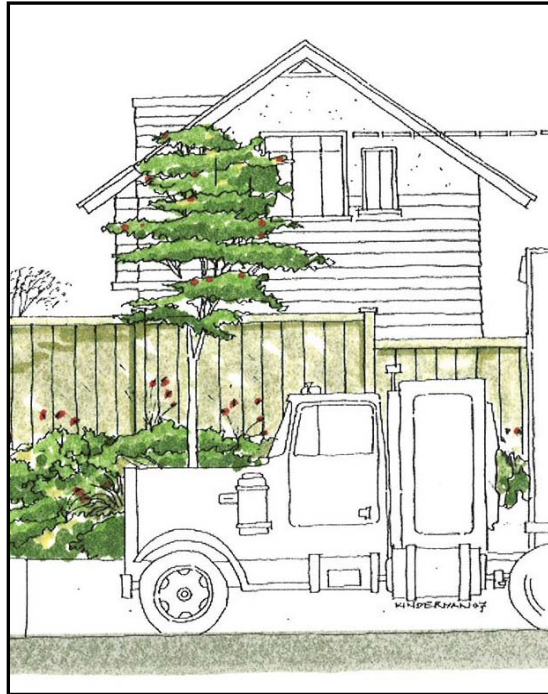


Appendix 2 - Improving the Noise Environment When Standard Options Aren't Applicable

Community-scale noise alternatives that transportation projects may consider where noise impacts do not meet requirements for noise abatement, but opportunities for enhancements exist within the project scope.

When abatement is not reasonable and feasible, federal funding can only be used for eligible activities per 23 CFR 772.



Executive Summary

This document describes situations when enhanced community-scale shielding may be available for major state roadway projects involving roadway expansion. Selection of projects depends on available budgets and timing when standard noise abatement is not warranted. The process of developing community-scale shielding is accompanied by additional community involvement. The concept is to showcase lower-cost options on a continuum from “green” to “gray”. The options of shielding range from additional vegetation to low-height visible structures.

The enhanced shielding may provide measurable noise reduction in some locations or only provide psychological relief by blocking the line-of-sight with vegetation.

Application

Transportation related noise can be distracting and annoying for many residents living near major roadways. Limited budgets for transportation agencies and federal requirements mean

that consideration of noise abatement (like noise walls and berms) is evaluated only for transportation projects that will install new roadway, add lanes to existing roadway, or significantly realign a roadway (horizontally or vertically).

There may be extended opportunities for some major state roadway projects within available scopes and budgets to improve the noise environment for those communities where official noise abatement is not reasonable or feasible according to state and federal rules. In other words, there may be areas where noise abatement is considered ineffective or does not meet our cost-benefit requirements, but we can still look for options.

The following document describes various opportunities and methods that a project may consider to improve the noise environment, either physically or psychologically, for wayside residents using lower cost options. These methods are also intended to enhance community participation and awareness as transportation projects affect noise sensitive areas within existing neighborhoods where standard noise abatement is not warranted.

WSDOT transportation design teams shall evaluate these opportunities when input from community involvement identifies a significant community concern about effects on quality of life due to excessive traffic noise.

Guidance for additional public involvement when there is significant community concern about excessive traffic noise

Major state roadway projects follow public involvement procedures that are established in Chapter 460 of WSDOT Roadside Manual¹, Chapter 210 of the Design Manual², Chapter 410 of the Environmental Procedures Manual³, and federal environmental regulations. These procedures may include hosting a certain number of public meetings and hearings, placing newspaper advertisements, sending out fliers, providing opportunities to review environmental review documents and project designs, and more to assure that the project meets its legal obligations and gathers appropriate input from affected communities about the project. For those locations where noise levels are above impact criteria but abatement is not warranted and there is significant community concern about noise, the project design team shall augment its community involvement activities to conduct specific outreach. This outreach is intended to identify community concerns and priorities regarding traffic noise and determine if there are other possible low-cost solutions to the community concerns within the existing project budget. These steps may include:

- Additional public, neighborhood association, or small scale residential meetings with residents to identify the nature of their traffic concerns and brainstorm and discuss options during or after completion of the official environmental process.
- Set up a volunteer community subcommittee (e.g., steering committee, advisory committee) of select community representatives with diverse perspectives and skills to

1 <http://www.wsdot.wa.gov/publications/manuals/fulltext/M25-30/Roadside.pdf>

2 <http://www.wsdot.wa.gov/publications/fulltext/Policy/DesignManual/desEnglish/210-E.pdf>

3 <http://www.wsdot.wa.gov/publications/manuals/fulltext/M31-11/410.pdf>

work with the project to craft solutions and work with their neighbors on an effective outcome.

- Polling, questionnaires asking community members what method of involvement would work better for them.

Typical roadside and community issues

At times, community coordination and input reveal that aesthetic shielding is not desired by the majority of residents affected by the transportation project. In such cases, the project designer may consider other issues that residents may be concerned about. Examples may include:

- bus stops
- view screening or clearing
- sidewalks
- access/ land – for example, enabling residents who share a border with state right of way to extend their activities onto state right of way if a structure is offset in a location that is not easily maintained by WSDOT.
- water features (masking)
- incorporate alternative design principles in harmony with surroundings
- sound absorbing materials placed on retaining walls
- choice of alternative methods for retaining walls that use earth instead of concrete
- private property owners building a fence on public ROW
- private plantings to cover chain link ROW or block view of road themselves provided that no permanent structures are established
- safety concerns -- people from roadway hopping over ROW fence onto private property (higher fence or increase security in some way)
- Light pollution – placement and direction of permanent roadway lighting
- Air quality – dust-particulate control of highway – using plantings to alleviate perception
- View and placements of signage (perhaps that residents do not want to see – e.g., placard for available businesses at the next exit)

Enhanced Shielding Opportunities

The main concepts for this document cover two areas of interest when considering other options to improve the noise environment. These concepts may not measurably reduce the noise levels, but they may affect the psychological impressions of adjacent listeners.

1. Start with green (vegetation) solutions and move to gray (human made) elements
2. Community scale

Starting with “**green**” and moving to “**gray**” means looking at opportunities for improvement starting with natural elements like vegetation and earthen/topographical features (also referred to as “green” features). That continuum extends through more intrusive placement of structures (“gray” features) that fit the “**community scale**” of the neighborhood. Unlike official noise barriers which can extend up to 30 feet high, “community scale” structures such as solid fences and visual barriers are intended to be no more than six to eight feet high and fall within

the local jurisdictional height restrictions without overpowering the existing neighborhood features already in place.

Green (the benefits of vegetation)

Vegetation has many functions and adds value to the roadside. Functions include:

- Screening
- Enclosing
- Blending
- Buffers
- Water quality filtering
- Perception of noise protection
- Increased oxygen production for air quality
- Corridor continuity
- Visual quality, and among others⁴

Western Washington is renowned for its lush vegetation. Eastern Washington has a varied palette of more drought resistant plants. Vegetation enhances, and in many ways defines, the quality of life for many of us. Vegetation is used to enhance the visual experience along the highway corridor and provide continuity. Plantings can be used to blend the roadway with and reflect the character of and transition to the adjacent areas. Plants can also be used to define a community from the roadway. In such cases the plantings viewed from the road blend with the corridor plantings and the vegetation viewed from the neighborhood blends with and transitions into the neighborhood. If the plantings are accompanied by solid barriers, then lower story vegetation (shrubs and groundcover) on either side may be very different to showcase these goals.

Recent research has shown that vegetation may reduce stress, decrease recovery time following surgery, may lower crime rates⁵, may have economic benefits for business districts⁶, and may increase real estate values⁷ as opposed to areas that don't have vegetation. Plants can also shield the view of noise sources and create a more psychologically soothing noise environment. Very densely planted vegetation can absorb more high frequency noise than low frequency noise. Humans usually find high frequency noise more disturbing. Plants sequester carbon and generate oxygen. Friends of Trees, a non-profit organization, estimate that a mature tree in Portland sequesters 223 pounds of carbon annually⁴.

4 For a more extensive list of functions see Chapter 800 of the Roadside Manual

5 Wolf, K. L. 2003. Ergonomics of the City: Green Infrastructure and Social Benefits. In C. Kollin (ed.), Engineering Green: Proceedings of the 11th National Urban Forest Conference. Washington D.C.: American Forests. <http://www.cfr.washington.edu/research.envmind/UF/AmForErg.pdf>

6 Wolf, K. L. 2005. Business District Streetscapes, Trees and Consumer Response. Journal of Forestry, 103, 8, 396-400. http://www.cfr.washington.edu/research.envmind/CityBiz/BizTreesAll_JFor.pdf

7 McPherson, E.G., S.E. Maco, J.R. Simpson, P.J. Peper, Q. Xiao, A.M. VanDerZanden and N. Bell. 2002. Western Washington and Oregon Community Tree Guide: Benefits, Costs, and Strategic Planting. Silverton, OR: International Society of Arboriculture, Pacific Northwest
http://www.fs.fed.us/psw/programs/cufr/products/5/CUFR_164_Western_WA_OR_Tree_Guide.pdf

Vegetation can be planted alone or in conjunction with earth berms or solid barriers. Design teams must take care in choosing appropriate planting options that will be self-sustaining. Given WSDOT maintenance budget constraints, once planted there will be minimal care of the area, other than mowing in appropriate locations.

“Roadside Classification Plan” on how to incorporate vegetation in transportation projects

The *Roadside Classification Plan* (WSDOT Manual 25-31, 1996) establishes the policy to coordinate and guide the management of Washington State highway roadsides. The Roadside Classification Plan (RCP) categorizes the roadside in five classifications. These classifications have guidelines for vegetation, land forms, and architectural treatments and are used to restore the roadside during maintenance and construction activities. They also are used during environmental retrofit projects.

Enhancement of vegetation will require following the policies outlined in the *Roadside Classification Plan* and must follow the goal of a sustainable roadside with lowest life cycle cost. The emphasis is placed on use of native plant species in order to achieve a more sustainable roadside. Given WSDOT budget constraints, once planted the roadside receives minimal care.

Development of solutions for roadside treatment shall involve the WSDOT Region Landscape Architect. If the designer team or communities identify treatments that are outside of the *Roadside Classification Plan*, the treatments must be approved by the WSDOT Headquarters Landscape Architect prior to use on projects.

WSDOT makes planting choices with entire corridor themes in mind

Corridor continuity provides a high level of visual quality of our highways by providing unity and improving intactness. Also, corridor continuity provides predictability for the driving public and simplifies maintenance requirements. Maintaining corridor continuity blends the highway into the natural and built environment and provides visual cues to the driver and limits distractions. Because of this, it is important to WSDOT to maintain corridor continuity. Vegetation and strategic use of materials, colors, and textures contribute to the unifying elements that provide corridor continuity.

There is no set length for a corridor. A corridor may be easily defined by a specific road such as Interstate 405 or it may be a segment of a highway such as State Route (SR) 99 through Seattle. If a corridor planning study has not been done for a segment of roadway, WSDOT advises the designer to look on either side of the project to pick up visual elements that may define the corridor. The existing visual elements can be used as a guide to transition and blend with new elements. If a Roadside Master Plan or Architectural Guidelines exist for an area within a highway corridor, then WSDOT advises the designer to use those documents to guide their design. If none of these documents exist then the designer needs to involve the Region Landscape Architect and the State Architect to identify logical corridor end points.

Transitions between corridor treatments need to occur gradually. The length of these transition areas depends on the speed of the roadway. For a freeway setting the transition area might be over several miles. For a slower speed facility the transition area may be between one-half and one mile. Elements from the corridor should be used to transition and introduce new elements.

In some cases it may be desirable to use other types of fencing, barriers/walls, or architectural treatments than is the standard for that corridor. This may be acceptable if the introduced element is or can be permanently screened by vegetation. It is desirable that the vegetation used to screen be in place before the element is installed. If the screen is not present then WSDOT encourages the designer to designate plantings that include a mixture of fast growing plants and longer lived, but slower growing plants to provide a permanent screen.

Incorporating community scale walls/barriers into the roadside design

There are a host of materials that WSDOT and other agencies may consider to provide visual and aesthetic screening along the roadway. In order to improve the noise environment for wayside residents the material must be solid and provide no breaks, openings, or gaps in the material. Examples of potential materials include standard concrete crash barriers, fences, and walls already detailed in WSDOT Standard Plans. Other options include solid wood fencing and six to eight-foot tall structures made from metals, composites, plastics, concrete, rubber, foam, and more.

The WSDOT new products group led by the headquarters Materials group in Tumwater, Washington spearheads the evaluation and acceptance of new materials for use along the roadside. Product approval includes input from many key stakeholders in WSDOT, including maintenance, safety, structures, acoustics, architecture, and landscape architecture. For a list of approved or provisionally approved noise related products, please contact the WSDOT Air, Noise, Energy Program.

To continue with the “continuum of green to gray” identified at the start of this document, if a design team wishes to include a solid fence or structure of some kind into the project in an effort to shield residents or slightly improve the noise environment, the design team shall also link placement of the structure with an appropriate vegetative planting plan to shield the structure with vegetation. The following sections outline various concepts to include when pairing shielding structures with vegetation.

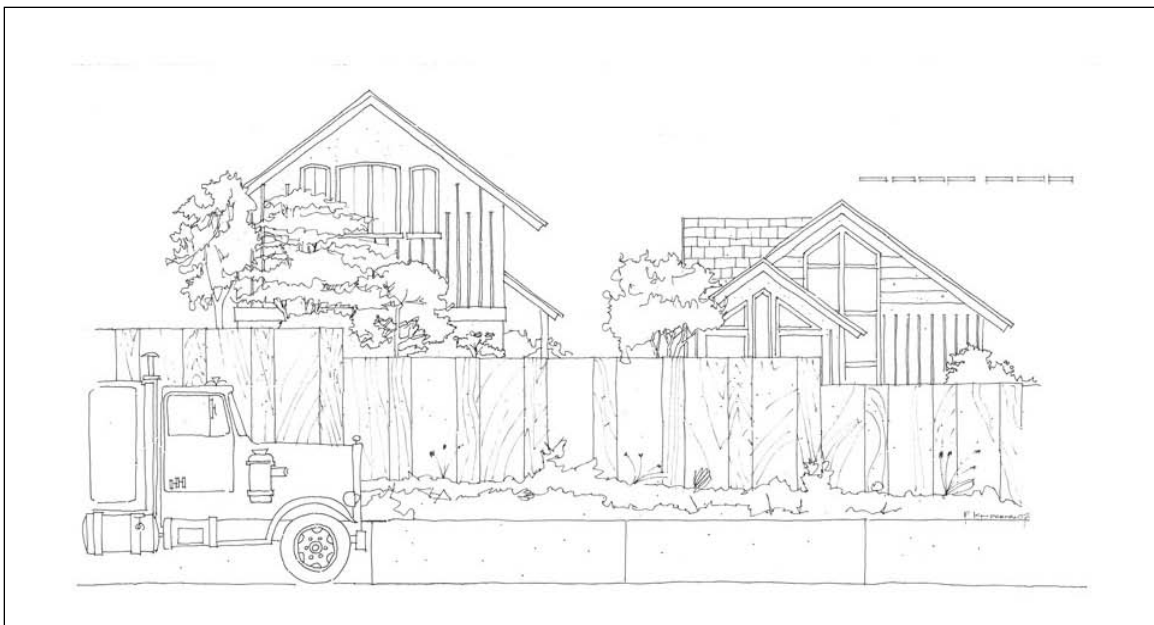
Earth berm/organic structures

Earth berms are by nature a “green” and effective noise shield, and can sometimes be incorporated on projects that have available right of way. Create berms with slopes that have a maximum steepness of 2:1 and plant trees and shrubs to provide long term erosion control. Compact the soil on the outer 2 feet of the berm surface only by cat track method to allow maximum ability for the plants to survive.

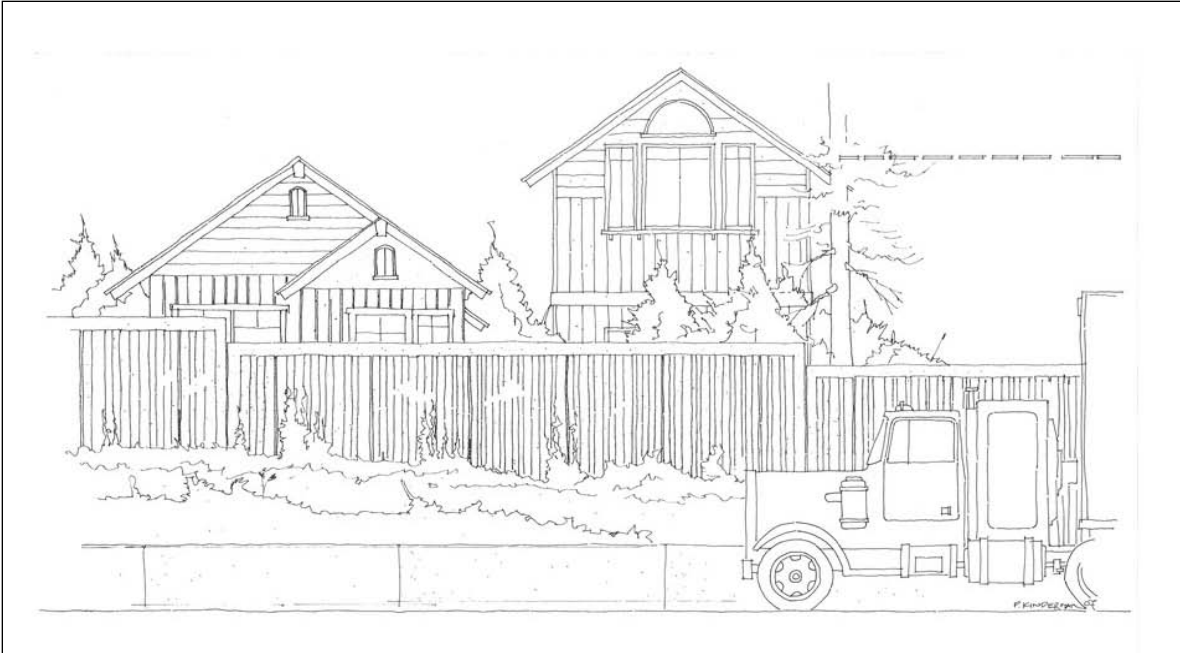
Non-organic structures (barriers, fences, and walls)

For locations where plants are intended to visually screen the structure, “hiding” it in some way, the designer may consider reducing the amount of texturing or aesthetic treatment than for barriers in more exposed areas. For example, barriers that span ravines where they are not visible may be constructed with less texturing or aesthetic treatment to save funds.

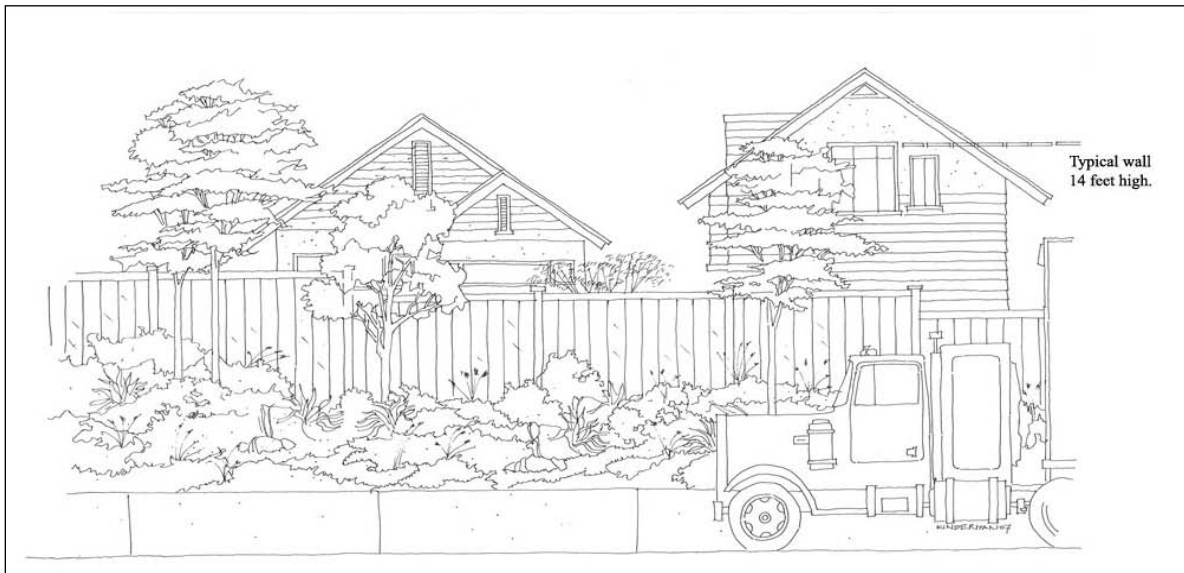
If vegetative covering is not an option for the structure, the designer must evaluate other aesthetic treatments (designs, colors/tints) that will help the structure blend into the corridor theme of the roadway and may reflect the character of the community. The following four examples show wood, random board design concrete, plastic, and concrete block illustrations that are intended to be solid, yet fit into the community scale of the area.



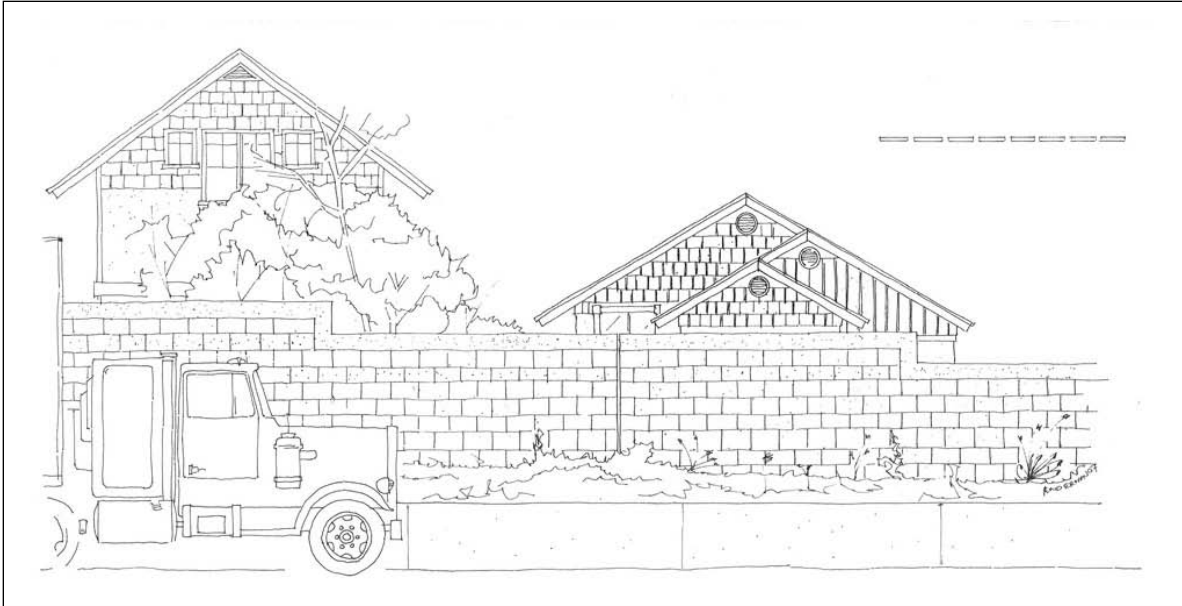
Example of community scale wood wall 6 to 8 ft high. Dashed line above roof on the right shows typical noise wall height at 14 ft.



Example of community scale random board wall 6 to 8 ft high. Dashed line near the roofline on the right shows typical noise wall height at 14 ft.



Example of community scale plastic wall with vegetation at 6 to 8 ft high. Dashed line through the roofline on the right shows typical noise wall height at 14 ft.



Example of community scale block wall 6 to 8 ft high. Dashed line above the roof on the right shows typical noise wall height at 14 ft

Vegetation and aesthetic treatments for structures facing the roadway

Structures set back against the Right of Way (ROW) line or offset from the shoulder with sufficient width to plant shall be planted using the following criteria:

- Work with the Region or Headquarters Landscape Architects to develop the appropriate planting design that will blend with the context and be sustainable over time.
- Use the Roadside Classification Plan (RCP) treatment levels for the classification⁸ and the design manual clear zone and line of sight requirements
- If a Roadside Master Plan has been developed for the project area through the Context Sensitive Solutions process, the planting design shall incorporate those recommendations.
- Design plantings to meet any commitments made in the permit process.
- Follow guidance in Design and Roadside Manual standards for design of roadside planting.
- Blend the proposed vegetation to match the existing vegetation (if the existing vegetation fits with roadside classification).
- Design plantings to be appropriate for available width of planting area.
- Roadside design for areas that WSDOT will be responsible to maintain must be maintainable and sustain over time. Seek maintenance office input to incorporate maintenance constraints, abilities and access needs within their budget constraints.
- Secure city buy off and maintenance agreement for plantings that the local jurisdiction (or designee) will maintain.

⁸ See the Roadside Classification Log found in the back of the RCP.

- Design set backs from structures based on operational or maintenance requirements of structures or plantings.

The WSDOT Region Landscape Architect or Headquarters Region Liaison Landscape Architect shall be the lead for design of any roadside vegetation treatments. It is critical to coordinate with the area maintenance staff during the design phase so that they will be able to maintain the plantings after the plant establishment period. Project leads need to contact local agencies and adjacent landowners, either individually or in public meetings, to gather feedback on the proposed plantings and help work through any expectations for the look and feel of the area once the project is complete. If the plantings will be turned over to a local agency, it is critical that the local agency representative be an active team member during the design phase to ensure that the local agency receives a product that it can maintain and that reflects its city.

Planting along a freeway is very different than planting along a city street. The first difference is the speed scale. At 60 miles per hour (MPH) a viewer is moving at 88 feet per second. This means that the designer needs to avoid minute details in the plantings or structural treatments because they will be too small to be seen. These speeds also require that fixed objects, such as trees, be set further back from the edge of the shoulder to provide a recovery zone. On the other hand, an urban roadway with lower speeds and stop lights needs to have more detailed designs. Not only will they be seen but in some cases the details may help slow the traffic down by constricting the perceived visual width of the corridor when combined with other more urban features like sidewalks and curbs.

Structures on the shoulder of the roadway

Structures on the shoulder are the most difficult to screen with vegetation. However, there are some design features that can be incorporated to help soften their visual effect. These structures usually have a safety barrier section at the bottom so that cars do not snag on the structure's pattern and support columns. Provided that snagging hazards are eliminated, the structure could be set back slightly from the safety barrier to provide a planting strip for shrubs and vines. The structure could be staggered to provide pockets for planting and to provide visual relief, or slots could be provided at the base of the structures to provide planting pockets for vines. Such pockets or slots may only be viable if irrigation is also evaluated to assure successful plant establishment and long-term viability of the desired vegetation and they do not pose a roadside hazard.

Designers must account for additional maintenance needs when considering these types of options. Maintenance needs may include access points or access doors, lane closures to conduct maintenance, etc. Designers need to work closely with their regional maintenance office when considering these types of features.

Structures not on the right of way (ROW) line -- but not on the shoulder

At times solid screening can neither be on the ROW line nor on the shoulder. Because of topography, drainage, or roadway design requirements, they may be somewhere in the middle of the roadside area or at the top of a retaining wall. If there is room in front, on the roadway side of the retaining wall, then the designer needs to use the guidelines listed above. If there is not enough room in front of the screen to follow those guidelines then the designer needs to consider the following:

- For shielding set on top of retaining walls, set the shielding back to allow for a planting strip.
- Use narrow planters or slots in the screening to allow for plantings (vines) to cover structures.
- Put in planting pockets or stagger walls to provide planting areas.
- Consider maintenance access and safety on steep planted slopes or areas between mainline and interchange ramps. Hand rails or tie-off appurtenances may need to be installed.

Plantings on structures facing homes or other sensitive receivers

Depending on project budgets there may be greater discretion for aesthetic treatments for the back sides of structures. Examples of choices include sealant color, mural type, and use of various patterned form-liners to provide texture on the wall face. There are simple ways to provide relief to the flat gray surface of a wall, such as providing various textures or patterns on the wall face. Although WSDOT is ultimately responsible for the choice of treatment, neighborhood and local jurisdiction involvement is key.

Structures that have houses backing up to them

There are several options to choose from depending on agreements with adjacent property owners and WSDOT maintenance preferences.

- Plant nothing (except grass) and let the homeowner plant and maintain the area to blend with their yard. (Note: Produce a brochure that lists desirable characteristics of plants and possible list of plants applicable to the specific area.)
- Work with the Roadside Classification Plan, property owner, and WSDOT Landscape Architect and maintenance area staff to choose appropriate low maintenance plantings.
- In order to allow for preserving the structural integrity of wall structures, adjacent landowners are not allowed to attach structures, such as trellis, to the walls; however a structure can abut the wall.

Structures that have roads or other public spaces behind them

- Use the same criteria as planting in front of walls on secondary roads.
- Defer to the city or county's landscape ordinance or agreements up to the cost of standard treatments. The local jurisdiction must pay for any improvements beyond standard unless part of environmental commitments.
- Local jurisdiction (or designee) must maintain all improvements beyond standard.
- If the planting is in a city with a population less than 25,000 or a county and WSDOT is doing the maintenance of the planting, then the plantings will be in accordance with WSDOT base treatments (RCP) and local maintenance and operations requirements. Plantings on both sides of the fence shall be consistent.

Options not available at this time

(1) Quieter pavement

WSDOT is experimenting with various ways to reduce the tire-pavement noise coming from both asphalt and Portland cement concrete pavements. These quieter pavement designs are experimental features at several limited locations in Washington. WSDOT selected these locations carefully based on their traffic volumes, project timing, and locations that enable appropriate data gathering. Until WSDOT completes the experiments to determine the noise quantity, noise quality, safety, and durability of these test sections, experimental quieter pavement will not be considered as a viable long-term method to improve the noise environment for wayside residents.

WSDOT is also working with other states and national research projects to better understand the potential characteristics and longevity of quieter pavement designs.

(2) Transparent and translucent materials

At this time WSDOT does not recommend the use of transparent or translucent materials along public roadways. WSDOT has not resolved issues of cost, long-term maintenance and replacement responsibilities, cleaning regimes (especially on structures and near sensitive water bodies), graffiti, and fair treatment of view-sheds to adequately decide where and when to use transparent or translucent barrier material.

(3) Changes to private structures

In the same way that WSDOT does not modify private structures for noise abatement, WSDOT will not make improvements on private structures in the context of improvements to the noise environment. For the purposes of this guidance, WSDOT will not insulate, caulk, replace windows and doors, install weather-stripping, provide air conditioning, or make other improvements to private structures to reduce long-term operational road noise.

Summary

WSDOT intends for this document to help guide transportation designers, architects, and landscape architects in when and how they can choose alternative shielding options and community improvements when a community experiences high noise levels but does not qualify for full noise protection. It is important to use an interdisciplinary approach to address solutions for these locations in your design. People that use this document must note that these “community scale” options may not dramatically improve the noise environment for residents or render an area quiet. These methods are meant to provide low-cost, small changes that may improve the noise and aesthetic environment for wayside residents. Some locations may experience greater benefits than others due to the local topography, distance to the roadway, orientation of buildings to the roadway, residential construction techniques, and more.

This document is also meant to help guide designers with options available in working with community residents and city officials when deciding the best course of action for specific corridors that may have unique characteristics and values to specific groups.

It is important to document your process in your design documentation.

If you have questions

Or, if you need clarifications about how to use this document, contact the Washington State Department of Transportation Noise Program through Environmental Services at (360) 705-7483 or Roadside and Site Development Program (360) 705-7242.