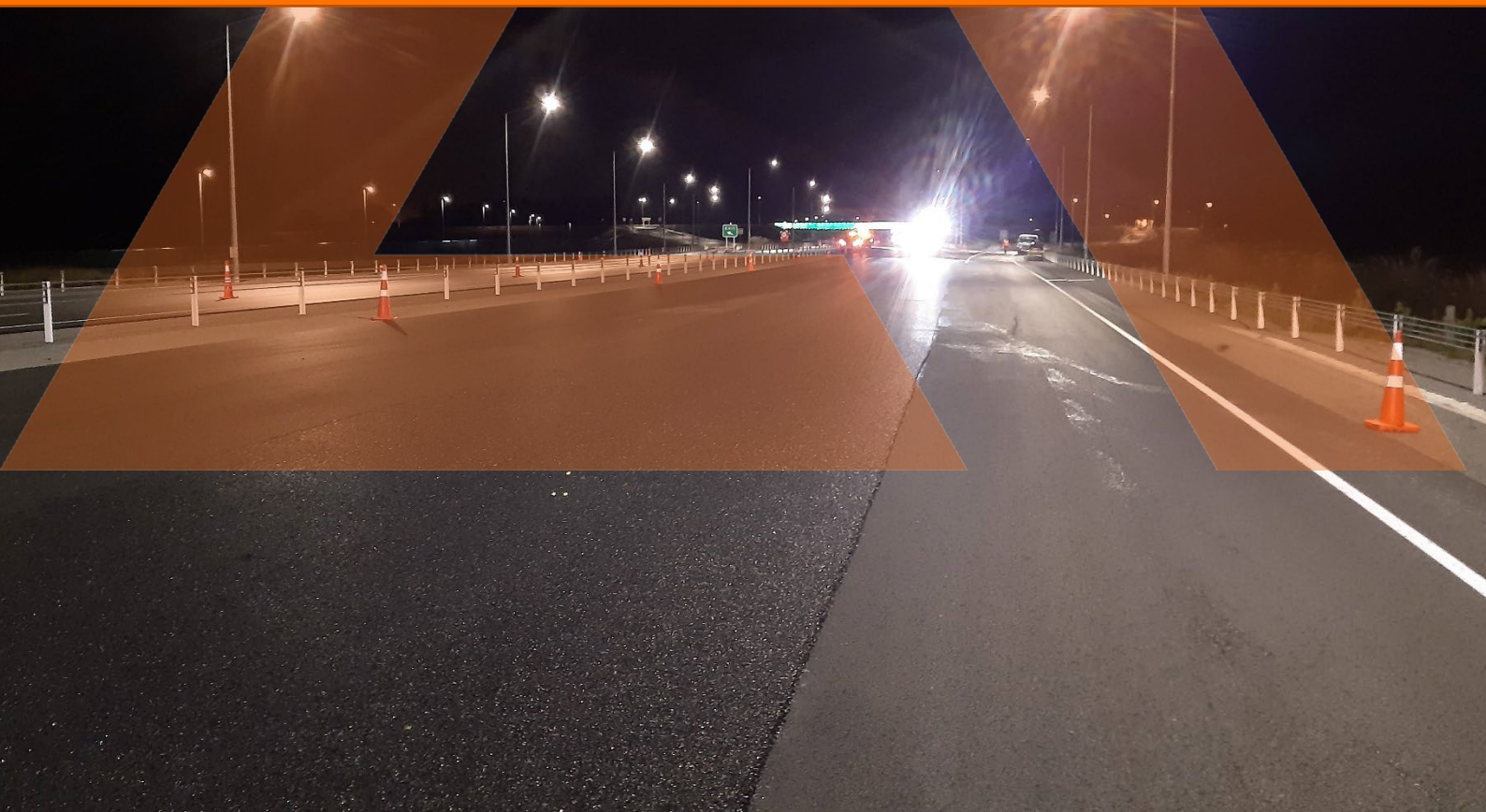


ROAD SURFACE NOISE

Summary of CPX measurements in
2023 / 2024

Client: NZ Transport Agency - Waka Kotahi
Date: 13th July 2024
Ref: 23-108-R02-B



Prepared for (the Client)
NZ Transport Agency - Waka Kotahi

Prepared by (the Consultant)
Altissimo Consulting Ltd

Project Road Surface Noise
Report Summary of CPX measurements in 2023 / 2024
Reference 23-108-R02-B

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A	24/06/2024	Release for client review.
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Glossary

CPX	Close proximity
CAPTIF	Canterbury Accelerated Pavement Indoor Testing Facility
Chip	Chipseal
EPA	Epoxy-modified porous asphalt
ENRAC	Enrichment Seal Over Asphalt
GIS	Geographic Information System
IMU	Inertial Measurement Unit
$L_{CPX:P1,80,mic\{1,2\}}$	Close proximity sound pressure level using energy average of microphones 1 and 2. Same value as $L_{CPX:P1,80}$ but with microphones explicitly stated.
MPD	Mean Profile Depth
PA	Porous asphalt
RAMM	Road Assessment and Maintenance Management
SMA	Stone mastic asphalt
SEL	Sound Exposure Level measured in dB LAE
Top surfaces table	Tables maintained by RAMM and CAPTIF that record information about top surface of pavements in New Zealand.
TWIN	Used in conjunction with PA/EPA to specify a twin-layer porous asphalt
P1	Standard reference test tyre (passenger tyre)
WEX	Waikato Expressway

1 Introduction

Waka Kotahi engaged Altissimo Consulting to perform a routine survey of road surface noise on a subset of the NZ State Highway network. This report documents the time and location of the survey and presents a summary of the measured road surface noise levels. No detailed results, GIS maps, or analyses are presented in this report.

Raw measurement files, detailed results and GIS maps are stored on the Waka Kotahi CPX Trailer System SharePoint for each measurement session. Summary results are provided in the CPX Data and GIS Viewers on the SharePoint site.

2 Measurement Details

Measurements were performed by Robin Wareing of Altissimo Consulting using the Waka Kotahi Close Proximity (CPX) trailer, details of the trailer can be found at <https://captif-nz.github.io/captif-cpx-docs>. During the 2023/2024 survey the trailer was set-up to record audio from microphone positions 1,2,4,5 (Figure 1) in the left wheel enclosure. Positions 1 and 2 are mandatory for all CPX measurements. No audio was recorded within the right wheel enclosure.

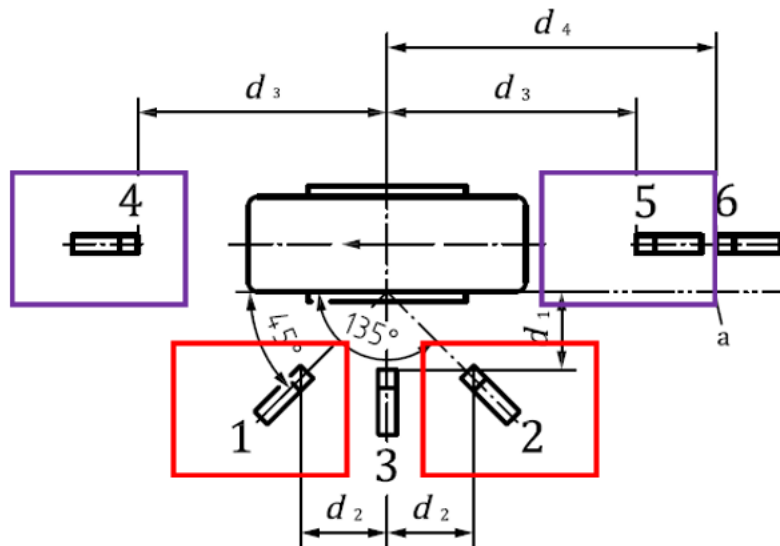


Figure 1: Microphone positions for CPX trailer (Reproduced from Figure 1 of ISO 11819-2)

The following were also recorded simultaneously with the audio data:

- Acceleration of left wheel on suspension arm and trailer chassis.
- GPS location.
- 9-axis IMU data from chassis.
- Air, road surface and tyre temperature.
- Transverse laser profiles of surface in front of left tyre (newly operational for 2023/2024 season)¹.

¹ The laser data collected during the 2023/24 survey was affected by dropouts, as such MPD has been calculated for a small subset of measurement sessions. This issue was identified and corrected in June 2024.

2.1 Calibration and field checks

The details of the microphones and their positions during the 2023/24 survey are presented in Table 1.

Table 1: Microphone details

Position	Type	Serial Number	Last calibrated
Position 1	GRAS Type 146A	400696	2023-07-06
Position 2	GRAS Type 146A	400708	2023-07-06
Position 4	GRAS Type 146A	400697	2023-09-11
Position 5	GRAS Type 146A	400708	2023-09-11

Prior to all measurement sessions a field check was performed using GRAS 42AG Multifunction Sound Calibrator (S/N: 279837, Calibrated: 8-8-2023) with the following level and frequency combinations:

- 94 dB at 1000 Hz
- 114 dB at 1000 Hz
- 94 dB at 100 Hz
- 114 dB at 100 Hz

All four microphones were within 0.1 dB of the input noise level for all field checks.

The trailer enclosure corrections were last measured 2023-11-14.

2.2 Summary of measurements

The measurement dates, locations, and towing vehicles are detailed in Table 2.

Table 2: Measurement details from 2023/2024 CPX survey

Description of location	State Highway	Operator(s)	Towing Vehicle	Date(s)
Christchurch. Yaldhurst Road to The Groynes	SH1	Robin Wareing John Bull	Toyota Hiace	2023/11/16 2024/06/04
Christchurch. Christchurch Northern Corridor (Cranford Street to Tram Road)	SH74 SH1	Robin Wareing John Bull	Toyota Hiace	2023/11/22 2023/12/05 2024/01/12 2024/06/03-04
Christchurch. Western Belfast Bypass (The Groynes to Tram Road)	SH1	Robin Wareing John Bull	Toyota Hiace	2023/11/22 2023/12/05 2024/01/12 2024/06/03-04
Canterbury. Chipseal trial sites (West Melton to Kirwee): - Kirwee - Alysbury Corner - Paparua Prison	SH73	Robin Wareing John Bull	Toyota Hiace	2023/12/05 2024/01/12
Christchurch. Christchurch Southern Motorway. (Brougham St to Rolleston)	SH1 SH76	Robin Wareing John Bull	Toyota Hiace	2023/12/06 2024/01/12
Wellington. Petone to Kaitoki	SH2	Robin Wareing	Toyota Hilux	2024/03/01
Wellington. Transmission Gully, McKays to Peka Peka, Peka Peka to Ōtaki.	SH1	Robin Wareing	Toyota Hilux	2024/03/01
Wellington Haywards Hill Rd and Paremata Haywards Rd SH2 interchange to SH1 interchange	SH58	Robin Wareing	Toyota Hilux	2024/03/01
Waikato Hampton Down to south of Cambridge Bypass	SH1	Robin Wareing	Ford Range	2024/05/07 2024/05/09
Auckland. SH18 interchange to Silverdale	SH1	Robin Wareing	Ford Range	2024/05/08
Auckland. Upper Harbour Motorway. SH16 interchange to SH1 interchange	SH18	Robin Wareing	Ford Range	2024/05/08
Auckland. St Lukes Rd to SH18 interchange	SH16	Robin Wareing	Ford Range	2024/05/08
Auckland. Hillsborough Rd to Waterview tunnel	SH20	Robin Wareing	Ford Range	2024/05/09

3 Results Summary

The mean CPX levels for specific projects (by surface) are presented in Tables 2 - 5. The CPX level is only presented for the average of microphones 1 and 2, this is for consistency with prior surveys.

Table 3: Summary of CPX 2023/2024 survey in Wellington

Site	Surface	L _{CPX P1,80,mic(1,2)} (dB)	Standard Deviation (dB)	Length (km)
SH1 - Mackays to Peka Peka	PA10 (30 mm)	96.7	1.7	45.4
	PA10 (30 mm)	96.6	1.9	14.5
	SMA10 (40 mm)	94.8	1.2	0.3
SH1 - Peka Peka to Ōtaki	EPA10 (25 mm)	97.4	1.3	43.4
	SMA12 (50 mm)	99.5	0.6	2.5
SH1 - Transmission Gully	Chip 2/4	98.8	0.7	55.4
	PA10 (30 mm)	97.0	1.0	5
	SMA10 (40 mm)	98.7	0.7	32.7

Table 4: Summary of CPX 2023/2024 survey in Canterbury

Site	Surface	L _{CPX P1,80,mic:(1,2)} (dB)	Standard Deviation (dB)	Length (km)
SH1 - Russley Road	EPA7 (30 mm)	94.1	1.1	2.0
	PA10 (30 mm)	97.4	1.9	11.8
	SMA10 (40 mm)	98.7	1.5	2.6
SH1 - Sawyers to Harewood	PA10 (30 mm)	99.3	0.6	5.4
	SMA10 (30 mm)	99.3	0.6	0.2
SH1 - The Groynes to Sawyers	EPA10 (30 mm)	98.2	1.7	0.7
	EPA10 HV (30 mm)	96.5	1.6	0.9
	EPA14 (30 mm)	99.2	2.1	0.8
	EPA7 (40 mm)	92.7	1.0	1.6
	PA10 (30 mm)	95.6	1.4	8.5
	SMA10 (30 mm)	98.8	0.5	0.1
	SMA10 (40 mm)	98.9	0.5	2.5
	SMA10 (50 mm)	99.3	0.5	0.1
SH1 - Western Belfast Bypass	EPA7 (30 mm)	94.3	1.9	0.7
	EPA7 (40 mm)	93.3	1.3	18.4
	EPA7 (50 mm)	91.5	0.6	0.8
	SMA10 (40 mm)	98.1	0.8	0.6
SH73 - Aylesbury Corner	Epoxy Chip 3-5 Dry-Lock	101.4	0.3	0.6
SH73 - Chipseal Noise Trial Site	Chip 2 Single-Coat	100.6	0.3	0.5
	Chip 2/4 Racked-In	100.7	0.3	0.5
	Chip 2/4 Two-Coat	100.6	0.2	0.5
	Chip 2/4/6 Multi-Coat	100.7	0.3	0.5
	Chip 3 Single-Coat	100.5	0.2	1.1
	Chip 3/5 Two-Coat	100.4	0.5	0.7
SH74 - Christchurch Northern Corridor	EPA7 (30 mm)	94.4	1.2	9.9
	EPA7 (50 mm)	91.2	0.8	13.4
	PA10 (30 mm)	94.9	1.9	1.1
	PA7 (30 mm)	95.7	0.8	15.2
	PA7 HS (30 mm)	93.8	0.7	1.0
	PA7 LV (30 mm)	94.9	0.9	0.8
	SMA7 (30 mm)	95.5	0.6	1.0

Site	Surface	LCPX P_{1,80,mic}(1,2) (dB)	Standard Deviation (dB)	Length (km)
SH76 - Christchurch Southern Motorway Stage 1	EPA10 (40 mm)	101.2	0.7	0.9
	PA10 (40 mm)	101.7	0.5	0.9
	PA10(40 mm)	101.7	0.5	1.6
	PA14 (40 mm)	100.2	1.2	8.1
	SMA10 (40 mm)	100.0	1.0	0.1
SH76 - Christchurch Southern Motorway Stage 2	EPA7 (40 mm)	93.7	1.2	16.9
	SMA10 (45 mm)	99.4	0.5	4.5

Table 5: Summary of CPX 2023/2024 survey in Auckland

Site	Surface	L_{CPX P1,80,mic(1,2)} (dB)	Standard Deviation (dB)	Length (km)
SH16 - Causeway Upgrade	PA10 (30 mm)	97.0	1.1	5.8
	PA10 TWIN (70 mm)	93.9	1.0	4.8
	PA14 (30 mm)	96.1	1.8	0.4
	PA14 (35 mm)	94.6	0.9	0.2
	PA14 (45 mm)	95.0	2.0	0.2
	AC10	97.1	1.3	12.4
	PA10 (30 mm)	95.4	1.9	0.1
SH16 - Lincoln to Westgate	EPA10 (30 mm)	97.0	0.8	3.7
	PA10 (30 mm)	98.1	1.2	1.6
SH16 - Te Atatu Interchange	EPA10 (30 mm)	98.9	0.6	0.4
	PA10 (30 mm)	97.9	1.7	0.5
	AC10	97.8	0.7	0.1
SH20 - Waterview Connection	PA10 (30 mm)	97.3	1.3	6.1
	PA10 TWIN (70 mm)	95.0	1.3	1.4

Table 6: Summary of CPX 2023/2024 survey in Waikato

Site	Surface	L_{CPX P1,80,mic(1,2)} (dB)	Standard Deviation (dB)	Length (km)
SH1 - WEX - Hamilton	EPA7 (30 mm)	93.3	1.3	5.8
	EPA7 (50 mm)	91.5	1.0	9.6
	SMA14 (50 mm)	99.3	0.4	73.8
SH1 - WEX - Huntly	SMA10 (40 mm)	98.3	0.5	1.3
	SMA10 (50 mm)	98.4	0.7	59.5
SH1 - WEX - Longswamp	SMA10 (50 mm)	99.3	0.6	12.2
SH1 - WEX - Rangiriri	Chip 4/6 Racked-In	101.3	0.5	9.1
SH1 - WEX - Tamahere and Cambridge	EPA10 (30 mm)	96.2	1.4	57.9
	PA10 (30 mm)	96.5	1.6	2.1
	SMA10 (40 mm)	96.2	1.9	1.0