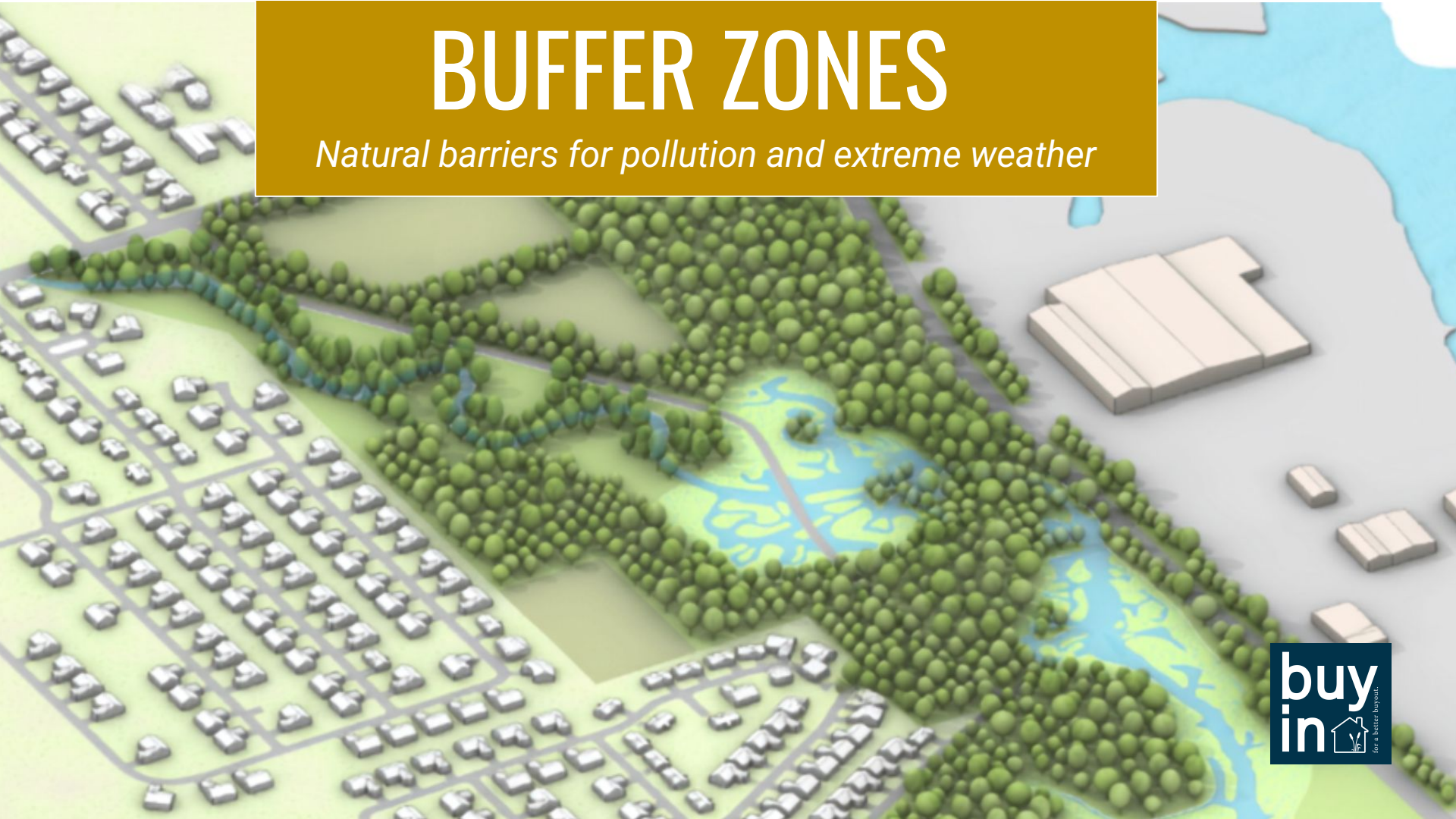
BUFFER ZONES

Natural barriers for pollution and extreme weather



ABOUT BUY-IN COMMUNITY PLANNING

The mission of Buy-In Community Planning is to support the well-being of people whose homes and communities are threatened by environmental hazards by assisting them in planning for and relocating to safer areas. Using the power of geospatial data and participatory planning, we help communities design voluntary relocation assistance programs that are transparent, equitable, and environmentally restorative to ensure that no household is left in harm's way.

PEOPLE



Who wants to move?

And under what conditions?

HOUSING



Where will they go?

And is there safe, secure, and affordable housing available?

LAND

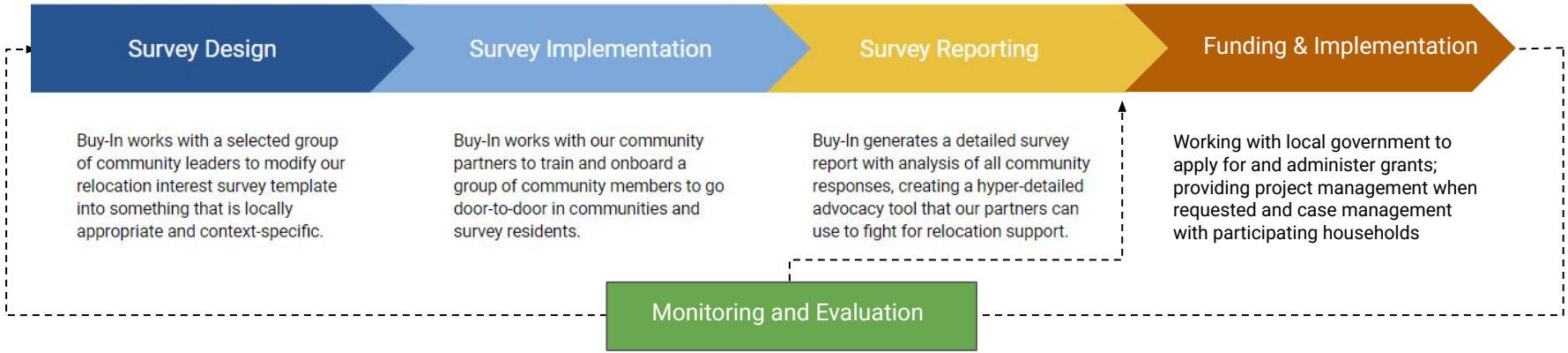


What happens to the land that gets left behind?

And who will care for it?

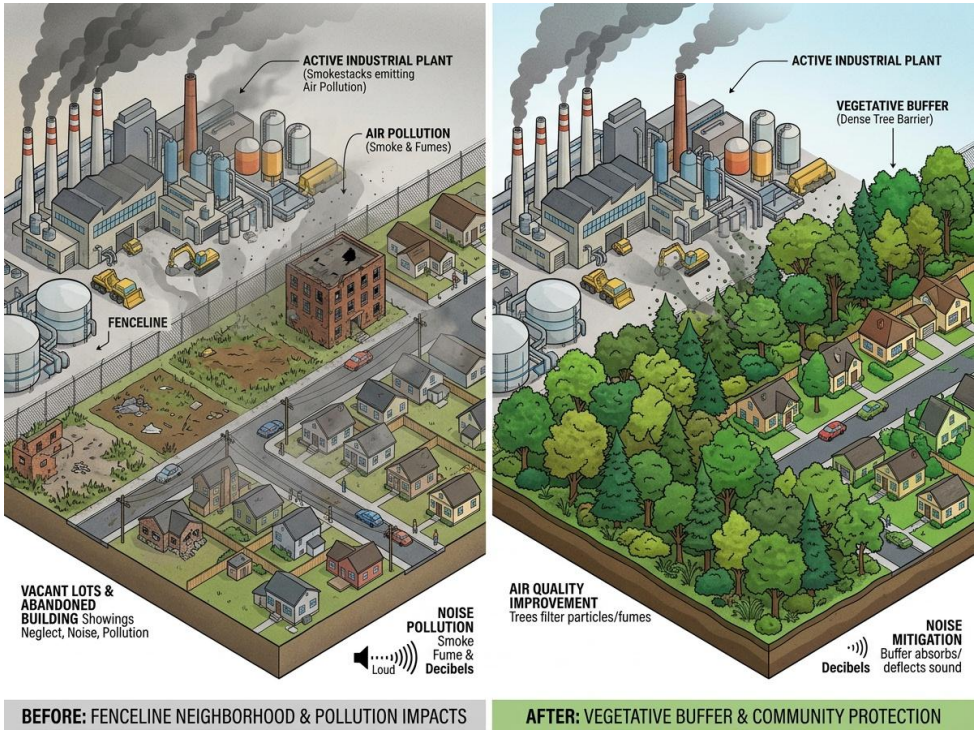
COMMUNITY PARTNERSHIP PROGRAM + TECHNICAL ASSISTANCE

Buy-In works with a network of Community-Based Organizations (CBOs) in towns and cities across the country through our Community Partnerships Program (CPP). The CPP program puts relocation planning in the hands of local neighborhood groups and individual residents.



The Community Partnerships Program represents a replicable and scalable process that does not pre-determine outcomes. The project is built from an aggregation of individual needs into a neighborhood-scale strategy.

BUFFER ZONES: INDUSTRIAL ENCROACHMENT



- Industrial expansion has created deteriorating quality of life for many neighborhoods. In some cases, properties may be vacated or abandoned.
- Replanting these parcels with thick vegetative buffers can provide some relief from air and noise pollution.
- These enhancements can improve quality of life and property values.

BUFFER ZONES: COMPOUND HAZARDS

Compound hazards describes the intersection of two or more hazards, flood + industrial pollution. Rising temperatures and extreme weather intensifies the risks/impacts of compound hazards.

- More extreme weather means more toxins released during storms, overland contamination, and pollution mixing with stormwater.
- Extreme heat can trap polluted air in place, worsening air quality.

October 3, 2024 | 5 min read Add Us On Google

In Floods like Hurricane Helene's, Toxic Chemicals Are a Silent and Growing Threat

People living near industrial facilities often have few details about the chemicals inside, which poses major risks when floods occur

BY JAMES R. ELLIOTT, DOMINIC BOYER, PHYLICIA LEE BROWN & THE CONVERSATION US

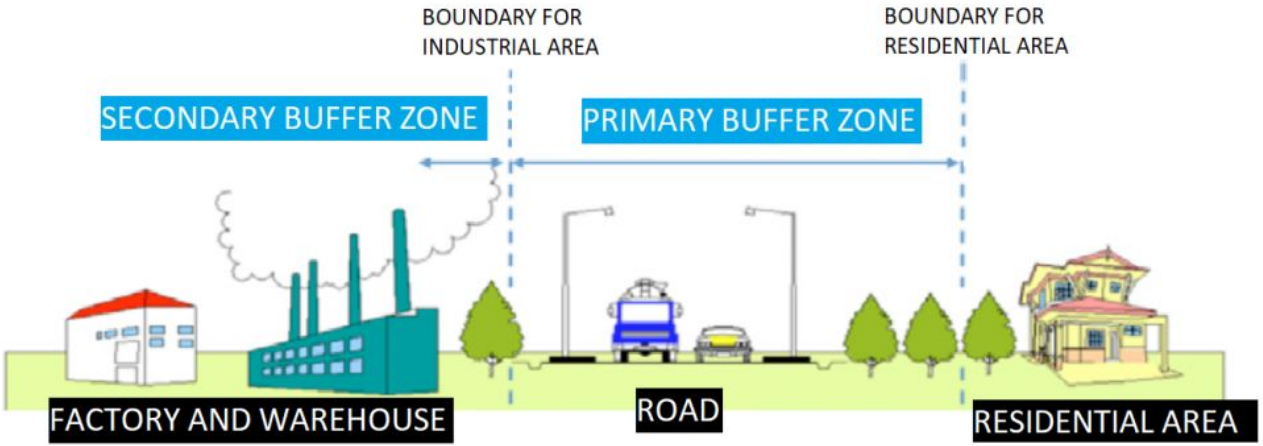
More Than 40 Sites Released Hazardous Pollutants Because of Hurricane Harvey

By TROY GRIGGS, ANDREW W. LEHREN, NADJA POPOVICH, ANJALI SINGHVI and HIROKO TABUCHI SEPT. 8, 2017



WHAT IS A “BUFFER ZONE”?

A buffer zone refers to an area of land that serves as a **transitional space** between two distinct land uses or property types. The primary purpose of a buffer zone is to **mitigate potential conflicts or negative impacts** that may arise from the proximity of different uses. Buffer zones can help mitigate the impacts of **toxic pollution** and are most effective when **immediately adjacent** to pollution sources. Exploring the role nature-based solutions can play in remediation is a **new and emerging field of study.**



CHEROKEE FOREST RELOCATION TO RESTORATION

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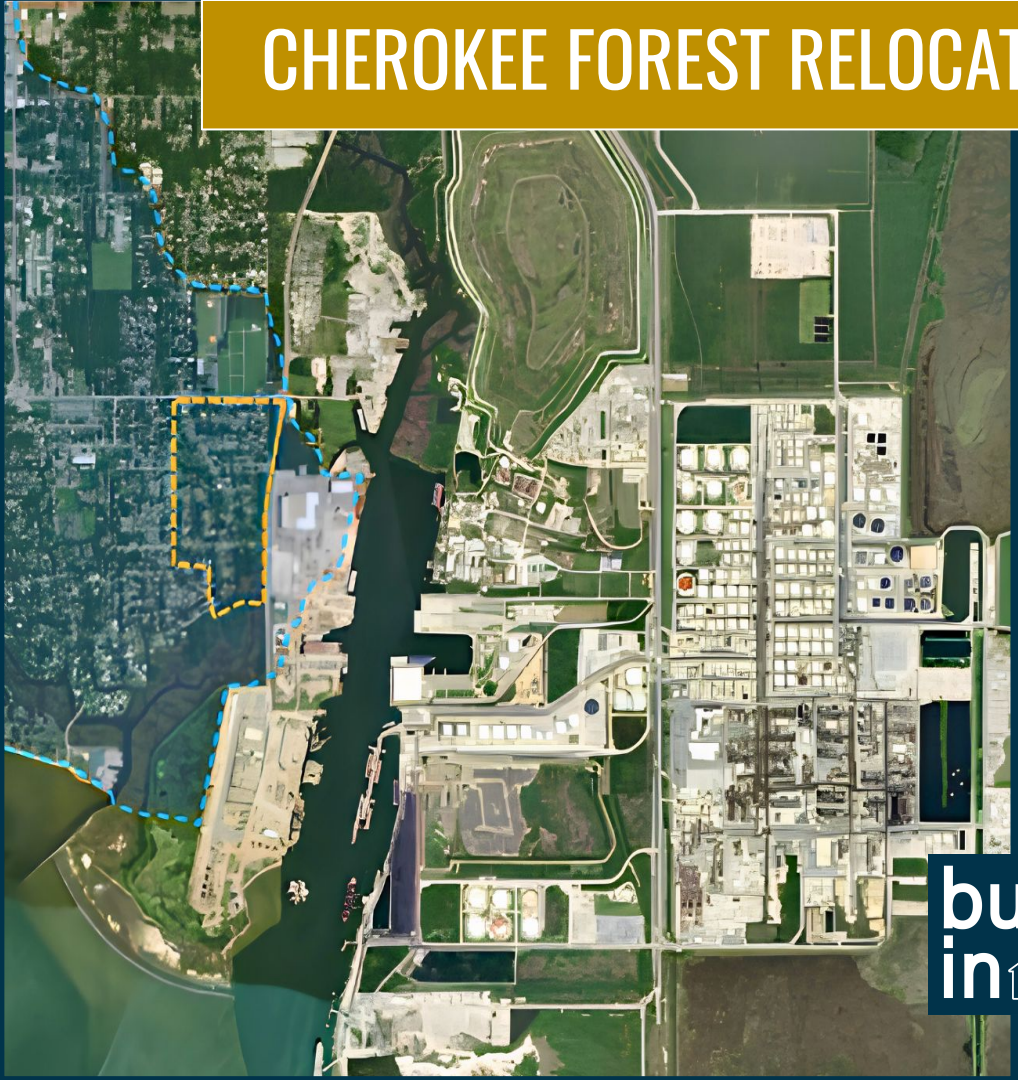
CHEROKEE FOREST RELOCATION TO RESTORATION



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By integrating voluntary relocation with end-use restoration, this project reframes conventional buyout programs and environmental justice campaigns that are often constrained by narratives of risk, liability, and loss, alternatively as investments in ecological, economic, and social resilience. This holistic approach helps overcome common barriers to buyouts, fosters government and community buy-in, and creates shared value for both those who relocate and those who remain.

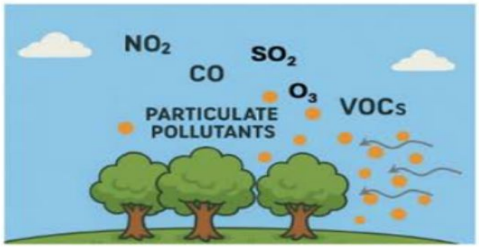
CHEROKEE FOREST BUFFER

While the Bayou Casotte Industrial Complex has natural buffers to air pollution to its east through the Grand Bay National Estuarine Research Reserve (NERR), to the north from undeveloped forested land, and to the south with the Gulf waters, there is no longer an equivalent natural buffer to the west protecting residential areas from industrial activity. A forested buffer along the entire eastern side of the neighborhood can protect neighborhoods farther to the west, such as Delmas, by slowing, dispersing, and capturing pollutants as they spread. Additionally, given the neighborhood's proximity to coastal marshland, a buffer zone returns floodplains to natural buffering capacity and more space for wetland migration, providing more flood protection and water quality improvements.

Dispersing Air Pollution



Capturing Air Pollution



Reducing Noise



Visual Barrier to Industry



CREATING BUFFER ZONES: LEGAL FRAMEWORK

While buffer zones (physical strip of land being protected) are increasingly being utilized, within the context of laws and regulations, they are more often seen as a best practice rather than a requirement. Additionally, the approaches and legal requirements (where they exist) differ across levels of government given their respective authority.

- At the **federal & state level**, **buffer zones (and setbacks) are used to create a functional safety shield** to filter air, catch chemical drift, or absorb a storm surge, taking into account a dynamic ecosystem.
- Alternatively, **localities are often exclusively use setbacks** as a means of creating distance between different land uses, **narrowly focusing on property lines** and the physical land/water boundaries **and not the air and broader ecosys**

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LEGAL FRAMEWORK: FEDERAL

EPA legally requires mandatory buffers to limit water and soil pollution, but only for specific high-impact industrial, construction, and chemical activities. **It does not require geographic buffer zones to keep heavy industry (and air pollution) away from homes.**

- Instead of regulating where a facility can be built, **the EPA regulates the impacts of pollution that cross the property line.** Under the Clean Air Act, they enforce National Ambient Air Quality Standards (NAAQS), which set limits for criteria pollutants.
- **The regulation of pollutants varies depending on the source.** The EPA explicitly classifies open-air, uncontained dust as fugitive emissions, pollutants that escape from a site layout that cannot cross property boundaries in quantities that cause a public health hazard. On the other hand, pollutants that leave a smoke stack can cross property boundaries, but regulations are set based on ambient air quality metrics.

FEDERAL: FENCELINE MONITORING GAP

So, if the federal law outlaws this drift, why is a neighborhood like the one in Pascagoula actively getting sandblasting dust? This brings us to the core systemic failure of environmental enforcement: the fenceline monitoring gap.

- The EPA delegates its Clean Air Act enforcement authority to state agencies, in this case, MDEQ. **State agencies do not measure ambient air quality at the literal fenceline of neighborhoods.** In Pascagoula, the official state air monitor is positioned miles away from the heavy industrial shipyards, measuring ambient air quality.
- The state monitors also do not run twenty-four hours a day, three hundred and sixty-five days a year. **They operate on a periodic, cyclical sampling schedule**, often pulling only during specific seasons of the year and averaging data over these periods –**meaning significant spikes in pollution levels are often missed.**

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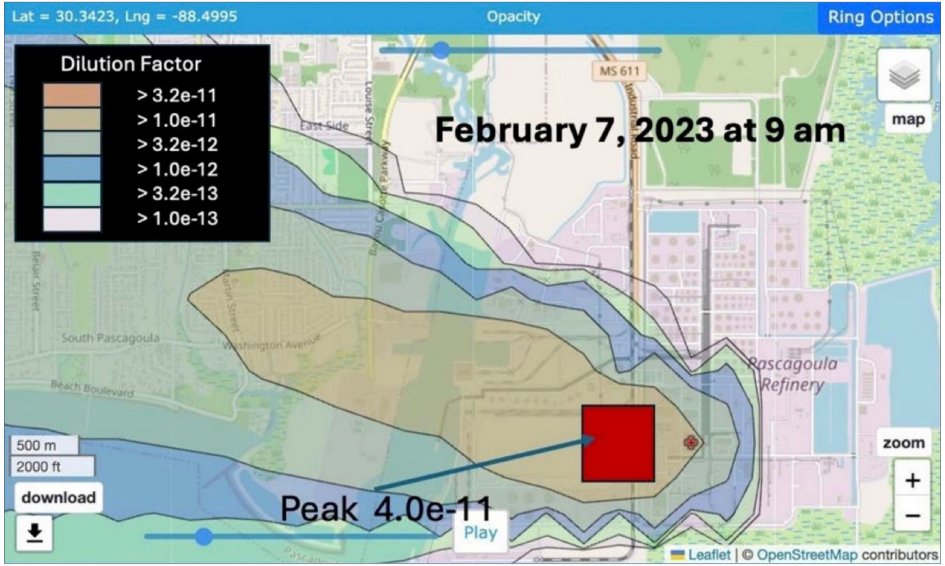
CHEROKEE FOREST: AIR MONITORING



NOAA HYSPLIT simulation of a hypothetical polluted plume from an oil refinery flaring incident on February 7, 2023 when Cherokee Forest residents reported strong odors. The emissions rate is based on sulfur dioxide flare emissions previously reported by Chevron.

Cherokee Forest is uniquely impacted when winds are from the southeast, east, and northeast, often experiencing levels of pollution over 10X greater than the background levels recorded by MDEQ.

The image shows concentration levels decrease by 75% as the plume reaches Cherokee Forest. However, concentration levels at the southern end of the neighborhood are 3x higher than surrounding areas, demonstrating the disproportionate risks.

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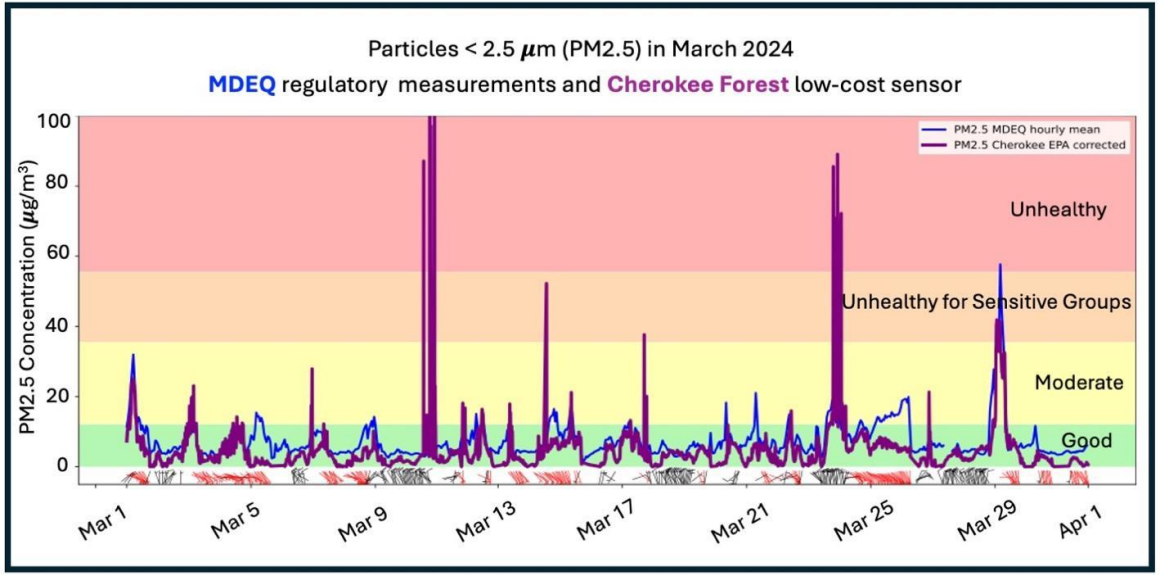
CHEROKEE FOREST: AIR MONITORING

The Cherokee Concerned Citizens (CCC) has collected their own measurements over the past decade, using a variety of cost-effective sensors and collection techniques.

While their sensors often detect similar patterns in air pollution as MDEQ's measurements, the Cherokee Forest sensors show when there are local spikes in air quality.



Data analyzed by K. A. Duderstadt, the University of New Hampshire and C. Frischmon, the University of Colorado Boulder

LEGAL FRAMEWORK: STATES

Most states only require setbacks for industries that pose an extreme risk and are based on standards that do not take into account local context and specifically designed to mitigate water and soil pollution and not air.

	General residence setback	School setback	Property line setback	Highway/road setback
MS	**500 ft (waste facilities)**	**500 ft (waste facilities)**	**200 ft (waste facilities)**	**1,000 ft (unless screened)**
LA	None statewide	None statewide	None statewide	None statewide
AL	None statewide	None statewide	None statewide	None statewide
FL	200 ft (waste); 500 ft (oil/gas)	1,000 ft (oil/gas); 500 ft (waste)	200-500 ft	
TX	500 ft (landfills)	1,320 ft (concrete batch plants)	250 ft (landfills)	Varies
AK	300 ft (waste facilities)	500 ft (waste facilities)	100 ft (waste facilities)	1,000 ft (unless screened)
OK	300 ft (oil/gas operations)	600 ft (oil/gas operations)	Included in 300 ft bldg. setback	Not specified

LEGAL FRAMEWORK: MUNICIPALITIES

Because states do not mandate standard manufacturing buffers, most of the burden of protecting residential neighborhoods shifts to local councils and county planning commissions. **Traditional local zoning ordinances treat buffers as static space (fixed, vertical) rather than functional safety shields.** This approach is fundamentally flawed for three major reasons:

- Pollution is dynamic and moves across invisible property lines.
- Traditional setbacks only measure horizontal distance on the ground. They fail to account for how high a pollution plume rises or how wind currents carry toxic dust over flat public roads.
- Traditional setbacks ignore the functional work the land is already doing. A living wetland acts as a biological filter and an extreme-weather sponge.

MUNICIPALITIES: DIMENSIONAL VS. PERFORMANCE CRITERIA

Historically, local governments have relied entirely on dimensional criteria (rules based on static map of horizontal boundaries) to mitigate impacts of industrial activity. To protect human health and ensure climate resiliency, we need a transition to performance criteria (rules based on how pollution and environment actually behave).

Planning Metric	Dimensional Criteria	Performance Criteria
Measures Success	By checking a box if a building is 35, 60, or 100 feet from a residential property line.	By mathematically proving a 75% to 90% reduction in fugitive dust (PM2.5) at the border.
Air Quality Protection	Assumes a flat public road or a strip of grass stops microscopic toxic particulates.	Mandates specific biological shielding depth or source-containment enclosures.
Climate Resiliency	A 35-foot natural wetland and 35 feet of paved industrial parking are legally identical protections.	Assigns value to ecosystem services. Mandates a zero-net-runoff standard and protects natural wetlands as storm-surge sponges.
Enforcement	A single code inspection at the time the building permit is issued	Requires continuous monitoring

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TRANSITIONS TO PERFORMANCE CRITERIA

Jurisdiction	Industrial Setback	Mandatory Screening	Public Rd Separation	Environmental Buffer
Pascagoula, Jackson County, MS	30 to 100+ ft (City UDO). 60 ft side-street setback for County industrial sites facing residential zones.	Minimum 8-ft solid wall or opaque fence required by County.	35-ft natural buffer required on secondary streets.	No official credit natural wetlands toward structural building setbacks.
Savannah & Chatham County, GA	50 to 200+ ft depending on heavy industrial (I-H) classification.	Opaque Buffer Yard mandated. Requires a minimum 6-ft masonry wall or tight evergreen hedge 6ft within 3 years.	A public street does not eliminate the buffering requirement.	Georgia Marshlands Protection Act mandates an automatic 50-ft structural buffer from coastal marshlands, layered on top of local zoning setbacks, providing heavy natural weather barriers.
Houston & Harris County, TX	No traditional zoning setbacks. Regulated instead via private Deed Restrictions	Municipal codes mandate specific 8-ft buffers only for "Open Storage" and heavy machinery visible from major thoroughfares.	Industrial sites must adhere to strict City Traffic Impact Analyses (TIA).	Harris County Flood Control District heavily enforces massive regional bayou/wetland detention basins, acting as default multi-acre natural buffers to catch industrial petrochemical runoff and mitigate severe hurricane storm surges.


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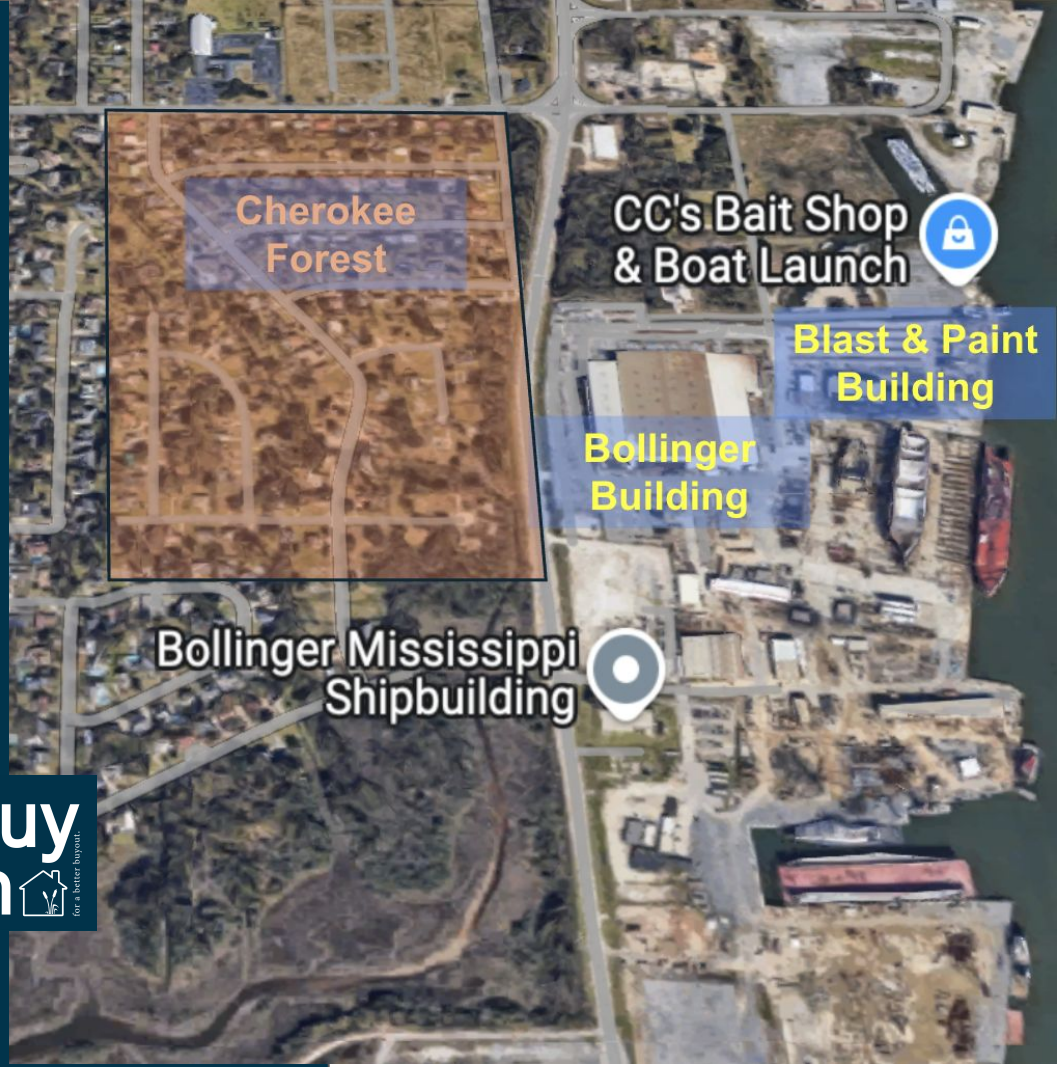
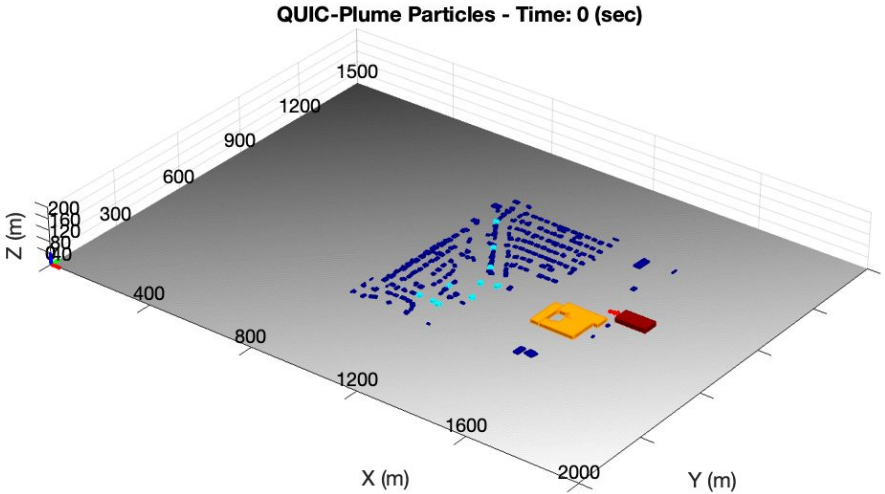
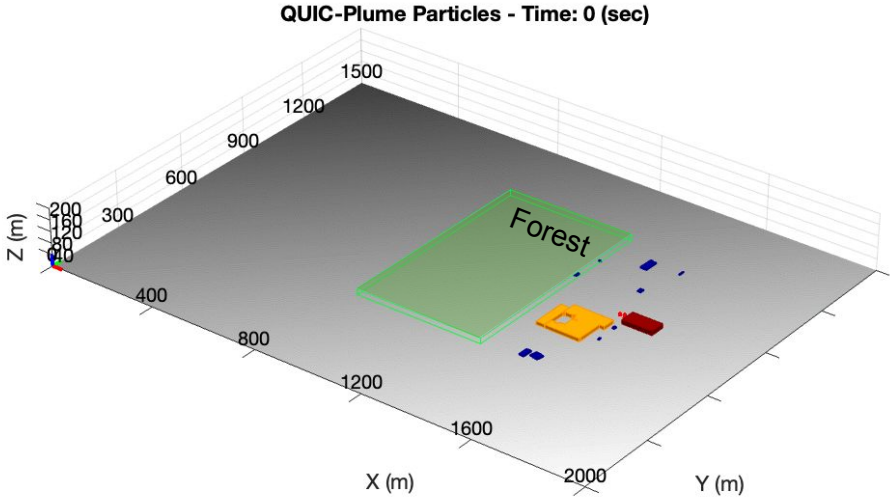
CFR2R BUFFER MODELING

The USDA recommends a forested buffer of at least 600 ft to reduce particulate matter (PM) levels by 75%. The air pollution modeling conducted during Phase I shows similar results for large PM. The LANL QUIC-URB model was used to run simulations on how well a 600 ft forested buffer (just under half of the width of the neighborhood) and one that extended across the entire neighborhood reduces PM pollution from the nearby shipyard. The study also evaluated levels of reduction for different size particles, 15 and 5 microns.



What if the neighborhood receives a buyout and houses are replaced with a forested buffer?

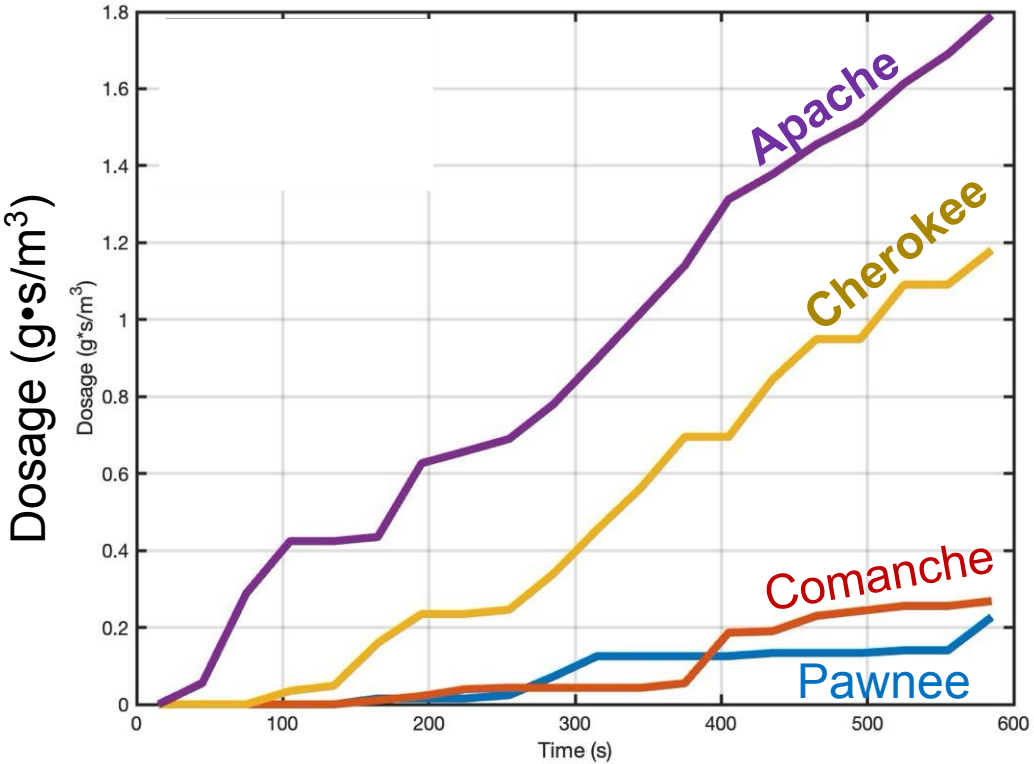


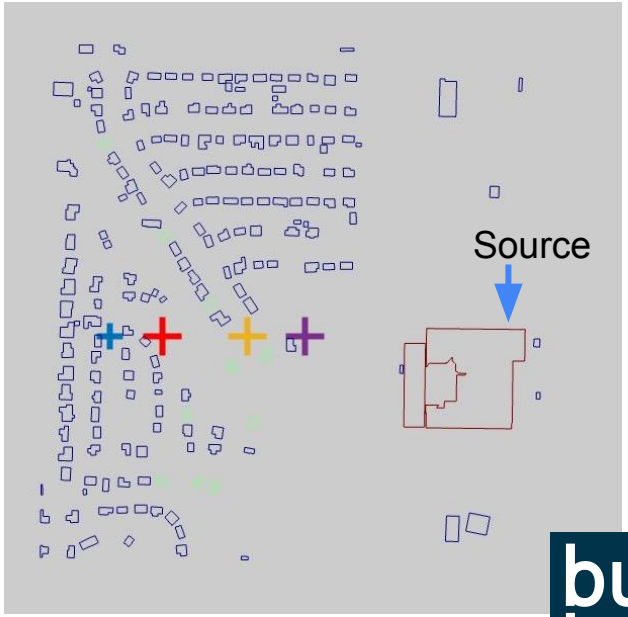


Red particles are airborne

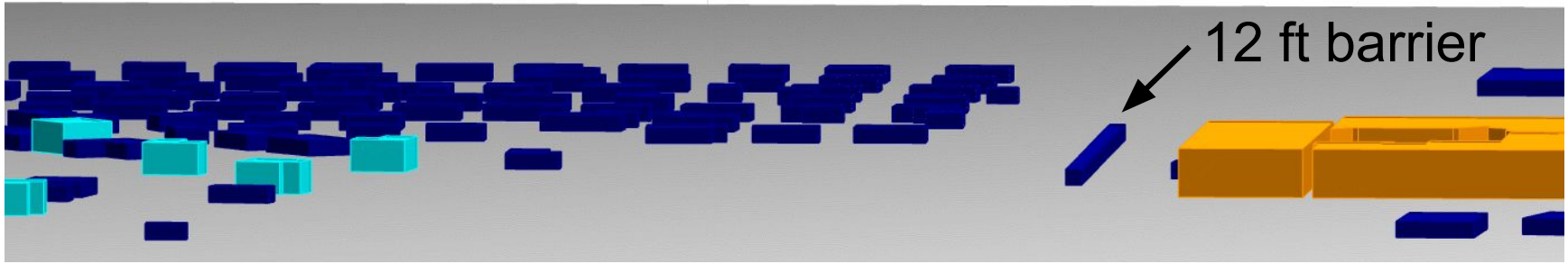
Yellow particles have been deposited to surface

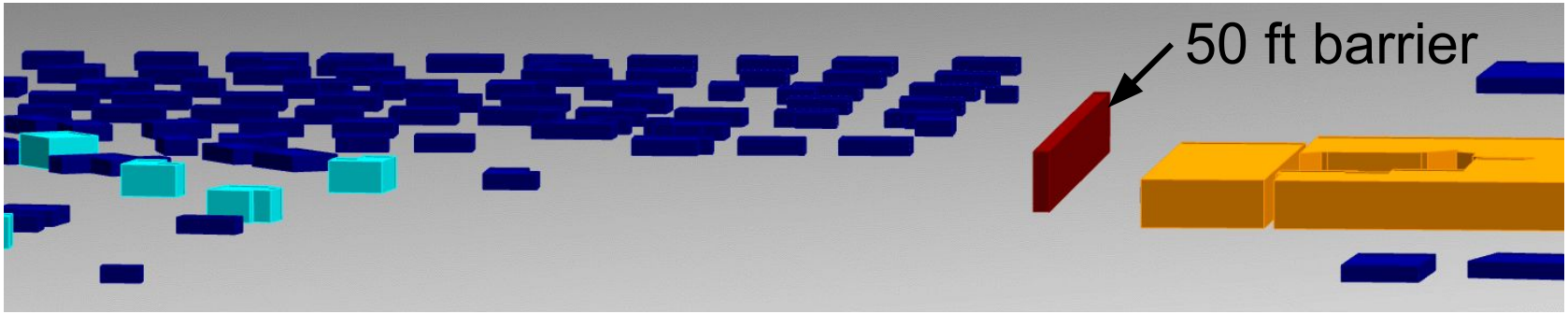
Pollution closer to the shipyard is much greater than farther in the neighborhood. *(For example, **Cherokee receives 6 times more pollution than Pawnee**)*

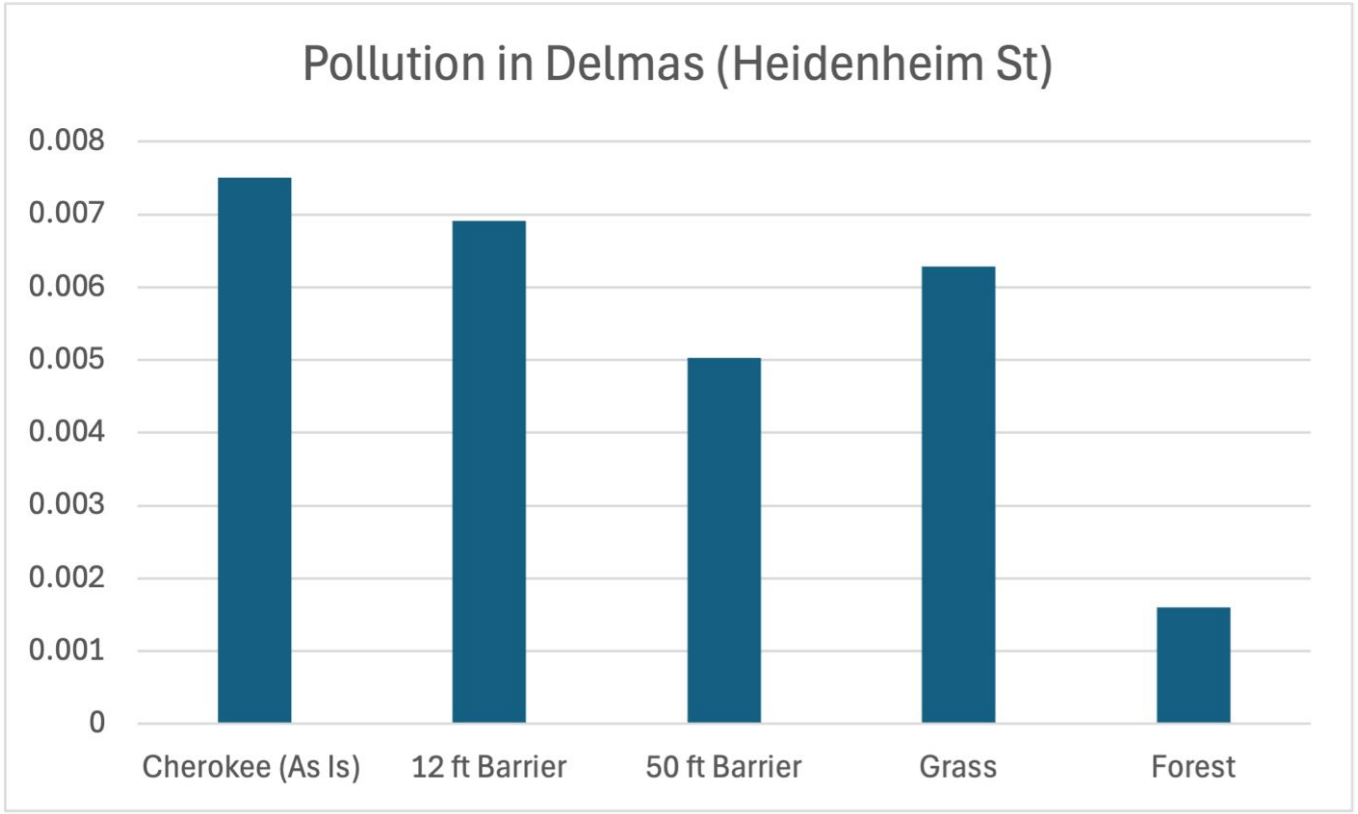




Masonry walls help a bit…but do not significantly stop the pollution from reaching the Cherokee neighborhood

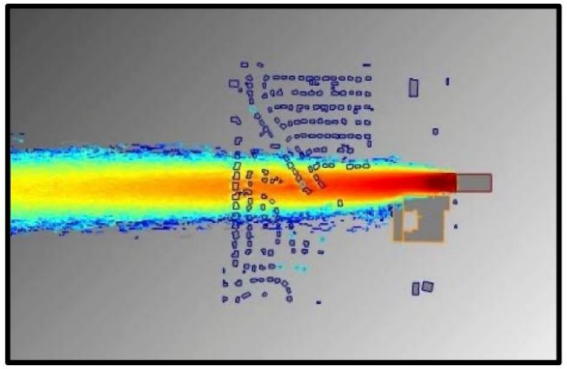




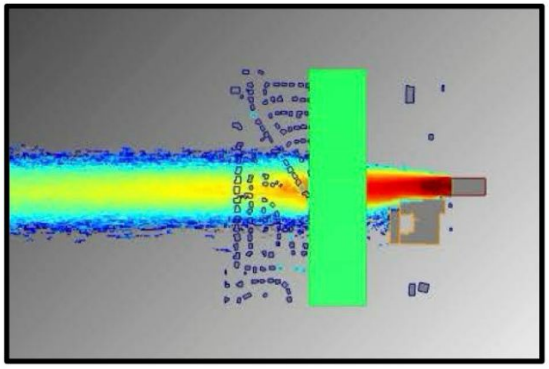


Replacing houses with **FOREST** results in **FIVE TIMES LESS** pollution downwind of the Cherokee neighborhood

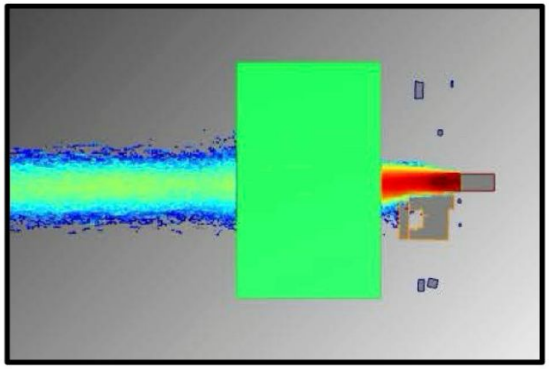
Cherokee Forest homes (no trees)



600 ft Forested Buffer



Forest (Entire Neighborhood)



Reduction of particles in the Delmas neighborhood (Heidenheim St) compared to the Cherokee Forest homes modeled without trees.		
	15-micron particles	5-micron particles
600ft buffer of young trees (10 m)	39%	2%
600ft buffer of tall trees (20 m)	71%	10%
Young complete forest (10 m)	55%	1%
Tall complete forest (20 m)	93%	47%

FORESTED BUFFERS & INDUSTRIAL POLLUTION

Decades of scientific research support the role of forested greenbelts on the uptake of air pollution from industrial sources.

- **Mechanical Deposition of Particles:** trees trap pollutants, particularly PM, on their leaves, branches, and stems. When it rains, the pollutants wash off and fall to the soil. Evergreen trees with leaves that are large with fuzzy/hairy surfaces are ideal for trapping more pollutants.
- **Chemical Uptake of Gases:** tree leaves can also trap or absorb gases. Trees with large, waxy leaves trap volatile organic compounds (VOCs) and other hazardous pollutants (HAPs) that then reacts with the bacteria on the leaf to transform these pollutants into less toxic chemicals. Gas pollutants such as nitrogen dioxide (NO2), sulfur dioxide (SO2), and ozone (O3) are absorbed by leaves through stomatal uptake, similar to the absorption of carbon dioxide during plant respiration. The rate of uptake depends on environmental conditions, such as sunlight, soil moisture, and relative humidity.
- **Forest Canopy Wind Speed:** Because wind speed decreases dramatically within and above a forest canopy and thus, becomes more turbulent, the forest canopy disrupt plumes, mixing pollution with the cleaner air above, and disperses pollutants.

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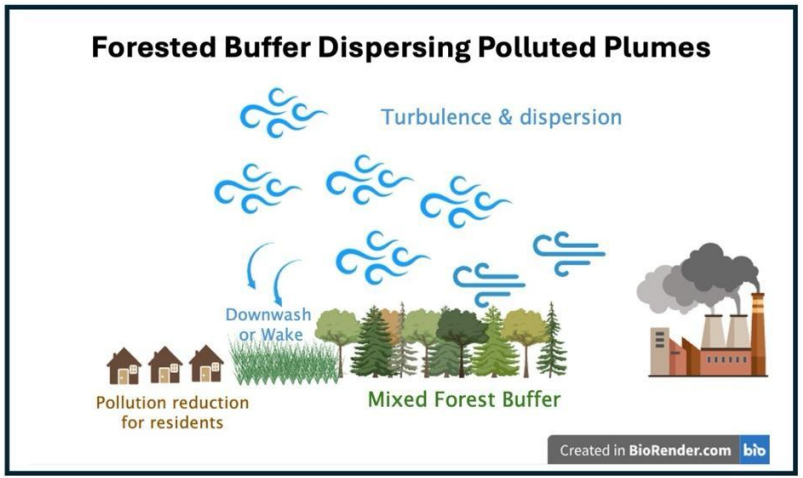
BUFFER DESIGN: CANOPY HEIGHT

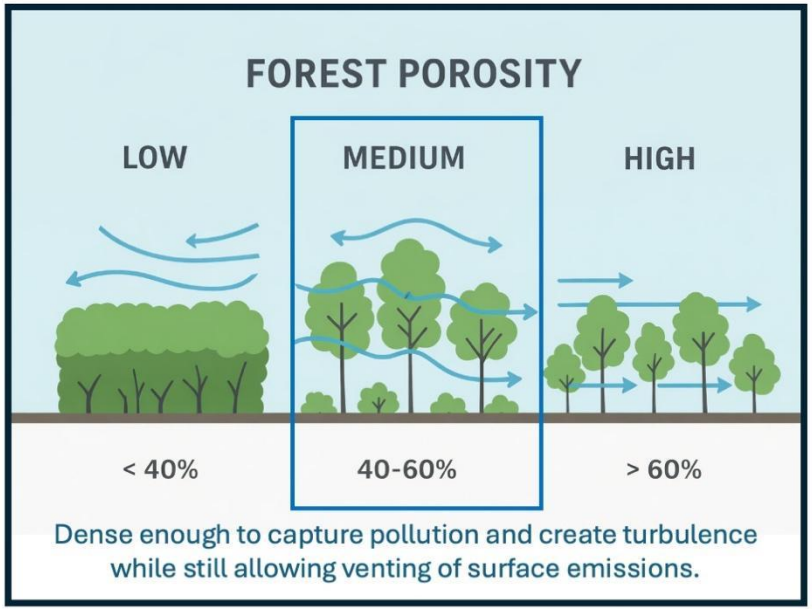
All forest canopies generate a mixing and dispersion of industrial air pollutants, even if emissions remain unchanged, lowering the exposure for residents downwind, but forest height, width, and density do impact the amount of pollutants that are trapped and/or dispersed.

- **A mix of tree species with variable canopy height and a setback downwind of the forest between the trees and residences** helps account for wake and downwash effects at the forest edge that can bring pollutants aloft down to the surface, preventing unintended increases in pollution. Another solution would be to have a variety of landscapes, such as forest, riparian, and wetland zones.



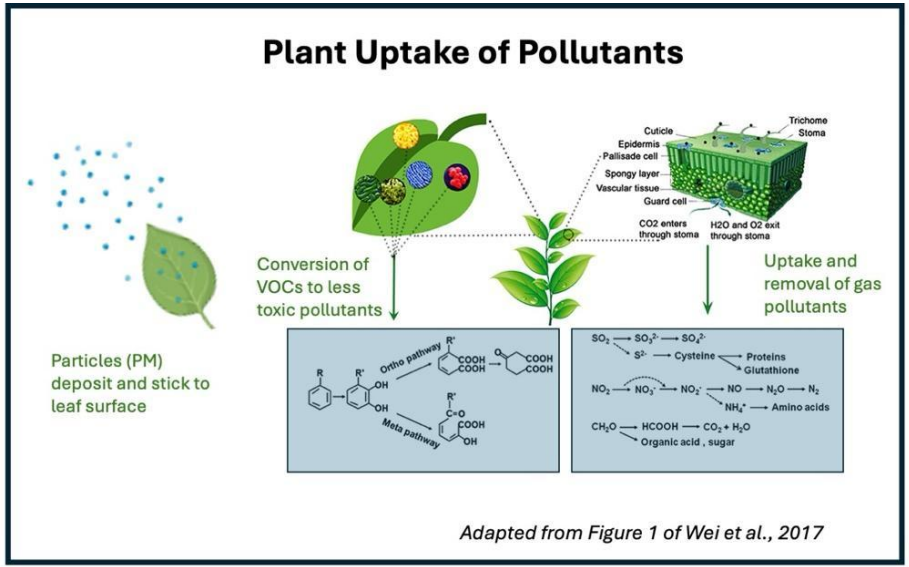
BUFFER DESIGN: FOREST WIDTH & DENSITY

- Forest **widths greater than 600 ft** are required to show significant reduction in pollution downwind.
- Forests with **40-60% forest density** are required to capture pollutants and create turbulence while allowing venting of surface emissions. Forest with canopies that are too dense can trap pollutants emitted within the forest near the surface. Forests that are too sparse or have unhealthy vegetation with large gaps also provide minimal pollution reduction.



BUFFER DESIGN: TREE TYPES

Some species of trees can also emit VOCs, often also called “biogenic hydrocarbons.” While not as toxic as industrial pollutants, this can occasionally enhance peak afternoon ozone and nighttime particle formation. Instead of planting monocultures of high biogenic VOC-emitting species such as oaks and poplar, **prioritize mixed evergreen forest that include a variety of shrubs and undergrowth with many low emitters native to the area and appropriate for the soils and wetland.**



CFR2R PHASE I & II

The Phase I Report provides the strategic rationale for the project and is part of the project narrative we will use to increase buy-in from residents, key decision-makers, and funders to help move us closer to implementation.

The goal of Phase II Planning & Design is to secure an implementation partner for Phase I Restoration. During Phase II Planning & Design, we will complete:

- Detailed site assessments
- 30-60% restoration design plan
- Funding strategy
- Rehousing plan

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Jennifer Fasolino, CPP Manager, jennifer@buy-in.org
Kelly Leilani Main, Founder & Executive Director, kelly@buy-in.org

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