



Thinking Outside the Box

LEADING THE WAY ON WILDFIRE PROTECTION

The East Bay Regional Park District Introduces
a Groundbreaking, Environmentally Friendly
Tool for Fuels Management

East Bay 
Regional Park District

In the fall of 2020 while conducting ongoing vegetation management work, the East Bay Regional Park District Fire Department noticed significantly more dead and dying trees than they had seen in past years. More than they had ever seen. In some areas, half of the trees were either dead or showing signs that they would die within a year.



Further investigation identified over 1,500 acres of tree mortality within its regional parks. While there are many contributing factors, the overarching cause is now believed to be drought stress due to climate change.

As this realization took hold and significant numbers of distressed trees were observed in many regions of the parks, it became clear to East Bay Regional Park District General Manager Sabrina B. Landreth and the District's Fire Department that the public agency, which was already years into a program for removing dead trees and other vegetation from the

parks, suddenly had an exponentially larger accumulation of potential fire fuel to remove.

The Park District is the largest regional park district in the nation with its 73 parks, 1,330

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– Sabrina B. Landreth
Park District General Manager



miles of trails, and over 125,000 acres. It directly serves an estimated 30 million visitors a year through park and trail access, visitors centers, and programs. The park system spans Alameda and Contra Costa Counties in the San Francisco Bay Area with 45 miles of wildland-urban interface in a state that has experienced eight of its ten biggest wildfires just since 2017. With the tragedy and devastation of the 1991 East Bay hills fire always in memory, Landreth, who had been Oakland's city manager and joined the District in early 2021, saw that with the tree die-off, what had already been of great concern had become a crisis waiting to happen.

Landreth also realized that the Park District, as a local wildfire prevention leader since the devastating East Bay Hills Fire and a founding member of the Hills Emergency Forum fire-safety consortium, needed to lead the way in miti-

gating the dangers caused by the tree die-off, which was also affecting other local agencies.

“There was no time to sit back. We had to take action to mitigate the wildfire risk. My direction,” says Landreth, “was, ‘This is an emergency, and as a public agency, we’ve got muscle memory and are trained to deal with it. We’ve been on the front lines. We have our own fire department, our own fuels management crew. We’re the ones who have been doing this on the ground. No one else has anything close to this.’”

Landreth says she and staff from the District's fire, public safety, government affairs, stewardship, public affairs and operations departments activated a type of operations center, holding frequent briefings in order to put together a game plan, “like you would have when there's an earthquake,” she says.

Innovative Answers to a Complex Problem– From Funding to Science-based Solutions

Prolonged drought — which can weaken trees and make them more susceptible to other naturally occurring forces such as fungus, beetles, and woodpeckers — was the prime suspect in the tree die-off. Wanting to know more, the District's in-house scientists in their stewardship department collaborated with academics at the University of California, Berkeley, and gathered information from other local agencies, which it turned out were also experiencing the tree die-off.

But whatever the confluence of factors killing trees, Landreth wanted to avoid wildfires. “I said we’re not going to wait for the science to tell us why,” says Landreth. “A standing dead tree is much more dangerous than a live tree. Those embers can fly for miles.”

As the largest park district of its kind in the country and a leader in fuels management, the District had overcome many challenges through the years, including securing necessary environmental clearances, while juggling the demands named in two opposed community lawsuits. The now resolved lawsuits had divergent views, one that wanted to remove all eucalyptus trees and the other that wanted to protect and preserve a dense forest.

As a governing agency, the Park District was able to work toward a compromise.

Landreth explains, “The solution was to thin the forest. The District had to thread the needle to find a compromise where we did not remove all trees nor did we keep all trees. And so, we were able to move forward and take action.”

In 2021, the District’s government affairs officials, Landreth and Fire Chief Aileen Theile, the Park District’s first female fire chief and a scientist, approached the State of California with the situation, and the state responded with a \$10 million direct appropriation from the legislature through Senator Nancy Skinner, D-Berkeley, and then Senator Bob Wieckowski, D-Fremont.



“Having trees like matchsticks in our parks was really quite an alarming public safety emergency to our delegation and really expedited their interest in funding direct appropriations,” says Erich Pfuehler, the District’s chief of government and legislative affairs.

Landreth says, “For a public agency to get a \$10 million direct appropriation in the state budget for a specific purpose is extraordinary.”

From funding to the scope of the work to looking at science for solutions, the Park District needed to act, leading the way in its response to the wildfire threat.

Adding to the complexity of the situation was the fact that removing so much dead and dying vegetation by traditional means, which in general meant hauling it in trucks to cogeneration plants that would burn it for fuel, was cost-prohibitive, disruptive to the residential areas adjacent to parklands, potentially dangerous, and would create the same sort of greenhouse gases and pollution that were causing environmental problems – and provoking more wildfires and perhaps even tree die-off in the first place.

“Current methods place hundreds of logging trucks with diesel exhaust on long drives to cogeneration plants in Woodland or Stockton, which is over 75 to 80 miles away,” says Fire Chief Theile. “That wasn’t a good option for us. Because we are a park district, we are driven by an environmental ethic. We had to find a better way.”

Meet the Carbonator

The solution that Landreth and her staff started to consider for handling the large amounts of dead or dying biomass without increased long-distance hauling is called the Carbonator. Neither sleek nor sexy, this machine, a Tigercat 6050, resembles a trucking container with no top. In its box-like metal chamber, the device burns organic matter with very little oxygen and extremely low emissions in a process called pyrolysis. Pyrolysis, which occurs at very high temperatures (about 1,300 degrees Fahrenheit in this case), causes heat, or thermal vibration, to break down the molecules in organic matter into smaller units, but without proceeding all the way to ash.

The resulting solid residue, basically elemental carbon called biochar — which is conveyed out of the Carbonator as it works — can provide benefits to processes such as enriching soil by improving its water retention or pH, accelerating and deodorizing composting of green waste and filtering toxins from water. Furthermore, biochar actually reduces the amount of CO₂ that would naturally be emitted into the atmosphere from decaying plant matter, storing the carbon in a stable form for hundreds and even thousands of years.

So, in addition to existing fuels management strategies that include reducing vegetation with cattle, goat, and sheep grazing, clearing heavy underbrush, removing hazardous trees, and partnering with communities and local, state, and federal agencies, there was general agreement among park officials that the Carbonator was the best option because you could reduce the amount of vegetation mass to very small amounts on site, have the benefit of sequestering carbon and be able to use the biochar in soil and compost-related efforts.

There was also agreement among Landreth and others that the District should organize a Carbonator project as a pilot “to see if this concept was even doable,” says Park District Assistant Fire Chief Khari Helae.





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– Secretary Wade Crowfoot
California Natural Resources Agency

“We wanted to pilot it because it had the potential to be a really good thing, but we wanted to test out the contractors to see that they were sensitive to our land, we wanted to make sure we could get permits to do this, and we didn’t know if the contractors would perform,” Helae says. “No one had done this before. There were no templates or things you could just copy. It was all new.”

Creating a Model for the Nation

Using pyrolysis to convert biomass to biochar has gone on for years in Germany, Canada, and the Nordic countries, and even somewhat in larger forested areas of the United States, but this project was decidedly different.

“As a park district in a major metropolitan area, with a lot of wildland-urban interface, the fact that we were going to be using this technology at a significant scale was groundbreaking,” says Fire Chief Theile. “We wanted to be thoughtful in that process.”

Conducting the pilot project, which required alternative funding in the form of a \$1 million matching grant from the California State Coastal Conservancy, also gave the District more opportunity to take on the appropriate leadership role, says Landreth.

“I was feeling a sense of incredible responsibility for the fact that we’re the largest property owner in the East Bay, we’ve been on the front lines of what is happening to the climate, and we’re the only agency that could do this fuels reduction work at scale,” Landreth says. “We have a huge responsibility to our community and to other jurisdictions. With a pilot, the lessons learned were going to be shared with the state and with all of our agency partners.”

Taking Bold and Persistent Action

At the same time, converting the District’s overabundance of flammable biomass into biochar in an environmentally conscious way fit into state initiatives going back years. In 2015, the Governor’s Office of Planning and Research, under Jerry Brown, issued a report defining a strategy that would “build resilience into natural systems and prioritize natural and green infrastructure solutions.” In 2019, after two years of deadly and damaging fire seasons, Governor Gavin Newsom directed CAL FIRE to immediately accelerate vegetation management to prevent wildfires, even allowing, on a case-by-case basis, suspension of the state’s environmental permitting requirements.

In January 2021, the Governor’s Wildfire and Forest Resilience Task Force developed an action plan calling for fuels reduction, forest thinning, vegetation management, prescribed burns, and defensible space.

The action plan stated, “bolder action is required to address the key drivers of catastrophic fires, significantly increase the pace and scale of forest management, and improve the resilience of increasingly threatened communities.”

“The Park District is a force of nature when it comes to fuels management, environmental stewardship, and climate resilience,” says California Secretary for Natural Resources Wade Crowfoot, who leads the state’s efforts to find sustainable solutions to the growing wildfire crisis. “Their approach to fuels reduction, especially using a carbonator, is cutting edge and helps push the entire state forward in finding climate-resilient solutions to improve forest health and reduce the risk of catastrophic fire.”

The dead and distressed trees in the District’s parks, many of them non-native eucalyptus and pines, constituted a catastrophe waiting to happen.

“We are proud to work in partnership with the Park District as they take proactive steps to mitigate wildfire risks,” says California Department of Forestry and Fire Protection (CAL FIRE) Chief Joe Tyler. “These actions are absolutely essential for the health and safety of communities.”

Eucalyptus, native to Australia and first planted in the park by an Oakland developer in the beginning of the 1900s, have ardent fans and enemies. Known for their minty, medicinal aroma, the trees drop leaves and curled streamers of bark that accumulate on the forest floor, and anyone who has ever built a fire would recognize how a dead or dying eucalyptus, its dry litter in an airy mound at its base and fallen branches and bark peels hanging from the trunk to the ground, could combust easily. Worried about that very prospect, the District nonetheless rejects the idea of - removing all eucalyptus, living or dead, acknowledging that taking out whole stands would result in huge expanses of brush, which are also a serious fire hazard.

The park’s tree die-off problem had actually first been noticed in a 40-acre stand of eucalyptus off of South Park Drive in Tilden Regional Park in the East Bay hills, where an estimated 50 percent are dead or will die within a year. Nearby, non-native pines have also fared badly, their dead, spindly tops poking above a greener, lush canopy. Other big tracts of the parks are similarly affected.

Some of the pines on South Park Drive and elsewhere simply became “over-mature,” District officials say, in effect dying of old age. But many of the trees that were distressed by drought succumbed ahead of their time to all manner of incursions, including the aforementioned fungus, beetles, and even woodpeckers that continued the work of the beetles.

The Carbonator Gets to Work

On September 15, 2022, the Carbonator pilot project, which would remove accumulated flammable plant material from an 80-acre forest that was predominantly eucalyptus, began near a former shooting range in Anthony Chabot Regional Park. Healthy native trees such as oaks, bays, and madrone were preserved, dead and dying trees and overcrowded non-natives were cut down, and “ladder fuels,” meaning vegetation and plant debris that can provide a route for flames on the ground to ignite progressively higher levels of vegetation and reach the tree canopy, were removed.

“Firefighters need to keep fire on the ground. When we manage a forest, we go in and upset the fuel ladder, making it difficult for the fire to climb from the ground to the tree canopy,” Fire Chief Theile says. “If the fire goes in the treetops, embers will be thrown aloft and cast into the wind, which means we end up chasing the fire. That’s how conflagrations like the Camp Fire [which in 2018 killed 85 people and destroyed two towns in Butte County, California] became so dangerous and so difficult to fight.”

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As part of the pilot preparation, machines called “masticators” that chew up smaller vegetation and leaves and branches from trees were used to create mulch that was applied at depths considered healthy for enriching the soil and plants that grow in the area.



The actual onsite biomass-to-biochar process was fired up at the end of January and began work on its first tree trunks, which in an aerial video looked like sticks being laid in the faintly red-glowing tray of the Carbonator. A conveyor belt exiting one end of the burn chamber carried small quantities of biochar to an accumulating pile. A pumping truck with 500 gallons of water, a vegetation free zone around the Carbonator with a radius of 300 feet, and constant surveys of the perimeter to watch that no sparks flew ensured that the operation was safe.

When the work ended on March 12, 2023, more than 2,000 tons of biomass had been processed into 88 tons of biochar. Testing showed the biochar was free of toxins and of excellent quality according to specifications developed by the International Biochar Initiative, including having a very low hydrogen-to-carbon ratio, barely a third of the ration that indicates the biochar would remain inert for at least a hundred years.

With emissions from the Carbonator and associated activities negligible — a tiny fraction compared, for instance, to open burning or hauling — the overall tally of pros and cons of the project weighted heavily on the pros side.

All in all, the fire hazard in the 80 acres had been vastly reduced, the health of the forest was improved and the environmental impact of the pilot proved to be net-positive, especially as applications for the biochar within the parks are explored.

“We’re really excited about this and think it’s a really exciting opportunity to better manage our lands where we have to do fuels management activities, because we can reduce the overall carbon footprint of these projects,” says District Stewardship Chief Matt Gaul, adding, “the Carbonator is a useful tool to help us accelerate our work to improve forest health in the parks and to enhance and improve habitat.”

General manager Landreth says she is thrilled with the pilot project results.

“We were able to show that you can actually remove these dead and dying standing trees to keep our communities safe — and with all the benefits that we get from not having to haul this biomass around, not to mention what the benefits will be from the biochar itself.”

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– Chief Aileen Theile
Park District Fire Dept.

Benefits of Using Biochar

“When eucalyptus and pine trees are cut down, they don’t have a lot of value,” says Assistant Fire Chief Helae, who as the head of fuels management, works mostly on the “prevention side” of the fire department. “To take something that didn’t have a lot of value, capture that carbon, and then use the biochar for water retention or enhancing different plants — all of that means desirable outcomes for us.”

The ways that the biochar will be applied in the parks is still being investigated, partly because much of the focused research that has been done on the uses of the substance has involved farming.

“There’s a lot more to do around the study of how we can use the biochar,” says Landreth.

Graul says his stewardship department is working “really hard to make sure we place and reutilize the biochar in ways that will provide the most benefit.”

Meta-analyses that gather the results of multiple research studies into biochar have found clear evidence that it is a valuable additive for improving soil and plant health. The possibilities for its use in the parks, which were explored in an end-use analysis specific to the District and activities in the parks, are numerous and promising.

Biochar is extremely porous — almost like a sponge although rigid rather than soft — and its many little internal caverns can store water and nutrients for plant roots, host microorganisms and “adsorb” certain toxins, meaning that the toxins accumulate as a film on the many inner surfaces of the biochar structure, drawing the toxins out in much the same way that activated charcoal works in emergency rooms in the case of accidental poisonings or overdoses.

Added to green waste composting, biochar can accelerate the composting process, reduce methane off-gassing, reduce odors, reduce nutrient losses, and increase the activity of beneficial microbes. Used on runoff water from roads and parking lots, biochar can help remove contaminants. Blended with nutrients, it can improve planting and replanting operations, boosting the survival rate of trees and other plant seedlings. It can even be spread on the forest floor and on rangeland and has shown promise in restoration of such areas, although more research and soil testing are needed to determine how much biochar is suitable for different types of soil.

Leading the Way – Expanding Strategic Efforts with Success of Pilot Project

With all of this in mind, the Park District has already started another Carbonator project, this time involving 365 acres in Anthony Chabot Regional Park, and budgeting \$7.5 million of the \$10 million direct appropriation from the state, plus federal funds of \$1.5 million and an anticipated \$1.8 million, secured through Senator Alex Padilla, D-Calif. A second Carbonator will be enlisted. Officials contend that going forward, up to half of the biomass removed from parks could be converted into biochar.

Assistant Fire Chief Helae calls the Carbonator technology “an additional tool for our toolbox,” pointing out that, despite its many advantages, it will not be suitable for all of his department’s fuels management work, depending on time of year, location of a project and the size of an individual

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project. For smaller projects, Helae says, the District will use methods such as chipping on site, explaining that the District’s stewardship unit has developed “fuels prescriptions” for how much chip depth is appropriate depending on what is growing in a certain area.

He, like others working in the parks, is nonetheless content that the District chose to pursue a new idea.

“It makes sense for us to lead in this way, to do something that potentially could have

failed. We can do work that other agencies can't," Helae says. "It was important for us to be a leader for this area, prove a concept that not only benefits us but could benefit the other agencies around us."

The government affairs team says the government support that the District has received is "an investment toward longer-term solutions – using the most sustainable tools available to us – to address a critical issue."

"We are working and planning for both now and the future, and we're committed to playing the long game."

– Sabrina B. Landreth
Park District General Manager

We activated our emergency response, and the state heard us loud and clear and has been highly supportive. It's incredibly fast how we've been able to lift this up and get it going. We have proven that we can do fuels management to protect our lands and our 3 million constituents — and all in an environmentally responsible way."

General Manager Landreth says it is inspiring to have witnessed the District and government working in such "an innovative, collaborative, and speedy way.

We activated our emergency re-

The East Bay Regional Park District's leadership, firefighters, scientists, park rangers, and its dedicated staff across departments continue to focus on wildfire mitigation strategies and the innovative, large-scale fuels management program, all while seeking new partnerships and ways to protect the public.

The innovative, strong partnership approach to securing funding, the use of the Carbonator in a pilot project and its subsequent use in a large scale effort to reduce wildfire danger, and our desire to find a sustainable science-based solution in East Bay parks "is being seen as a model statewide, as well as nationally," says Landreth.

"The risks and dangers that our community has faced in the past presented the East Bay Regional Park District with the opportunity for forward-thinking innovation," Landreth highlights.

She adds, "by doing this work now, we will gain a more sustainable eco-system in the long-term to benefit generations to come. We are working and planning for both now and the future, and we're committed to playing the long game."

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