# Transport noise
# Stormwater and barrier design

NZ TRANSPORT AGENCY
WAKA KOTAHI

## NOISE BARRIER CASE STUDY 10

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Noise barriers installed under the Noise Improvement Programme by the AMA at Otahuhu

## AMA noise barrier project

**The Auckland Motorways Alliance (AMA) Noise Barrier Project (2008 – 2011) was set up to retrospectively install noise barriers under the NZ Transport Agency (NZTA) Noise Improvement Programme (NIP), along key sections of the state highway network in Auckland. Under the NIP, where houses are exposed to state highway noise above a funding threshold of 65 dB $L_{Aeq(24h)}$, an application can be made for noise mitigation measures. Allocation of funds under the NIP is prioritised on the basis of assessment criteria set out in the *NZTA Environmental Plan*. The AMA Noise Barrier Project was the first to install noise barriers under the NIP.**

This case study relates to noise barriers installed adjacent to State Highway 1 at Takanini and Otahuhu. Specifically, this case study examines issues with the stormwater design and modular concrete panels used for the barriers. The approximate cost of the noise barriers was $900 per linear metre, with a barrier height of 2.4 to 3.6 metres.

## Stormwater design

Noise barriers have the potential to interfere with primary drainage systems and overland stormwater flow paths and create flooding in the surrounding area. This relates mainly to stormwater runoff from surrounding land rather than from the motorway itself. In this instance, when designing retrospective noise barriers, the stormwater systems were assessed with regards to existing stormwater management issues and assests, topography, property access and ownership. Each noise barrier required assessment and was modified if needed to incorporate the appropriate stormwater system. The rear of the noise barriers are offset from the adjoining property boundary by approximately 300mm in order to incorporate the barrier foundations and stormwater systems. Where required, stormwater design and construction increased the cost of the noise barriers by approximately 20–30%.

Stormwater management systems used included:

- **Planted swales** – These swales are located parallel to the noise barrier and the motorway carriageway, allowing water to be directed from neighbouring properties and the motorway. These swales utilised existing open drains and act to divert and direct water runoff. Swales were planted with native rushes and sedges to assist in the filtration of road derived sediments.
- **Holes in barriers** – In order to prevent flooding from a 1 in 100 year storm, holes were created in the barriers to allow water to pass through. For large flows grilled slots were installed. Holes located in line with or below ground level help to ensure they are screened from direct noise propagation paths. However, if used on other projects with higher noise barriers, noise transmission through such holes may require modification, such as by adding secondary screens.
- **Aco drains** – These drains are located behind the noise barriers. They are polycrete trench drains chosen due to their narrow profile, with grates available but not installed due to potential blockages and access issues. These drains were used initially on the project, but due to the relatively high capital cost and maintenance needs, for the later stages of the project Aco drains were replaced by more basic Hynds concrete channel drains.
- **Hynds drains** – These drains are located behind the noise barriers. They are rectangular concrete trench drains slightly wider than the Aco drain design. As such a wider offset from the property boundary was required.


Planted swales and slots in barriers


Holes in barriers

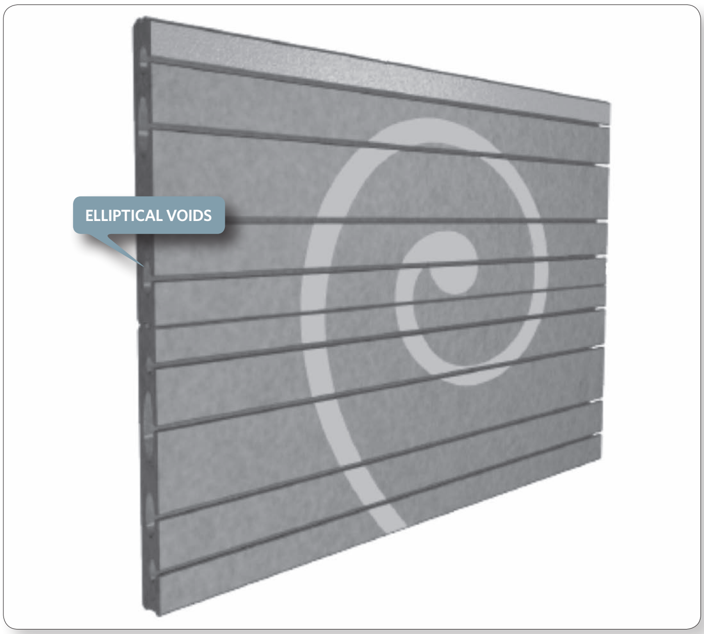

Aco drains


Hynds drains

# Post and panel design

The noise barriers are a post and panel system. Replaceable concrete panels are stacked 2 to 3 high between steel I-posts. The use of pre-stressed concrete panels allowed the distance between posts to be increased to 8 metres instead of the 2 to 4 metre spacings often used for noise barrier systems. The reduction in the overall number of posts resulted in significant time and cost savings during construction. The panel design also allowed the inclusion of stormwater holes and slots (discussed above) without requiring support from lintels/beams.

As part of a trial, plastic strips known as 'De Vinci Lips' were initially included within horizontal slots cut into elliptical voids in the face of 'LGB' concrete panels. The objective of this design was to reduce reflected noise, which can be an issue particularly with parallel barriers on both sides of a road. Although the LGB panels were used for this trial, in this location the barriers are relatively low and are adequately separated such that reflected noise should not be significant. Advice on when sound absorptive barriers may be required is provided in Section 2.4 of the *NZTA State highway noise barrier design guide*.




Sketch of LGB concrete panel showing elliptical voids


Ferrite magnets were used to pack gaps between noise barrier posts and panels

During manufacture, 70% of the first batch of concrete panels failed due to the collapsing of the elliptical voids within the panels. A standard 150mm hollow core panel was then selected to avoid this issue and due to this change only some of the noise barriers at Takanini have the De Vinci Lips. For visual consistency the standard hollow core panels had the 'Lips' painted on instead.

After installation, a number of the De Vinci Lips were found to be detaching from within the concrete voids. This is due to the thermodynamic properties of the concrete that hadn't been adequately allowed for in the design. As a result, the concrete panels with De Vinci Lips have required some maintenance, with the lips needing to be glued back within the voids.

The original LGB concrete panels were 135mm deep which fit snugly into a UC150 150mm post. However when the LGB concrete panels were replaced with a 150mm hollow core concrete panel, a UC200 200mm post was required. As a result a 50mm gap required packing.

Initially, lateral steel bearing pads were to be welded to the steel posts to pack the gap between the posts and panels. However the final design uses ferrite magnets to fill gaps which are significantly quicker to install. The individual magnets (2 per panel) were inserted between each steel post and concrete panel as shown in the photograph above. The speed of panel installation helped to limit the disruption to traffic on the state highway.

# Lessons learnt

- Combinations of different stormwater management systems were required to deal with the primary drainage system and potential overland flow issues created by the barriers. Existing on-site drainage issues were also rectified.
- The use of ferrite magnets to infill gaps between noise barrier panels and post was an effective solution to what would otherwise have been a time consuming and costly task.
- The use of pre-stressed concrete panels allows for increased distances between steel I-posts.
- The modular concrete panel system means panels can be quickly removed and replaced in the event they are damaged.
- A number of issues arose with the LGB concrete panels and De Vinci Lips system. The NZTA should set clear performance specifications (acoustic and non-acoustic) for noise barriers, and if new products are to be trialled on site, contingency plans should be prepared in case the product does not meet the specifications.

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