

Landscaping Guidance for Improving Air Quality near Roadways

Plant Species and Best Practices for the Sacramento Region



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I. Introduction

Roadside green space and landscaping has served aesthetic and roadway functionality purposes. Vegetation along roadways provides value to wildlife, human mental health and social benefits, storm water interception and retention, carbon sequestration and urban heat island mitigation. Recent scientific studies show that roadside landscaping and barriers can also reduce roadway-generated pollutant exposure for nearby sensitive populations. The air quality benefit occurs when particles are captured by leaf surfaces as air flows past. In July 2016, the United States Environmental Protection Agency (EPA) released [Recommendations for Constructing Roadside Vegetation Barriers to Improve Near-Road Air Quality](#) (EPA Recommendations), summarizing the current research findings and best practices. The Sacramento Metropolitan Air Quality Management District (SMAQMD) has developed this *Landscaping Guidance for Improving Air Quality near Roadways* (Landscaping Guidance), which focuses on the Sacramento region and aims to translate information from the EPA Recommendations for use by the region's land use planners and developers.

The goals of this landscaping guidance document are to:

- Provide guidelines for evaluating a potential vegetation barrier site;
- Offer vegetation planting recommendations appropriate to the Sacramento region to meet height, thickness and porosity goals;
- Evaluate appropriate vegetation characteristics through a recommended plant species list;
- Address best practices for vegetation planting;
- Offer suggestions for effective long term maintenance; and
- Suggest sample condition of approval language.

Please direct any questions about this document to Rachel DuBose of SMAQMD staff: (916) 874-4876 or rdubose@airquality.org.

II. Important Considerations for Potential Vegetation Barrier Locations

Consideration of location feasibility is the critical first step in designing a roadside vegetation barrier that will result in near-road air quality improvements. Not every roadside will have the physical attributes required to establish an effective vegetation barrier.

While the EPA guidelines recommend a thickness of at least 10 meters¹ (32.8 feet or more, rounded to 33 feet), the modeling also suggests that any type of barrier (solid, vegetation, or combination) will limit the distance and amount of air pollution travel from a roadway.

Ensure that adequate space is available to support the long-term establishment of a permanent vegetation barrier. An effective barrier should consist of at least 33 feet of an uninterrupted vegetation thickness, and be at least 16 feet tall. Also, adequate access space must be preserved to allow for long term success and maintenance. Please see Section III for more information on design options.

Before advancing to design and plant species selection, the following steps must be undertaken:

Underground and Overhead Utility Requirements

Always contact the utility provider(s) for review of landscape plans prior to site preparation and installation. Underground and overhead utilities create a variety of limitations depending upon the type of utility and its operator. For example, trees must be no taller than 15 feet at maturity if planted within SMUD's overhead transmission line easement. A complete inventory of on-site utilities and space separation requirements must be undertaken. Furthermore, always call 811 before initiating ground disturbance.

Useful resources can be found in Appendix B.

Local Fire Safety Requirements

Local fire prevention standards may restrict the location and types of vegetation allowed near roadway areas. In addition, defensible space allowances under Public Resources Code may preclude vegetation barrier installations if buildings are nearby. In general, roadside vegetation should remain 10 feet from roadside edges and 15 feet in vertical clearance from the roadway surface. Useful resources can be found in Appendix B.

¹ Throughout this document, we've converted the EPA's metric units (meters) to US customary units (feet) and rounded accordingly.

Caltrans Requirements

Many roadways that are prime locations for roadside vegetation barriers to improve near-road air quality are under Caltrans jurisdiction. For vegetation within the roadway right-of-way, general Caltrans tree and vegetation guidelines are as follows, with more specific information in Appendix B:

- Plant trees at least 30 feet from the edge of the traveled way.
- Overhanging foliage must be 15 feet vertically from the pavement to the overhanging branches.
- Tree trunks should be at least 20 feet from any manholes.
- Shrub setback distance is determined by the height and width of the species.
- Plant all vegetation at least 10 feet from fences, walls, ditches or drainage features.² In some circumstances, vegetation can be placed closer to these features with an encroachment permit.
- Vegetation must not interfere with safety features such as shoulders, existing barriers, guardrails or signs, and must not interfere with a driver's ability to see a continuous length of roadway.
- The vegetation should not add a maintenance burden to Caltrans; it should be managed in perpetuity by the entity responsible for planting or through an agreement with Caltrans or other relevant agency.
- Coordination with the appropriate Caltrans District Office is recommended as part of your site evaluation process.

Additional Location Factors

Proximity to sensitive populations (human populations such as educational facilities, or endangered plant populations) may indicate special consideration during plant selection.

Examples include avoiding poisonous plants in areas where children may come into contact with them, or avoiding planting native plants near similar unique or endangered native populations³. Consideration of micro-site characteristics such as localized wind flow patterns, unique or challenging soil types, site topography and drainage, past history of landscape area use by transients, and wildlife attractiveness may inform plant selection and maintenance activities to ensure long term project success. Water availability and road geometry (visibility and site-stopping distance) should also be considered.

² In some circumstances, vegetation can be placed closer to these features with an encroachment permit. See the Caltrans website for more information on fees and requirements. <http://www.dot.ca.gov/trafficops/ep/apps.html>.

³ For example, *Fremontedendron californica* near *Fremontedendron decumbens*, an endangered plant found in El Dorado County.

III. Best Practices

Horizontal and Vertical Clearance

In general, roadside vegetation should remain 10 feet from roadway edges and 15 feet in vertical clearance from the roadway surface. On a Caltrans facility, trees must be planted at least 30 feet from the edge of the traveled way. Caltrans will not maintain vegetation planted less than 10 feet from fences, walls, ditches or drainage features.

Barrier Length

Barriers should extend 164 feet or more beyond the area to be protected, or can wrap around and extend perpendicularly away from the roadway.

Vegetation Spacing

Expect tighter plant spacing when compared to landscape designs that are for solely aesthetic uses.

Stagger spacing and plant low vegetation in between trees to maximize growth space and ensure uniform coverage.

Fill the available space, both horizontally and vertically, with vegetation. (Note that the species listed in Appendix C will ensure space coverage for the first 7 to 10 years.) Once mature, foliage should be a minimum of 33 feet thick, 16 feet high, and at least 3 feet higher than associated noise barriers.

Species Mix

Use at least two types of vegetation (i.e. trees and shrubs) to ensure that the foliage covers from ground level to top of canopy. Avoiding monocultures will reduce the risk of project failure due to an infestation of pests that target a certain species.

Vegetation Acquisition and Planting

Because the preferred plants may not be readily available in the appropriate quantity or plant size, the landscape plans should include several alternatives that can fill the same space and functionality. Give nurseries or contract growers advance notice so they can have the materials you need in stock. Smaller pot sizes may be more readily available than larger ones.

Fall and winter are the best seasons to plant trees and shrubs. The individual planting sites may need to be pre-irrigated if it has not rained at least 2 inches within the prior 30 days.

Smaller-sized plants (#5 pots or smaller) will encourage healthy root establishment and future drought tolerance. In most cases, smaller-sized materials "catch up" to larger plant materials in

2 to 4 years and greatly outperform them year 5 and on. Planting appropriately-sized materials is also the most cost-effective method when establishing a new landscape.

Inspect plant materials before planting and after they are in the ground. To ensure a continuous barrier, plants should be spaced apart the same distance as their crown diameter (See Appendix A)

See Appendix D for more resources on proper planting.

Long-Term Maintenance

Careful implementation and strategic care of vegetation barriers will result in greater effectiveness and lower maintenance costs over the long term. Vegetation must be adequately maintained to meet both short and long term plant growth and establishment goals.

The establishment period covers the first 3 to 5 seasons after planting. An effective maintenance plan will address irrigation, plant protection, weed management and plant replacement.

Healthy establishment of native and drought-tolerant plants will require supplemental irrigation during the dry season (May-November) for the first three dry seasons⁴. Temporary irrigation systems or other methods may be appropriate. Irrigate in accordance with individual plant species needs and in response to soil and climatic conditions, which will vary with planting location.

Use stakes, planting tubes or other protective materials to avoid damage from weather, animals and weed abatement activities, where appropriate. Remove stakes and other protective materials after the roots are established sufficiently to survive a wind event (typically 3 years). Materials left behind can damage growing plants when used improperly.

Abatement of invasive species will support the healthy establishment of vegetation barrier plants and will reduce fire hazards. Mulch application, mowing and herbicide application may be appropriate for weed management depending on the location and types of weeds to be controlled.

⁴ Supplemental irrigation rates are dependent on a variety of factors, including amount of rainfall in current and recent seasons, soil type, slope and aspect. In all cases, deep, infrequent watering will result in greater establishment of native and drought tolerant vegetation.

Replacement of damaged plants during the establishment period is necessary to ensure a consistent and fully vegetated barrier. Pruning, with the exception of targeted structural pruning of trees, should be avoided during the establishment phase.

Long-term maintenance should be guided by a project-specific adaptive management plan, with a minimum of 2 assessments per year with corresponding interventions depending on observed barrier conditions. For example, plants within the vegetation barrier that are in poor health may be slated for replacement the following fall. Avoid regular and significant pruning. Landscape management contractors may need to be closely overseen to ensure proper care.

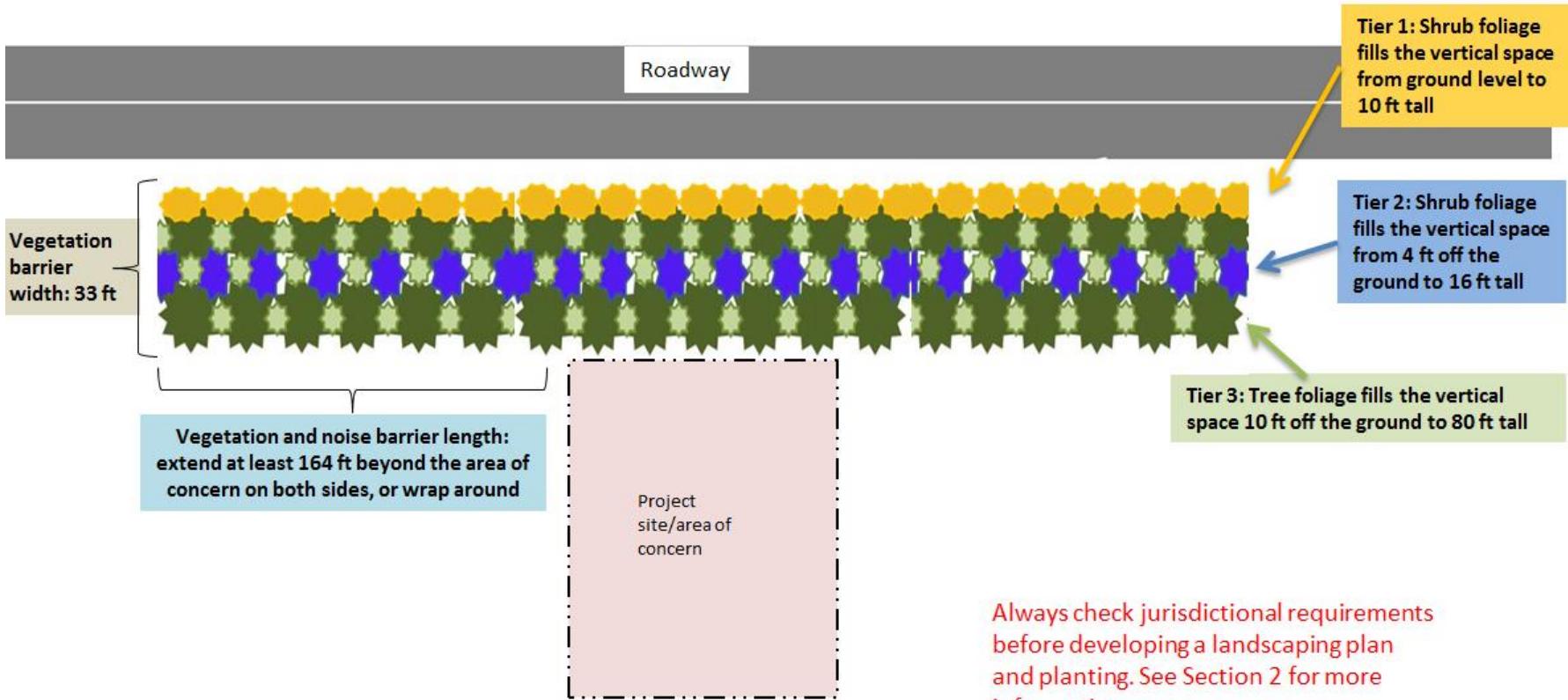
IV. Vegetation Barrier Design: Example Scenarios⁵

Because the Sacramento region has significant opportunities to retrofit existing roadsides, the first three scenarios on the following pages have been developed that meet EPA guidelines. Scenario 4 provides recommendations for locations that do not meet the EPA's recommended 10 meter-thickness (32.8 feet, rounded to 33 feet).

⁵ Throughout this document, we've converted the EPA's metric units (meters) to US customary units (feet) and rounded accordingly.

Scenario 1 - Vegetation Only

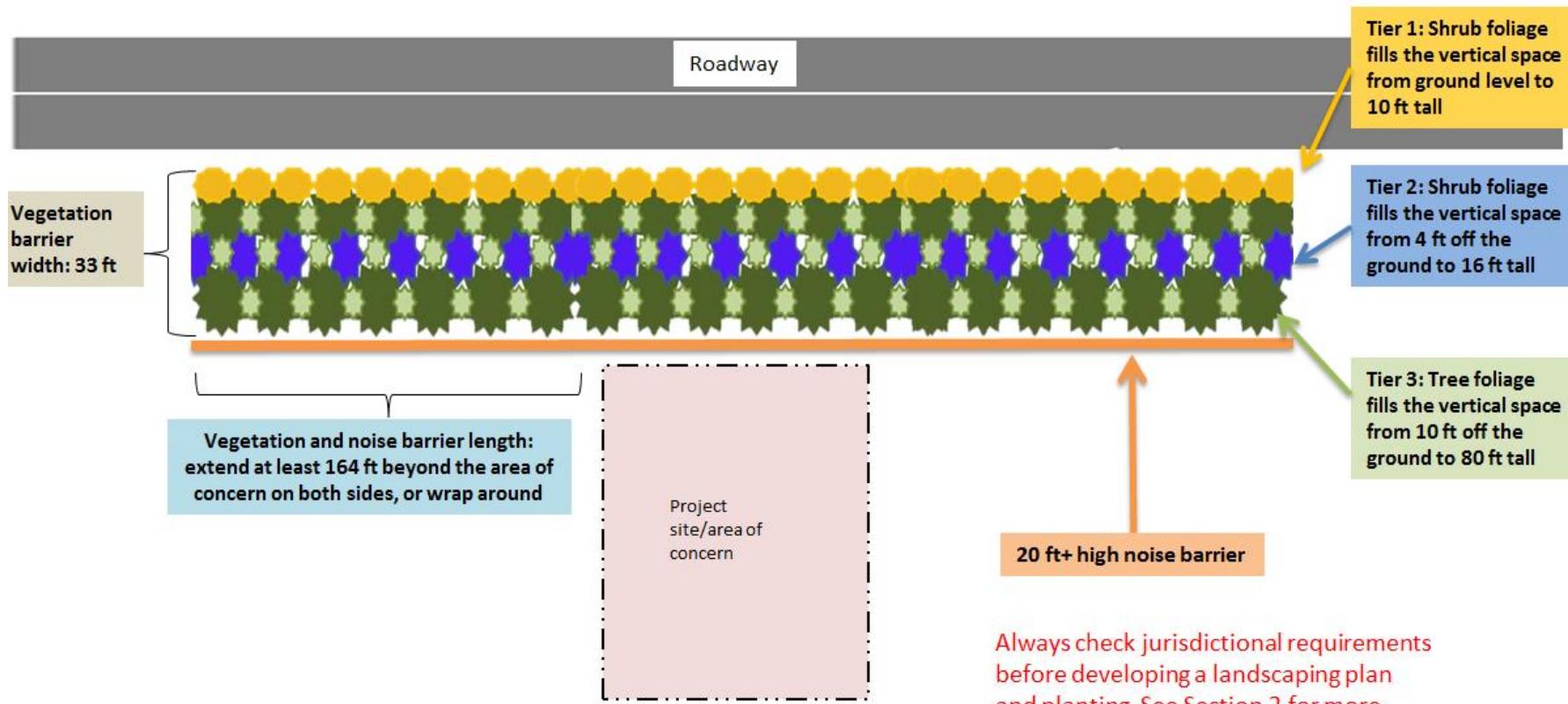
Not to scale



Scenario 2 - Vegetation on One Side of Noise Barrier

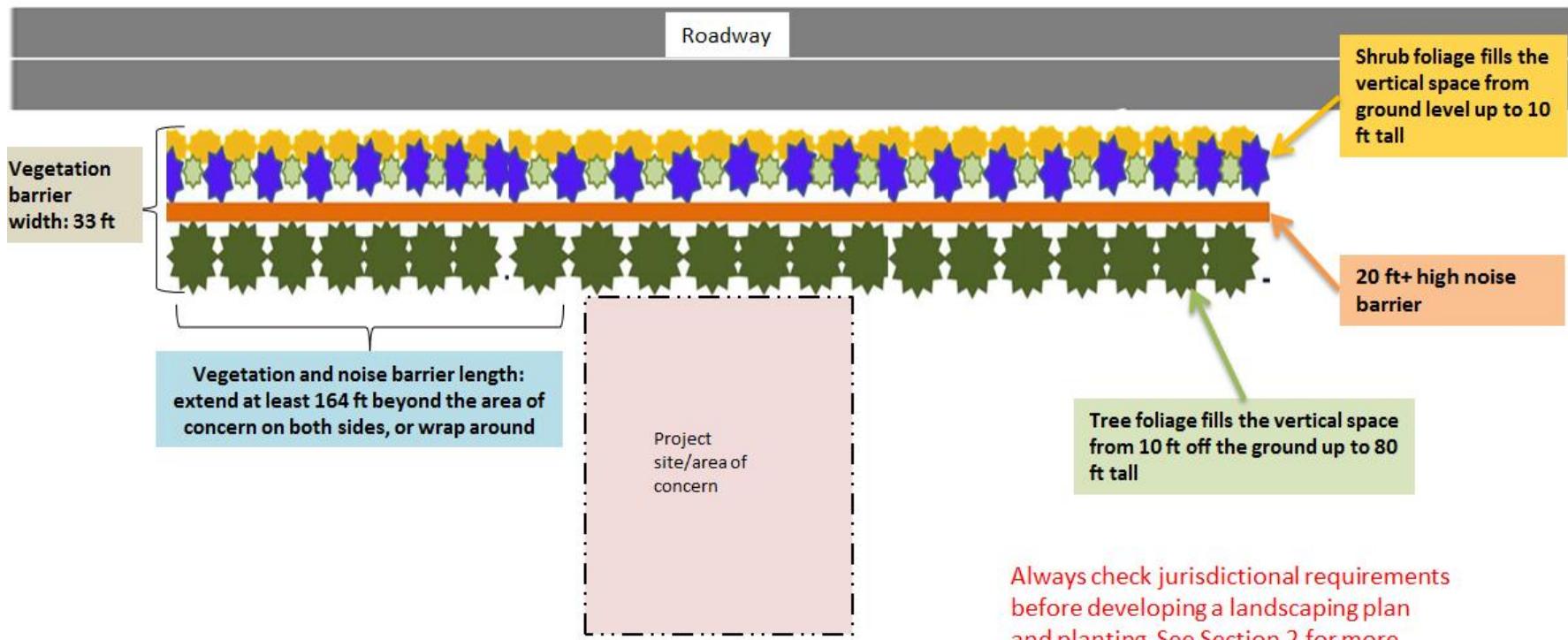
Solid noise barriers (sound walls) can be effectively paired with vegetation barriers to improve near-road air quality. Vegetation should extend a minimum of 3 feet higher than the nearby noise barriers.

Not to scale



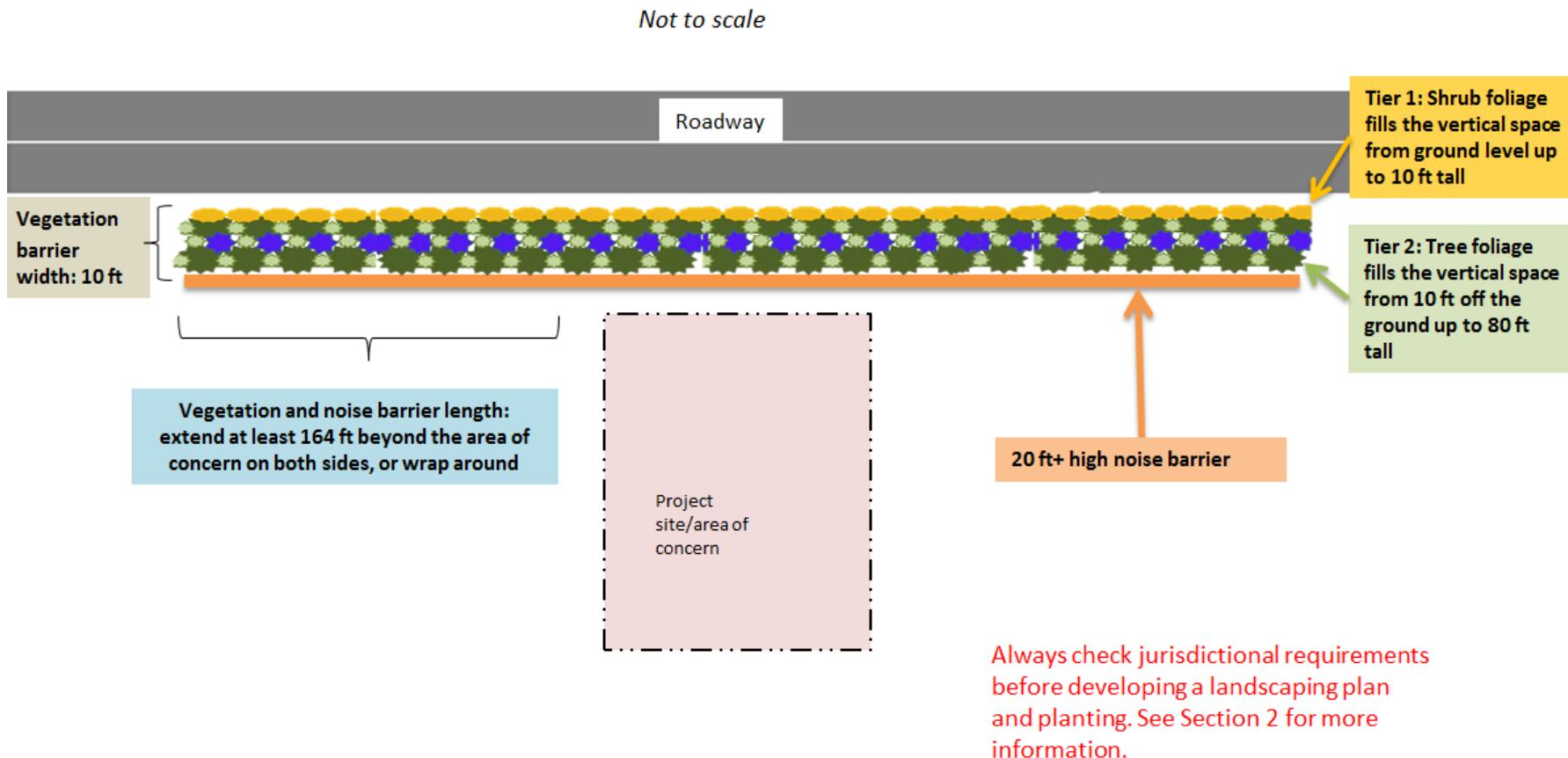
Scenario 3 - Vegetation on Both Sides of Noise Barrier

Vegetation can be planted on both sides of a solid noise barrier. The recommended 33 feet vegetation thickness can be achieved through canopied trees or multiple rows of tall vegetation.



Scenario 4 - Narrow Vegetation Strip on One Side of Noise Barrier

While this design does not meet the EPA Recommendations, modeling suggests that, when compared to a scenario lacking any sort of barrier, this design will reduce near-road air quality and pollutant dispersal.



Appendix A – Recommended Species Matrix

Scientific Name	Common Name	Height	Crown Diameter*	Porosity^②	CA Native	BVOC^④	Type	Notes
<i>Artemisia californica</i>	California sagebrush	3'	3'	L	Yes	Not Rated	Shrub	Green-gray foliage, appropriate for north side of sound wall or noise barrier, limit summer irrigation
<i>Cneoridium dumosum</i>	Coast Spice Bush	3'	3'	M	Yes	Not Rated	Shrub	Fragrant flowers and red fruit, best on north/east side of noise barriers, may cause skin irritation
<i>Trichostema lanatum</i>	Woolly Blue Curls	3'	3'	L	Yes	Not Rated	Shrub	Fuzzy spikes of violet flowers, no water post establishment
<i>Abutilon palmeri</i>	Indian mallow	4'	4'	M	No	Not Rated	Shrub	Apricot flowers, fuzzy leaves
<i>Malacothamnus fasciculatus</i>	Bush mallow	4'	4'	M	Yes	Not Rated	Shrub	Tolerates sand, pink 1" flowers, hairy stems and leaves
<i>Senna nemophila</i>	Desert cassia	4'	4'	H	No	Not Rated	Shrub	Needlelike structure, airy habit, bright yellow flowers. Also known as Cassia nemophila.
<i>Artemisia tridentata</i>	Big sagebrush	5'	5'	L	Yes	Not Rated	Shrub	Yellow-green flowers, twisted trunk
<i>Baccharis pilularis</i>	Coyote Bush/Brush	5'	5'	L	Yes	Not Rated	Shrub	Lots of white-yellow flowers along stems
<i>Berberis aquifolium</i>	Oregon grape	5'	5'	M	Yes	Not Rated	Shrub	Dark green leaves, fragrant yellow flowers. Also known as Mahonia aquifolium.

Scientific Name	Common Name	Height	Crown Diameter*	Porosity^⑨	CA Native	BVOC^⑩	Type	Notes
<i>Ceanothus cuneatus</i>	Buckbrush	5'	5'	L	Yes	Not Rated	Shrub	Tough fleshy leaves, white flowers, very tough and extremely drought tolerant
<i>Ceanothus x 'Blue Jeans'</i>	California Lilac	5'	5'	L	Yes	Not Rated	Shrub	No shade or summer water post-establishment, lavender flowers
<i>Cercocarpus betuloides</i>	Mountain mahogany	5'	5'	M	Yes	Not Rated	Shrub	Birch-like leaves, tail-shaped fruit, small clustered white flowers, tolerates clay and sand
<i>Eriodictyon californicum</i>	Yerba santa	5'	5'	M	Yes	Not Rated	Shrub	Long narrow leaves, bluish bell-shaped flowers
<i>Eriogonum giganteum</i>	Saint Catherine's lace	5'	5'	L	Yes	Not Rated	Shrub	Leathery wooly oval leaves, tiny pinkish white flower
<i>Isomeris arborea</i>	Bladderpod	5'	5'	L	Yes	Not Rated	Shrub	Long, pointed oval shaped leaves; abundant yellow flower clusters
<i>Lavandula x ginginsii</i> 'Goodwin Creek Grey'	Goodwin Creek lavender	5'	5'	L	No	Not Rated	Shrub	Silvery leaves, scented, purple flowers
<i>Leucophyllum frutescens</i>	Cenizo	5'	5'	L	No	Not Rated	Shrub	Purple flowers, evergreen, silvery leaves
<i>Leucophyllum langmaniae</i> 'Lynn's Legacy'	Lynn's Legacy Ileucophyllum	5'	5'	L	No	Not Rated	Shrub	Fragrant purple bell-shaped flowers, evergreen
<i>Myrsine africana</i>	African boxwood	5'	5'	L	No	Not Rated	Shrub	Very dense foliage, appropriate for a hedge, may be poisonous, occasional irrigation post-establishment

Scientific Name	Common Name	Height	Crown Diameter*	Porosity^⑨	CA Native	BVOC^⑩	Type	Notes
<i>Peritoma arborea</i> , Syn. <i>Cleome arborea</i>	Bladderpod	5'	5'	M	Yes	Not Rated	Shrub	Lacy gray-green leaves, yellow flowers year round, tolerates alkalinity
<i>Phlomis purpurea</i>	Pink phlomis	5'	5'	M	No	Not Rated	Shrub	Colorful flowers, fuzzy leaves, pleasant aroma, poisonous if ingested
<i>Rosmarinus officinalis</i>	Rosemary	5'	5'	L	No	Not Rated	Shrub	Pleasant scent, long-stemmed shoots, edible, white, purple or blue flowers
<i>Salvia clevelandii</i>	Cleveland sage	5'	5'	L	Yes	Not Rated	Shrub	Wrinkly-leathery leaves, rounded purple flower clusters
<i>Teucrium fruticans</i>	Bush germander	5'	5'	L	No	Not Rated	Shrub	Evergreen, silvery blue leaves, lavender flowers
<i>Rhaphiolepis indica</i>	Indian hawthorn	5'	5'	L	No	Not Rated	Shrub	Thick leathery leaves, white star shaped flowers, blue-black fruits
<i>Rubus ursinus</i>	Blackberry	5'	5'	L	Yes	Not Rated	Shrub	Prickly branches, white flowers, edible fruit
<i>Rhus integrifolia</i>	Lemonade berry	5'	8'	L	Yes	Not Rated	Shrub	Leathery, dark green leaves, small pink flowers, shorter on slopes
<i>Rosa californica</i>	Wild rose	5'	8'	L	Yes	Not Rated	Shrub	Prickly stems, 5-petaled colored leaves, scented
<i>Carpenteria californica</i>	Bush anemone	6'	3'	L	Yes	Not Rated	Shrub	Shiny evergreen foliage, white flowers, native to Fresno County.
<i>Atriplex lentiformis</i>	Salt bush	6'	6'	L	Yes	Not Rated	Shrub	Silver-gray foliage, tolerates alkaline soil and clay

<i>Scientific Name</i>	<i>Common Name</i>	<i>Height</i>	<i>Crown Diameter*</i>	<i>Porosity^⑨</i>	<i>CA Native</i>	<i>BVOC^⑩</i>	<i>Type</i>	<i>Notes</i>
<i>Xylosma congestum</i>	Shiny xylosma	6'	6'	L	No	Not Rated	Shrub	Shiny light green leaves, occasional irrigation post-establishment
<i>Acacia vestita</i>	Hairy wattle	8'	6'	M	No	Not Rated	Shrub	Hairy foliage, yellow flowers
<i>Baccharis salicifolia</i>	Mulefat	10'	5'	H	Yes	Not Rated	Shrub	White, fuzzy pink flowers, long pointed leaves
<i>Myrtus communis</i>	True myrtle	10'	5'	L	No	Not Rated	Shrub	Glossy green leaves and white fragrant flowers
<i>Philadelphus lewisii</i>	Mock orange	10'	5'	L	Yes	Not Rated	Shrub	Light green leaves, pale yellow, scented blossoms, occasional irrigation post-establishment
<i>Adenostoma fasciculatum</i>	Chamise	10'	6'	M	Yes	Not Rated	Shrub	White flowers, possibly not compatible with fire resistant landscaping
<i>Callistemon citrinus</i>	Crimson bottlebrush	10'	6'	M	No	Not Rated	Shrub	Red bottle shaped flowers, citrus smell, hummingbirds love it
<i>Frangula californica</i> , syn. <i>Rhamnus californica</i>	Coffeeberry	10'	10'	L	Yes	Not Rated	Shrub	Dark red branches, coffee-like berries
<i>Garrya fremontii</i>	Bearbrush	10'	10'	L	Yes	Not Rated	Shrub	Smooth green oval-shaped leaves, edible purple berries
<i>Heteromeles arbutifolia</i>	Toyon	10'	10'	L	Yes	Not Rated	Shrub	Dense small white flowers, evergreen, sharply toothed leaves
<i>Juniperus californica</i>	California juniper	10'	10'	L	Yes	Not Rated	Shrub	Alkali tolerant, edible berries, very dense foliage
<i>Quercus berberidifolia</i>	California scrub oak	10'	10'	M	Yes	Not Rated	Shrub	Dull green, oval or toothed leaves, rounded acorns

Scientific Name	Common Name	Height	Crown Diameter*	Porosity^⑨	CA Native	BVOC^⑩	Type	Notes
<i>Acacia boormanii</i>	Snowy river wattle	15'	10'	M	No	Not Rated	Shrub	Golden ball-shaped flowers, frost tolerant
<i>Arctostaphylos manzanita</i>	Manzanita	15'	10'	H	Yes	Not Rated	Shrub	Bright shiny leaves, smooth red bark
<i>Fremontodendron californicum</i>	Flannel bush	15'	15'	L	Yes	Not Rated	Shrub	Fuzzy leaves, large yellow blossoms
<i>Osmanthus x fortunei</i>	Hybrid tea olive	15'	15'	L	No	Not Rated	Shrub	Small white flowers, dark green dense leaves, gray bark
<i>Pittosporum tobira</i>	Japanese pittosporum	15'	15'	L	No	Not Rated	Shrub	Evergreen, fragrant white flower clusters, leathery green leaves
<i>Allocasuarina verticillata</i>	Drooping she-oak	20'	15'	H	No	Not Rated	Tree	Needles, can have sparse foliage
<i>Cupressus arizonica</i>	Arizona cypress	20'	15'	L	No	Not Rated	Tree	Gray-green, conical, dense foliage, needs well drained soil, tolerates alkaline soils
<i>Geijera parviflora</i>	Australian willow	20'	15'	L	No	2 Stars	Tree	White flowers, older trees take on weeping form
<i>Prunus illicifolia</i> ssp. <i>Iyonii</i>	Catalina cherry	20'	15'	M	Yes	Not Rated	Tree	Upright form, white flowers and edible, large-seeded fruit
<i>Eriobotrya japonica</i>	Loquat	20'	20'	M	No	3 Stars	Tree	White flowers and edible fruit
<i>Arbutus unedo</i>	Strawberry tree	25'	20'	M	No	1 Star	Tree	Flowers and fruit, red bark
<i>Laurus nobilis</i>	Sweet bay	30'	30'	L	No	3 Stars	Tree	Yellow flowers and berries
<i>Ceratonia siliqua</i>	Carob tree	35'	30'	M	No	1 Star	Tree	Large; seeded pods; dark green leathery leaves; deep, infrequent irrigation

Scientific Name	Common Name	Height	Crown Diameter*	Porosity^⑨	CA Native	BVOC^⑩	Type	Notes
<i>Olea europaea</i> 'Swan Hill'	Swan Hill olive	35'	30'	M	No	3 Stars	Tree	required Fruitless, low pollen
<i>Brachychiton populneus</i>	Bottle tree	40'	30'	M	No	3 Stars	Tree	Unusual, wide trunk
<i>Pinus eldarica</i>	Afghan pine	45'	25'	M	No	1 Star	Tree	Needles, dense canopy, tall form, tolerates poor soils
<i>Pinus nigra</i>	Austrian black pine	45'	25'	M	No	2 Stars	Tree	Dense canopy with dark green needles
<i>Umbellularia californica</i>	California bay laurel	45'	30'	M	Yes	2 Stars	Tree	Fragrant leaves, small flowers and fruit
<i>Pinus halepensis</i>	Allepo pine	45'	40'	M	No	3 Stars	Tree	Needles, cones persist on tree
<i>Cinnamomum camphora</i>	Camphor	50'	65'	M	No	3 Stars	Tree	Fragrant leaves, dark berries
<i>Quercus wislizenii</i>	Interior live oak	55'	55'	M	Yes	1 Star	Tree	Dark green glossy leaves, distinct and more appropriate than Coast live oak
<i>Abies pinsapo</i>	Spanish fir	60'	20'	L	No	Not Rated	Tree	Needles, conical tree
<i>Podocarpus gracilior</i>	Fern pine	60'	30'	L	No	3 Stars	Tree	Can be frost sensitive
<i>Quercus ilex</i>	Holly oak	60'	55'	L	No	1 Star	Tree	Dark green leaves, acorns, dense canopy
<i>Quercus suber</i>	Cork oak	60'	60'	M	No	3 Stars	Tree	Cork-like bark, acorns
<i>Pinus canariensis</i>	Canary Island pine	65'	30'	H	No	2 Stars	Tree	Dark reddish bark, needles
<i>Cedrus deodara</i>	Deodar cedar	65'	45'	H	No	3 stars	Tree	Silver-gray needles, airy canopy when fully mature
<i>Magnolia grandiflora</i>	Southern magnolia	65'	45'	H	No	2 Stars	Tree	Leathery leaves, fragrant white flowers
<i>Calocedrus decurrens</i>	California incense	70'	20'	H	Yes	2 Stars	Tree	Fragrant needles, lifted

<i>Scientific Name</i>	<i>Common Name</i>	<i>Height</i>	<i>Crown Diameter*</i>	<i>Porosity[◎]</i>	<i>CA Native</i>	<i>BVOC[◆]</i>	<i>Type</i>	<i>Notes</i>
<i>Pinus ponderosa</i>	cedar Ponderosa pine	100'	30'	H	Yes	Not Rated	Tree	canopy when fully mature Needles, conical tree, appropriate for north side of a sound wall or noise barrier

*Crown Diameter: Space plants at crown diameter distance for a continuous barrier. For example, space California sagebrush every 3 feet.

◎Porosity: Thickness of Plant: High, Medium, Low.

◆Biogenic Volatile Organic Compounds. 1 to 3 star comparative rating scale; 1 is good, 2 is better, and 3 is best for air quality.

Appendix B - Sample Condition of Approval Language

Condition of approval language is most effective when it is clear and concise. It will need to be tailored to each project, dependent on the specific project design and plant materials used.

Conditions of Approval

Planning

- A landscape plan shall include a vegetation barrier consistent with the Sacramento Metropolitan Air Quality Management District's Landscaping Guidance for Improving Air Quality near Roadways, to the extent feasible. The landscape plan shall include individual plant locations, species, approved alternate species for substitutions, plant material size and plant material source. Landscape plans shall be approved by _____ prior to site preparation and installation activities.

Installation

- All vegetation shall be inspected prior to planting by a certified arborist or similarly qualified woody plant expert. Vegetation showing poor rooting structure, "topping", poor root structure, disease, insect infestation, low vigor or other indicators of poor quality should not be planted. Pre-installation reports shall be submitted to _____ within 15 days of the inspection.
- Planting holes shall, to the extent feasible, be dug a minimum diameter of four times the size of the container to be planted and at least as deep as the container is tall.
- Planting holes should be pre-watered.
- Root crowns shall be level with the surrounding soil or less than 2" above.
- All vegetation shall receive five gallons of water applied directly to the planting hole and root ball within 24 hours of planting. Rainfall of 2" or greater during this time will override the need for immediate post-planting supplemental irrigation.
- 4 inches of organic mulch shall be applied within a 4 foot radius of each plant. Mulch must not be in direct contact with plant stems and/or trunks.
- Nursery stakes shall be removed from all plant materials at time of planting. New staking will be installed only if indicated by conditions and/or plant materials.
- All vegetation shall be inspected post-planting by a certified arborist or similarly qualified woody plant expert and improperly planted or damaged plant materials will be corrected or replaced. Post-installation reports shall be submitted to _____ within 15 days of the inspection.

Maintenance

- During the first dry season after planting, each plant shall receive a minimum of ten gallons of water each week applied in a single event to ensure deep saturation of soil in the rooting area.
- During the second dry season after planting, each plant shall receive a minimum of ten gallons of water twice a month applied in a single event to ensure deep saturation of soil in the rooting area.
- Plants irrigated by automatic watering system shall be adjusted to meet plant water needs and seasonal conditions.
- State and local water efficiency landscape guidelines and/or ordinances must be adhered to.
- During the third dry season after planting, each plant shall receive a minimum of ten gallons of water once a month applied in a single event to ensure deep saturation of soil in the rooting area.
- Landscape shall be inspected by a certified arborist or similarly qualified woody plant establishment expert in March and September of each year. The following conditions and their recommended corrective actions shall be noted:
 - Damaged/diseased/dying/dead plants: Treat or replace.
 - Hazardous growth or damaged plants: Perform corrective pruning.
 - Irrigation system operability: Repair or replace.
 - Weedy or invasive undergrowth: Perform maintenance, which may include mowing, herbicide application, mulch application or groundcover planting and establishment.
 - Overall site condition including vandalism, refuse accumulation, improper site use (i.e. camping, dumping): Remediate and maintain to avoid inappropriate site conditions.

All landscape inspection reports including the above-suggested corrective actions shall be submitted to _____ within 30 days of the inspection.

- All plant support stakes shall be inspected annually and removed as soon as vegetation can support itself and is properly rooted.
- All pruning, cutting or limb removal from vegetation barrier plants shall be performed under direct supervision of a certified arborist or similarly qualified woody plant expert.

Funding and Reporting

- For each vegetation roadside barrier project, a _____ (non-revocable funding mechanism) shall be established to provide perpetual funding for ongoing maintenance and monitoring.
- Copies of landscape plans, maintenance plans and all reporting shall be submitted to the _____ (City arborist, Department of Transportation, Planning Department, Community Development Department, etc.)

Appendix C - Resources

Utilities

For information regarding use of electric transmission easement, contact SMUD's Property Administrator (916) 732-5016.

SMUD's Guide for Transmission Encroachment :

<https://www.smud.org/assets/documents/pdf/Guide-for-Transimssion-Encroachment.pdf>

SMUD's technical standard TP0601, "Requirements for Excavation in Proximity of SMUD's Underground Transmission Cables".

<https://www.smud.org/assets/documents/pdf/Requirements-for-Excavations.pdf>

SMUD's Quick Guide for Requirements and Guidelines for Uses within Electric & Gas Transmission Easement Areas:

<https://www.smud.org/assets/documents/pdf/Requirements%20and%20Guidelines%20for%20Uses%20Within%20Electric%20and%20Gas%20Transmission%20Easements.pdf>

The SelecTree website outlines various utility precautions as they relate to vegetation.

<http://selectree.calpoly.edu/>

Fire

Local Fire Prevention Standards:

Sacramento Metro Fire Community Wildfire Protection Plan, Weed Abatement Requirements and Inspections

<https://metrofire.ca.gov/index.php/fpb-forms/category/64-initial-study-mnd>

<https://metrofire.ca.gov/index.php/component/phocadownload/category/61-weed-abate-docs?download=93:fps11-weed-abatement>

CalFire Wildland-Urban Interface Codes:

http://www.fire.ca.gov/fire_prevention/fire_prevention_wildland_codes

Caltrans

CalTrans district offices: <http://www.dot.ca.gov/hq/jobs/districtoffices.htm>

CalTrans Roadside Maintenance and Adopt A Highway Information:

<http://www.dot.ca.gov/hq/maint/roadside.htm>

CalTrans Landscape Architecture Program: <http://www.dot.ca.gov/design/lap/>

Includes links to the Scenic Highway program, which may pertain to your project given specific location.

CalTrans Encroachment Permits <http://www.dot.ca.gov/trafficops/ep/index.html>

Sacramento Tree Foundation- How to plant trees and woody vegetation

<http://www.sactree.com/plantvideo>

<http://www.sactree.com/pages/60>

Selection, Design and Planting

California Invasive Plant Inventory <http://www.cal.ipc.org>

California Center for Urban Horticulture- Information on planting, irrigation and comprehensive

California based plant lists <http://ccuh.ucdavis.edu/Resources>

Water Use Classification of Landscape Species <http://ucanr.edu/sites/WUCOLS/>

Calscape: Interactive Native Plant Database <http://calscape.org/>

UC Davis Arboretum All-Stars http://arboretum.ucdavis.edu/arboretum_all_stars.aspx

Tong, Z.; Baldauf RW, Isakov V, Deshmukh P, Zhang KM. 2016. Roadside vegetation barrier designs to mitigate near- road air pollution impacts. Science of the Total Environment. Vol 541, pp. 920-927.

Shady Eighty Tree Guide. Sacramento Tree Foundation. <http://www.sactree.com/shady80>

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