

Landscaping Guidance for Improving Air Quality Near Roadways

Plant Species and Best Practices for the Sacramento Region

Version 2.0

May 2020



Introduction 1

Important Considerations for Designing a Vegetation Barrier 3

 Location Feasibility 3

 Barrier Dimensions and Vegetation Characteristics 3

 Underground and Overhead Utility Requirements 4

 Fire Prevention Standards 5

 Caltrans Requirements 5

Best Practices 7

 Climate Change Resiliency 7

 Allergen Hazard Reduction 8

 Plant Acquisition, Installation, and Establishment 9

 Long-Term Care 11

Resources 12

 Scenario Illustrations 12

 Shrub and Tree Information Table for the Sacramento Region 18

 Sample Conditions of Approval Language 26

Introduction

“Forest air is the epitome of healthy air.” -Peter Wohlleben

Roadside vegetative has long been used for aesthetic and roadway functionality purposes: wildlife habitat, human mental health and social benefits, storm water interception and retention, carbon sequestration and urban heat island mitigation. However, recent scientific studies show that roadside landscaping and barriers can also reduce roadway-generated pollutant exposure for nearby people.

In 2016, the Environmental Protection Agency (EPA) published *Recommendations for Constructing Roadside Vegetation Barriers to Improve Near-Road Air Quality*. The EPA guidelines describe how vegetation and soundwalls or noise barriers can be used to reduce air pollution exposure to people in homes, schools, and other land uses alongside heavily-traveled roadways.

The Sacramento region has significant and very diverse opportunities to retrofit existing roadsides with vegetation barriers. In 2017, using the EPA’s guidelines, the Sacramento Metropolitan Air Quality Management District (Sac Metro Air District) developed *Landscaping Guidance for Improving Air Quality Near Roadways: Plant Species and Best Practices for the Sacramento Region*, which focuses on the Sacramento region and aims to translate information from the EPA for use by the region’s land use planners, landscape architects, developers and other interested parties. This manual, Version 2.0, is a 2020 update of that guidance.

The goals of this guidance are to:

- Provide guidelines for evaluating a potential vegetation barrier site;
- Offer vegetation planting recommendations appropriate to the Sacramento region to meet vegetation height, thickness and porosity goals;
- Evaluate appropriate vegetation characteristics in a table format;
- List best practices for vegetation planting;
- Offer suggestions for effective long-term maintenance; and
- Suggest sample language for recommending to local jurisdictions the installation of vegetation barriers as a condition of approval in project development applications.

Version 2.0 (2020) includes the following major updates:

- Emphasis on selecting species that can thrive in the face of climate change;
- Practical information on choosing and caring for plants to reduce airborne allergens; and
- Clarification of key concepts to support design, implementation and maintenance of effective barriers.

For questions, comments or suggestions on how to improve this document, please contact ProjectReview@airquality.org or 916-874-4800.

Special thanks to the Sacramento Tree Foundation for assisting in the development of this document.

New in Version 2.0

Focus on resilience to climate change

Detailed information on reducing allergen potential

Important Considerations for Designing a Vegetation Barrier

“The best time to plant a tree was 20 years ago. The next best time is now.” -Chinese Proverb

Vegetation barriers established near roadways improve air quality and reduce a population’s exposure to particulate air pollution in two main ways:

- **Deposition:** The capture of airborne pollution particles by leaf surfaces as air flows past.
- **Dispersion:** By allowing airborne particles to be forced vertically up the barrier, slowing the airflow and mixing it with greater air volumes, reducing the concentration of pollutants in the air.

Vegetation can also absorb gaseous air pollution (such as carbon monoxide and nitrogen oxide), but care should be taken in species selection as some plants can emit biogenic volatile organic gases (BVOCs), contributing to ground-level ozone formation. The Shrub and Tree Information Table in the Resources section includes BVOC ratings, where data is available. Choose vegetation with low or medium BVOC ratings whenever possible.

The following are characteristics and considerations for designing vegetation barriers to reduce air pollution exposure near roadsides.

Location Feasibility

Consideration of location feasibility is critical. Not every roadside will have the physical attributes required to establish an effective vegetation barrier, and lack of space can be a significant challenge when designing vegetation barriers. This is especially true in “retrofit” situations when roadway setbacks, infrastructure has already been constructed and vegetation has already been established. Some modification of the ideal barrier dimensions may be needed to accommodate a lack of space.

Barrier Dimensions and Vegetation Characteristics

The EPA guidelines recommend that vegetation barriers consist of rows of shrubs and trees and be at least 33 feet wide, 165 feet long, and 16 feet tall. According to EPA modeling, the higher, longer and wider the barrier, the greater the benefit to people protected by the barrier.

The vegetation should extend 3 feet above any sound wall or noise barrier.

Barrier Porosity

The barrier should exhibit low porosity. Porosity is the degree to which air can pass through the vegetation barrier. A high porosity barrier (i.e., very porous) lets more air through than a low porosity barrier. Foliage density and the density of shrub and tree plantings inform barrier porosity.

Foliage Density

The vegetation barrier should consist of shrubs and trees with moderately dense to dense foliage. In general, vegetation with denser leaf and branch structures provides increased surface area and is more effective at removing particulate pollution. Examples include bushy pine trees with numerous tightly-packed needles.

The species in the Shrub and Tree Information Table have been evaluated by local professionals and rated Low, Medium or High foliage density.

Density of the Shrub and Tree Plantings

The shrubs and trees should be planted as closely together as feasible. The more densely packed the plants are, in general, the less porous the barrier will be and the more effective it will be removing air pollution. Spacing should be equivalent to crown diameter.

Planting plants with less dense foliage closer to the roadway and plants with more dense foliage furthest away from the roadway should have the most benefit to near-road air quality. This is a significant area for further research and on the ground testing.

The Resources section of this document includes depictions of four hypothetical design options. Three designs meet EPA guidelines for width and the fourth is provided to illustrate a siting situation with limited space.

Underground and Overhead Utility Requirements

Utilities and fire prevention standards may restrict the siting and types of vegetation allowed near roadways. Before advancing to design and plant species selection, identifying the rights-of-way, utilities, and easements will help inform vegetation species selection, spacing and placement.

Always contact the utility providers for review of landscape plans prior to species selection and site preparation. A complete inventory of on-site utilities, existing site conditions, and space separation requirements must be developed because underground and overhead utilities create a variety of limitations depending on the types of utilities and their operators. For example, in general, roadside vegetation should remain at least 10 feet from roadside edges and 15 feet

above the roadway surface. However, for vegetation within the Sacramento Metropolitan Utility District's overhead transmission line easement, trees should be no taller than 15 feet at maturity.

Always call 811 before digging.

More information:

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

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

SMUD's easement information:

<https://www.smud.org/en/Corporate/Do-Business-with-SMUD/Land-Use>

Know What's Below. Call 811 Before You Dig:

<http://call811.com/before-you-dig/how-811-works>

Fire Prevention Standards

Evaluate potential conflicts with fire safety codes during the site evaluation process. "Defensible space" requirements may preclude installations of vegetation barriers where buildings are nearby, or may limit thickness, layering or canopies of vegetation in areas near or around water tanks and other water storage equipment, pumps, and outdoor barbeques and outdoor fireplaces.

More information:

Sacramento Metro Fire Community Wildfire Protection Plan:

<https://metrofire.ca.gov/index.php/cwpp-crrd> See pages 2-25 through 2-28.

Sacramento Metro Fire Weed Abatement Requirements Inspections:

<https://metrofire.ca.gov/index.php/weed-abatement>

CalFire Wildland-Urban Interface Codes:

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

Caltrans Requirements

Many roadways that are prime locations for roadside vegetation barriers to improve near-road air quality will be under the jurisdiction of Caltrans; throughout Sacramento County, the jurisdiction is Caltrans District 3. Always coordinate with a [Caltrans Landscape Specialist](#) if the project could be within or adjacent to Caltrans property.

Below are general Caltrans tree and vegetation guidelines for vegetation within roadway rights-of-way. Note that in some circumstances, vegetation can be placed closer to these features if an encroachment permit is obtained.

- Trees must be planted at least 30 feet from the edge of the “traveled way”.
- Overhanging foliage must be at least 15 feet from the pavement.
- Trees must be at least 20 feet from any manholes.
- Shrub setback distance is determined by the height and width of the specific.
- All vegetation should be planted at least 10 feet from fences, walls, ditches and drainage features.
- Plants must not interfere with the function of 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 highway.
- Plants cannot add a maintenance burden to Caltrans, thus must be managed in perpetuity by the entity responsible for the vegetation barrier.

These requirements can be found in Caltrans Adopt-A-Highway program guidelines:

http://adopt-a-highway.dot.ca.gov/tree_shrub_p&s08.pdf

More information:

Caltrans District Offices:

<https://dot.ca.gov/caltrans-near-me>

Caltrans Landscape Specialists:

<https://dot.ca.gov/-/media/dot-media/programs/maintenance/documents/landscape-specialist-list-a11y.pdf>

Key Summary Points: Site Evaluation

Evaluate space availability

Review local fire safety codes

Identify potential utility conflicts and adjust plant selection accordingly

Review and comply with Caltrans vegetation requirements

Best Practices

“Native plants give us a sense of where we are in this great land of ours. I want Texas to look like Texas and Vermont to look like Vermont.” -Lady Bird Johnson

Climate Change Resiliency

Resiliency to climate change must be one of the foremost considerations when designing, planting, and maintaining a vegetation barrier to reduce air pollution exposure from heavily-traveled roadways. A vegetation barrier that is resilient to climate change will thrive and continue provide to near-road air quality benefits, especially for the most highly affected communities, in the face of increased temperatures and drought conditions. Implementing the following recommendations can improve the climate resiliency of vegetation barriers.

- Select species with high adaptability potential to increasing heat and drought stress.
- Select species with high carbon sequestration potential and/or ability to provide ecosystem benefits such as attracting beneficial insects or improving stormwater retention.
- Include more than one species. A diverse plant population protects a barrier’s integrity, because if one species is harmed by a pest or disease, the barrier as a whole will not fail.
- Many people suffer from allergies. Choose a low-allergen species whenever possible. For more information, see the Allergen Hazard Reduction section.
- Select species or varieties that are not only native to California, but that are local to this region.
- To preserve regional biodiversity and prevent outcompeting, avoid planting certain native plants close to similar unique or endangered native populations (e.g. Fremontedendron californica near Fremontedendron decumbens, an endangered plant found in El Dorado County).
- Ensure proper maintenance, which will help mitigate pest, disease, and fire risks, and will lower economic costs in the long-term. See the Long-Term Care section for more information.

Our Climate Future

Temperatures in the Sacramento region are expected to be 10F higher by the end of the century, and Sierra snowpack may nearly disappear by 2100.

-UC Davis Science and Climate, California’s Fourth Climate Change Assessment

Key Summary Points: Climate Change

Species must tolerate heat and drought conditions

Include more than one species

Identify how climate change will impact nearby communities, and avoid species that may contribute to worsening conditions

Allergen Hazard Reduction

While all plants pose some sort of allergy risk, some of the most effective species at reducing near-roadway air pollution have high allergen ratings, and many rely on the wind for pollination. This includes members of the Pine family (Pinaceae) such as the stately Deodar Cedar (*Cedrus deodara*) that is commonly seen along freeways and highways in California.

Tips for reducing allergen hazards:

- Create a diverse vegetation selection. Over-exposure to a large population of one species (especially a monoculture) can cause or worsen a person's sensitivity to that species, *even if it has a low allergen rating*.
- Among dioecious species (those with separate male and female plants) consider female plants as they pose minimal to no allergen risk because they do not produce the pollen associated with allergies. However, they can drop fruit, seed and seed pods that can litter walkways, and may not be appropriate for areas over or next to walkways and bicycle paths.
- Many species have both male and female flowers on one plant, and there can be considerable differences in allergy hazards among their cultivars and varieties. Cloned male cultivars have traditionally been favored in urban environments because they do not to produce fruit, seed or seedpods which can litter sidewalks. However, they can produce substantial amounts of pollen, increasing risk of allergies. Nursery tags will note the variety or cultivar, but will not identify the gender, so we recommend asking the grower for more information.
- Consider species that are pollinated by insects versus by the wind.
- Select species with a short pollination period.

As a general rule of thumb, species within a plant family will have similar allergen potentials.

As always, avoid poisonous plants in areas where children and pets may encounter them. The Shrub and Tree Information Table includes allergy hazard information, if data is available.

Key Summary Points: Allergens

Plant multiple species

Prioritize dioecious female plants

Opt for insect-pollinated plants

Refer to our Shrub and Tree Information Table to see allergen ratings (where available)

Plant Acquisition, Installation, and Establishment

Create a list of substitution species in case there is limited nursery availability. Landscaping plans should specify additional species if the desired plants are not available.

- Order early. Give nurseries or contract growers as much lead time as possible to ensure that they will have the items in stock.
- Buy and plant smaller sized plants (#5 pots or smaller). Installing smaller versus larger, older plants will assist with healthy root establishment, help ensure future drought tolerance, and cost less at the outset and over the long-term. Within two to four years, they will be comparable in size to larger plants, and typically exceed them within five years.
- Inspect plant materials for damage and pests before and after planting.
- The barrier should extend 165 feet or more beyond the site of concern (where people or buildings are located) or can wrap around the site perpendicularly from the roadway. Preserve adequate access space to allow for installation and long-term maintenance activities.
- Fill the available space both horizontally and vertically with vegetation. Species on the Shrub and Trees Information Table will ensure space coverage for the first 7 to 10 years. Expect tighter plant spacing than landscapes designed for aesthetic uses.
- The establishment period covers the first three to five seasons after planting. Proper maintenance of vegetation during this time will increase the barrier's ability to survive excessive heat, drought conditions, pests and diseases.

Planting should occur in fall or winter.

Irrigation: Pre-irrigate individual planting sites if rainfall has not yet occurred for the season. Irrigation must be applied in accordance to individual plant species need and in response to soil and climatic conditions, which will vary due to planting location. Irrigation rates and amounts depend on a variety of factors including amount of rainfall in current and recent seasons, soil type, and ground slope characteristics.

A carefully designed vegetation barrier will contain water runoff from irrigation and rain, and can improve soil health by reducing erosion.

Even plants that are native and drought-tolerant will require supplemental irrigation during the first three dry seasons (May-November) after planting. Temporary irrigation systems or other watering methods may be appropriate.

Deep, infrequent watering will result in a healthier establishment of vegetation.

Staking and Pruning: For new plants, stakes, planting tubes or other protective materials may be used to avoid damage from weather, animals and weed abatement. Remove tree stakes by the third year of establishment.

Pruning, except for targeted structural pruning of trees to encourage development of a strong trunk, is not recommended during the establishment phase.

Key summary Points: Planting and Establishment

Create a list of substitution species in case there is limited nursery availability

Choose smaller, younger plants to enhance root establishment

During the first May-November, irrigate to establish drought tolerance

Proper maintenance of vegetation during this time will increase the barrier's ability to survive excessive heat, drought conditions, pests and disease

Long-Term Care

Long-term maintenance of vegetation barriers must occur in order to manage natural processes and to replace failed or damaged plant materials.

Adaptive Management Plan: Develop an adaptive maintenance plan before problems arise to support the vegetation barrier's integrity and lower maintenance costs over the long term. The plan should include a system for rating plant health and implementing corrective actions. For example, the plan could stipulate that plants that are in very poor health will be slated for replacement the following fall. An effective adaptive management plan will include a minimum of two inspections per year to determine the health of the vegetation barrier and correct any deficiencies.

Fire Hazard Reduction: Remove invasive weeds, leaf litter, and dead plants or branches immediately to support a healthy vegetation barrier and reduce fire hazards. Mulching, mowing and herbicide application are all methods that may be appropriate for weed management. Replace dead plants as soon as is appropriate, as specified by the adaptive management plan.

Pruning: As with the establishment phase, regular and significant vegetation pruning is unnecessary, and this expectation should be clearly stated in order to achieve a thick barrier of vegetation. This sort of approach is not common within the landscaping industry and landscape management contractors will need to be trained and closely overseen to ensure the integrity of the vegetation barrier.

Key Summary Points: Long-Term Care

Develop an adaptive management plan before problems arise

Use mulch, planting tubes, mowing, and approved herbicides as needed for weed management

To encourage thickness, avoid unnecessary pruning

Replace plants as needed to maintain the integrity of the vegetation barrier and to reduce fire hazards

Resources

“Between every two pines is a doorway to a new world.” -John Muir

Scenario Illustrations

To provide guidance in designing vegetation barriers, following are four illustrations showing hypothetical scenarios.

Scenario 1 - Vegetation Barrier without a Noise Barrier/Soundwall

Scenario 2 - Vegetation Barrier on One Side of a Noise Barrier/Soundwall

Scenario 3 – Vegetation Barrier on Both Sides of a Noise Barrier/Soundwall

Scenario 4 - Limited Space Scenario: Narrow Vegetation Barrier on One Side of a Noise Barrier/Soundwall

Scenarios 1 through 3 adhere to the EPA guidelines’ vegetation width recommendation of at least 33 feet.

Scenario 4 is provided for the reason that while many roadside situations will not have enough space to meet the minimum of 33 feet barrier thickness, modeling results suggest that any type of barrier (solid, vegetative or combination) will limit the distance and amount of air pollution travel from a roadway.

Scenario 1 - Vegetation Barrier Without a Noise Barrier/Soundwall
Aerial View, Not to Scale

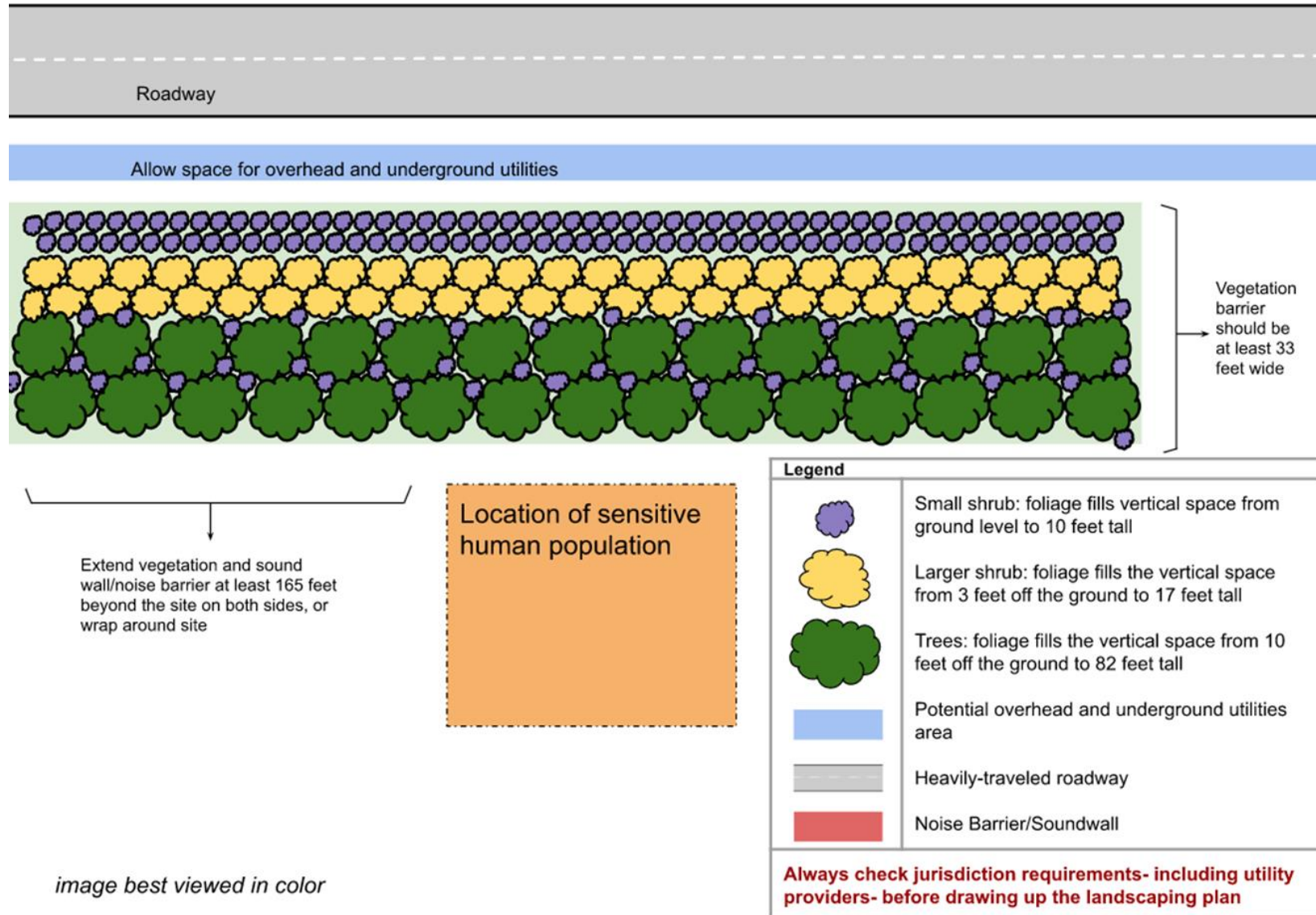
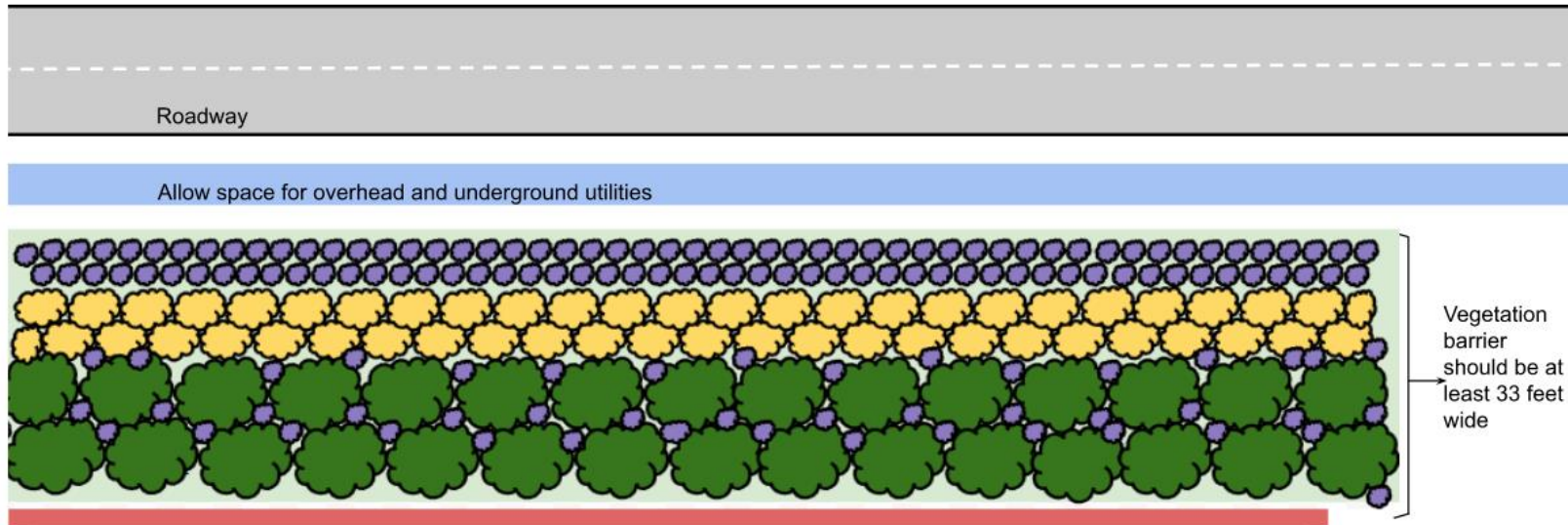








image best viewed in color

Scenario 2 - Vegetation Barrier on One Side of a Noise Barrier/Soundwall
Aerial View, Not to Scale



Extend vegetation and sound wall/noise barrier at least 164 feet beyond the site on both sides, or wrap around site

Location of sensitive human population

Legend	
	Small shrub: foliage fills vertical space from ground level to 10 feet tall
	Larger shrub: foliage fills the vertical space from 3 feet off the ground to 17 feet tall
	Trees: foliage fills the vertical space from 10 feet off the ground to 82 feet tall
	Potential overhead and underground utilities area
	Heavily-traveled roadway
	Noise Barrier/Soundwall

Always check jurisdiction requirements- including utility providers- before drawing up the landscaping plan

image best viewed in color

Scenario 3 - Vegetation Barrier on Both Sides of a Noise Barrier/Soundwall
Aerial View, Not to Scale

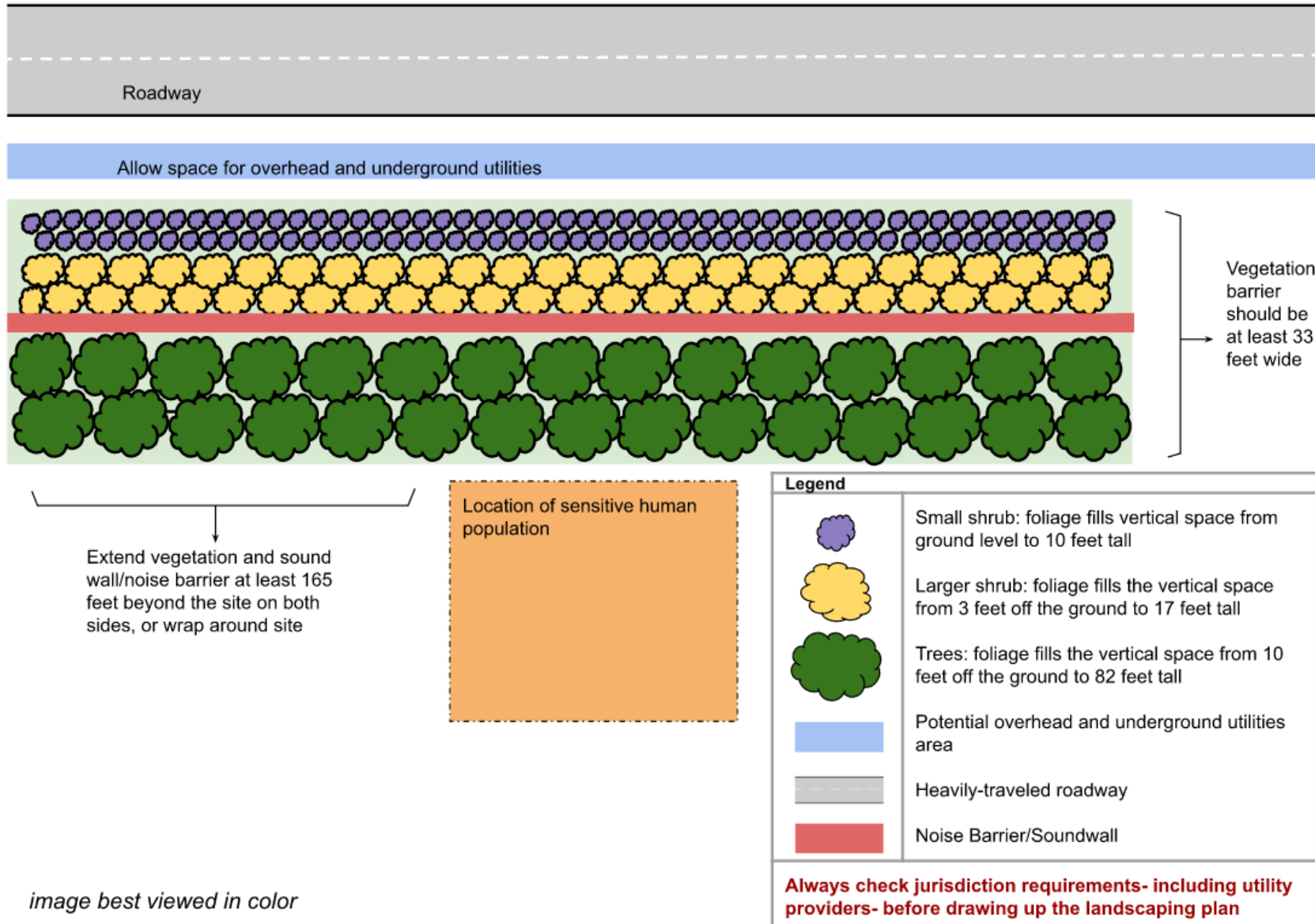
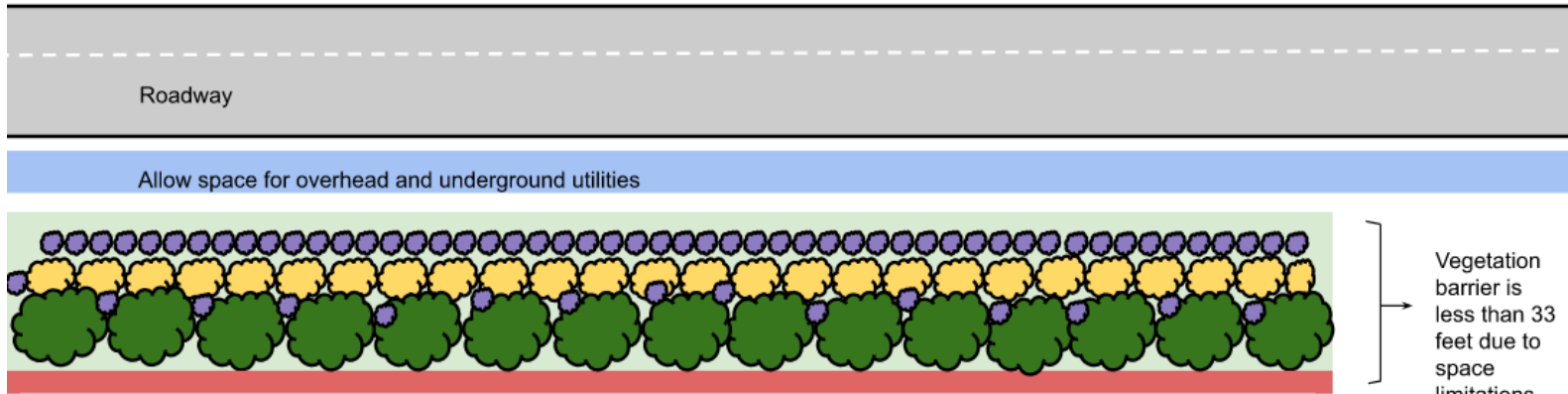
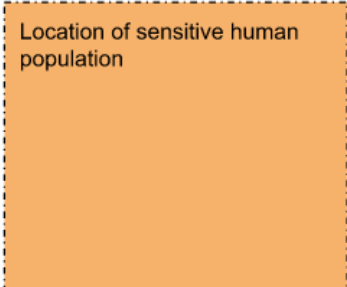


image best viewed in color

Scenario 4 - Limited Space Scenario: Narrow Vegetation Barrier on One Side of a Noise Barrier/Soundwall
Aerial View, Not to Scale



Extend vegetation and sound wall/noise barrier as far as possible beyond the site on both sides, or wrap around site



Note: While this scenario does not meet the EPA's minimum recommendations, modeling data suggests that any type of barrier (solid, vegetative or combination) will limit the distance and amount of air pollution travel from a roadway.

image best viewed in color

Legend	
	Small shrub: foliage fills vertical space from ground level to 10 feet tall
	Larger shrub: foliage fills the vertical space from 3 feet off the ground to 17 feet tall
	Trees: foliage fills the vertical space from 10 feet off the ground to 82 feet tall
	Potential overhead and underground utilities area
	Heavily-traveled roadway
	Noise Barrier/Soundwall

Always check jurisdiction requirements- including utility providers- before drawing up the landscaping plan

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Shrub and Tree Information Table for the Sacramento Region

The Shrub and Tree Information Table that follows provide lists of species that are appropriate for use in the greater Sacramento region. Species included in the table are generally available within the local nursery trade or can be easily acquired through the horticultural industry and meet the EPA recommendation for minimal seasonal and climatic variability; i.e., they do not shed their leaves seasonally. The species are either native or projected to be climate-resilient with limited specialized care beyond the three-to-five-year establishment period. Plants that show invasive tendencies, have a high susceptibility to pests and diseases, or pose particularly high allergen risks have not been included.

This list is not comprehensive, and all species have varying levels of benefits and trade-offs. Other species may meet the criteria outlined in the EPA Guidelines and may be appropriate for use.

Table Key:

*Foliage Density: Low, Medium or High

** Allergy rating is based on an overall potential to produce allergen health risks and can be highly dependent on plant species, variety, and/or the selection of female-sexed plants.

***Biogenic volatile organic compounds (BVOCs): Organic compounds emitted by plants, through their normal processes, that precursors to ground-level ozone in the atmosphere. Choose low or medium ratings when possible.

--- Insufficient data to form a rating

Common Name	Scientific Name	Family	Type	Height	Crown Diameter	Foliage Density	CA Native	Allergen**	BVOC***	Notes
'Blue Jeans' Mountain Lilac	Ceanothus 'Blue Jeans'	Rhamnaceae	Shrub	5'	5'	Low	Yes	---	---	No shade or summer water after establishment. Lavender flowers.
'Goodwin Creek' Lavender	Lavandula x gingsinii 'Goodwin Creek Grey'	Lamiaceae	Shrub	5'	5'	Low	No	---	---	Silvery leaves. Scented, purple flowers.
'Lynn's Legacy' Leucophyllum	Leucophyllum langmaniae 'Lynn's Legacy'	Scrophulariaceae	Shrub	5'	5'	Low	No	Low	---	Fragrant purple bell-shaped flowers.
African Boxwood	Myrsine africana	Primulaceae	Shrub	5'	5'	Low	No	---	---	Very dense foliage, appropriate for a hedge. May be poisonous. Occasional irrigation after establishment.
Bearbrush	Garrya fremontii	Garryaceae	Shrub	10'	10'	Low	Yes	High	---	Smooth green oval-shaped leaves, edible purple berries.
Big Sagebrush	Artemisia tridentata	Asteraceae	Shrub	5'	5'	Low	Yes	High	---	Yellow-green flowers and twisted trunk.
Big Saltbush	Atriplex lentiformis	Amaranthaceae	Shrub	6'	6'	Low	Yes	High	---	Silver-gray foliage. Tolerates alkaline soil and clay.
Bladderpod	Peritoma arborea	Cleomaceae	Shrub	5'	5'	Medium	Yes	---	---	Lacy gray-green leaves and abundant yellow flowers year-round. Tolerates alkalinity.
Buck Brush	Ceanothus cuneatus	Rhamnaceae	Shrub	5'	5'	Low	Yes	---	---	Tough fleshy leaves and white flowers. Very tough and extremely drought tolerant.
Bush Germander	Teucrium fruticans	Lamiaceae	Shrub	5'	5'	Low	No	Low	---	Slivery blue leaves and lavender flowers.
Bush Mallow	Malacothamnus fasciculatus	Malvaceae	Shrub	4'	4'	Medium	Yes	---	---	Tolerates sand. Pink 1" flowers, hairy stems and leaves.
California Bush Anemone	Carpenteria californica	Hydrangaceae	Shrub	6'	3'	Low	Yes	Low	---	Shiny foliage and white flowers. Native to Fresno County.

Common Name	Scientific Name	Family	Type	Height	Crown Diameter	Foliage Density	CA Native	Allergen**	BVOC***	Notes
California Flannel Bush	<i>Fremontodendron californicum</i>	Malvaceae	Shrub	15'	15'	Low	Yes	---	---	Fuzzy leaves and large yellow blossoms.
California Juniper	<i>Juniperus californica</i>	Cupressaceae	Shrub	10'	10'	Low	Yes	Low	---	Alkali-tolerant with edible berries and very dense foliage.
California Sagebrush	<i>Artemisia californica</i>	Asteraceae	Shrub	3'	3'	Low	Yes	High	---	Green-gray foliage. Appropriate for north side of sound wall or barrier. Limit summer irrigation.
California Scrub Oak	<i>Quercus berberidifolia</i>	Fagaceae	Shrub	10'	10'	Medium	Yes	High	---	Dull-green oval or toothed leaves, rounded acorns.
California Wildrose	<i>Rosa californica</i>	Rosaceae	Shrub	5'	8'	Low	Yes	---	---	Prickly stems, 5-petaled and colored leaves. Scented.
Cenizo	<i>Leucophyllum frutescens</i>	Scrophulariaceae	Shrub	5'	5'	Low	No	Low	---	Purple flowers, silvery leaves.
Chamise	<i>Adenostoma fasciculatum</i>	Rosaceae	Shrub	10'	6'	Medium	Yes	---	---	White flowers. May not be fire-resistant.
Cleveland Sage	<i>Salvia clevelandii</i>	Lamiaceae	Shrub	5'	5'	Low	Yes	Low	---	Wrinkled leathery leaves and rounded purple flower clusters.
Coffeeberry	<i>Frangula californica</i> syn. <i>Rhamnus californica</i>	Rosaceae	Shrub	10'	10'	Low	Yes	High	---	Dark red branches and coffee-like berries.
Coyote Brush	<i>Baccharis pilularis</i>	Asteraceae	Shrub	5'	5'	Low	Yes	High	---	Many white/yellow flowers along stems.
Crimson Bottlebrush	<i>Callistemon citrinus</i>	Myrtaceae	Shrub	10'	6'	Medium	No	High	---	Red bottle-shaped flowers and a citrus smell. Attracts hummingbirds.
Desert Cassia	<i>Senna nemophila</i>	Fabaceae	Shrub	4'	4'	High	No	---	---	Needlelike structure with an airy habit and bright yellow flowers.

Common Name	Scientific Name	Family	Type	Height	Crown Diameter	Foliage Density	CA Native	Allergen**	BVOC***	Notes
Hairy Wattle	<i>Acacia vestita</i>	Fabaceae	Shrub	8'	6'	Medium	No	High	---	Hairy foliage and yellow flowers.
Hybrid Tea Olive	<i>Osmanthus x fortunei</i>	Oleaceae	Shrub	15'	15'	Low	No	---	---	Small white flowers. Dark green dense leaves and gray bark.
Indian Hawthorne	<i>Rhaphiolepis indica</i>	Rosaceae	Shrub	5'	5'	Low	No	---	---	Thick leathery leaves, white star-shaped flowers and blue-black fruits.
Japanese Pittosporum	<i>Pittosporum tobira</i>	Pittosporaceae	Shrub	15'	15'	Low	No	---	---	Fragrant white flower clusters and leathery green leaves.
Lemonade Sumac	<i>Rhus integrifolia</i>	Anarcadiaceae	Shrub	5'	8'	Low	Yes	High	---	Leathery, dark green leaves and small pink flowers. Grows shorter on slopes.
Manzanita	<i>Arctostaphylos manzanita</i>	Ericaceae	Shrub	15'	10'	High	Yes	Low	---	Bright shiny leaves and smooth red bark.
Mountain Mahogany	<i>Cercocarpus betuloides</i>	Rosaceae	Shrub	5'	5'	Medium	Yes	---	---	Birch-like leaves and tail-shaped fruit. Small clustered white flowers. Tolerates clay and sand.
Mule Fat	<i>Baccharis salicifolia</i>	Asteraceae	Shrub	10'	5'	High	Yes	High	---	White fuzzy pink flowers and long pointed leaves.
Oregon Grape	<i>Berberis aquifolium</i>	Beberidaceae	Shrub	5'	5'	Medium	Yes	Low	---	Dark-green leaves and fragrant yellow flowers.
Palmer's Indian Mallow	<i>Abutilon palmeri</i>	Malvaceae	Shrub	4'	4'	Medium	No	Low	---	Apricot-colored flowers and fuzzy leaves.
Purple Phlomis	<i>Phlomis purpurea</i>	Lamiaceae	Shrub	5'	5'	Medium	No	Low	---	Colorful flowers, fuzzy leaves, and a pleasant aroma. Poisonous if ingested.
Rosemary	<i>Rosmarinus officinalis</i>	Lamiaceae	Shrub	5'	5'	Low	No	---	---	Pleasant scent with long-stemmed shoots. Edible. White, purple or blue flowers.

Common Name	Scientific Name	Family	Type	Height	Crown Diameter	Foliage Density	CA Native	Allergen**	BVOC***	Notes
Saint Catherine's Lace	<i>Eriogonum giganteum</i>	Polygonaceae	Shrub	5'	5'	Low	Yes	---	---	Leathery woolly oval leaves and tiny pinkish-white flower.
Shiny Xylosma	<i>Xylosma congestum</i>	Salicaceae	Shrub	6'	6'	Low	No	Low	---	Shiny light green leave. Needs occasional irrigation after establishment.
Snowy River Wattle	<i>Acacia boormanii</i>	Fabaceae	Shrub	15'	10'	Medium	No	High	---	Golden ball-shaped flowers. Frost tolerant.
Toyon	<i>Heteromeles arbutifolia</i>	Roseaceae	Shrub	10'	10'	Low	Yes	Low	---	Dense small white flowers, with sharply toothed leaves.
True Myrtle	<i>Myrtus communis</i>	Myrtaceae	Shrub	10'	5'	Low	No	Low	---	Glossy green leaves and white fragrant flowers.
Woolly Blue Curls	<i>Trichostema lanatum</i>	Lamiaceae	Shrub	3'	3'	Low	Yes	Low	---	Fuzzy spikes of violet flowers. Needs no water after establishment.
Yerba Santa	<i>Eriodictyon californicum</i>	Asteraceae	Shrub	5'	5'	Medium	Yes	---	---	Long narrow leaves and bluish bell-shaped flowers.
'Skyrocket' Juniper	<i>Juniperus scopulorum</i> 'Skyrocket'	Cupressaceae	Tree	15'	2'	Low	No	Low	---	Columnar juniper with blue-green foliage. Needs occasional water when established.
'Spartan' Chinese Juniper	<i>Juniperus chinensis</i> 'Spartan'	Cupressaceae	Tree	15'	3'	Low	No	Low	---	Thick, compact columnar juniper. Needs well-drained soil. Tolerates alkaline soils.
Afghan/Turkish Pine	<i>Pinus eldarica</i>	Pinaceae	Tree	45'	25'	Medium	No	---	Low	Needles, dense structure, and tall form. Tolerates poor soils.
Aleppo Pine	<i>Pinus halepensis</i>	Pinaceae	Tree	45'	30'	Medium	No	---	High	Needles. Cones remain on tree for many years.
Arizona Cypress	<i>Cupressus arizonica</i>	Cupressaceae	Tree	20'	15'	Low	No	Low	---	Gray-green, conical, dense foliage. Needs well-drained soil. Tolerates alkaline soils.

Common Name	Scientific Name	Family	Type	Height	Crown Diameter	Foliage Density	CA Native	Allergen**	BVOC***	Notes
Australian Willow	<i>Geijera parviflora</i>	Rutaceae	Tree	20'	15'	Low	No	Low	Medium	White flowers. Older trees take on weeping form.
Austrian Black Pine	<i>Pinus nigra</i>	Pinaceae	Tree	45'	25'	Medium	No	---	Medium	Dense structure with dark-green needles.
Bronze Loquat	<i>Eriobotrya deflexa</i>	Rosaceae	Tree	15'	15'	Low	No	Low	High	Fragrant white flowers. Sensitive to frost.
California Bay Laurel	<i>Umbellularia californica</i>	Lauraceae	Tree	45'	30'	Medium	Yes	---	Medium	Fragrant leaves, small flowers, and fruit.
California Incense Cedar	<i>Calocedrus decurrens</i>	Cupressaceae	Tree	70'	20'	High	Yes	High	Medium	Fragrant needles, lower branches absent when mature.
Camphor	<i>Cinnamomum camphora</i>	Lauraceae	Tree	50'	30'	Medium	No	---	High	Fragrant leaves and dark berries.
Canary Island Pine	<i>Pinus canariensis</i>	Pinaceae	Tree	65'	30'	High	No	High	Medium	Dark reddish bark and needles.
Carob Tree	<i>Ceratonia siliqua</i>	Fabaceae	Tree	35'	30'	Medium	No	---	Low	Large, seeded pods and dark green leathery leaves. Deep, infrequent irrigation required. Male flowers may give distasteful odor.
Catalina Cherry	<i>Prunus ilicifolia</i> ssp. <i>lyonii</i>	Rosaceae	Tree	20'	15'	Medium	Yes	---	---	Upright form and white flowers. Edible, large seeded fruit.
Cork Oak	<i>Quercus suber</i>	Fagaceae	Tree	60'	30'	Medium	No	Low	High	Cork-like bark. Acorns.
Deodar Cedar	<i>Cedrus deodara</i>	Pinaceae	Tree	65'	30'	High	No	High	High	Silver-gray needles, airy structure when fully mature.
Drooping She-Oak	<i>Allocasuarina verticillata</i>	Casuarinaceae	Tree	20'	15'	High	No	High	---	Needles. Can have sparse foliage.

Common Name	Scientific Name	Family	Type	Height	Crown Diameter	Foliage Density	CA Native	Allergen**	BVOC***	Notes
Fern Pine	<i>Podocarpus gracilior</i>	Podocarpaceae	Tree	60'	30'	Low	No	Low	High	Can be frost-sensitive.
Holly Oak	<i>Quercus ilex</i>	Fagaceae	Tree	60'	30'	Low	No	Low	Low	Dark-green leaves, acorns, and a dense structure.
Interior Live Oak	<i>Quercus wislizeni</i>	Fagaceae	Tree	55'	30'	Medium	Yes	---	Low	Dark-green glossy leaves and distinct form. More appropriate for the Sacramento region than similar Coast Live Oak.
Italian Cypress	<i>Cupressus sempervivens</i>	Cupressaceae	Tree	60'	3'	High	No	High	Low	Often used for privacy screening.
Jeffrey Pine	<i>Pinus jeffreyi</i>	Pinaceae	Tree	100'	20'	High	Yes	High	Low	Needles and cones. Bark smells like vanilla or butterscotch.
Kurrajong/Bottle Tree	<i>Brachychiton populneus</i>	Malvaceae	Tree	40'	30'	Medium	No	---	High	Some specimens have unusually wide trunk.
Lily of the Valley	<i>Crinodendron patagua</i>	Elaeocarpaceae	Tree	15'	10'	Medium	No	---	---	Glossy, dark green leaves and fragrant white bell-shaped flowers.
Loquat	<i>Eriobotrya japonica</i>	Rosaceae	Tree	20'	20'	Medium	No	---	High	White flowers and edible fruit.
Mulga	<i>Acacia aneura</i>	Fabaceae	Tree	15'	15'	High	No	High	---	Needle-like silver foliage and yellow blossoms in spring and fall.
Pineapple Guava	<i>Feijoa sellowiana</i>	Myrtaceae	Tree	10'	10'	Low	No	Low	---	Pink flowers and egg-shaped edible fruit.
Ponderosa Pine	<i>Pinus ponderosa</i>	Pinaceae	Tree	100'	30'	High	Yes	High	---	Needles, conical tree, appropriate for north side of a sound wall or barrier.
Southern Magnolia	<i>Magnolia grandiflora</i>	Magnoliaceae	Tree	65'	30'	High	No	High	Medium	Leathery leaves and fragrant white flowers.
Spanish Fir	<i>Abies pinsapo</i>	Pinaceae	Tree	60'	20'	Low	No	Low	---	Needles. Conical form.

Common Name	Scientific Name	Family	Type	Height	Crown Diameter	Foliage Density	CA Native	Allergen**	BVOC***	Notes
Strawberry Tree	<i>Arbutus unedo</i>	Ericaceae	Tree	25'	20'	Medium	No	---	Low	Flowers and fruit. Red bark.
Sweet Bay	<i>Laurus nobilis</i>	Lauraceae	Tree	30'	30'	Low	No	Low	High	Yellow flowers and berries.
Thuja/Arborvitae	<i>Thuja standishii</i> x <i>plicata</i> 'Green Giant'	Cupressaceae	Tree	50'	3-5'	High	No	High	--	Fast growing, used as a privacy screen.

Sample Conditions of Approval Language

If you are in a position to provide a recommendation to a local planning department that it require the installation of a roadside vegetation barrier, start with the suggested language below. Modify as necessary to meet the particulars of your project and/or agency to ensure a quality barrier will be created.

However, to ensure the language can be implemented, work with the applicant during the pre-application/planning phase to identify project priorities and limitations in line with near-roadway pollution reduction and climate resiliency potential. Site location and the characteristics of nearby communities will be determining factors for design and vegetation selection.

Planning Phase

A landscape plan shall be prepared including individual plant locations, species, approved alternate species for substitutions, plant material size and plant material source. Landscape plans shall be approved by _____ (Jurisdiction Arborist, Department of Transportation, Planning Department, Community Development Department, Public Works, etc.) prior to site preparation and installation activities. The landscape plan shall include a vegetative barrier consistent with the Sac Metro Air District's Landscaping Guidance for Improving Air Quality Near Roadways.

Funding and Reporting

If vegetative barrier is off-site of project, include a funding mechanism:

At the time of _____ (identify trigger, such as final map), a _____ (non-revocable funding mechanism, such as community facilities district) shall be established to provide perpetual funding for ongoing maintenance and monitoring of the vegetative barrier.

Copies of landscape plans, maintenance plans and all reporting shall be submitted to the _____ (Jurisdiction Arborist, Department of Transportation, Planning Department, Community Development Department, Public Works, etc.)

Installation

At the time of _____ (identify trigger, such as building permit), all trees and vegetation shall be inspected prior to planting by a certified arborist or similarly qualified woody plant expert. Plants showing poor rooting structure, disease, insect infestation, low vigor or other

indicators of poor quality shall not be planted. Pre-installation reports shall be submitted to _____ (Jurisdiction Arborist, Department of Transportation, Planning Department, Community Development Department, Public Works, etc.) within 15 days of the inspection.

Planting holes shall be dug a minimum of four times the size of the container to be planted and at least as deep as the container is tall.

Plant 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.

Six inches of organic mulch shall be applied within a four-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 _____ (Jurisdiction Arborist, Department of Transportation, Planning Department, Community Development Department, Public Works, etc.) within 15 days of the inspection.

Landscape Establishment Period

All plant support stakes shall be inspected annually and removed as soon as vegetation can support itself and is properly rooted.

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.

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.

Ongoing Landscape Inspection and Remediation

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 recommended corrective actions shall be noted:

- Treat or replace damaged/diseased/dying/dead plants.
- Correctively prune hazardous growth or damaged plants.
- Repair damaged irrigation systems.
- Manage weedy or invasive undergrowth through mowing, herbicide application, mulch application or groundcover planting and establishment, or other actions as warranted.
- Remediate and correct for inappropriate site conditions such as vandalism, refuse accumulation, improper site use (i.e. camping, dumping).
- All pruning, cutting or limb removal from vegetation barrier plants shall be implemented under direct supervision of a certified arborist or similarly qualified woody plant expert.
- All landscape inspection reports including suggested corrective actions shall be submitted to _____ (Jurisdiction Arborist, Department of Transportation, Planning Department, Community Development Department, Public Works, etc.) within 30 days of the inspection.