xatt (between Triq San Gorg and Triq Il-Gnien)	40.00	40.07	0.07	Negligible	40.06	40.14	0.09	Negligible

[20] Exceedances of the limit values are in red.

Table 13: Predicted PM_{10} 90.4th percentile of daily PM_{10} levels following GTP implementation [21]

Year:	2028 (base year of operation)				2033 (base year + 5 years)			
Receptor	**Baseline**	**Baseline plus Scheme**	**Change as a result of Scheme**	**Impact**	**Baseline**	**Baseline plus Scheme**	**Change as a result of Scheme**	**Impact**
1) Triq Censu Tabone (Neptunes waterpolo pitch)	60.28	60.41	0.13	Negligible	60.45	60.61	0.16	Negligible
2) Triq it-Torri (Independence garden)	59.95	60.11	0.16	Negligible	60.11	60.30	0.19	Negligible
3) Triq it-Torri (Pjazzetta junction)	57.60	57.72	0.12	Negligible	57.65	57.79	0.14	Negligible
4) Ix-Xatt ta' Qui-Si-Sana (west of STS access)	58.78	59.32	0.54	Moderate	58.87	59.51	0.64	Moderate
5) Ix-Xatt ta' Qui-Si-Sana (east of STS access)	58.91	59.48	0.57	Moderate	59.01	59.68	0.68	Moderate
6) Ix-Xatt ta' Tigne' (east of Fortina)	57.99	58.25	0.26	Moderate	58.04	58.35	0.31	Moderate
7) Ix-Xatt ta' Tigne' (west of Fortina)	58.63	58.93	0.30	Moderate	58.69	59.05	0.36	Moderate
8) Ix-Xatt ta' Tigne' (Sliema Ferries up to Triq Censu Xerri)	60.06	60.41	0.36	Moderate	60.16	60.58	0.42	Moderate
9) Ix-Xatt (between Triq Bouverie and Sliema Ferries)	60.35	60.58	0.23	Negligible	60.49	60.77	0.28	Moderate
10) Triq ix-Xatt (between Manoel island and Triq Ponsonby)	59.74	59.92	0.18	Negligible	59.87	60.08	0.21	Negligible
11) Triq ix-Xatt (Manoel Island)	60.41	60.61	0.20	Negligible	60.55	60.78	0.24	Negligible
12) Triq ix-Xatt (between Triq il-Gzira and Triq San Gorg)	59.66	59.82	0.16	Negligible	59.77	59.97	0.20	Negligible
13) Triq L-Imsida	57.57	57.65	0.08	Negligible	57.63	57.73	0.10	Negligible
14) Triq ix-Xatt (between Triq San Gorg and Triq Il-Gnien)	58.42	58.53	0.11	Negligible	58.51	58.64	0.13	Negligible

Table 14: Summary of impacts on air quality

Predicted Impact	Beneficial / Adverse / Neutral	Nature, scale and type of impact						Probability of impact occurring	Significance of impact	Proposed mitigation measures	Significance of residual impact
		Const'n / Oper'n	Extent of impact (Nat / Local / Site)	Direct / Indirect	S-term / L-term	Perm / Temp	Revers / Irrevers	(Likely / Unlikely / Remote / Uncertain)	(Major / Moderate / Minor / Not significant)		(Major / Moderate / Minor / Not significant)
Impact of vehicle emissions on sensitive receptors – change in NO_2 annual average	Adverse	Oper'n	Local	Direct	L-term	Perm	Irrevers	Likely	**Not significant** (all receptors and scenarios, years 2028 and 2033)	Green Transport Plan	Not significant
Impact of vehicle emissions on sensitive receptors – change in PM_{10} annual average	Adverse	Oper'n	Local	Direct	L-term	Perm	Irrevers	Likely	**Minor** at receptors: • 4 (2028 & 2033) • 5 (2028 & 2033) • 6 (2033) • 7 (2028 & 2033) • 8 (2028 **Not significant**: Other receptors / years considered	Green Transport Plan	Not significant to Minor

Predicted Impact	Beneficial / Adverse / Neutral	Nature, scale and type of impact						Probability of impact occurring	Significance of impact	Proposed mitigation measures	Significance of residual impact
		Const'n / Oper'n	Extent of impact (Nat / Local / Site)	Direct / Indirect	S-term / L-term	Perm / Temp	Revers / Irrevers	(Likely / Unlikely / Remote / Uncertain)	(Major / Moderate / Minor / Not significant)		(Major / Moderate / Minor / Not significant)
Impact of vehicle emissions on sensitive receptors – change in number of daily PM_{10} exceedances	Adverse	Oper'n	Local	Direct	L-term	Perm	Irrevers	Likely	**Moderate** at receptors • 4 (2028 & 2033) • 5 (2028 & 2033) • 6 (2028 & 2033) • 7 (2028 & 2033) • 8 (2028 & 2033) • 9 (2033) **Not significant**: Other receptors / years	Green Transport Plan	Not significant to moderate

Appendix 1: Air Dispersion Model

BREEZE ROADs Modelling
STS017 (update of STS014 and STS011)
ADM Ltd Project P2308 (Update of P2118 and P1820)
July 2023

Calibration

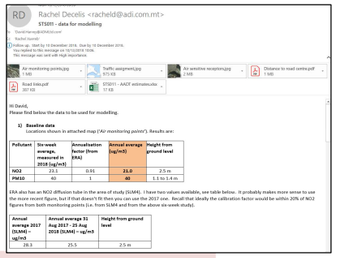
Calibration Factor for NOx and PM10	2.4	
Additional amount to be added to PM1	17.1	µg/m3

PM10 offset is 0.3 less than STS011 due to resuspension

This colour indicates change from from V2

UK average vehicle age	8	years
Maltese average vehicle age	15	years

Mark Scerri Factor	**µg/m3**	**%**	**%**	
Exhaust	1.5	3.4	3.4%	**Ratio (Road dust&crustal)/(Exhaust+tire&brake))**
Tire/Brake	7.3	17.0	16.6%	0.90
Road dust/crustal (resuspension)	7.9	18.0	18.0%	
Total	**44.0**			


Rachel Decelis <racheld@adl.com.mt>
STS011 – data for modelling

Hi David,
Please find below the data to be used for modelling.

1) **Baseline data**
Locations shown in attached map ('Air monitoring points'). Results are:

Pollutant	Site-result averaged, validated in 2018 (ug/m3)	Annualisation factor (from KRA)	Annual average (ug/m3)	Height from ground level
NO2	23.1	0.91	21.0	2.5 m
PM10	40	1	40	1.1 to 1.4 m

KRA also has an NO2 diffusion tube in the area of study (SLM4). I have two values available, see table below. It probably makes more sense to use the more recent figure, but if that doesn't fit then you can use the 2017 one. Recall that ideally the calibration factor would be within 20% of NO2 figures from both monitoring points (i.e. from SLM4 and from the above six-week study).

Annual average 2017 (SLM4) – ug/m3	Annual average 31 Aug 2017 - 29 Aug 2018 (SLM4) – ug/m3	Height from ground level
28.3	25.5	2.5 m

Oct 23: This methed amended. The relationship is used to calculate the maximum resuspension and then value used for all lin
Note: PM10 emission rates from Defra are for emissions+tryres+brakes+abrasion

Emissions assumes:

				Year
UK	8	Years Old	Model	2018
Maltese	15	Years Old	Emissions	2011

from: EFT2012_v5.1.3.xls

for calibratoin		**2018**			**Emission (g/Veh-km)**			
No	**Road Link**	**Veh/hr**	**HGV**	**KPH**	**NOx**	**PM10 (exhaust, brake, tyre, abrasion)**	**PM10 (Re-suspension)**	**PM10 Total (inc max resuspension)**
1	Triq Censu Tabone (Neptunes waterpol	645	9.7%	30	1.017	0.058	0.052	0.110
2	Triq it-Torri (Indipendence garden)	780	9.7%	30	1.017	0.058	0.052	0.110
3a	Triq it-Torri (N of Piazzetta junction)	612	7.0%	32	0.823	0.053	0.047	0.105
3b	Triq it-Torri (S of Piazzetta junction)	286	7.0%	32	0.823	0.053	0.047	0.105
4	Ix-Xatt ta' Qui-Si-Sana (west of STS acce	446	8.8%	33	0.914	0.055	0.050	0.107
5	Ix-Xatt ta' Qui-Si-Sana (east of STS acce	446	8.8%	33	0.914	0.055	0.050	0.107
6	Ix-Xatt ta' Tigne' (east of Fortina)	391	6.8%	30	0.843	0.053	0.048	0.105
7	Ix-Xatt ta' Tigne' (west of Fortina)	391	6.8%	30	0.843	0.053	0.048	0.105
8	Ix-Xatt ta' Tigne' (Sliema Ferries up to T	707	6.8%	30	0.843	0.053	0.048	0.105
9	Ix-Xatt (bewteen Triq Bouverie and Slie	1,051	8.0%	40	0.769	0.052	0.047	0.104
10	Triq ix-Xatt (between Manoel island and	1,069	8.0%	40	0.769	0.052	0.047	0.104
11a	Triq ix-Xatt (south of Manoel Island)	1,060	8.0%	40	0.769	0.052	0.047	0.104
11b	Triq ix-Xatt (Manoel Island arm)	128	5.1%	30	0.736	0.050	0.045	0.102
12	Triq ix-Xatt (between Triq il-Gzira and T	1,012	8.0%	40	0.769	0.052	0.047	0.104
13	Triq L-Imsida	487	6.7%	31	0.826	0.053	0.047	0.104
14	Triq ix-Xatt (between Triq San Gorg and	612	5.3%	30	0.748	0.050	0.045	0.102
						Max	**0.052**	

from: EFT2021_v11.0.xls

		Assessment Year		**2028**	**2033**	**2028**		**2033**	
		Emissions Year		**2021**	**2026**	**2021**		**2026**	
Link	**No**	**Road Link**	**HGV**	**KPH**	**NOx**		**PM10**	**PM10 Total**	**PM10**	**PM10 Total**
1	1	Triq Censu Tabone (Neptunes waterpol	9.7%	30	0.420	0.230	0.043	0.094	0.041	0.093
2	2	Triq it-Torri (Indipendence garden)	9.7%	30	0.420	0.230	0.043	0.094	0.041	0.093
3	3a	Triq it-Torri (N of Piazzetta junction)	7.0%	32	0.374	0.210	0.040	0.092	0.038	0.090
4	3b	Triq it-Torri (S of Piazzetta junction)	7.0%	32	0.374	0.210	0.040	0.092	0.038	0.090
5	4	Ix-Xatt ta' Qui-Si-Sana (west of STS acce	8.8%	33	0.390	0.215	0.041	0.093	0.040	0.092
6	5	Ix-Xatt ta' Qui-Si-Sana (east of STS acce	8.8%	33	0.390	0.215	0.041	0.093	0.040	0.092
7	6	Ix-Xatt ta' Tigne' (east of Fortina)	6.8%	30	0.385	0.216	0.040	0.092	0.038	0.090
8	7	Ix-Xatt ta' Tigne' (west of Fortina)	6.8%	30	0.385	0.216	0.040	0.092	0.038	0.090
9	8	Ix-Xatt ta' Tigne' (Sliema Ferries up to T	6.8%	30	0.385	0.216	0.040	0.092	0.038	0.090
10	9	Ix-Xatt (bewteen Triq Bouverie and Slie	8.0%	40	0.340	0.189	0.040	0.092	0.039	0.091
11	10	Triq ix-Xatt (between Manoel island and	8.0%	40	0.340	0.189	0.040	0.092	0.039	0.091
12	11a	Triq ix-Xatt (south of Manoel Island)	8.0%	40	0.340	0.189	0.040	0.092	0.039	0.091
13	11b	Triq ix-Xatt (Manoel Island arm)	5.1%	30	0.363	0.207	0.038	0.090	0.036	0.088
14	12	Triq ix-Xatt (between Triq il-Gzira and T	8.0%	40	0.340	0.189	0.040	0.092	0.039	0.091
15	13	Triq L-Imsida	6.7%	31	0.380	0.213	0.039	0.091	0.038	0.090
16	14	Triq ix-Xatt (between Triq San Gorg and	5.3%	30	0.365	0.208	0.038	0.090	0.037	0.089

Note: total PM10 includes the maximum re-suspension 0.052 g/veh-km)

		AADT				**Veh/hr**			
		2028		**2033**		**2028**		**2033**	
No	**Road Link**	**Scenario 1: Baseline**	**Scenario 2: Baseline plus Scheme**	**Scenario 1: Baseline**	**Scenario 2: Baseline plus Scheme**	**Scenario 1: Baseline**	**Scenario 2: Baseline plus Scheme**	**Scenario 1: Baseline**	**Scenario 2: Baseline plus Scheme**
1	Triq Censu Tabone (Neptunes waterpol	20,349	20,896	21,230	21,901	848	871	885	913
2	Triq it-Torri (Indipendence garden)	23,763	24,627	24,819	25,879	990	1026	1034	1078
3a	Triq it-Torri (N of Piazzetta junction)	16,558	17,468	17,246	18,362	690	728	719	765
3b	Triq it-Torri (S of Piazzetta junction)	7,232	7,232	7,542	7,542	301	301	314	314
4	Ix-Xatt ta' Qui-Si-Sana (west of STS acce	12,388	13,298	12,923	14,039	516	554	538	585
5	Ix-Xatt ta' Qui-Si-Sana (east of STS acce	12,388	14,985	12,923	16,108	516	624	538	671
6	Ix-Xatt ta' Tigne' (east of Fortina)	13,331	15,022	13,874	15,947	555	626	578	664
7	Ix-Xatt ta' Tigne' (west of Fortina)	13,576	15,267	14,119	16,192	566	636	588	675
8	Ix-Xatt ta' Tigne' (Sliema Ferries up to T	20,366	22,057	21,256	23,329	849	919	886	972
9	Ix-Xatt (bewteen Triq Bouverie and Slie	30,981	32,476	32,357	34,190	1291	1353	1348	1425
10	Triq ix-Xatt (between Manoel island and	32,608	34,061	34,068	35,849	1359	1419	1420	1494
11a	Triq ix-Xatt (south of Manoel Island)	33,521	34,974	34,968	36,749	1397	1457	1457	1531
11b	Triq ix-Xatt (Manoel Island arm)	7,245	7,245	7,420	7,420	302	302	309	309
12	Triq ix-Xatt (between Triq il-Gzira and T	31,746	33,031	33,128	34,682	1323	1376	1380	1445
13	Triq L-Imsida	15,194	15,827	15,852	16,627	633	659	661	693
14	Triq ix-Xatt (between Triq San Gorg and	18,698	19,350	19,525	20,324	779	806	814	847

	2018			**2028**				**2033**			
				Baseline	**Scheme**			**Baseline**	**Scheme**		
For the Model	**veh/hr**	**NOx**	**PM10**	**Veh/hr**	**Veh/hr**	**NOx**	**PM10**	**Veh/hr**	**Veh/hr**	**NOx**	**PM10**
Ref 1	645	1.017	0.110	848	871	0.420	0.094	885	913	0.230	0.093
Ref 2	780	1.017	0.110	990	1,026	0.420	0.094	1,034	1078	0.230	0.093
Ref 3a	612	0.823	0.105	690	728	0.374	0.092	719	765	0.210	0.090
Ref 3b	286	0.823	0.105	301	301	0.374	0.092	314	314	0.210	0.090
Ref 4	446	0.914	0.107	516	554	0.390	0.093	538	585	0.215	0.092
Ref 6	391	0.843	0.105	555	626	0.385	0.092	578	664	0.216	0.090
Ref 7	391	0.843	0.105	566	636	0.385	0.092	588	675	0.216	0.090
Ref 8	707	0.843	0.105	849	919	0.385	0.092	886	972	0.216	0.090
Ref 9	1,051	0.769	0.104	1,291	1,353	0.340	0.092	1,348	1425	0.189	0.091
Ref 10	1,069	0.769	0.104	1,359	1,419	0.340	0.092	1,420	1494	0.189	0.091
Ref 11a	1,060	0.769	0.104	1,397	1,457	0.340	0.092	1,457	1531	0.189	0.091
Ref 11b	128	0.736	0.102	302	302	0.363	0.090	309	309	0.207	0.088
Ref 12	1,012	0.769	0.104	1,323	1,376	0.340	0.092	1,380	1445	0.189	0.091
Ref 13	487	0.826	0.104	633	659	0.380	0.091	661	693	0.213	0.090
Ref 14	612	0.748	0.102	779	806	0.365	0.090	814	847	0.208	0.089
Ref 5	446	0.914	0.107	516	624	0.390	0.093	538	671	0.215	0.092

Predictions at Receptors

For Model Calibration

Year	2018

onedrive:\projects\P2308 Sliema Townsquare\ROADs_1 - for NOx
onedrive:\projects\P2308 Sliema Townsquare\ROADs_2 - for PM10

Run No			1	1				
		From Model		**After Calibration**		**Total**		
Receptor		**NOx**	**PM10**	**NOx**	**PM10**	**NOx**	**PM10**	**NO2**
Receptor 1		10.86	1.18	26.07	2.83	47.37	40.9	26.00
Receptor 2		10.41	1.13	24.99	2.71	46.29	40.8	25.68
Receptor 3		4.39	0.55	10.53	1.33	31.83	39.4	21.08
SLM04		7.19	0.89	17.25	2.14	38.55	40.2	23.32
Receptor 4		7.38	0.88	17.72	2.10	39.02	40.2	23.47
Receptor 5		7.71	0.91	18.50	2.20	39.80	40.3	23.72
MP1		6.61	0.78	15.87	1.88	37.17	40.0	22.88
Receptor 6		4.52	0.56	10.85	1.35	32.15	39.5	21.19
Receptor 7		5.87	0.73	14.10	1.76	35.40	39.9	22.29
Receptor 8		9.50	1.19	22.79	2.85	44.09	40.9	25.03
Receptor 9		9.16	1.23	21.99	2.95	43.29	41.0	24.79
Receptor 10		7.67	1.03	18.41	2.48	39.71	40.6	23.69
Receptor 11		8.56	1.15	20.53	2.77	41.83	40.9	24.35
Receptor 12		7.36	0.99	17.66	2.37	38.96	40.5	23.45
Receptor 13		3.75	0.48	9.01	1.15	30.31	39.3	20.54
Receptor 14		5.27	0.70	12.64	1.67	33.94	39.8	21.80

	25.5	91%
	21.0	109%
Measured	**Ratio**	
Average	100%	

	NO2	**PM10**	**NOx**
Background	14.5	21.0	21.3
Monitoring Location	21.0	40.0	
SLM4	25.5		

derived from this relationship for background (DEFRA TG4(00)) NO2 = 1.538 (NOx)^0.73

NOx Calibration Factor	2.4
Addition for PM10	17.1

NOx	**NO2**		**Factors**	
21.3	14.5	**Background**	1.5358	0.7341
21.3	17.0	**Roadside**	3.3931	0.5278

Run No		3	5	7	9
Assessment Year		**2028**		**2033**	
NOx (Road)		**Scenario 1: Baseline**	**Scenario 2: Baseline plus Scheme**	**Scenario 1: Baseline**	**Scenario 2: Baseline plus Scheme**
Receptor					
Receptor 1		5.90	6.06	3.37	3.48
Receptor 2		5.47	5.67	3.13	3.26
Receptor 3		2.26	2.40	1.32	1.41
SLM04		3.58	3.74	2.08	2.19
Receptor 4		3.70	4.35	2.13	2.57
Receptor 5		3.86	4.54	2.22	2.69
MP1		3.32	3.91	1.91	2.31
Receptor 6		2.76	3.07	1.61	1.82
Receptor 7		3.52	3.88	2.05	2.30
Receptor 8		5.22	5.64	3.05	3.34
Receptor 9		4.98	5.22	2.89	3.06
Receptor 10		4.33	4.52	2.51	2.64
Receptor 11		5.05	5.26	2.93	3.07
Receptor 12		4.27	4.44	2.48	2.60
Receptor 13		2.24	2.33	1.31	1.37
Receptor 14		3.19	3.32	1.89	1.97

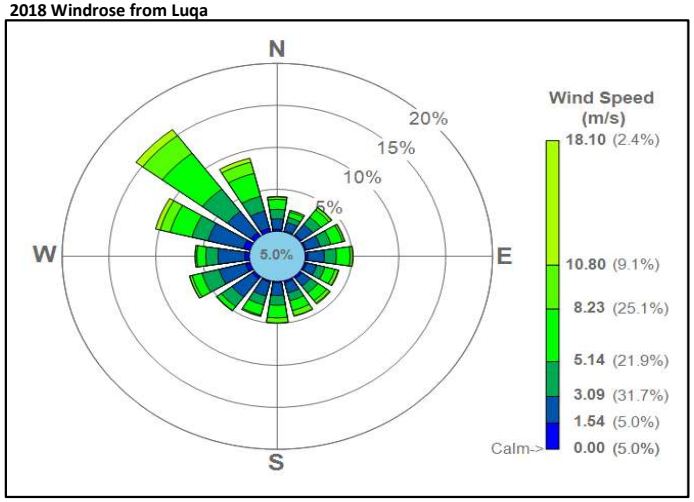
Run No		2	3	4	5
Assessment Year		**2028**		**2033**	
PM10 (Road)		**Scenario 1: Baseline**	**Scenario 2: Baseline plus Scheme**	**Scenario 1: Baseline**	**Scenario 2: Baseline plus Scheme**
Receptor					
Receptor 1		1.32	1.36	1.37	1.41
Receptor 2		1.22	1.27	1.27	1.33
Receptor 3		0.56	0.59	0.57	0.61
SLM04		0.87	0.91	0.90	0.94
Receptor 4		0.89	1.05	0.92	1.10
Receptor 5		0.93	1.09	0.96	1.15
MP1		0.80	0.94	0.82	0.99
Receptor 6		0.67	0.74	0.68	0.77
Receptor 7		0.85	0.93	0.87	0.97
Receptor 8		1.26	1.36	1.29	1.41
Receptor 9		1.34	1.40	1.38	1.46
Receptor 10		1.17	1.22	1.20	1.26
Receptor 11		1.36	1.41	1.40	1.47
Receptor 12		1.14	1.19	1.17	1.23
Receptor 13		0.55	0.57	0.56	0.59
Receptor 14		0.79	0.82	0.82	0.85

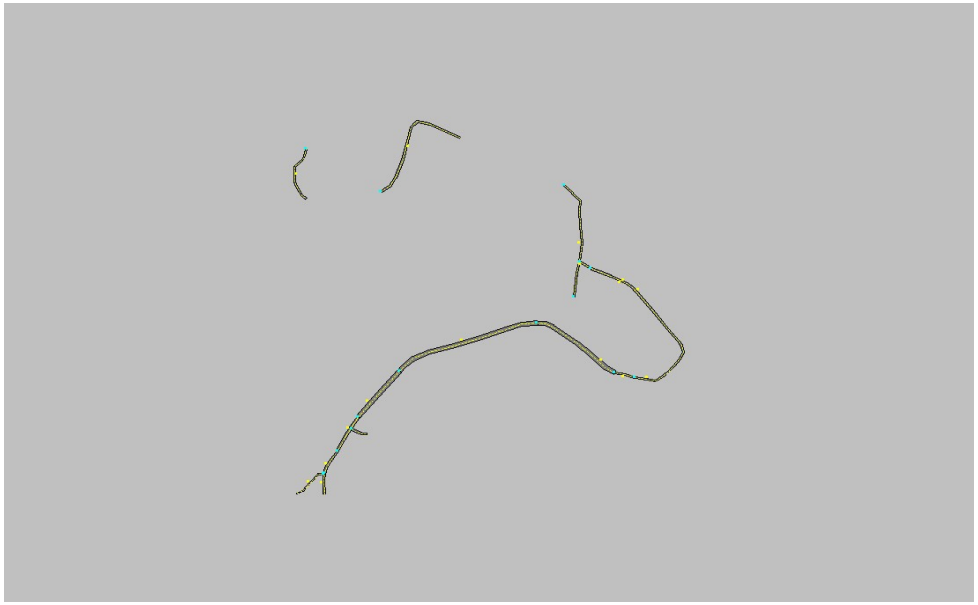
Assessment Year		**2028**		**2033**	
Total NO2 (µg/m3)		**Scenario 1: Baseline**	**Scenario 2: Baseline plus Scheme**	**Scenario 1: Baseline**	**Scenario 2: Baseline plus Scheme**
Age of Maltese Vehicles					
Receptor					
Receptor 1		22.31	22.44	20.21	20.30
Receptor 2		21.96	22.13	19.99	20.11
Receptor 3		19.22	19.35	18.34	18.43
SLM04		20.39	20.53	19.05	19.16
Receptor 4		20.49	21.04	19.10	19.50
Receptor 5		20.63	21.21	19.19	19.60
MP1		20.16	20.67	18.90	19.27
Receptor 6		19.67	19.94	18.62	18.81
Receptor 7		20.33	20.64	19.03	19.26
Receptor 8		21.76	22.10	19.93	20.18
Receptor 9		21.57	21.77	19.79	19.93
Receptor 10		21.02	21.19	19.45	19.56
Receptor 11		21.62	21.80	19.82	19.95
Receptor 12		20.98	21.12	19.42	19.52
Receptor 13		19.20	19.28	18.33	18.40
Receptor 14		20.05	20.16	18.88	18.95

Assessment Year		**2028**		**2033**	
Total PM10 (µg/m3)		**Scenario 1: Baseline**	**Scenario 2: Baseline plus Scheme**	**Scenario 1: Baseline**	**Scenario 2: Baseline plus Scheme**
Age of Maltese Vehicles					
Receptor					
Receptor 1		41.27	41.36	41.39	41.49
Receptor 2		41.04	41.15	41.15	41.28
Receptor 3		39.43	39.51	39.46	39.56
SLM04		40.20	40.29	40.25	40.36
Receptor 4		40.24	40.61	40.30	40.75
Receptor 5		40.33	40.72	40.39	40.87
MP1		40.02	40.36	40.07	40.48
Receptor 6		39.70	39.87	39.73	39.94
Receptor 7		40.14	40.34	40.18	40.43
Receptor 8		41.11	41.36	41.18	41.48
Receptor 9		41.31	41.47	41.41	41.60
Receptor 10		40.90	41.02	40.98	41.14
Receptor 11		41.36	41.50	41.45	41.62
Receptor 12		40.84	40.95	40.92	41.05
Receptor 13		39.41	39.46	39.46	39.52
Receptor 14		40.00	40.07	40.06	40.14

Road Layout

2018 Windrose from Luqa





PA/01398/23 (GF/00150/06): Amendments to PA 1191/05 including: increase in number of apartments from 159 to 234; reconfiguration of parking levels to increase number of parking spaces from 600+ to 850+; introduction of a green parking area for alternative mode of transport including cycling, scooters, and taxis; removal of vehicular access to the car park from Hughes Hallet street level; introduction of hotel (Class 3B) to also serve apartments (Class 1); addition of amenities level within double height level in tower; conversion of recessed level of tower into full floor and conversion of second recessed level of tower housing core into recessed level; removal of the Pavilion building; introduction of office levels within double height areas in lower buildings; internal reconfiguration of office spaces; internal reconfiguration and subdivision of retail and food and beverage outlets, increasing the total number of Class 4B units, changing the use of Class 4C outlets to Class 4D and increasing the number of Class 4D units; inclusion of external areas to cater for the use of tables and chairs. Site at, Townsquare, Tower Road, Hughes Hallet Street, Tigne Street, Qui-Si-Sana Lane, ix-Xatt ta' Qui-Si-Sana, Sliema.

Public consultation on Addendum to the EIA Report (Updated Air Quality Study) (consultation period: 03 September 2023 – 03 October 2023) – Review comments table

Date: 11 October 2023

Section 1: ERA Comments

No.	Ref.:	ERA Comment	EIA Coordinator's Response	ERA reply
1	General and page 11, para 43	Kindly detail the methodology and clarify the correction of the calibration factors used.	Kindly refer to Appendix 1. This shows the methodology including assumptions for model calibration.	Noted.
2	Page 9, para 29	Kindly detail the emission factors used for both PM10 and NO2, with a breakdown of the exhaust and non-exhaust fractions for PM10. The emission factors, notably the non-exhaust fractions, should be reflective of the Maltese context, as detailed in the recent study by Scerri, M. M. et al, 2023 (referenced to on page 9, para 29 of the AQ report). .	Kindly refer to Appendix 2. This shows a breakdown of the emission factors for sensitive receptors 1 to 14 in accordance with the Scerri, M. M. *et al*, 2023 paper.	Noted.
3	Page 21-22, Table 10	Kindly clarify why the impacts reported in this table are deemed reversible.	The impacts are deemed reversible because once the emissions are removed, then the air quality would improve again. However, following a discussion with ERA, we agreed with their position that such impacts are to be considered irreversible, noting that emitted pollutants are not recaptured (and thus 'reversed') if operational traffic generation would halt.	Noted.

Section 2: Comments by consultees and the public

A. Environmental Health Directorate (submissions dated 12 September 2023 and 03 October 2023)

Comment	EIA Coordinator's Response
There is no objection from this end provided that: • Applicant adheres with the copy of proposed sketch plans. • The volume of food preparation on site should commensurate with the size of the kitchen and the operator is to ensure food safety at all times. • It is imperative that once said development is approved applicant is to provide this office with detailed information related to the exact operation of all the catering/retail and accommodation business outlets within the proposed complex. • Proposed food outlets should be provided with suitable toilet/s. Toilets leading to food rooms should be provided with adequate ventilation and with an adequately ventilated ante room. Where natural ventilation is not possible, adequate extract ventilation by mechanical means is to be provided. • Prior to use, premises are to be regularly connected to the government main sewerage system, be provided with a supply of electricity and be provided with a supply of wholesome water from an approved source. • Height of proposed food rooms should not be less than 8ft (2.4m). • Proposed hotel should be provided with a number of adequate staff changing facilities. • Proposed grease trap (unless self-cleansing)/gully traps are to be located in the open air. • Loading bays leading directly to the storage area should be provided with an adequate ventilated space. • All food rooms including food stores are to be adequately ventilated. Where natural ventilation is not possible, adequate intake and extract ventilation by mechanical means is to be provided. • To provide adequate measures for the hygienic disposal of refuse. Passage-way used for garbage should not be the same used for foodstuffs. • Proposed cesspit/sump is to be made according to law. This should be of adequate size, easily accessible to a bowser all the year round for the purpose of emptying, made leak-proof and built in such a way as not to contaminate the surrounding area. • Applicant has to provide this Directorate a certification from a competent engineer/architect confirming that the cesspit/sump once constructed have been tested and confirmed leak-proof and that same have been constructed according to law and of the required size. • The Superintendent of Public Health reserves the right to order the abolition of the said cesspit/sump when he deems this is necessary and to order the connection of the drains to the public sewer or to adopt any other sewage drainage system. • Cesspit/sump is to be emptied regularly and in no way should foul matter overflow onto nearby areas. The material emptied from the cesspits/sumps by the bowser, should be discharged in the main public sewer at authorized points only, as directed by the Wastewater Unit within the Water Services Corporation.	Noted and passed onto applicant.

Comment	EIA Coordinator's Response
• Applicant should make all the necessary arrangements with a private consultant so that samples are collected as per LN 129 of 2005 and tested for microbiology and chemistry as required. • A pool safety operating procedure manual is to be made available according to regulation. • All pools (including jacuzzi) are to be duly registered with the Superintendent of Public Health and are to conform to the Swimming Pools Regulations, L.N. 129 of 2005. • Water system distribution for hot and cold water is to be sampled and tested for legionella bacteria from designated sentinel points as per L.N. 05 of 2006 prior opening an establishment and once every 6 months as per regulation and as per ECDC Guidelines of 2017. • Applicant is to take all the necessary measures to prevent above mentioned premises from being a statutory nuisance to neighbouring properties. • All the relevant building and sanitary laws and regulations are to be strictly adhered to. [Additional feedback received on 03 October 2023] The Environmental Health Directorate (EHD) would like to submit the following comments/recommendations regarding this proposal: • All drains are to be constructed and connected as per requirements of Chapter 10, Code of Police Laws. • Measures in relation to legionella control as per LN 5 of 2006 Control of Legionella, amended by LN 262 of 2006 must also be carried out for the showers and changing rooms mentioned in the Green Transport plan.	

B. Malta Sociological Association (submission dated 02 October 2023

Comment	EIA Coordinator's Response
With reference to the latest development proposals at the Townsquare site in Sliema, the Malta Sociological Association is requesting EIA Malta to commission an ongoing social impact assessment. Previous versions of this project, including the one that was approved by the Planning Authority in 2019, had corresponding social impact assessments, but the plans have changed yet again, as per application GF 00150/06 (ERA) and 01398/23 (PA), which refers to an "increase in number of apartments from 159 to 234; reconfiguration of parking levels to increase number of parking spaces from 600+ to 850+; introduction of a green parking area for alternative mode of transport including cycling, scooteris, and taxis; removal of vehicular access to the car park from Hughes Hallet street level; introduction of hotel (Class 3B) to also serve apartments (Class 1); addition of amenities level within double height level in tower; removal of the Pavilion building; introduction of office levels within double height areas in lower buildings; internal reconfiguration of office and retail areas; change of use of some Class 4C outlets to Class 4D.	Noted, however outside the remit of the EIA Addendum that focused on air quality as requested by ERA. *ERA note:* Social Impact Assessment does not fall within ERA's remit.

Comment	EIA Coordinator's Response
As per Malta's national census (2021), Sliema is now Malta's most densely populated locality. Various social characteristics of Sliema have changed since the approval of the previous version of the Townsquare project. These need to be analysed scientifically through social impact assessment in an ongoing process, and in conformity to guidelines such as those of the International Association for Impact Assessment.	

C. Members of the public (submissions dated 08 and 18 September 2023, respectively)

No.	Comment	EIA Coordinator's Response
1	I wish to write my objection to the new Townsquare development. The people had already protested in a demonstration at Qui-s-sana about the height of the apartment block. In 2018 the Environment and Planning Review Tribunal upheld the Appeals. Now, it seems, that there are to be more apartments added. Plus there is now a second high building which is to be a hotel. This will bring even much more pollution, lack of sunlight and fresh air to the surrounding residences. This apart from the constant deliveries necessary for a hotel. The plan is in the midst of apartments already built on roads surrounding the plot. Therefore the new buildings with exaggerated heights will add to the lack of air, sunlight and pollution, as Tigne Street is narrow, and the once pleasant area is now already suffocated. (I lived in a one storey detached house and garden there, so I know what we have lost). Infrastructure, the most important survey before building these high-rise horrors, was/is non existent. How are the drainage, electric cables. Water distribution etc. going to cope with the demand? The quality of life is already compromised, let alone if this suffocation is added to the area. Traffic, already a huge problem, will increase. It takes twenty minutes to exit Sliema from this area by car. It will only get worse with more building. Hotels and shops will need constant trucks to deliver their goods, as they already do. Why try to ruin what was pleasant about our Island? Why not improve the so many places that need arranging and upkeeping?	Noted and passed onto applicant.
2	The introduction of a hotel in an area previously reserved for an open space with no buildings close to Hughes Hallett street is an extreme revision from the original approved plan and an entire reassessment of the project must be held to ascertain the impact that this will have on environmental quality and logistical bottlenecks, and if so, the modification must be rejected.	Noted. The EIA Addendum considered the additional impact on air quality of the traffic generated from the hotel.

Appendix 1: Model Calibration Methodology

For Model Calibration

Year	2018

Total NOx; ie NOx road + brackground (21.3)

Total PM10: ie PM10 road + background (21) + addition (17.1)

The measured NO2 concentration are 25.5 and 21.0. Using a correction factor of 2.4 gives the closest total NO2 for these two location to the measured values. The facotor of 2.4 is 'back-calculated'

	From Model		After Calibration		Total				
Receptor	NOx	PM10	NOx	PM10	NOx	PM10	NO2		
SLM04	7.19	0.89	17.25	2.14	38.55	40.2	23.32	25.5	91%
MP1	6.61	0.78	15.87	1.87	37.17	40.0	22.88	21.0	109%
								Measured	**Ratio**
								Average	100%

Model predicted concentration of NOx and PM from the roads links

Concentration after calibration factor of 2.4 (ie model road * calibration) = actual road

Total NO2 using NOx to NO2 releationship for road side

	NO2	PM10	NOx
Background	14.5	21.0	21.3
Monitoring Location	21.0	40.0	
SLM4	25.5		

derived from this relationship for background (DEFRA TG4(00)) NO2 = 1.538 (NOx)^0.7341

NOx Calibration Factor	2.4
Addition for PM10	17.1

NOx	NO2		Factors	
21.3	14.5	**Background**	1.5358	0.7341
21.3	17.0	**Roadside**	3.3931	0.5278

After using the correction factor of 2.4 the total PM10 concentration at monitoring location is 17.1 less that the measure value of 40.0 so a value of 17.1 is added to all the prediction concentration of PM10 to ensure predicted = measured (40.0)

Appendix 2: Emissions Factors Calculations

Emissions (g/veh-km)

Road Type: Urban (not London)

		NOx	PM10 (exhaust, brake, tyre, abrasion)	PM10 (resuspension)	PM10 Total (exhaust, brake, tyre, abrasion + resuspension)
1	Triq Censu Tabone (Neptunes waterpolo pitch)	1.017	0.058	0.052	0.110
2	Triq it-Torri (Indipendence garden)	1.017	0.058	0.052	0.110
3a	Triq it-Torri (N of Piazzetta junction)	0.823	0.053	0.052	0.105
3b	Triq it-Torri (S of Piazzetta junction)	0.823	0.053	0.052	0.105
4	Ix-Xatt ta' Qui-Si-Sana (west of STS access)	0.914	0.055	0.052	0.107
5	Ix-Xatt ta' Qui-Si-Sana (east of STS access)	0.914	0.055	0.052	0.107
6	Ix-Xatt ta' Tigne' (east of Fortina)	0.843	0.053	0.052	0.105
7	Ix-Xatt ta' Tigne' (west of Fortina)	0.843	0.053	0.052	0.105
8	Ix-Xatt ta' Tigne' (Sliema Ferries up to Triq Censu Xerri)	0.843	0.053	0.052	0.105
9	Ix-Xatt (bewteen Triq Bouverie and Sliema Ferries)	0.769	0.052	0.052	0.104
10	Triq ix-Xatt (between Manoel island and Triq Ponsonby)	0.769	0.052	0.052	0.104
11a	Triq ix-Xatt (south of Manoel Island)	0.769	0.052	0.052	0.104
11b	Triq ix-Xatt (Manoel Island arm)	0.736	0.050	0.052	0.102
12	Triq ix-Xatt (between Triq il-Gzira and Triq San Gorg)	0.769	0.052	0.052	0.104
13	Triq L-Imsida	0.826	0.053	0.052	0.105
14	Triq ix-Xatt (between Triq San Gorg and Triq Il-Gnien)	0.748	0.050	0.052	0.102

Figure from the Scerri paper (below) suggest that

Exhaust = 3.4%
Tyre/brake wear = 17%
Road dust crustal = 18%

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		NOx	PM10 (exhaust, brake, tyre, abrasion)	PM10 (resuspension)	PM10 Total (exhaust, brake, tyre, abrasion + resuspension)
1	Triq Censu Tabone (Neptunes waterpolo pitch)	0.420	0.043	0.052	0.095
2	Triq it-Torri (Indipendence garden)	0.420	0.043	0.052	0.095
3a	Triq it-Torri (N of Piazzetta junction)	0.374	0.040	0.052	0.092
3b	Triq it-Torri (S of Piazzetta junction)	0.374	0.040	0.052	0.092
4	Ix-Xatt ta' Qui-Si-Sana (west of STS access)	0.390	0.041	0.052	0.093
5	Ix-Xatt ta' Qui-Si-Sana (east of STS access)	0.390	0.041	0.052	0.093
6	Ix-Xatt ta' Tigne' (east of Fortina)	0.385	0.040	0.052	0.092
7	Ix-Xatt ta' Tigne' (west of Fortina)	0.385	0.040	0.052	0.092
8	Ix-Xatt ta' Tigne' (Sliema Ferries up to Triq Censu Xerri)	0.385	0.040	0.052	0.092
9	Ix-Xatt (bewteen Triq Bouverie and Sliema Ferries)	0.340	0.040	0.052	0.092
10	Triq ix-Xatt (between Manoel island and Triq Ponsonby)	0.340	0.040	0.052	0.092
11a	Triq ix-Xatt (south of Manoel Island)	0.340	0.040	0.052	0.092
11b	Triq ix-Xatt (Manoel Island arm)	0.363	0.038	0.052	0.090
12	Triq ix-Xatt (between Triq il-Gzira and Triq San Gorg)	0.340	0.040	0.052	0.092
13	Triq L-Imsida	0.380	0.039	0.052	0.091
14	Triq ix-Xatt (between Triq San Gorg and Triq Il-Gnien)	0.365	0.038	0.052	0.090

2033

		NOx	PM10 (exhaust, brake, tyre, abrasion)	PM10 (resuspension)	PM10 Total (exhaust, brake, tyre, abrasion + resuspension)
1	Triq Censu Tabone (Neptunes waterpolo pitch)	0.230	0.041	0.052	0.093
2	Triq it-Torri (Indipendence garden)	0.230	0.041	0.052	0.093
3a	Triq it-Torri (N of Piazzetta junction)	0.210	0.038	0.052	0.090
3b	Triq it-Torri (S of Piazzetta junction)	0.210	0.038	0.052	0.090
4	Ix-Xatt ta' Qui-Si-Sana (west of STS access)	0.215	0.040	0.052	0.092
5	Ix-Xatt ta' Qui-Si-Sana (east of STS access)	0.215	0.040	0.052	0.092
6	Ix-Xatt ta' Tigne' (east of Fortina)	0.216	0.038	0.052	0.090
7	Ix-Xatt ta' Tigne' (west of Fortina)	0.216	0.038	0.052	0.090
8	Ix-Xatt ta' Tigne' (Sliema Ferries up to Triq Censu Xerri)	0.216	0.038	0.052	0.090
9	Ix-Xatt (bewteen Triq Bouverie and Sliema Ferries)	0.189	0.039	0.052	0.091
10	Triq ix-Xatt (between Manoel island and Triq Ponsonby)	0.189	0.039	0.052	0.091
11a	Triq ix-Xatt (south of Manoel Island)	0.189	0.039	0.052	0.091
11b	Triq ix-Xatt (Manoel Island arm)	0.207	0.036	0.052	0.088
12	Triq ix-Xatt (between Triq il-Gzira and Triq San Gorg)	0.189	0.039	0.052	0.091
13	Triq L-Imsida	0.213	0.038	0.052	0.090
14	Triq ix-Xatt (between Triq San Gorg and Triq Il-Gnien)	0.208	0.037	0.052	0.089

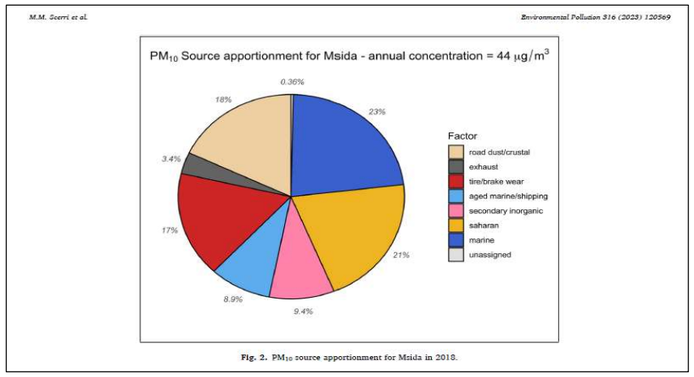

Fig. 2. PM_{10} source apportionment for Msida in 2018.

2018

Source_Name	Pollutant_Name	All Vehicle (g/km)	All LDV (g/km)	All HDV (g/km)	Ratio (abrasion+brake+tyre)/exhaust
1	PM10 (Abrasion)	0.010	0.007	0.004	**1.83**
2	PM10 (Abrasion)	0.010	0.007	0.004	**1.83**
4	PM10 (Abrasion)	0.010	0.007	0.003	**1.96**
5	PM10 (Abrasion)	0.010	0.007	0.003	**1.96**
6	PM10 (Abrasion)	0.009	0.007	0.003	**1.95**
7	PM10 (Abrasion)	0.009	0.007	0.003	**1.95**
8	PM10 (Abrasion)	0.009	0.007	0.003	**1.95**
9	PM10 (Abrasion)	0.010	0.007	0.003	**2.22**
10	PM10 (Abrasion)	0.010	0.007	0.003	**2.22**
12	PM10 (Abrasion)	0.010	0.007	0.003	**2.22**
13	PM10 (Abrasion)	0.009	0.007	0.003	**1.98**
14	PM10 (Abrasion)	0.009	0.007	0.002	**2.03**
11a	PM10 (Abrasion)	0.010	0.007	0.003	**2.22**
11b	PM10 (Abrasion)	0.009	0.007	0.002	**2.05**
3a	PM10 (Abrasion)	0.010	0.007	0.003	**2.01**
3b	PM10 (Abrasion)	0.010	0.007	0.003	**2.01**
1	PM10 (Brake)	0.016	0.011	0.005	
2	PM10 (Brake)	0.016	0.011	0.005	
4	PM10 (Brake)	0.016	0.011	0.005	
5	PM10 (Brake)	0.016	0.011	0.005	
6	PM10 (Brake)	0.015	0.012	0.004	
7	PM10 (Brake)	0.015	0.012	0.004	
8	PM10 (Brake)	0.015	0.012	0.004	
9	PM10 (Brake)	0.016	0.011	0.004	
10	PM10 (Brake)	0.016	0.011	0.004	
12	PM10 (Brake)	0.016	0.011	0.004	
13	PM10 (Brake)	0.015	0.012	0.003	
14	PM10 (Brake)	0.015	0.012	0.003	
11a	PM10 (Brake)	0.016	0.011	0.004	
11b	PM10 (Brake)	0.014	0.012	0.003	
3a	PM10 (Brake)	0.015	0.012	0.004	
3b	PM10 (Brake)	0.015	0.012	0.004	
1	PM10 (Exhaust)	0.020	0.011	0.010	
2	PM10 (Exhaust)	0.020	0.011	0.010	
4	PM10 (Exhaust)	0.019	0.010	0.008	
5	PM10 (Exhaust)	0.019	0.010	0.008	
6	PM10 (Exhaust)	0.018	0.011	0.007	
7	PM10 (Exhaust)	0.018	0.011	0.007	
8	PM10 (Exhaust)	0.018	0.011	0.007	
9	PM10 (Exhaust)	0.016	0.010	0.006	
10	PM10 (Exhaust)	0.016	0.010	0.006	
12	PM10 (Exhaust)	0.016	0.010	0.006	
13	PM10 (Exhaust)	0.018	0.011	0.007	
14	PM10 (Exhaust)	0.017	0.011	0.005	
11a	PM10 (Exhaust)	0.016	0.010	0.006	
11b	PM10 (Exhaust)	0.016	0.011	0.005	
3a	PM10 (Exhaust)	0.017	0.011	0.007	
3b	PM10 (Exhaust)	0.017	0.011	0.007	
1	PM10 (Tyre)	0.011	0.008	0.002	
2	PM10 (Tyre)	0.011	0.008	0.002	
4	PM10 (Tyre)	0.011	0.009	0.002	
5	PM10 (Tyre)	0.011	0.009	0.002	
6	PM10 (Tyre)	0.010	0.009	0.002	
7	PM10 (Tyre)	0.010	0.009	0.002	
8	PM10 (Tyre)	0.010	0.009	0.002	
9	PM10 (Tyre)	0.011	0.009	0.002	
10	PM10 (Tyre)	0.011	0.009	0.002	
12	PM10 (Tyre)	0.011	0.009	0.002	
13	PM10 (Tyre)	0.010	0.009	0.002	
14	PM10 (Tyre)	0.010	0.009	0.001	
11a	PM10 (Tyre)	0.011	0.009	0.002	
11b	PM10 (Tyre)	0.010	0.009	0.001	
3a	PM10 (Tyre)	0.010	0.009	0.002	
3b	PM10 (Tyre)	0.010	0.009	0.002	

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Source Name	Pollutant Name	All Vehicles (g/km)	All LDVs (g/km)	All HDVs (g/km)	Ratio (abrasion+brake+tyre)/exhaust
1	PM10 (Abrasion)	0.01042	0.00673	0.00369	**8.52**
2	PM10 (Abrasion)	0.01042	0.00673	0.00369	**8.52**
4	PM10 (Abrasion)	0.01014	0.00680	0.00334	**8.99**
5	PM10 (Abrasion)	0.01014	0.00680	0.00334	**8.99**
6	PM10 (Abrasion)	0.00953	0.00695	0.00258	**8.75**
7	PM10 (Abrasion)	0.00953	0.00695	0.00258	**8.75**
8	PM10 (Abrasion)	0.00953	0.00695	0.00258	**8.75**
9	PM10 (Abrasion)	0.00990	0.00686	0.00304	**10.10**
10	PM10 (Abrasion)	0.00990	0.00686	0.00304	**10.10**
12	PM10 (Abrasion)	0.00990	0.00686	0.00304	**10.10**
13	PM10 (Abrasion)	0.00950	0.00695	0.00255	**8.86**
14	PM10 (Abrasion)	0.00907	0.00706	0.00201	**8.94**
11a	PM10 (Abrasion)	0.00990	0.00686	0.00304	**10.10**
11b	PM10 (Abrasion)	0.00901	0.00707	0.00194	**8.96**
3a	PM10 (Abrasion)	0.00959	0.00693	0.00266	**9.04**
3b	PM10 (Abrasion)	0.00959	0.00693	0.00266	**9.04**
1	PM10 (Brake)	0.01648	0.01144	0.00504	
2	PM10 (Brake)	0.01648	0.01144	0.00504	
4	PM10 (Brake)	0.01613	0.01156	0.00457	
5	PM10 (Brake)	0.01613	0.01156	0.00457	
6	PM10 (Brake)	0.01534	0.01181	0.00353	
7	PM10 (Brake)	0.01534	0.01181	0.00353	
8	PM10 (Brake)	0.01534	0.01181	0.00353	
9	PM10 (Brake)	0.01581	0.01166	0.00416	
10	PM10 (Brake)	0.01581	0.01166	0.00416	
12	PM10 (Brake)	0.01581	0.01166	0.00416	
13	PM10 (Brake)	0.01530	0.01182	0.00348	
14	PM10 (Brake)	0.01475	0.01200	0.00275	
11a	PM10 (Brake)	0.01581	0.01166	0.00416	
11b	PM10 (Brake)	0.01468	0.01203	0.00265	
3a	PM10 (Brake)	0.01542	0.01178	0.00364	
3b	PM10 (Brake)	0.01542	0.01178	0.00364	
1	PM10 (Exhaust)	0.00447	0.00276	0.00171	
2	PM10 (Exhaust)	0.00447	0.00276	0.00171	
4	PM10 (Exhaust)	0.00415	0.00269	0.00146	
5	PM10 (Exhaust)	0.00415	0.00269	0.00146	
6	PM10 (Exhaust)	0.00406	0.00286	0.00120	
7	PM10 (Exhaust)	0.00406	0.00286	0.00120	
8	PM10 (Exhaust)	0.00406	0.00286	0.00120	
9	PM10 (Exhaust)	0.00362	0.00247	0.00115	
10	PM10 (Exhaust)	0.00362	0.00247	0.00115	
12	PM10 (Exhaust)	0.00362	0.00247	0.00115	
13	PM10 (Exhaust)	0.00400	0.00283	0.00116	
14	PM10 (Exhaust)	0.00383	0.00290	0.00093	
11a	PM10 (Exhaust)	0.00362	0.00247	0.00115	
11b	PM10 (Exhaust)	0.00380	0.00290	0.00090	
3a	PM10 (Exhaust)	0.00395	0.00277	0.00118	
3b	PM10 (Exhaust)	0.00395	0.00277	0.00118	
1	PM10 (Tyre)	0.01114	0.00858	0.00256	
2	PM10 (Tyre)	0.01114	0.00858	0.00256	
4	PM10 (Tyre)	0.01099	0.00867	0.00232	
5	PM10 (Tyre)	0.01099	0.00867	0.00232	
6	PM10 (Tyre)	0.01065	0.00886	0.00179	
7	PM10 (Tyre)	0.01065	0.00886	0.00179	
8	PM10 (Tyre)	0.01065	0.00886	0.00179	
9	PM10 (Tyre)	0.01085	0.00874	0.00211	
10	PM10 (Tyre)	0.01085	0.00874	0.00211	
12	PM10 (Tyre)	0.01085	0.00874	0.00211	
13	PM10 (Tyre)	0.01063	0.00887	0.00177	
14	PM10 (Tyre)	0.01040	0.00900	0.00140	
11a	PM10 (Tyre)	0.01085	0.00874	0.00211	
11b	PM10 (Tyre)	0.01036	0.00902	0.00135	
3a	PM10 (Tyre)	0.01068	0.00884	0.00185	
3b	PM10 (Tyre)	0.01068	0.00884	0.00185	

2033

Source Name	Pollutant Name	All Vehicles (g/km)	All LDVs (g/km)	All HDVs (g/km)	Ratio (abrasion+brake+tyre)/exhaust
1	PM10 (Abrasion)	0.01042	0.00673	0.00369	**15.05**
2	PM10 (Abrasion)	0.01042	0.00673	0.00369	**15.05**
4	PM10 (Abrasion)	0.01014	0.00680	0.00334	**15.71**
5	PM10 (Abrasion)	0.01014	0.00680	0.00334	**15.71**
6	PM10 (Abrasion)	0.00953	0.00695	0.00258	**14.97**
7	PM10 (Abrasion)	0.00953	0.00695	0.00258	**14.97**
8	PM10 (Abrasion)	0.00953	0.00695	0.00258	**14.97**
9	PM10 (Abrasion)	0.00990	0.00686	0.00304	**17.44**
10	PM10 (Abrasion)	0.00990	0.00686	0.00304	**17.44**
12	PM10 (Abrasion)	0.00990	0.00686	0.00304	**17.44**
13	PM10 (Abrasion)	0.00950	0.00696	0.00255	**15.14**
14	PM10 (Abrasion)	0.00908	0.00706	0.00201	**15.00**
11a	PM10 (Abrasion)	0.00990	0.00686	0.00304	**17.44**
11b	PM10 (Abrasion)	0.00901	0.00708	0.00194	**15.00**
3a	PM10 (Abrasion)	0.00959	0.00693	0.00266	**15.48**
3b	PM10 (Abrasion)	0.00959	0.00693	0.00266	**15.48**
1	PM10 (Brake)	0.01650	0.01146	0.00504	
2	PM10 (Brake)	0.01650	0.01146	0.00504	
4	PM10 (Brake)	0.01615	0.01157	0.00457	
5	PM10 (Brake)	0.01615	0.01157	0.00457	
6	PM10 (Brake)	0.01536	0.01183	0.00353	
7	PM10 (Brake)	0.01536	0.01183	0.00353	
8	PM10 (Brake)	0.01536	0.01183	0.00353	
9	PM10 (Brake)	0.01583	0.01168	0.00416	
10	PM10 (Brake)	0.01583	0.01168	0.00416	
12	PM10 (Brake)	0.01583	0.01168	0.00416	
13	PM10 (Brake)	0.01532	0.01184	0.00348	
14	PM10 (Brake)	0.01477	0.01202	0.00275	
11a	PM10 (Brake)	0.01583	0.01168	0.00416	
11b	PM10 (Brake)	0.01469	0.01204	0.00265	
3a	PM10 (Brake)	0.01544	0.01180	0.00364	
3b	PM10 (Brake)	0.01544	0.01180	0.00364	
1	PM10 (Exhaust)	0.00253	0.00179	0.00074	
2	PM10 (Exhaust)	0.00253	0.00179	0.00074	
4	PM10 (Exhaust)	0.00237	0.00175	0.00063	
5	PM10 (Exhaust)	0.00237	0.00175	0.00063	
6	PM10 (Exhaust)	0.00238	0.00186	0.00052	
7	PM10 (Exhaust)	0.00238	0.00186	0.00052	
8	PM10 (Exhaust)	0.00238	0.00186	0.00052	
9	PM10 (Exhaust)	0.00210	0.00161	0.00049	
10	PM10 (Exhaust)	0.00210	0.00161	0.00049	
12	PM10 (Exhaust)	0.00210	0.00161	0.00049	
13	PM10 (Exhaust)	0.00234	0.00184	0.00050	
14	PM10 (Exhaust)	0.00228	0.00188	0.00040	
11a	PM10 (Exhaust)	0.00210	0.00161	0.00049	
11b	PM10 (Exhaust)	0.00227	0.00189	0.00039	
3a	PM10 (Exhaust)	0.00231	0.00180	0.00051	
3b	PM10 (Exhaust)	0.00231	0.00180	0.00051	
1	PM10 (Tyre)	0.01117	0.00860	0.00257	
2	PM10 (Tyre)	0.01117	0.00860	0.00257	
4	PM10 (Tyre)	0.01101	0.00868	0.00233	
5	PM10 (Tyre)	0.01101	0.00868	0.00233	
6	PM10 (Tyre)	0.01067	0.00887	0.00180	
7	PM10 (Tyre)	0.01067	0.00887	0.00180	
8	PM10 (Tyre)	0.01067	0.00887	0.00180	
9	PM10 (Tyre)	0.01088	0.00876	0.00212	
10	PM10 (Tyre)	0.01088	0.00876	0.00212	
12	PM10 (Tyre)	0.01088	0.00876	0.00212	
13	PM10 (Tyre)	0.01066	0.00888	0.00178	
14	PM10 (Tyre)	0.01042	0.00901	0.00140	
11a	PM10 (Tyre)	0.01088	0.00876	0.00212	
11b	PM10 (Tyre)	0.01038	0.00903	0.00135	
3a	PM10 (Tyre)	0.01071	0.00885	0.00185	
3b	PM10 (Tyre)	0.01071	0.00885	0.00185	