


GUIDELINES ON GREENING OF NOISE BARRIERS

GREENING, LANDSCAPE AND TREE MANAGEMENT SECTION
DEVELOPMENT BUREAU
THE GOVERNMENT OF THE HONG KONG SPECIAL ADMINISTRATIVE REGION

APRIL 2012

Contents

Enquiries :
Greening and Landscape Office
Greening, Landscape and Tree Management Section
16/F, West Wing, Central Government Offices
2 Tim Mei Avenue, Tamar, Hong Kong
E-mail : gltms@devb.gov.hk

1 Purpose and Scope

1.1 This set of guidelines aims to facilitate project proponents and their works agents to achieve an optimal greening solution in designing with greening on noise barriers. The objective is to promote a holistic and integrated design for achieving quality greening for noise barriers.

1.2 These guidelines do not contain technical details for individual type of noise barriers and greening techniques. Reference can be made to other relevant documents in **Appendix A**, where such details are available.

1.3 In the context of this set of guidelines, the definition of noise barriers is taken to include all noise abatement/mitigation structures that form a part of the road[1] system, including vertical, cantilevered/curved and noise enclosure including semi-enclosure and full enclosure, at grade or on elevated structures. While the guidelines are written with greening and planting at-grade adjoining noise barriers and vegetative wall panels installation in mind, the generic principles would also be applicable to green roofs on noise enclosures and greening of decking-over type of noise barriers as well as greening on earth mounds/engineered earth mounds, where practicable. For those noise barriers along site boundaries and on building structures not related to roads, these guidelines would be applicable where considered practicable. For the purpose of this set of guidelines, it may not be applicable to noise barriers on railways where functional operations and maintenance concerns are very different from the road system. Nevertheless, the relevant project proponent and design teams are encouraged to observe the guidelines where practicable.

1.4 For simplicity, the term “noise barrier” hereafter would refer to noise enclosure and any other types of noise abatement structure related to roads.

2 Overview

2.1 Under the policy of greening, the incorporation of greening and landscaping on noise barriers is recommended based on environmental and aesthetic considerations. Greening is considered as a mitigation measure to reduce the visual impacts of noise barriers. Planting can

[1] 'Road' includes every highway, thoroughfare, street, lane, alley, court, square, car park, passage, path, way and place to which the public have access either continuously or intermittently in general, but does not include any private road.

help to soften and enhance the appearance of a noise barrier by imparting a more natural character and breaking the monotony of the structure, and more importantly, reducing the visual intrusion to the environment and providing a visual relief from the views of the residents and other sensitive receivers in the vicinity.

2.2 Apart from the conventional design of locating planting areas adjoining to noise barriers for at-grade planting, there are currently some pilot schemes to apply vegetative wall panel types of greening techniques to noise barrier design, which are on a trial basis. There are various vegetative wall panel systems that differ in design and performance. Planting together with soil-filled support or modular panels with growing medium is installed/mounted vertically onto the structural support of the noise barriers. There are different applications from solely vegetative wall panels to a combination of vegetative wall panels with other panel materials in the noise barrier design.

2.3 While there are merits of adopting vegetative wall panel types of greening technique for some situations, there are also limiting factors in the application to noise barriers that should not be overlooked. It should be noted that vegetative wall panel types of greening may not be appropriate for application to all situations and should not be regarded as the only design option.

3 Review of Current Guidance on Greening of Noise Barriers

3.1 There are several Government publications on design of noise barriers and greening related to road and highways structures, but the information on design considerations for greening of noise barriers is generally limited. A list of reference documents is attached in **Appendix A**.

3.2 Environmental Protection Department and Highways Department's "Guidelines on Design of Noise Barriers" sets out general principles and guidelines on the design of noise barriers with brief guidance on greening for noise barriers. It should be noted that design considerations of long-term maintenance requirements along with cost effectiveness are recommended. The document also deliberated the limiting factors of the vegetated barrier type of greening (modular planters placed vertically as barriers) for the long-term consequence in terms of maintenance, in particular for maintaining vegetation adjacent to an expressway.

3.3 Highways Department's "Structure Design Manual for Highways and

Railways" covers the aspects of greening and landscaping on structural elements related to road system in general but not specifically on greening of noise barriers.

3.4 The review of current guidance above indicated that practical guidance on design approach, principles and considerations specifically on greening of noise barriers would be useful to project teams to meet the goal for achieving quality and effective greening for noise barriers.

4 Designing with Greening on Noise Barriers

4.1 General

In designing with greening on noise barriers, it is essential to select the optimal greening solution with respect to its landscape context, site characteristics and conditions in terms of opportunities and constraints to meet the objectives and to achieve the greening effect in a cost effective and sustainable manner. Some recommended practices from local experiences are appended for reference in **Appendix B**.

4.2 Landscape Context and Objectives

The design of greening on noise barriers shall conform to the overall landscape strategy and be integrated into the landscape framework and the greening design of the entire transport corridor for achieving the ultimate landscape objectives to complement and improve the landscape and visual quality of the surrounding landscape.

4.3 Roadside Environment

While site characteristics and conditions would be varied subject to locations, roadside environment are commonly harsh and hostile to plant growth in general (exposed to wind, heat and pollutants, and other adverse weather and drought conditions).

4.4 Approach and Fundamentals in Planning and Design Process

In order that greening measures would be effectively incorporated into noise barriers, it is imperative that the considerations below are taken into account in the early planning and design stage.

4.4.1 <u>Holistic approach and integrated design</u>

- Noise barriers together with greening form an integral part of the road system. A holistic approach with due considerations of the landscape and greening framework of the whole transport corridor should be taken in the design.

- Attention to greening design details for better integration with the engineering design and careful consideration of site constraints, functions, aesthetics, greening effect, maintenance, safety and cost effectiveness at the early project planning stage rather than the design stage would achieve the best result.

4.4.2 Aesthetics and design intent

- From a landscape perspective, greening on noise barriers aims to accomplishing and enhancing the local landscape by blending the noise barriers into the immediate environs.

- Depending on the aesthetic and design intent, greening of noise barriers would be varied in scale and coverage, having the objectives of receding the noise barriers into the landscape, or alternatively creating a landmark feature in the landscape with the distinctive structural form of the noise barrier, where greening is subordinate. It should be noted that both intents can achieve aesthetically pleasing and desirable results.

- While greening can effectively mitigate the visual impact of noise barriers, it is not the only means and may not resolve the unappealing design of noise barrier structures.

4.4.3 Conservation of existing vegetation

- Minimising impacts on existing vegetation particularly trees should be considered in the planning and design process, and the prevailing technical circular and guidelines on tree preservation refer. Existing vegetation including trees should be treated as a landscape and environmental asset both aesthetically and ecologically, and should be integrated into the design of the noise barrier greening, where possible.

- Noise barrier design which adds greenery at the expense of existing and well-established greenery is not recommended. The alignment of noise barriers should take into account existing vegetation that is suitable for preservation.

- Visual connection to the existing vegetation including trees should be considered in the design of noise barriers. The transparent noise barrier panel type that provides penetrable view to the existing vegetation for “borrowing” the landscape is preferable.

4.4.4 Sustainable design

- Sustainable design of noise barrier greening, taking account of resource efficiency including energy saving and water conservation in initial installation and long-term maintenance as design parameters, should be one of the primary design considerations.

- Overall sustainability on all aspects apart from individual aspect on greening should be critically evaluated against the greening effect at the planning and design stages of projects.

4.4.5 Space requirements

- Allocation of sufficient space, both above ground and below ground for greening of noise barriers should be allowed in the planning stage and design stage.

- In provision of greening on noise barriers, space requirements related to maintenance operations including safe maintenance access should be thoroughly examined and suitably allowed for.

4.4.6 Plant selection and planting design

- Given that the roadside environment is harsh, selection of hardy and drought tolerant species in simple and bold planting scheme for easy long-term horticultural maintenance is recommended.

4.4.7 Maintenance

- Maintenance requirements should be well defined and spelt out early in the design process.

- Close liaison, and agreement of the maintenance party on the design early in the design process is required.

- Capital and recurrent costs should be clearly defined and secured for maintenance.

4.5 Significant Aspects of Design Considerations

4.5.1 Apart from technical considerations of function, cost and other aspects on engineering and traffic engineering in designing noise barrier greening, four key aspects:- **effectiveness, maintenance, safety** and **sustainability** should be considered when selecting the optimal greening solution and types of noise barrier greening during the

planning and design stage.

4.5.2 A checklist of key aspects of designing with greening on noise barrier is recommended below.

Checklist of Key Aspects of Designing with Greening on Noise Barrier	
Aspects	**Considerations**
A. Effectiveness	1. Has sufficient space been allowed for optimising design options? 2. Is the proposed greening effective in meeting the functions and the objectives? 3. Has the visual impact of the noise barriers been reduced/softened/mitigated? 4. Is the greening design effective in reducing the scale/dominance of the noise barriers and providing visual relief to the potential sensitive receivers/the local residents? 5. Is the greening design compatible with the local character/landscape? 6. Is the greening quality good value for money?
B. Maintenance	1. Has the long term consequence on maintenance considered in the design? 2. Is the design and planting robust enough to withstand the harsh conditions of roadside environments? 3. How often will replacement of planting be necessary? Is it cost effective? 4. Is the anticipated frequency of vegetation maintenance operations including pruning reasonable and acceptable to the maintenance agent(s)? 5. Is it easy for replacement and replanting following accidental damages/typhoons? 6. Is safe access and reasonable loading/unloading areas

	available for maintenance? 7. Has the frequency for arranging temporary traffic arrangement (TTA) and lane closure for the vegetation maintenance operation been agreed with the relevant parties? 8. Have other specific requirements on maintenance been conveyed to the project team and maintenance agent(s), and included in the operation and maintenance manual? 9. Have sufficient recurrent costs required by the maintenance agent and the funding been secured? 10. Has minimization of recurrent implications arising from greening of noise barriers been considered?
C. Safety	1. Is the design safe for road users[2], pedestrians and maintenance crew, in particular for cases requiring TTA and road closure in conducting vegetation maintenance operations? 2. Is there sufficient working space for regular maintenance of greening on noise barriers? 3. Are the safety requirements from the maintenance agent(s) satisfied?
D. Sustainability	1. Is the design sustainable in the long run, including selection of sustainable plant species? Does it require regular replacement? 2. Does the design require excessive irrigation water? 3. Is the design and planting still appealing with minimal or low maintenance? 4. Is the design environmentally friendly and sound? 5. Has energy saving and water conservation been

[2] The proposed greening and landscaping features would not obstruct/obscure the sightline of road users, traffic signs, directional signs, traffic signals, traffic control and surveillance system and relevant facilities.

	considered in the design?

5 Experience of Applying Vegetative Wall Panels on Noise Barriers in the Local Context

5.1 The experience of adopting vegetative wall panel types of noise barriers in the local context has been revisited and reviewed by examining some cases of the current retrofitting of noise barriers programmes. Two generic cases, which are composited for illustration purpose, are presented below. The aim is to set out design recommendations and guidance for project proponents and design teams to consider.

5.2 Case A

5.2.1 Context/Location

The noise barriers are installed along a main approach road to a town centre. Some sections of the noise barriers are positioned on an elevated road structure screened by existing mature trees at the fringe of a park with a residential area nearby.

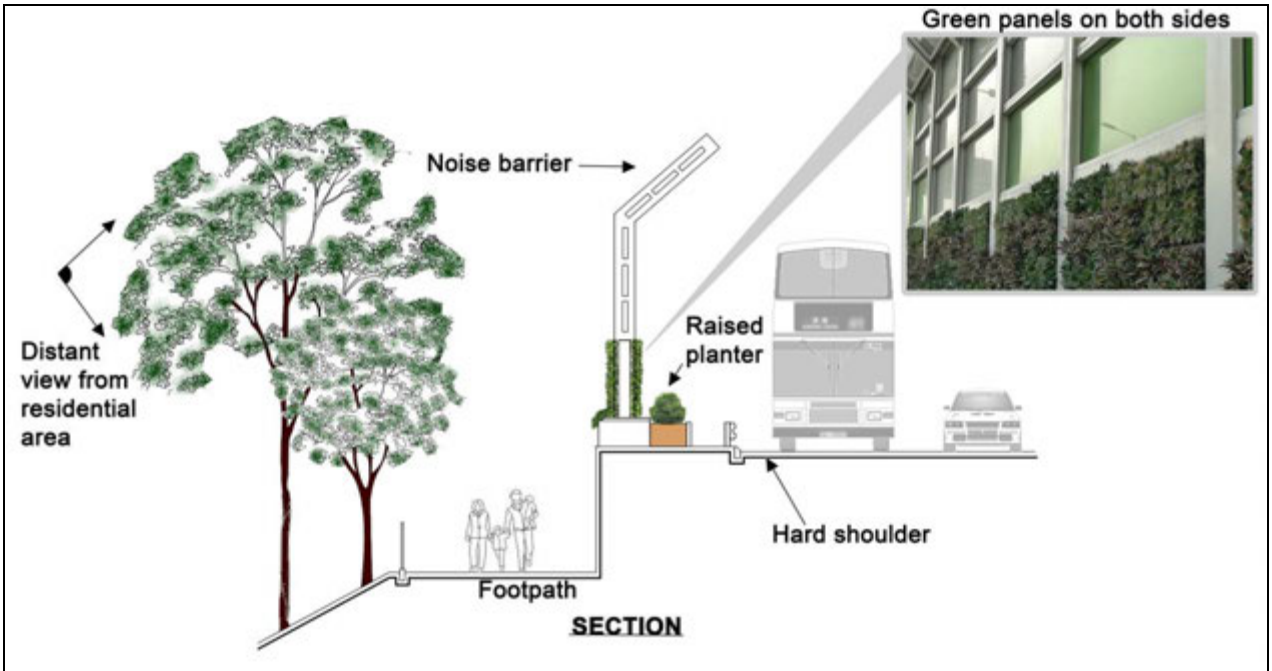

Figure 1 Case A

5.2.2 Design

The vegetative walls are installed on both sides of the noise barriers at

the lower third of vertical barrier, and are combined with reflective type of noise barriers at the upper portion. A raised planter is also built in front of the panels facing the traffic. An automatic irrigation system is integrated in the panel design **(Figure 1)**.

5.2.3 Observations

- The existing trees visually screen the barriers from one side; and where the transparent type of noise barrier panels is used, road users can view the trees beyond.

- Unlike the upper transparent panels allowing penetration of sunlight, the solid vegetative wall panels cut off light and cast shadow to the adjoining footpath, which is intensified by the adjoining trees.

- The thickness of the growing medium and the plant materials together with the associated irrigation system of the vegetative wall panels make the structure quite bulky.

- Maintenance access and working space have to be provided on both sides of the noise barriers with footway for access to maintain the vegetation.

5.2.4 Comments

- The existing trees provide sufficient green ambience for the noise barriers. These valuable landscape resources should be integrated into the design of noise barriers greening.

- Despite that the vegetation on the noise barriers provides more greenery to the local landscape, the effect is less significant in view of the abundance of mature trees in the park nearby. The added value is therefore limited.

- The vegetative wall panel cum raised planter at the roadside is a complex design. Alternatively, the space along the footpath has the potential for constructing planters which would be a better option as at-grade planters can accommodate more soil and growing space to support better plant growth **(Figure 2)**.

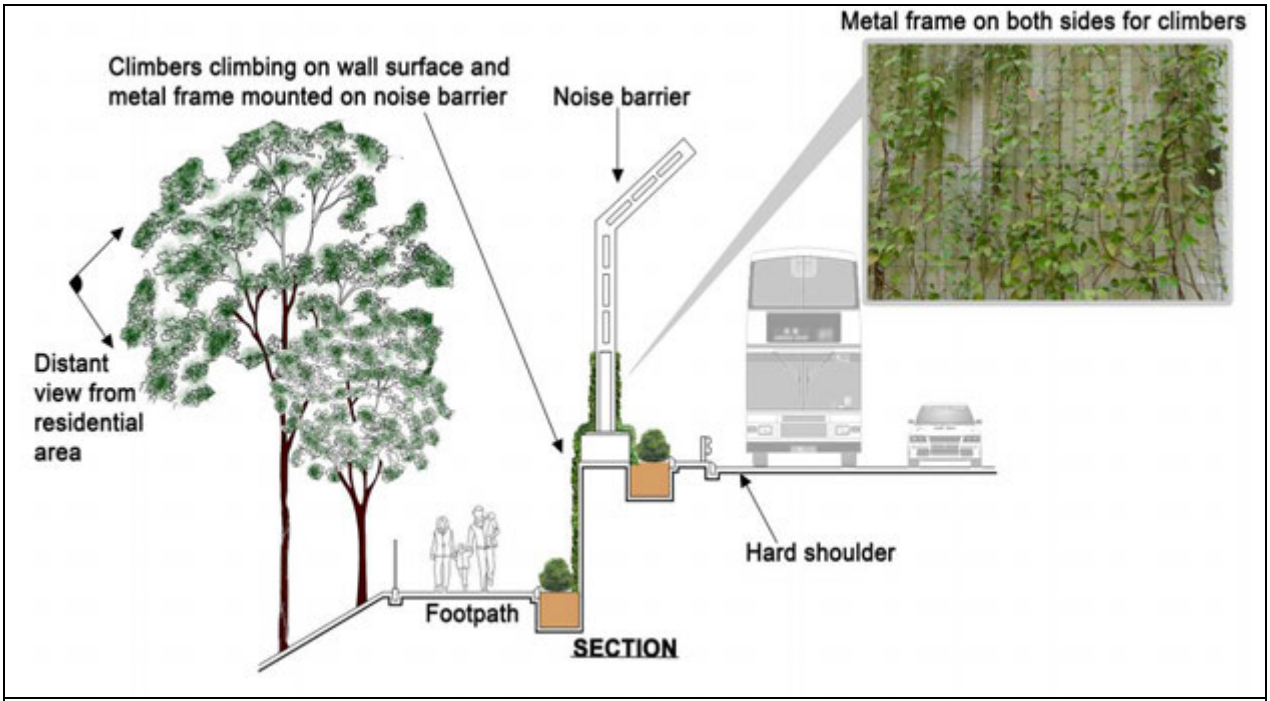

Figure 2 Case A (Options to be considered)

- Vegetative wall panels placed vertically are inevitably subject to severe draining and therefore it is hard to retain moisture in the planting medium. Frequent irrigation is required. Water availability for plants is likely a key limiting factor for successful plant growth. Further research and study on this aspect is recommended.

- The resulted shading effect and light cut-off of the solid vegetative panels may induce demand of artificial lighting on the footpath.

- Apart from common maintenance requirements as for at-grade greening, special equipment and working platform would be required as the vegetative wall panels are well above the level of the adjoining footway.

5.3 Case B

5.3.1 Context/Location

The noise barriers are installed along a trunk road/expressway. Most of the sections of the road together with the noise barriers are exposed on high ground with some sections of slopes which are scarcely vegetated. The view of the noise barrier is open to the sensitive receivers from the residential development at a distance.

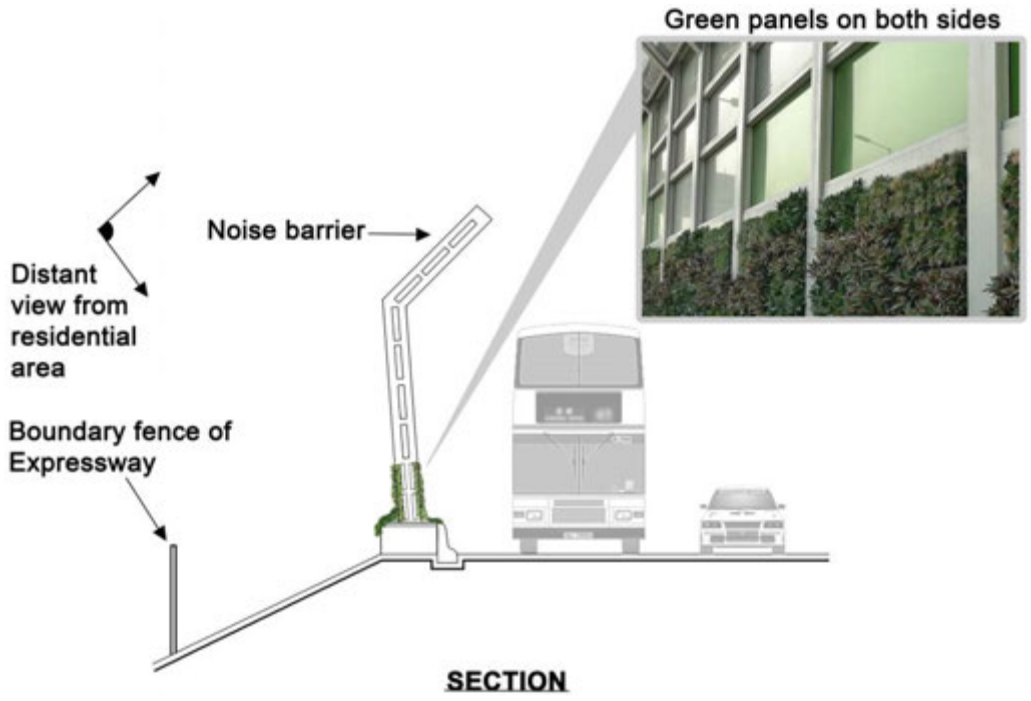

Figure 3 Case B

5.3.2 Design

The vegetative wall panels are installed on both sides and at the lower part of the noise barrier. The planting is mostly small shrubs and ground cover to fit in modular panels which are mounted onto the structural support of the noise barrier panels. Automatic irrigation system is installed **(Figure 3)**.

5.3.3 Observations

- The vegetative wall panels contribute a small portion of the overall height of the noise barriers. The thin layer of greenery at an oblique angle is not significant for road users travelling at speed.

- Temporary traffic arrangement/lane closure is required for routine vegetation maintenance operations.

5.3.4 Comments

- The overall greening effect of the noise barrier is limited and therefore considered not cost effective.

- Alternatively, conventional at-grade planting of trees and shrubs would provide a better greening effect and visual relief of the noise barriers. In addition, visual transparency of the noise barrier structure will open up views of the adjacent roadside

planting **(Figure 4)**.

- High maintenance commitment is anticipated as it requires more maintenance effort for quality planting in exposed areas where soil volume and water retention is restricted by the panel size.

- Frequent temporary traffic arrangement for maintenance is required. It is anticipated that there will be problem in obtaining approval for road closure for frequent vegetation maintenance operations.

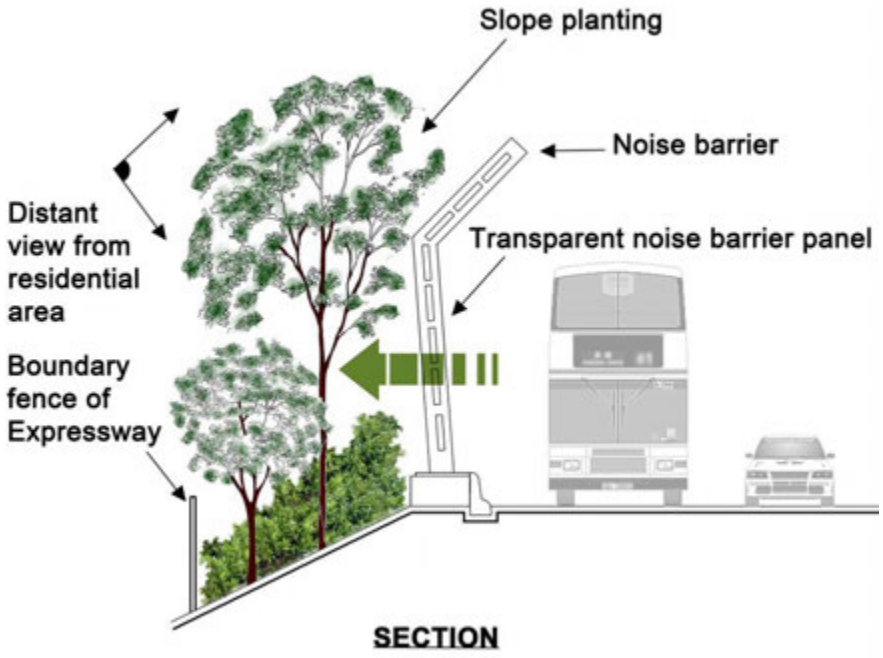

Figure 4 Case B (Option to be considered)

5.4 Key Considerations and General Principles of Applying Vegetative Wall Panel Types of Noise Barriers

After reviewing the above cases, the following design considerations are recommended and should be taken into account when applying vegetative wall panel types of greening to noise barriers:

- Consider if the achieved greenery and greening effect is effective and appropriate with due consideration of the local characteristics and targeted visual receivers' viewing angle and traffic speed;

- Consider if the adoption of at-grade planting would achieve similar if not a better greening effect, which is also more sustainable and cost effective;

- Consider the limitations of the choice and sizes of plant materials when using vegetative wall panels and the sustainability of the planting design;

- Consider long-term maintenance commitment and the costs including capital and recurrent costs in the light of value for money principle;

- Ensure the selection of plants can grow well in a harsh roadside environment with low maintenance;

- Put quality over quantity and not to over-emphasise instant greening effect of vegetative wall panels;

- Ensure the design of the vegetative wall panels have satisfied the maintenance requirements, including provision of safe access, adequate working space for maintenance crew, and agreement sought from respective maintenance parties on both hard-work and soft-work for the maintenance;

- Secure in-principle agreement from relevant parties on the proposed TTA and road closure based on the frequency of vegetation maintenance operation of the proposed vegetative panel; and

- Ensure provision of automatic irrigation system for the works.

6. Way Forward

6.1. Project proponents and design teams are recommended to observe the above guidelines in the planning, design and implementation of greening on noise barriers.

6.2. At-grade planting should be accorded priority for greening as more soil volume, better moisture retention and space would be provided for supporting more sustainable plant growth and allowing flexibility in planting design. The application of vegetative wall panel types should

be carefully evaluated on an individual site basis. Its use should serve as a supplement where at grade planting is not appropriate or space is not available; and indiscriminate use should be avoided.

6.3. Wide adoption of vegetative wall panels is subject to further study to examine their pros and cons, life cycle performance and recurrent consequences and development of technologies to enhance their sustainability.

Greening, Landscape and Tree Management Section
Development Bureau
April 2012

Appendix A

List of Reference Documents

I. General application of greening on highways:-

1. *Structures Design Manual for Highways and Railways" (3rd ed.).* Highways Department HKSARG (2006) ‹http://www.hyd.gov.hk/eng/public/publications/sdm/index.htm›

2. *HQ/GN/15 - Guidelines for Greening Works along Highways.* Highways Department HKSARG (2009)

3. *Transport Planning and Design Manual.* Transport Department HKSARG

II. Design of noise barriers:-

1. *Housing Design and Mitigation Measures to Abate Traffic Noise in Hong Kong.* Environmental Protection Department HKSARG ‹http://www.epd.gov.hk/epd/english/environmentinhk/noise/guide_ref/hous_design.html›

2. *Screening Structures and Building Designs against Transportation Noise in Hong Kong.* Environmental Protection Department HKSARG ‹http://www.epd.gov.hk/epd/english/environmentinhk/noise/guide_ref/screen_stru.html›

3. *Guidelines on Design of Noise Barriers (2nd issue).* Environmental Protection Department & Highways Department HKSARG (2003) ‹http://www.epd.gov.hk/epd/english/environmentinhk/noise/guide_ref/files/barrier_leaflet.pdf› ‹http://www.hyd.gov.hk/eng/public/publications/g_noise_barriers/doc/barrier_leaflet.pdf›

4. *Practice Notes No. BSTR/PN/003 – Revision C - Noise Barriers with Transparent panel.* Highways Department HKSARG (2009) ‹http://www.hyd.gov.hk/eng/public/publications/sdpn/pdf/PN3.pdf›.

Appendix B

Recommended Good Practices when Designing with Greening on Noise Barriers

Figure 1 - Minimising impacts on existing vegetation

Figure 2 - Noise barrier blends into the immediate environs

Figure 3 - Sufficient space is allowed for planting

Figure 4 - Simple planting design for easy maintenance

Figure 5 - According priority for at-grade planting and use of climbers

Figure 6 - Self-sustainable greening on noise barriers at elevated road