Policy Strategy A – Vegetative Buffers/Barriers

Vegetative Buffers are strips of dense trees and shrubs that are used to filter or block air pollution. They are commonly placed between a polluting source and vulnerable land-use areas where people spend a significant amount of time. These can be deployed on public lands between high-traffic transportation corridors as well as along the perimeter of industrial land-uses that abuts a vulnerable land use such residential, school, park, hospitals or other sensitive uses and can effectively mitigate human exposure to traffic-related or off-site drift of industrial related air pollution.[1]

Policy Recommendation:

Identify target vegetated buffer locations such as along parks, schools in relation to goods movement corridors such as Freeways or upwind industrial uses zones. Develop a plan to install, establish, and maintain proposed vegetated buffers in addition to protecting other adjacent trees that can reduce exposure to air pollution.

Implementation: Partner with local nonprofit groups and encourage/incentivize trees on private property. Include vegetative buffers for new construction as well as for changes/alterations/ expansions of structures or operations along industrial-residential or freeway interface sites. When next to freeways, overlap vegetation with sound walls or other green barriers for maximum benefit.

"Best Practice" Buffer Design Specifics:

- **Heights** - Suggested "grow-to" heights of 80-100 feet if possible. Heights should be at least 13 feet tall to effectively limit downwind concentrations of air pollution emissions. Plant at least to be 3 feet above any sound wall barrier. Trees when planted new should be typ. 24-gallon trees that are 6-8 feet in height to provide some initial absorption. In some cases, funders or other site conditions may require 15-gallong trees which also allow more adaptation by trees to the site. Surround the plants with a layer of mulch that is four- to six inches deep within a three-foot radius.
- **Density** - Sufficient to reduce turbulence, wind speed and intercept particulate matter pollution at least 16-32 feet thick or better, layer trees into a zone up to 60 ft. or more 2-3 layers of trees). Overlap planting so as not create gaps between trees that could cause air pollution to funnel through. Maintain horizontal and vertical continuity, i.e., a full, dense coverage from the ground to the top of the buffer. Horizontally extend beyond the area of

[1] Vegetative Buffers, as an environmental intervention, have been commonly used in agriculture domain (field borders or vegetative filter strips) as a practical and environmentally friendly solution to minimize soil erosion and nutrient runoff, reduce wind speed, and field movement and drift of chemicals and pesticides and protect habitat areas in certain cases.

concern (by at least 164 feet) to maximize air pollution reductions and/or wrap it around vulnerable land-use as an alternative.

- **Spacing:** Trees should be 10-30 feet apart (depending on species selected). If spacing at further distance trees should be layered and staggered to maximize horizontal coverage.
- **Selection:** Trees should be selected to be low VOC-emitting trees with no known asthma triggers. Trees that are best suited to trapping PM include: Pine (Pinus nigra var. maritima), Cypress (X Cupressocyparis leylandii), Hybrid popular (Populus deltoids X trichocarpa), and Redwood (Sequoia sempervirens).
- **Maintenance:** Develop an ongoing maintenance and stewardship program with community groups, school, and local nonprofits.

Background: Vegetative Buffers/Barriers

"Vegetative buffers are strips of dense trees and shrubs that are used to filter or block air pollution. They are commonly placed between a polluting source and vulnerable land-use areas where people spend a significant amount of time… If improperly designed, a vegetative buffer may increase air pollution concentration rather than decrease it." (Community Action to Promote Health Environments Resource manual, Buffers and Barriers, 2016).

- **Background:** Planting certain trees can be an effective strategy for reducing exposure to air pollution. Some trees and vegetation type may trap and filter coarse and fine particulates in their leaves. Trapped particles are eventually washed to the ground by rainfall.
- The effectiveness of fine PM removal depends on the tree species planted and design of layout, how densely they are planted. Other important considerations include proximity to tall buildings, the carbon sequestration potential as well as water quality impacts (storm water uptake/slowing), pest management, pollen, aesthetics, property values and more. Additionally, some trees emit volatile organic compounds (VOCs) which can lead to the formation of ozone.
- Typically, for a buffer seek large, evergreen trees with long-life spans. In addition, trees with branches and leaves that have a sticky surface are best at trapping fine PM. Trees with a fine, complex foliage structure that allows significant in-canopy airflow will also perform better at trapping particulate matter.
- Buffers can be applied along freeways (roadways) or as on or off-site mitigations along industrial-residential interface areas.
- Buffers should be identified as part of urban forestry plans and reflected in regional plans (such as MTC's SCS) and coincide with local resilience, adaptation, climate, and flooding plans.

Many studies indicate that vegetation has the potential to alter pollutant transport and dispersion and can, in some cases, translate to air pollution concentration reductions of up to 20 percent (CARB 2017). The magnitude of the reduction and its spatial extent depend on the height of the barrier, the width of the road, and micrometeorology. Maximum benefits have been shown to occur when mature vegetation is combined with solid barriers that can increase vertical dispersion of pollutants emitted by vehicles.[2] The researchers also found that trees planted outside a home can provide substantial reductions in PM inside the home.

[2] Studies have consistently found that pollution concentrations downwind of a barrier range from a 10 percent to 50 percent reduction compared to concentrations measured on or directly adjacent to high-volume roadways (CARB 2017).

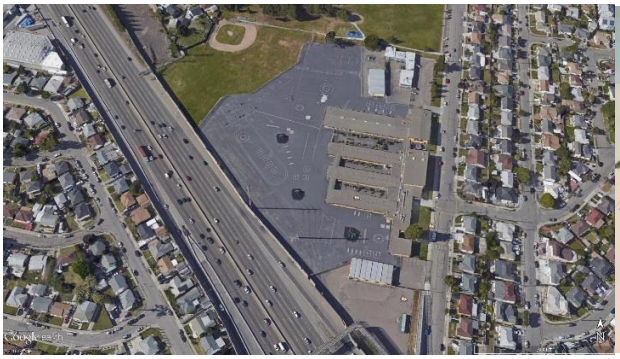
Implementation Design and Maintenance are Key

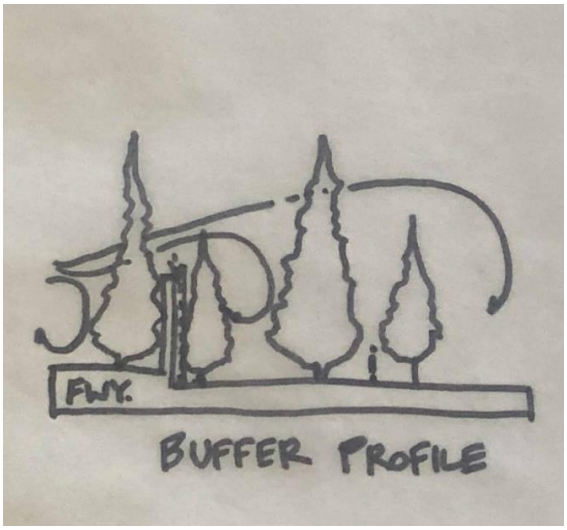
To implement effective vegetative buffers care must be taken in terms of design, spacing, density and species. The overarching best management practice, as recommended for urban forestry in general, is to plant a diversity of species where no more than 30 percent of trees should be species within the same family; no more than 20 percent should be from the same genus; and no more than 10 percent should be the same species. Diversity not only reduces concentrations of allergens, but also protects against pests, invasive species, climate change, and severe weather.

In planting vegetative buffers within urbanized areas with tall buildings considerations should be taken for any effects of urban street canyons downwind from pollution sources or adjacent to freeways that might interfere with intended air quality benefits. Urban street canyons are cases where the building heights (of continuous and tall buildings on both sides of the street in respects to street width) is greater than a 2:1 ratio, e.g., 10-story buildings (100-foot-tall) for a 50-foot-wide road. This canyon effect can negatively impact wind patterns and air quality by trapping emissions brought in by the wind in a vortex and combine with emissions from the street. This incursion will be especially worse for the leeward side of the street. In such cases, the priority should be for installing street shrubs and trees included within the streets (in addition to any specific upwind buffer).

Finally, considerations must also be taken in terms of maintenance which is often overlooked. Policies approaches can include local governments setting up "green job" training programs and workforce development programs for landscape maintenance, and stewardship programs. Such a complementary vegetative buffer policy was included in the 2019 West Oakland Community Action Plan strategies (#12 – *Vegetative Filters Between Sources of PM and Sensitive Uses* and #11 - *Train to Maintain*).

CASE STUDY – Brookfield School/I-880 Freeway, Oakland





Graphic depictions of the Brookfield Vegetative Buffer project as designed and drawn by Air District Staff. School site adjacent to the I-880 freeway is shown referenced from a Google Earth map (top left). Photo of the Air District sponsored volunteer planting day (photo credit D. Ralston, Air District).

About the Project

The Air District joined forces with a USEPA sponsored project (initiated 2016) designed to research whether carefully designed roadside vegetation can significantly reduce air pollution within 5-7 years of planting. (The data measurements from this research will be posted soon.)

The project called for installing a vegetated buffer to block freeway emissions at a public elementary school site along the I-880 freeway in Deep East Oakland. The project design established a multi-layered zone of trees and shrubs to intercept and filter airborne particulates and auto exhaust emissions from the adjacent upwind freeway.

For this case, the buffer was designed to have an active zone depth of a 60-80 ft. from the sound wall to the edge of the asphalt play area and included the installation of a layer of bamboo and shrubs followed by three rows of trees. The length of the buffer extends along the sound wall for approximately 400 feet. Initially, approximately 75 coniferous trees (18 feet in height at planting to grow to 30+ feet) were installed 12 feet away from the wall for the first layer. A secondary line of trees 30-40 feet from the first line was planted (limited in height due to overhead PG&E wire zone to reach a maximum height of 25 feet). The planting of dense bushy vegetation and fast-growing bamboo along the sound wall is intended to trap circulating particles in the cavity areas behind the trees. A second phase of the project calls for installing a line of trees and shrubs along the Caltrans freeway side of the wall and continue planting more trees in the prime buffer area in conjunction with the school and community partners.

The project also had ancillary co-benefit goal of creating new habitats for birds in this part of school yard, creating a hands-on science living green lab area within the tree buffer zone, as well as helping alleviate rising ground-water flooding along the wall.

Sources

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