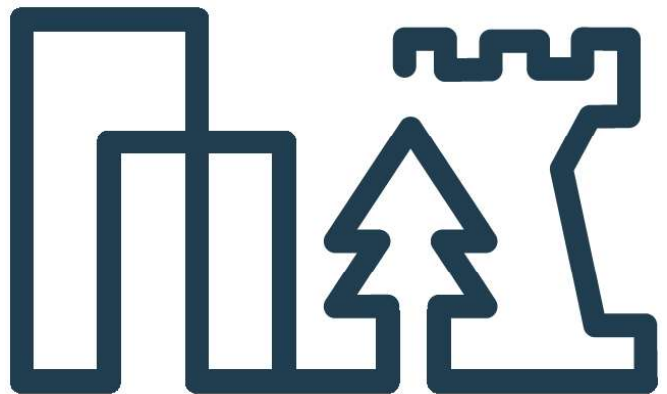


APPENDIX 12: NOISE AND VIBRATION ASSESSMENT REPORT





ACOUSTICS & VIBRATION

TE KARAKA FLOOD MANAGEMENT PROJECT
TE KARAKA, GISBORNE

PREPARED FOR
Gisborne District Council

DATE
16 April 2026



Assessment prepared by Styles Group for Gisborne District Council.

REVISION HISTORY

Rev:	Date:	Comment:	Version:	Prepared by:	Reviewed by:
1	16/04/26		Final	Jamie Exeter, MASNZ Principal Styles Group	Jon Styles, MASNZ Director and Principal Styles Group

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1.0 Introduction

Gisborne District Council (**GDC**) has engaged Styles Group to assess the potential noise and vibration effects of the proposed Te Karaka flood protection works.

The proposal involves earthworks for the realignment of the Te Karaka stopbank and raising sections of State Highway 2 (**SH2**) and two local roads (the **Proposal**).

The purpose of this report and information on its preparation are set out in Sections 1.1 to 1.3. A glossary of acoustics terms is provided as Appendix A.

1.1 Purpose of report

This technical report has been prepared to accompany the resource consent application. Its purpose is to:

- identify the construction and operational noise and vibration sources associated with the Proposal and assess the noise and vibration levels at the neighbouring sites
- identify where consent is needed for any infringements of the relevant GDC noise and vibration standards
- describe the potential noise and vibration effects in the context of the existing environment, the relevant Gisborne District Plan (**GDP**) standards, and s16 of the Resource Management Act 1991 (the **Act**)
- recommend mitigation measures and conditions of consent based on our findings.

This report should be read together with the Assessment of Environmental Effects and other technical assessments prepared in support of the application.

1.2 Basis of assessment and relevant Standards

Our assessment is based on information provided by the project team and the application plans. Our calculations and assessments comply with the following Standards and guidance where relevant, as required by the GDP:

- NZS 6801:1991 *Measurement of sound*
- NZS 6802:1991 *Assessment of environmental sound*
- NZS 6803P:1984 The measurement and assessment of noise from construction, maintenance and demolition work
- NZS 6803:1999 Acoustics – Construction noise

- Association of Australasian Acoustical Consultants Guideline for Interpreting and Applying NZS 6803-1999.

We have assessed the noise levels against the requirements of s16 of the Act, which states:

Every occupier of land (including any premises and any coastal marine area), and every person carrying out an activity in, on, or under a water body or the coastal marine area, shall adopt the best practicable option to ensure that the emission of noise from that land or water does not exceed a reasonable level.

We have based our assessment of 'reasonable' on the level, character, timing, frequency, and duration of noise in the existing environment including the noise levels and effects authorised by the relevant permitted standards of the GDP.

1.3 Author and reviewer

The author of this report, Jamie Exeter, is a Principal at Styles Group Acoustics & Vibration Consultants and has over 20 years' experience in acoustics. Jamie has specialised for more than 18 years in the measurement, prediction, and assessment of environmental noise and vibration in relation to District Plans and the Act.

Jamie holds a Diploma in Audio Engineering and is a professional Member of the Acoustical Society of New Zealand. He has experience in construction projects and regularly undertakes peer review work for local authorities. Jamie is one of three authors of the Association of Australasian Acoustical Consultants *Guideline for Interpreting and Applying NZS 6803-1999*, the New Zealand Standard for measuring and assessing construction noise.

The reviewer, Jon Styles has been the Director and Principal of Styles Group Acoustics and Vibration Consultants for over 21 years. He has twice been the President of the Acoustical Society of New Zealand and has been an elected Council Member for more than 18 years. He is also on the Board of Directors of the AAAC.

Jon has over 25 years' experience providing advice on managing noise and vibration effects and is an experienced expert witness for Council, Environment Court, District Court, High Court, and Board of Inquiry hearings.

The author and reviewer confirm that this report covers matters within their expertise. They have not left out any material facts that could change or weaken the opinions given. Information that has been supplied by the client or obtained from external sources is identified in this report and has been assumed to be accurate.

2.0 The proposed stopbank realignment

The proposal involves upgrading flood protection for Te Karaka by realigning the existing stopbanks and increasing their height by up to 4.5 m.

The proposal includes the following stages of works:¹

- Establishing works
 - relocation of powerlines
 - gas main refurbishment work
 - fencing
 - potential waterpipe diversion
 - establishing borrow pits to supply materials
 - establishing set down areas
- Stopbank construction
 - construction of a new 2.9 km long stopbank along the western and northern side of Te Karaka
 - construction of a new 1.3 km long stopbank along the eastern side of Te Karaka
 - installation of new stormwater culverts under stopbanks
 - extension of a stormwater culvert under an existing stopbank
- Road raising
 - raising of SH2 at the eastern and western tie ins with the new stopbanks
 - raising of Rangatira Road where the western stopbank intersects
 - raising of Kanakanaia Road where the western/northern stopbank finishes.

The existing stopbanks, proposed alignment, borrow pits, and laydown areas are shown in Figure 1.²

¹ Construction methodology sourced from Gisborne District Council, Te Karaka – Flood Resilience Project, Stopbank Construction Methodology, ALTA, 15 April 2026.

² Existing and Proposed Flood Scheme, SLR, 16 March 2026.

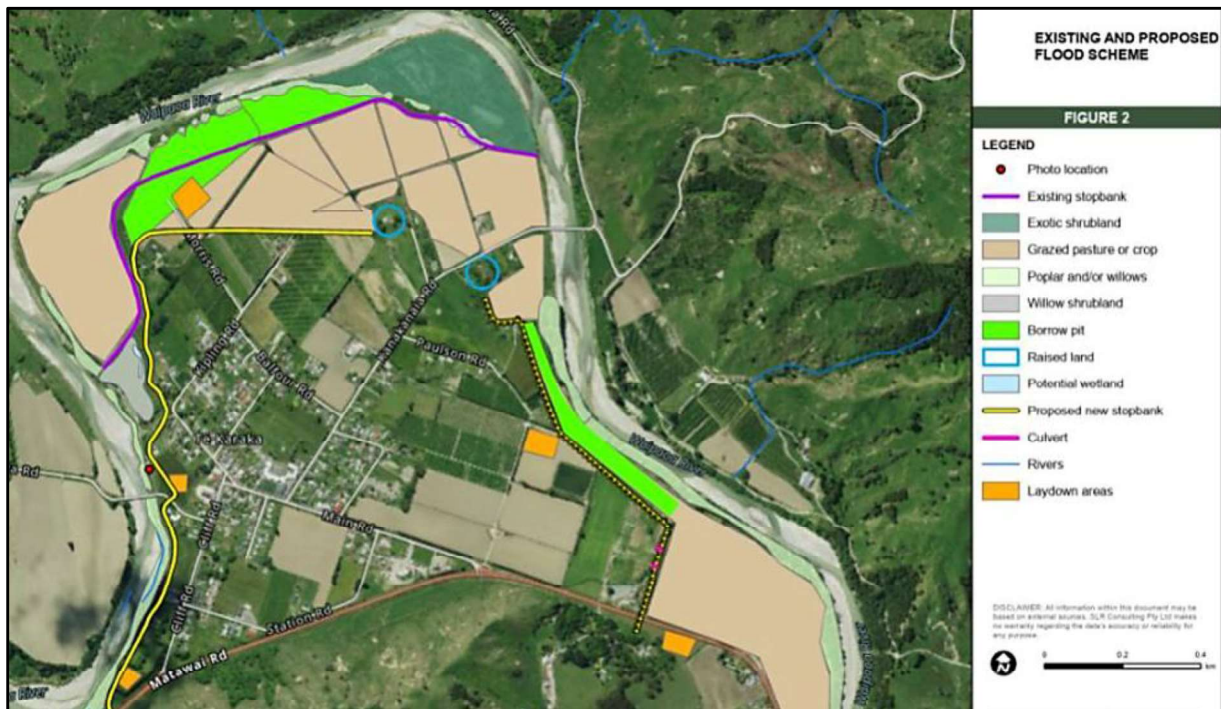


Figure 1: Proposed stopbank realignment

The project is expected to take approximately 11-13 months to complete. Construction hours for noisy works (use of heavy plant and trucks) will be between 7:30 am and 6:00 pm on Monday to Saturday, excluding public holidays.

The major noise and vibration generating activities associated with the project are:

- Site establishing works including relocation of powerlines and a power pole on Rangatira Road, gas main refurbishment work, fencing, and potential waterpipe diversion.
- Construction and use of five laydown areas across the site for storage of equipment and materials.
- Relocation of materials from the borrow pits to the stopbanks involving approximately 80 truck and trailer movements per day on local roads over approximately two-four months.
- Stabilisation and landscaping of borrow pits at the completion of earthworks activities.
- Earthworks for drainage, silt control, haul roads, and stopbank construction.
- Extension of the existing culvert under SH2 including tree and vegetation removal.
- Road construction works for road raising on Rangatira Road and at the east and west sections of SH2 that intersect the proposed stopbank.
- Truck and trailer movements on local roads for aggregate delivery involving approximately 60 movements per day over approximately two-three months.

- Approximately 80-120 Six-wheeler truck movements per day on haul roads to transport aggregate to the road raising sites.
- Watercart movements on haul roads for dust suppression.

Not all construction work activities will take place at the same time. We understand there may be up to 85 truck movements per day as an average if stopbank and road raising activity take place concurrently.

We understand that the proposed construction work will be undertaken using the following equipment (primarily):

- petrol chainsaws
- woodchipper
- excavators, 5-t, 14-t, 20-t, 30-t
- vibratory and static compaction rollers, 12-t, 15-t
- bulldozers
- tractors and scoops
- motor graders
- motor scrapers
- articulated dump trucks, 30-t, 40-t
- truck and trailer trucks
- six-wheeler and eight-wheeler trucks
- watercarts
- road surfacing plant (bitumen sprayer, chip spreader trucks).

No significant noise or vibration generating activities are required (e.g. driven piling, hydraulic breaking, or dynamic compaction).

3.0 GDP zones and permitted standards

This section identifies the GDP zoning in the area and sets out the permitted standards relevant to construction noise and vibration.

The proposed construction work will take place on private land and within the road. The works and nearest receivers are within five GDP zones: Rural Residential, Rural General, Rural Commercial, General Residential, and Recreational Reserve.

The relevant parts of the GDP standards for construction works are reproduced below.

C11.2.15.2 Rules and Standards for Noise for Construction Activities- All Zones

A Long Term Construction

1. Emissions of construction noise shall not exceed 168 calendar days in any 12 month period.
2. The construction activity shall comply with the noise limits specified in Figure C.11.

Construction & temporary activity noise measured within the	Time Period	AVERAGE MAXIMUM NOISE LEVEL (dBA)		
		L ₉₅	L ₁₀	L _{MAX}
Residential Zone	Mon – Sat 7am-6pm	60	75	90
	all other times	Refer to Figure C11.3	Refer to Figure C11.3	Refer to Figure C11.3
Commercial and Suburban Commercial Zones	Mon – Sat at all times	60	75	90
	all other times	-	Refer to Figure C11.4	-
Industrial and Port Zones	Mon – Sat at all times	-	90	-
	Sun & Public Holidays at all times	-	Refer to Figure C11.4	-
Rural Zone	Mon – Sat 0600-6pm	60	75	90
	all other times	Refer to Figure C11.6	Refer to Figure C11.6	Refer to Figure C11.6
Reserves Zone	Mon – Sat at all times	60	75	90
	Sun & Public Holidays at all times	-	Refer to Figures C11.3, C11.7 and C11.8	Refer to Figures C11.3, C11.7 and C11.8

Figure C11.9 – Rules for Construction Noise in all Zones

C11.2.15.4 Rules for Vibration for Construction Activities – All Zones

A Residential and Rural Zones

Short Term Construction

1. The period for which vibration is emitted shall not exceed 15 calendar days in any 12 month period; and
2. All activities shall comply with the rules specified in Figure C11.12.
3. The maximum weighted vibration level (Wb or Wd) arising from any zone as measured at or within the boundary of any site zoned residential, or Rural Lifestyle or the notional boundary of any dwelling zoned Rural Production, Rural General, shall not exceed the following limits:

Zones	Time	Maximum Weighted Vibration Level (Wb or Wd)
Residential	7am – 6pm Monday to Saturday	60mm/s ²
	All other times	15mm/s ²
Rural	0600 – 6pm Monday to Saturday	60mm/s ²
	At all other times	15mm/s ²

Figure C11.12 – Rules for Vibration Construction in Residential and Rural Zones

C11.2.15.8 Method of Assessment of Noise

A General Noise Assessment

1. All measurements shall be taken in accordance with:
 - a) NZS6801:1991 "Measurement of Sound";
 - b) NZS 6802:1991 "Assessment of Environmental Sound"; NZS 6802:1999 "Acoustics – Assessment of Environmental Sound" and
 - c) NZS 6803P:1984 "The measurement and Assessment of Noise from Construction, Maintenance and Demolition Work", NZS6803:1999 "Acoustics – Construction Work"

Consent will be required for infringements of C11.2.15.2.A.1 and C11.2.15.4.A.1 due to the duration of the construction noise and vibration emissions. We recommend that consent is also sought to infringe and deviate from the GDP construction noise and vibration limits specified in standard C11.2.15 because:

- The 1984 provisional version of the New Zealand construction noise Standard has long been outdated by the 1999 version.
- The L_{A10} noise descriptor is outdated and has widely been replaced by L_{Aeq} in New Zealand acoustics and internationally. The L_{Aeq} provides a better representation of potential construction noise effects on receivers because it is more closely aligned with how people experience noise.
- L_{A95} noise limits are not relevant to managing construction noise effects. They would not be practical to monitor compliance with and are not included in NZS 6803:1999.
- The construction noise timeframes and noise limits stated in the GDP are not in accordance with the guidance of NZS 6803.
- The GDP construction noise limits apply on vacant and unoccupied properties where there will be no effect.
- The construction vibration limits are overly stringent because they apply amenity-based limits at any point within the receiving site, rather than in occupied buildings. Additionally, the limits are stated in terms of weighted acceleration that would be below the level of perceptibility within the nearest dwellings at frequencies that are typical of construction vibration.
- In our experience, vibration levels of up to 2 mm/s Peak Particle Velocity (**PPV**) with limited periods of up to 5 mm/s PPV are clearly noticeable inside buildings during normal residential activities but they are unlikely to cause complaint if the source of the vibration is known and the receivers know that the effects are temporary.
- There are no vibration controls in the GDP for avoiding building damage.

We recommend that, wherever practicable, construction noise should comply with the L_{Aeq} and L_{Amax} limits of NZS 6803:1999 and construction vibration should comply with 2 mm/s PPV in occupied dwellings to avoid annoyance. Construction vibration must consistently comply with the vibration limits of DIN 4150–3:2016 in all buildings to avoid cosmetic damage.³

It will not be practicable for some of the proposed works to comply with the recommended limits due to the short distances between the works and the nearest receivers. Appropriate limits for these activities are discussed in Section 5.2. The best practicable options to minimise the potential effects of these activities on the nearest receivers will be identified in (and required by) a Construction Noise and Vibration Management Plan (**CNVMP**) for the project. The CNVMP must be prepared by a suitably qualified person and certified by GDC.

We have recommended a condition set in Section 9.0 for the project construction noise and vibration limits and a CNVMP. Consent will be needed to infringe and deviate from the GDP permitted construction noise and vibration limits.

The recommended limits and assessment methods are considered industry best practice. They are very typically adopted in district plan rules and consent conditions in New Zealand. We consider that they will be more appropriate for managing the potential construction noise and vibration effects of the proposed works than the permitted standards in the GDP.

4.0 The neighbouring properties

We understand that the properties on which the proposed works will take place are part of the subject site. We have not considered any potential effects on these sites because they will be partially or fully acquired, or written approval will be provided.

The properties nearest to the proposed works that are not part of the subject site (the **Receivers**) are identified in Figure 2. The locations of the proposed stopbanks and road raising are also shown

The properties nearest to the proposed works are predominantly used for residential activities but there are some commercial properties and vacant land in the area.

³ The DIN 4150–3:2016 sets vibration limits that ensure cosmetic and minor damage to buildings, such as cracked plaster, will not occur from ground-borne vibration.

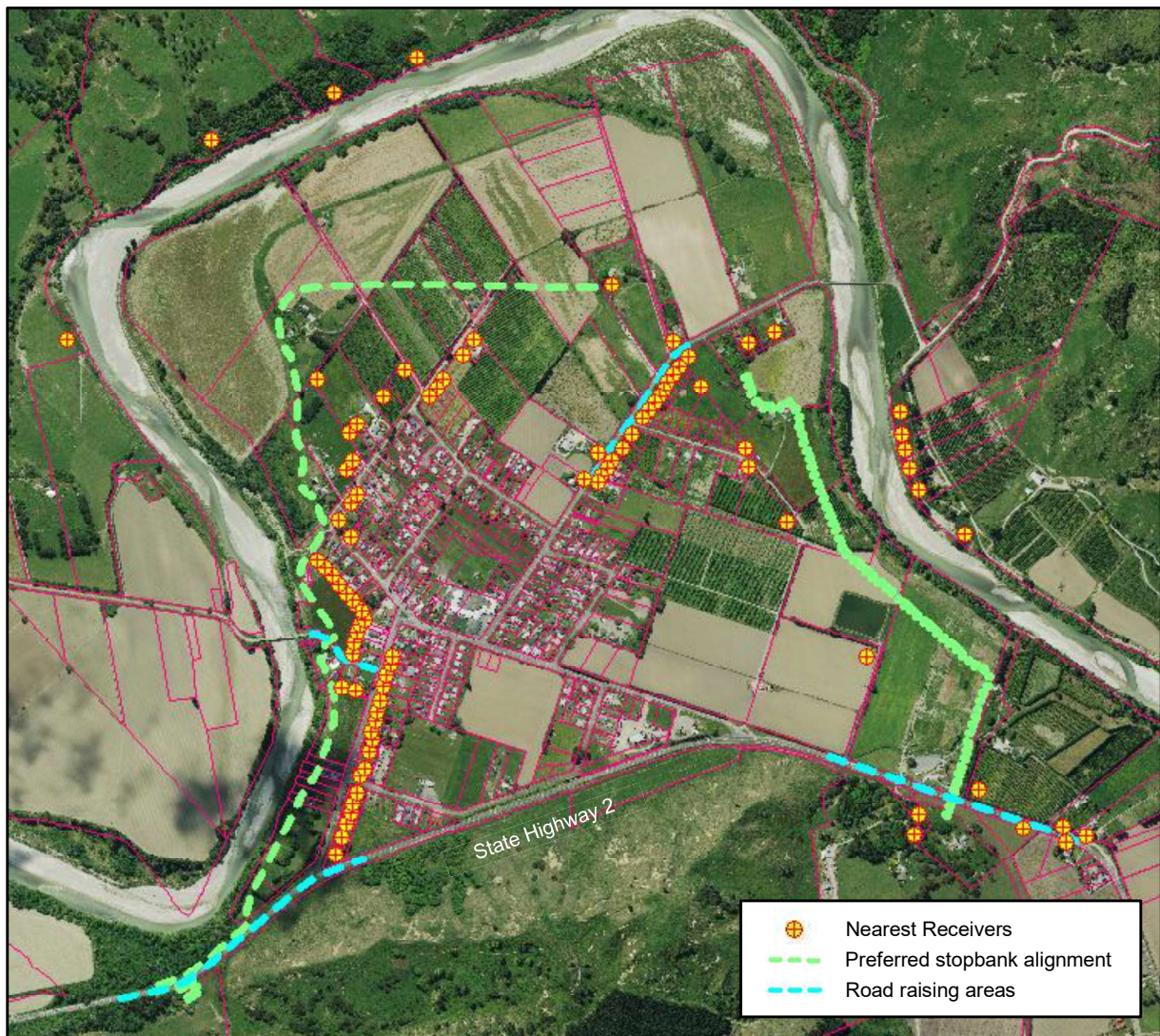


Figure 2: The nearest Receivers and proposed stopbank and road raising

5.0 Construction noise

This section assesses the potential construction noise associated with the project. The construction methodologies, plant, timeframes, and locations included in our assessment have been provided to us by the project team.

5.1 Construction noise references and setback distances

We have calculated construction noise levels at the neighbouring sites based on worst-case scenarios and the references displayed in Table 1. Our references are based on measurement data from previous projects. They are generally consistent with the data provided in NZS 6803:1999 Appendix C *Guide to Sound Level Data on Site Equipment and Site Activities* but are more appropriate for modern construction equipment.

Table 1 also displays the minimum separation distances for each activity to comply with the recommended daytime construction noise limit of 70 dB L_{Aeq} based on the following assumptions:

- The minimum distance stated is from the noise generating plant to the assessment position at 1 m from the most exposed façade of the building e.g. from the excavator engine to 1 m from the façade
- The plant is being used continuously at the reference distance over a 15-minute sample period (i.e. 100% on-time) unless otherwise stated
- The distances include a +3 dB adjustment to the noise levels for reflections from the façade of the receiving building (as required by NZS 6803:1999)
- Acoustically reflective ground is assumed between the noise source and the receiver
- The mitigated compliance distances are based on construction noise barriers effectively screening the ground level of the building from the noise generating activity. Our modelling assumes that a 2.4 m high barrier will reduce the construction noise levels outside a neighbouring building by approximately 10 dB at the ground level.

Table 1: Reference noise levels and compliance distances

Construction activity	Unmitigated reference noise level at 10 m	Unmitigated compliance distance	Mitigated compliance distance
Mulcher / chipper	83 dB $L_{Aeq}(15 \text{ min})$	60 m	19 m
Excavator mounted stump grinder	80 dB $L_{Aeq}(15 \text{ min})$	43 m	14 m
Petrol chainsaw felling trees (based on 33% on time)	78 dB $L_{Aeq}(15 \text{ min})$	34 m	11 m
D6, D7, or D10 bulldozer working in small area*	76 dB $L_{Aeq}(15 \text{ min})$	27 m	9 m
Padfoot vibratory compaction roller 15-t*	76 dB* $L_{Aeq}(15 \text{ min})$	27 m	9 m
Plate compactor	74 dB $L_{Aeq}(15 \text{ min})$	22 m	7 m
Padfoot vibratory compaction roller 6-t*	73 dB $L_{Aeq}(15 \text{ min})$	19 m	6 m
Earthworks works and loading trucks with a 20-t excavator	69 dB $L_{Aeq}(15 \text{ min})$	12 m	4 m
Vibratory compaction roller 5-t to 7-t*	69 dB $L_{Aeq}(15 \text{ min})$	12 m	4 m
Concrete pump and truck discharging	69 dB $L_{Aeq}(15 \text{ min})$	12 m	4 m

Construction activity	Unmitigated reference noise level at 10 m	Unmitigated compliance distance	Mitigated compliance distance
Earthworks works and loading trucks with a 12-t excavator	67 dB $L_{Aeq}(15 \text{ min})$	10 m	3 m
Single drum static compaction roller 5-t*	67 dB $L_{Aeq}(15 \text{ min})$	10 m	3 m
Vibratory compaction roller 3-t*	67 dB $L_{Aeq}(15 \text{ min})$	10 m	3 m
Single drum static compaction roller 3-t*	65 dB $L_{Aeq}(15 \text{ min})$	8 m	3 m
Motor scraper 30-t*	65 dB $L_{Aeq}(15 \text{ min})$	8 m	3 m
Use of handheld power tools	65 dB $L_{Aeq}(15 \text{ min})$	8 m	3 m
Motor grader*	62 dB $L_{Aeq}(15 \text{ min})$	6 m	2 m
Idling delivery truck or dump truck	62 dB $L_{Aeq}(15 \text{ min})$	6 m	2 m

* Reference noise level is for a moving noise source.

5.2 Compliance with recommended noise limits

The vegetation and tree removal works will generate the most noise, but they will be significantly outside the minimum unmitigated compliance distances shown in Table 1.

The shortest distances between the nearest receivers (at 1 m from the dwellings) and the use of dozers, excavators, compaction rollers, and heavy vehicles on site are 10-25 m. The dwellings on these sites are all single level.

In most cases, noise from the proposed works will be able to comply with the recommended noise limits of 70 dB L_{Aeq} and 85 dB L_{Amax} by using temporary construction noise barriers (as shown in Table 1). However, there will be times when this may not be practicable, for example during the road raising works on Rangatira Road when works are elevated above the dwelling and space between the works and the boundary is limited.

For these works, we recommend applying a limit of 80 dB L_{Aeq} outside any occupied dwelling, providing that the activity is identified in the CNVMP and the residents are given notice before the works take place. The information in the CNVMP and provided to the residents must set out the dates, timing, and duration of the works. The CNVMP must also state why it is not practicable to comply with the project limits and set out the best practicable options for mitigating the noise effects.

Construction noise levels are only expected to exceed 70 dB L_{Aeq} and 85 dB L_{Amax} outside the dwellings nearest to the road raising works on Rangatira Road, Kanakanaia Road, SH2 at the

eastern extent of the project where acoustic screening may not be practicable. It will be possible to mitigate the noise emissions to comply at all other properties.

6.0 Construction vibration

The proposed vibration generating activities include excavation, vibratory compaction, and the movement of other heavy machinery and vehicles. Typical vibration levels for these activities are provided in Table 2. These references are based on our previous measurements using a geophone buried in the ground. The levels measured from the foundations of a building at the same distance are likely to be lower.

Table 2: Typical construction vibration levels

Construction activity	Distance	Typical vibration levels (PPV)
Vibratory compaction with a 10-t roller	2 – 10 m	2 – 10 mm/s
Vibratory compaction with a 3-t roller	2 – 10 m	1.5 – 5 mm/s
Compaction with a large static roller	2 – 10 m	1 – 2 mm/s
Excavator works, loading trucks, and tracking slowly with a 6-t to 20-t excavator	2 – 10 m	0.5 – 2 mm/s
Heavy vehicle or tractor pass-by	10 m	0.1 – 1 mm/s

Vibration levels above 0.3 mm/s PPV within buildings can be perceptible and levels exceeding 1 mm/s PPV can cause concern if the vibration is unexpected. However, intermittent construction vibration during the day of up to 2 mm/s PPV with limited periods of up to 5 mm/s PPV are typically acceptable in dwellings if notice is given to the receivers and they assured that building damage will not occur.

We recommend that construction vibration should comply with the guideline vibration values of DIN 4150–3:2016 to avoid building damage. The values depend on the dominant frequency of the vibration but start at 5 mm/s PPV for short-term vibration in dwellings. Construction vibration from the proposed works will readily comply with the DIN 4150–3:2016 limits at all nearby dwellings.

To manage potential effects on amenity, we recommend that construction vibration should comply with a limit of 2 mm/s PPV at the foundations of any occupied dwelling. This will be possible for most of the proposed activities, but vibratory compaction may generate higher levels depending on the ground conditions, the response of the receiving building, and the size of the machinery required to achieve the compaction specification.

The vibration generated during compaction may be between 2 mm/s and 5 mm/s PPV at the dwellings nearest to the road raising works on Rangatira Road and Kanakanaia Road, and the eastern works on SH2. This would occur intermittently over a short period while compaction is completed within approximately 15-20 m of the dwellings.

Where it is not practicable to comply with 2 mm/s PPV during compaction works, we recommend applying a vibration amenity limit of 5 mm/s PPV at the foundations of any occupied dwelling, providing that the activity is identified in the CNVMP and the residents are provided with notice before the works take place. The information in the CNVMP and provided to the residents must set out the dates, timing, and duration of the works. The advice to the residents must also state that the vibration will comply with limits for avoiding cosmetic building damage. The CNVMP must also state why it is not practicable to comply with 2 mm/s PPV and set out the best practicable options for mitigating any vibration effects on the residents. Such options would include using the smallest vibratory compactor and the highest frequency settings available or using a static roller and plate compactors if possible.

7.0 Potential construction noise and vibration effects

Noise from the proposed construction works will mostly comply with the recommended construction noise limits of 70 dB L_{Aeq} and 85 dB L_{Amax} . The recommended noise limits are similar to the GDP permitted construction noise limits but adopt current industry best practice in terms of the noise descriptors, assessment locations, and Standards. They also only apply where the building on the receiving site is occupied. Adopting these limits will not result in any additional noise effects on the receivers compared to compliance with the GDP standards.

There will be short periods during road raising works when compliance with the project limits is unlikely to be practicable. We have recommended temporary noise limits of 80 dB L_{Aeq} and 95 dB L_{Amax} for these works. We consider that the noise emissions will be reasonable provided that the best practicable options to minimise the effects are adopted and the residents are given notice of the works. These measures would be implemented through the provisions of a CNVMP that has been reviewed and certified by Council.

The potential noise effects typically associated with construction are displayed in Table 3. The internal noise effects are based on the windows of the receiving building being closed and a noise level reduction of 20 dB being achieved through the façade. This is a typical reduction for older buildings with thinner glass and less air-tight joinery than modern buildings. The façades of modern or upgraded buildings will typically provide a reduction of at least 25 dB.

The potential effects described for noise levels greater than 70 dB L_{Aeq} are unlikely to be experienced at any neighbouring site for longer than approximately two-three weeks. The residents will know when to expect this noise and will generally be able to seek respite indoors during these periods. Once the nearest earthworks have been completed, the potential noise effects will generally be no greater than those shown for noise levels of 55- 65 dB L_{Aeq} . There will be no noise generated at night.

Table 3: Temporary daytime construction noise effects

Noise level at 1 m from the façade	Potential effects outside the building	Potential effects inside the nearest room of the building
55-65 dB L_{Aeq}	Conversations may require raised voices. Construction noise may be dominant (depending on existing ambient level).	Up to 42 dB L_{Aeq} inside. Noise may be noticeable inside the building, but it is unlikely to interfere with daily residential and commercial activities.
65-70 dB L_{Aeq}	Conversation will require raised voices. People are unlikely to spend time outside.	Up to 47 dB L_{Aeq} inside. Noise will be noticeable inside the building, but still unlikely to interfere with daily residential and commercial activities.
70-75 dB L_{Aeq}	Conversation will require raised voices. People are unlikely to spend time outside. Businesses that use outdoor areas (e.g. cafes and restaurants) would experience considerable disruption.	Up to 52 dB L_{Aeq} inside. Annoyance for some occupants. Concentration may be affected but residential and commercial activities can generally continue. Sound levels for television, radio, and phone conversations would need to be slightly raised.
75-80 dB L_{Aeq}	Conversation will be difficult even with raised voices. People will likely leave the area or seek respite indoors. Some people may choose to wear hearing protection if they cannot leave (e.g. due to their job). Businesses that use outdoor areas would experience considerable disruption.	Up to 57 dB L_{Aeq} inside. Annoyance for some occupants. Concentration likely to be affected but residential and commercial activities can generally continue. Sound levels for television, radio, and phone conversations would need to be raised. People are likely to seek respite by moving to another room if the noise continues for extended periods.

Like construction noise, we consider that the permitted construction vibration standards do not represent current industry best practice. They would be impossible for many construction projects to monitor and comply with. They are overly stringent, they apply at vacant sites and in vacant buildings. The assessment locations are also not representative of vibration amenity effects on the occupants of buildings. We have recommended vibration amenity limits in occupied buildings and limits to avoid building damage.

Construction vibration will be perceptible intermittently during the day inside the nearest dwellings while vibratory compaction and the operation of other heavy machinery is undertaken nearby. However, the residents will have been provided notice, and the vibration will not cause unreasonable disruption to residential activities or building damage if our recommended limits are complied with. The recommended vibration limits are widely adopted for projects in New Zealand and are consistent with best practice.

Construction noise and vibration effects are generally unavoidable when upgrading infrastructure near to dwellings. The potential effects will be reduced by communicating with

the neighbours, using temporary construction noise barriers wherever practicable, and limiting the works to daytime hours. The proposed construction noise levels up to 80 dB L_{Aeq} and vibration levels up to 5 mm/s PPV during the day are expected to be tolerated for short durations providing the noise and vibration is no greater than necessary and the residents have been given notice. The vibration effects will be mitigated by assuring the residents that the expected levels will not cause building damage such as forming cracks or enlarging existing cracks in plaster.

We consider overall that construction noise and vibration from the proposed works will not exceed a reasonable level or cause unreasonable disruption for the receivers.

8.0 Road raising

SH2 must be lifted at the western and eastern stopbank intersections to allow tie-in with the new stopbank levels. The western section will be raised by approximately 1 m and the eastern section by approximately 2 m. Sections of Rangatira Road and Kanakanaia Road must also be lifted to allow tie-in with the new stopbank levels, by approximately 3 m above the existing surface.

We have modelled before and after scenarios to calculate the potential difference in road traffic noise levels for the nearest receivers at the completion of the road raising. Our models assume that all other factors will be consistent, such as road surface, speed, traffic flow, and heavy vehicle counts. We have sourced local ground heights and the relevant positions of the roads and dwellings from online sources.

The calculation have been undertaken using DGMR iNoise computer noise modelling software, a successor to Bruel & Kjaer Predictor which is no longer supported. DGMR iNoise is widely used by acoustics consultants internationally. The noise level predictions calculated by the models are based on the International Standard ISO 9613-2:2024 *Attenuation of sound during propagation outdoors*.

The differences have been calculated at 1.5 m above local ground level at the notional boundaries and the façades of the nearest dwellings to assess the potential noise effects of the road raising. The maximum changes resulting from the road raising are displayed in Table 4.

Table 4: Maximum changes in road traffic noise resulting from road raising

Location	Maximum change in road traffic noise level at nearest notional boundaries	Maximum change in road traffic noise level at façades of nearest dwellings
SH2 east	+2 dB	+2 dB
SH2 west	0 dB	+1 dB
Rangatira Rd	+1 dB	+1 dB
Kanakanaia Rd	+1 dB	+1 dB

The changes in road traffic noise resulting from the road raising are 0-1 dB for most of the nearest receivers, and 2 dB for two receivers near to the eastern tie-in on SH2. These changes are very small will not be noticeable. We have not therefore recommended any additional mitigation measures.

9.0 Recommended conditions

We recommend the following conditions for the project:

Construction hours

1. Construction work may only take place between the hours of 7:30 am and 6:00 pm, Monday to Saturday. This condition does not prevent quiet construction activities and meetings from taking place at any time, provided that any noise generated is generally inaudible at the notional boundary of any occupied dwelling.

CNVMP

2. At least ten working days before any construction works authorised by this consent begin, the consent holder must submit a Construction Noise and Vibration Management Plan (CNVMP) to Gisborne District Council for written certification.

The objectives of the CNVMP must be to:

- a) Set out the procedures to identify and adopt the best practicable options for minimising adverse construction noise and vibration effects; and
- b) Define the procedures to be followed to ensure that the project construction noise and vibration standards are being met.

To achieve the objectives above, the final CNVMP must be prepared by a suitably qualified person and with reference to Annex E of NZS 6803:1999 *Acoustics – Construction noise* and the Association of Australasian Acoustical Consultants *Guideline for Interpreting and Applying NZS 6803-1999*.

The CNVMP must include the following information:

- The consented construction noise and vibration limits for the project.
- Requirements and specifications for acoustically effective barriers and any localised screening required for compliance with the project limits.
- Minimum setback distances for compliance.
- Identification of surrounding noise and/or vibration sensitive receivers.
- Details of general noise and vibration mitigation measures.
- Details for advising the occupiers of the neighbouring buildings of the works, including when the highest noise levels and perceptible vibration can be expected.

- Procedures for responding to concerns from neighbours and dealing with any complaints (including the provision of contact details for any concerns regarding noise and vibration).
- Procedures for noise and vibration monitoring to be undertaken during the works and for applying any corrective action measures.
- Procedures for ensuring that all contractors and operators on site are aware of the construction noise and vibration monitoring requirements during the works, and the requirement to minimise noise and vibration effects as far as practicable on the neighbouring sites.

Advice note: The CNVMP may be subject to amendment through the life of the project. Any subsequent amendment of the certified CNVMP which comprises changes to the construction methodology must be tracked and the revised CNVMP submitted to the Council for certification.

Notice of works to receivers

3. At least ten working days before any earthworks authorised by this consent begin, the consent holder must advise the occupants of all buildings within 100 m of the works. The advice must be provided in writing and include the following information:
 - A general description of the construction works.
 - The construction hours and expected duration of the works.
 - The approximate dates, times, and durations of the activities that will generate the highest levels of construction noise and vibration.
 - A contact name and phone number for any questions or complaints regarding noise and vibration throughout the project.

Construction noise limits

4. Construction works on the site must be designed and conducted to ensure that noise emissions do not exceed the following limits at 1 m from the façade of any occupied dwelling outside the subject site between 7:30 am and 6:00 pm on Monday to Saturday:
 - a) the project limits of 70 dB L_{Aeq} and 85 dB L_{Amax}
 - b) higher limits of 80 dB L_{Aeq} and 95 dB L_{Amax} when an activity cannot practicably comply with the project limits in (a). Before the activity begins, notice of the higher noise levels must be provided to the residents including the dates, times, and duration of the activity. The activity must be identified in the CNVMP. The reasons why compliance with the project limits in (a) is not practicable must be stated and the best practicable options for mitigating noise effects of the activity must be identified.

The L_{Amax} noise limits in this condition do not apply at 1 m from the façade of any occupied building that does contain a noise sensitive activity.

5. All construction noise must be measured and assessed in accordance with NZS 6803:1999 *Acoustics – construction noise*.

Construction vibration amenity limits

6. Construction works on the site must be designed and conducted to ensure that vibration does not exceed 5 mm/s PPV within any occupied building outside the subject site. Where vibration is expected to exceed 2 mm/s PPV within an occupied building outside the site, the consent holder must provide the following information in writing to the occupants:
 - The dates, times, and duration of the vibration expected to exceed 2 mm/s PPV.
 - A phone number and contact person for any questions or to advise of any sensitive times for construction vibration during the day.

The advice must be provided no less than 3 days before the works expected to exceed 2 mm/s PPV begin. The consent holder must maintain records of any consultation and provide them to Gisborne District Council on request.

The vibration from all other works must comply with 2 mm/s PPV within any occupied building.

Advice note: The vibration amenity limits do not apply at any building that is not occupied during the works. This allows higher vibration works to be scheduled when occupants are not in the building, subject to compliance with building damage criteria and compliance with the amenity limits at other nearby buildings that are occupied.

Construction vibration limits to avoid building damage

7. Construction works on the site must be designed and conducted to ensure that vibration does not exceed the limits set out in German Industrial Standard DIN 4150–3:2016 *Vibration in buildings – Part 3: Effects on structures* when measured in accordance with that Standard on any structure not on the same site.

10.0 Conclusion

Styles Group has assessed the potential noise and vibration effects of the proposal.

The GDP construction noise and vibration limits are outdated and in our view are not suitable for controlling the potential noise and vibration effects of the project. We have recommended project specific limits that we consider to be suitable and in accordance with current industry best practice. Adopting these limits will not result in additional noise or vibration effects on the receivers.

We have also recommended provisions for these limits to be exceeded for short periods when compliance is not practicable. This is primarily to enable vibratory compaction works during road raising when it may not be practicable or safe to use temporary construction noise barriers.

Our recommended conditions require a CNVMP to be prepared to set out the procedures to identify and adopt the best practicable options for minimising adverse construction noise and vibration effects and ensure that the consented limits are complied with. The conditions also require written notice to be provided to the receivers to advise them of the potential construction noise and vibration. These measures will help to reduce the potential construction noise and vibration effects.

The works will generate noise and vibration intermittently and only during daytime hours. The project will not undertake noisy activities at night or on Sundays and public holidays.

During periods of higher noise levels and perceptible vibration, occupants of the nearest dwellings may experience some temporary annoyance if they are home during the day, but they will be able to continue daily activities. Noise and vibration effects of this nature are typical of infrastructure works in residential areas and are generally accepted. Overall, the construction noise and vibration effects will be reasonable and will not give rise to serious, undue, or unreasonable disruption.

Any increase in road traffic noise resulting from the proposed road raising will be no greater than 2 dB. This will not be a perceptible change. We have not therefore recommended any additional mitigation measures.

Resource consent will be required for infringements of the following GDC standards with respect to noise and vibration:

- C11.2.15.2: Infringement and deviation from the permitted construction noise limits to exceed the duration limit, adopt current industry best practice, and enable the required vibratory compaction for road raising works.
- C11.2.15.4: Infringement and deviation from the permitted vibration limits to exceed the duration limit, adopt current industry best practice, enable the required vibratory compaction for road raising works, and adopt DIN 4150–3:2016 for the avoidance of building damage from vibration.
- C11.2.15.8: Deviation from the construction noise Standard referenced by the GDP to adopt the current New Zealand construction noise Standard.

Appendix A Glossary

Noise	A sound which serves little or no purpose for the exposed persons and is commonly described as 'unwanted sound'. The definition of noise includes vibration under the Resource Management Act.
dB (decibel)	The basic measurement unit of sound. The logarithmic unit used to describe the ratio between the measured sound pressure level and a reference level of 20 micropascals (0 dB).
A-weighting	A frequency filter applied to the full audio range (20 Hz to 20 kHz) to approximate the response of the human ear at lower sound pressure levels.
Z-weighting	Zero frequency weighting. No filter is applied to the measured level.
L_{A10} (dB)	A statistical noise descriptor. The A-weighted sound level which is just exceeded for 10% of the measurement period (t). Sometimes referred to as the average maximum noise level. Largely outdated in environmental acoustics and replaced by the L_{Aeq} .
$L_{A90(t)}$ (dB)	The A-weighted sound level in decibels equalled or exceeded for 90% of the of the measurement interval. It is the component of the total sound perceived as continuously present. Used in current New Zealand Standards as the descriptor for background noise.
$L_{Aeq(t)}$ (dB)	The A-weighted equivalent sound pressure level with the same energy content as the measured varying acoustic signal over a sample period (t). The preferred metric for sound levels that vary over time because it considers the total sound energy over the time period of interest.
L_{AFmax} (dB)	The maximum A-weighted sound pressure level recorded during the measurement period using a fast time-weighting response.
L_{Zpeak} (dB)	The maximum un-weighted peak sound pressure level recorded during the measurement period.
L_{WA} (dB)	Sound power level (L_{WA}) is the acoustical energy emitted by a sound source. It is an absolute value and is not affected by distance or the environment. The L_{WA} is used in computer noise modelling to calculate the sound pressure level (e.g. L_{Aeq}) at a given distance.
SEL or L_{AE} (dB)	The A-weighted single event noise exposure level. It is used to quantify the noise generated by individual events referenced to a standard period of one second. It is the dBA noise level over one second that would produce the equivalent sound energy as the actual event.
Notional boundary	A line 20 metres from any side of a residential unit or other building used for a noise sensitive activity, or the legal boundary where this is closer to such a building.

PPV (mm/s)	Peak particle velocity is the metric commonly used for measuring construction vibration in New Zealand. It is the instantaneous maximum velocity reached by a vibrating element as it oscillates about its rest position.
CNVMP	Construction noise and vibration management plan. A document developed by a suitably qualified person to set out the procedures for a contractor to manage and mitigate construction noise and vibration effects.
