Equitable Access Research Project

New Approaches to Understanding Equitable Access to the Outdoors

Equitable Access Research Project Final Report

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Executive Summary

Access to parks and open spaces is crucial for our physical and mental health. This has been shown in study after study in recent years. But we know that access to nature and the outdoors is not equitably distributed in the United States. That, too, has been shown in study after study in recent years, at different spatial scales, from the neighborhood level to nationwide.

We know that having access to neighborhood parks within walking distance — about a half-mile or a 10-minute walk — is highly correlated with positive health outcomes. We also know that access to neighborhood parks is inequitably distributed. We studied six states, in a preliminary study that we hope to expand nationwide, and found that from 22% to 68% of the residents in those states did not have a neighborhood park near their homes.

So we also wanted to see how many of those households had regional parks or open spaces that they could visit within driving distance of their homes. We used the average distance of a social or recreational trip from the National Household Travel Survey to measure this distance. We were surprised to find that percentage was much, much greater than we had imagined. From 98.5% to 99.9% of the residents in the six states we studied have regional parks or open spaces within driving distance of their homes. And many have numerous to choose from.

Why is this important? Regional parks and open spaces can provide access to nature and the outdoors for people who lack nearby parks. This does not substitute for the need to build neighborhood parks, which are most highly correlated with positive health outcomes. But we also know that time spent outdoors is highly correlated with positive health outcomes.

So out of this research, we draw several conclusions and recommendations. First, investing in building neighborhood parks remains the highest priority for more regular equitable access to nature and the outdoors. Second, investing in programming that attracts people to regional parks and open spaces from neighborhoods that lack nearby parks is also a very high priority. Addressing the transit needs of people who do not have access to vehicles should also be prioritized.

As we conducted this research we created some new data tools as well, in response to requests from users in California, which we hope to expand to other states as well. We used humanitarian data that pinpoints household locations precisely (rather than using broader U.S. Census areas) to measure where people live in relation to parks and open spaces. We then overlaid a one-square-mile grid across the state to measure the number of households in each square mile who do not have a park within a half-mile of their homes. We call this the PerSquareMile tool. This enabled us to see where new parks could be located to serve the most households that do not have a nearby park, which could enable prioritizing investments to serve the greatest number of people in need.

The PerSquareMile tool also enabled us to add additional attributes. In some of our user testing, we were asked to look at the potential relationship between park need and biodiversity and habitat conservation. We were only able, so far, to do this in California. But what we found surprised us again. Roughly half of the areas with the greatest number of households without access to a park are also areas with high terrestrial biodiversity scores. If it were possible to protect or restore habitat to protect biodiversity with appropriate access for people to visit in these locations, the number of households without access to nearby nature in California would be cut by 25%, providing park access to more than 2 million people.

This finding, based on data analysis and mapping, needs to be ground-truthed, of course. And we are excited to be embarking on a project to support efforts to do just that using the Link model for community-engagement, park planning, and building, which is described below.

If our hypothesis is correct, that means that in a significant number of places we could potentially achieve the goals of conserving habitat for the health of nature and providing access to nearby nature for people who do not currently enjoy the benefit it provides for human health and well-being.

Recommendations

Priority of neighborhood parks

While our research found that the vast majority of residents in the states we studied are within an average social or recreational trip's driving distance of parks and open space, a large portion of the population of each of the states does not have a park or open space within walking distance of their homes. Over the past two decades research has consistently corroborated the correlation between nearby nature—parks and green spaces within a half-mile of residents—and positive health and mental health outcomes. Investing in creating parks and green spaces in neighborhoods that do not currently have them should be our highest priority for providing equitable access to nature.

Accessibility is not just proximity, it is also programming

Accessibility is about so much more than proximity. This is true for nearby parks as well as more distant parks. Research has shown that whether people visit parks depends not just on whether they can get to the parks, but also whether the parks feel safe and welcoming; whether the parks contain amenities such as parking, restrooms, trash cans, recreational equipment, trails, sports fields, and a wide variety of other amenities; whether information is provided in languages other than English; and whether programs in the parks attract particular audiences and participants. And, of course, people have to know about these things in the first place. So information and communication are also key. We group all of these things under the broad rubric of "programming" and note the importance of all of them. Investing in programming is likely especially important to attract people who do not currently have a nearby park to more distant parks.

Advocacy for transit to parks for people without vehicles

Driving to a park or open space to spend time in nature is a good option for residents who do not have access to green spaces within walking distance of their homes. But that option is not as readily available to all residents equally because of constraints such as time, money, and access to a vehicle. Our research found that there are significant populations in all of the states that we studied where households that have no parks within walking distance of their homes also have limited access to vehicles. Mapping these areas could help advocates for transit to parks prioritize those areas.

Prioritization for areas of greatest number of people without access to parks

Our research points to the potential of using spatial data and mapping to prioritize where the greatest number of people live without access to nearby parks. By prioritizing areas with the greatest number of people, investments can have the biggest impact in new local parks, in programming designed to attract people to more distant parks, and transportation to bring people to parks. This data can also be combined with data on household income, social vulnerability, pollution burden, health outcomes, and other demographic characteristics to further prioritize investments and impact.

Overlap with biodiversity

One of the intriguing findings of our research was a surprising overlap between high priority park need—areas where the most residents do not have access to nearby parks—and high terrestrial biodiversity scores in California. We found that nearly half of the highest priority areas—those with the highest concentration of households without access to nearby parks—also had high biodiversity scores. If we were able to protect and restore habitat in these areas that also provided appropriate access to nature for people, we could cut the number of Californians without access to nearby nature by 25%, providing park access to more than 2 million people. More research and ground-truthing is needed to further explore this potential to achieve both goals harmoniously—biodiversity conservation and equitable access to nature— in California and other states.

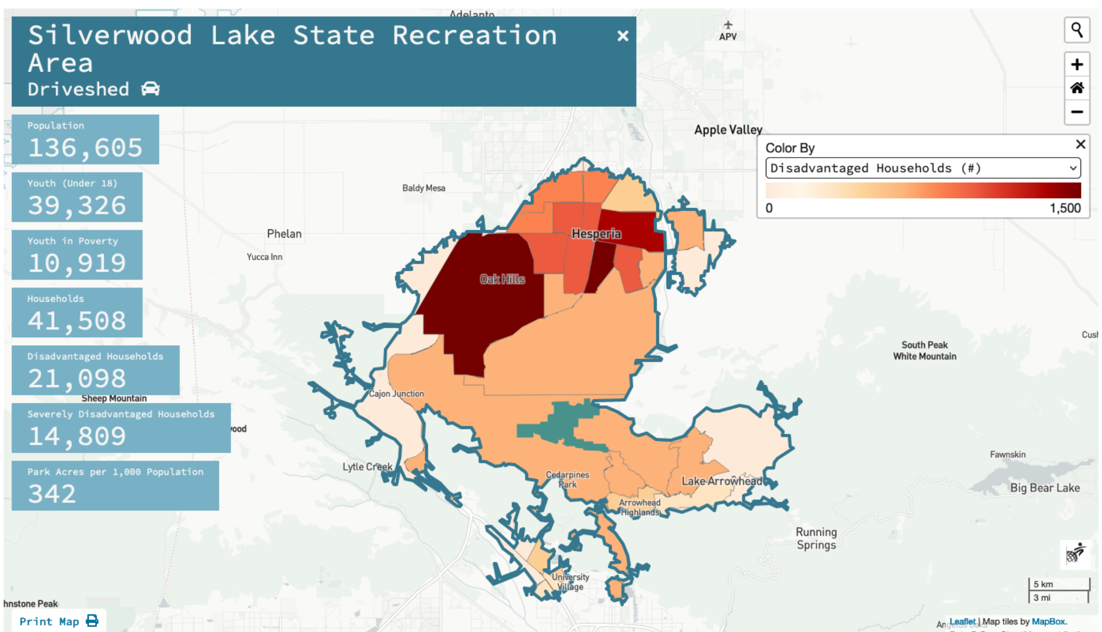
Need for more data related to access for differently abled and ADA accommodations at parks

In the user testing that we conducted as part of our research, a number of users lifted up the importance of accessibility for people who are differently abled. Under the Americans with

Disabilities Act (ADA), accessibility standards apply to all places of public accommodation, commercial facilities, and state and local government facilities, including parks. These standards apply to all new construction, alterations, and additions. We do not currently have sufficient, widespread, and uniform data to be able to analyze access to parks and nature in terms of ADA accessibility standards. We hope that data will be created and shared publicly so that we can understand equitable access for all to the benefits of nature.

Building New Tools to Understand Access

In 2019, UCLA and GreenInfo Network conducted [a research project into state parks as a resource for youth mental health] for the California State Parks Foundation. For that work, we developed a methodology to create "visitorsheds" based on road network analysis. Combined with Census demographics, we were able to get a remarkably detailed view of potential visitors to California's 280 state parks. Where were the most young people? And especially the most low-income young people? That is information the state could use to ensure equity in its outreach programs.



But that work was only for 280 state parks in California. The reality of park access is that people visit parks managed by many different agencies. Could we expand this work beyond California State Parks? And if so, could we expand it beyond California?

In 2022, GreenInfo and UCLA partnered with the Resources Legacy Fund and The Wilderness Society to expand this research to every park in California and five other states: Arizona, New Mexico, Montana, Washington, and Georgia. We developed methods using open data and open source tools to run the analysis at scale for each state, using data from the Protected

Areas Database of the United States, OpenStreetMap, Meta's Humanitarian Data Exchange, and the United States Census.

We set out to produce detailed, statewide analyses of park access based on every park and every person in each state, calculating walking distance for smaller neighborhood parks and driving distance for larger regional parks. From there, we hoped to provide policy or other recommendations for improving park access, while also allowing users to do their own analysis of park access at any location within each of the six states we studied.

Once we had completed out analysis and an alpha version of a website, we continued the work on two fronts:

- We engaged in targeted user research to better understand how to best present our findings for the use of people working on statewide access issues in our target states.
- We conducted special research in California in direct dialogue with the California Natural Resources Agency to answer their questions about access and biodiversity, to help advance efforts for equitable access to nature in California.

Both of those activities are described in more detail below.

Findings

On access to neighborhood parks within walking distance

Across all six states we analyzed, 22.7 million people do not have a park within a half-mile walk of their home. That's approximately the population of Florida, the third most populous state in the nation.

Not surprisingly given its enormous total population, California is home to the largest absolute number of people who lack a nearby park, about 8.5 million people. But as a *percentage* of population California is actually doing the best among the states we studied, with 22% of people lacking a nearby park.

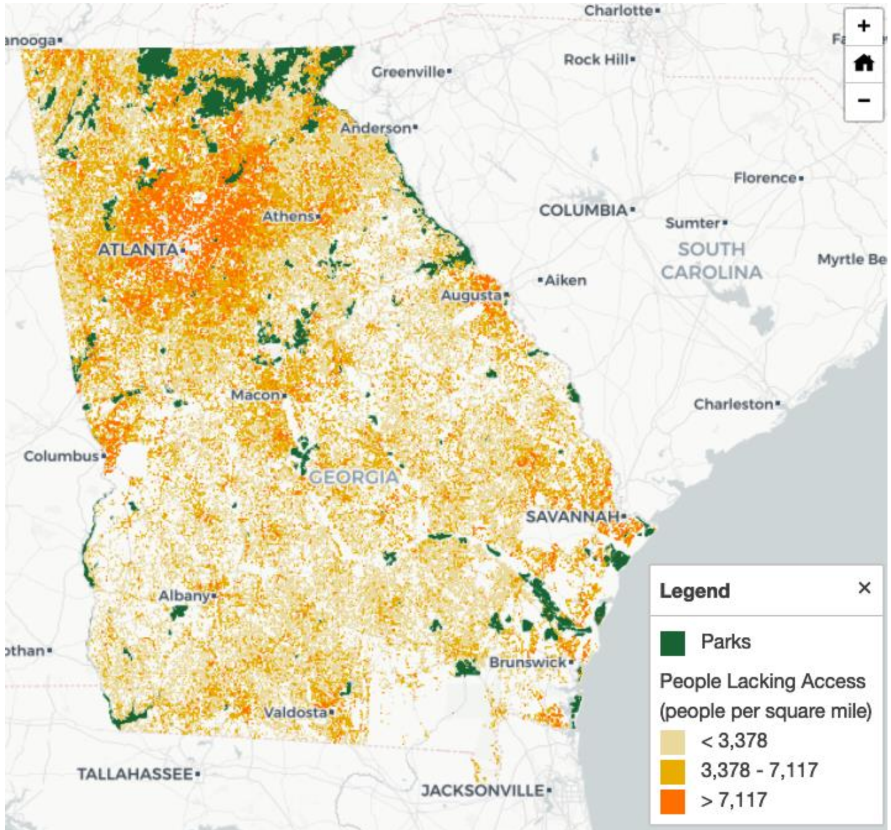
Georgia, with a quarter of California's total population, has nearly as many people who lack a nearby park, and they make up 68% of the population.

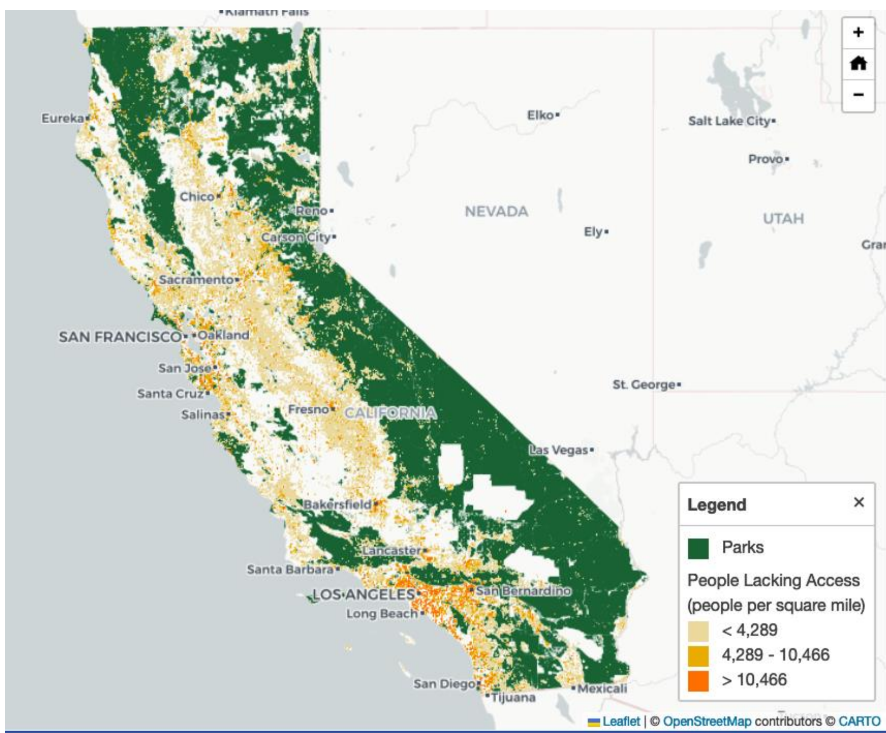
This table shows the values for all the states we analyzed:

State	Lack Neighborhood Park	Total Population	Percent of Pop
Arizona	3,538,422	7,050,299	50%
California	8,532,733	39,283,388	22%
Georgia	7,115,085	10,403,847	68%
Montana	501,629	1,050,649	48%
New Mexico	819,845	2,092,454	39%
Washington	2,195,842	7,404,107	30%
TOTAL	**22,703,556**	**67,284,744**	**34%**

ParkAccess.org provides detailed maps of each state, and they can be zoomed down to a local level. The following map shows people who lack local parks across Georgia.

We see obvious urban concentrations in Atlanta and elsewhere, but when viewed in contrast to a state like California, shown below, we can also see how park access strategies will necessarily be different between states, given the huge differences in the distribution of people and public lands.





On race, ethnicity, and income

Race and Ethnicity

In the first table below, we report the proportion of each state's total population without access to a local park by race and ethnicity. For the sake of comparison, in the second table, we report the proportion of the state's total population by race and ethnicity. We can see that there are some variances that would require more detailed research to explore and explain. In some states, white residents are over represented in the population without access to a neighborhood park, and Hispanic/Latino and Black residents are underrepresented. While the variances may be significant, they are not large, so the proportion of people without access to a neighborhood park roughly reflects the general population at the scale of whole states. That said, we do know from other research that low-income communities of color in some parts of states, such as California, disproportionately suffer from a lack of neighborhood parks.

Population without access to a neighborhood park								
State	**White Alone**	**Hispanic/ Latino**	**Black Alone**	**American Indian and Alaska Native Alone**	**Asian Alone**	**Native Hawaiian and Pacific Islander Alone**	**Some Other Race Alone**	**Two Or More Races Alone**
Arizona	59%	27%	4%	5%	3%	0%	0%	2%
California	44%	38%	5%	1%	10%	0%	0%	3%
Georgia	58%	9%	27%	0%	4%	0%	0%	2%
Montana	86%	3%	0%	8%	1%	0%	0%	2%
New Mexico	36%	45%	1%	16%	1%	0%	0%	1%
Washington	76%	11%	2%	2%	4%	0%	0%	4%

Total Population								
State	White Alone	Hispanic/ Latino	Black Alone	American Indian and Alaska Native Alone	Asian Alone	Native Hawaiian and Pacific Islander Alone	Some Other Race Alone	Two Or More Races Alone
Arizona	55%	31%	4%	4%	3%	0.2%	0.2%	2%
California	37%	39%	6%	0%	14%	0.4%	0.3%	3%
Georgia	53%	10%	31%	0%	4%	0.0%	0.3%	2%
Montana	86%	4%	0%	6%	1%	0.1%	0.1%	3%
New Mexico	37%	49%	2%	9%	1%	0.1%	0.2%	2%
Washington	69%	13%	4%	1%	8%	0.6%	0.2%	5%

Income

As with race and ethnicity, we find that at the scale of the states, the proportion of low income and very low income households that do not have access to a neighborhood park is roughly proportional to the total low and very low income population. Our data shows that between 36% and 43% of all people who live farther than a half-mile from a park have either low income or very low income. Low income is defined as 80% of the state median household income and very low income is defined as 60% of the state median household income. We would expect that using that metric about 40% of each state's households would be defined as low income and about 30% as very low income. As with race and ethnicity, we know from other studies that this pattern does not hold at smaller spatial scales, such as cities and neighborhoods, where we find low-income communities in parts of states such as California suffer from a lack of neighborhood parks.

Household income of people who lack parks

State	Low Income % of all people without local park	Very Low Income	Low Income No-park Population (Estimate)	Very Low Income Population (Estimate)
Arizona	36%	27%	1,273,832	955,374
California	42%	32%	3,583,748	2,730,475
Georgia	37%	28%	2,632,581	1,992,224
Montana	38%	29%	190,619	145,472
New Mexico	43%	33%	352,533	270,549
Washington	41%	29%	900,295	636,794

On access to regional parks, open spaces, and public lands within driving distance

One of the more notable findings of this work is that *virtually everyone lives within a reasonable driving distance of a park of more than 100 acres.*

As noted in our methods documentation, we used national travel survey data to determine reasonable driving distance for a frequent social or recreational trip. According to the National Household Travel Survey, the average recreational or social trip by car is 13 miles in urban areas and 23 miles in rural areas. We set the threshold for regional parks at 100 acres based on work done in Los Angeles and elsewhere. These are necessarily approximations: There are parks smaller than 100 acres that draw people from far and wide, and there are large parks that do not. Some people are able to drive further for recreational trips and others are not. But the data we used is appropriate for overall statewide analysis, while presenting enough detail to be a useful if not definitive reference at the local scale.

With all that in mind, we found that just about 0.14% of Californians (about 50,000 people) lack a park within easy driving distance. Even in Georgia, with its massive lack of neighborhood parks, car access was only slightly lower. Ultimately this analysis emphasized that in a car-centric society, most people live within driving distance of parks.

State	Limited access to car	Limited access to car and no park within half mile
Arizona	5%	2%
California	5%	1%
Georgia	5%	3%
Montana	3%	2%
New Mexico	5%	2%
Washington	3%	1%

When we reviewed this information with target users in our user research phase, this finding was surprising to users, but it was also deemed an unhelpful distraction. Millions and millions of people lack access to a park within walking distance, and a small fraction of those same people lack a park within driving distance. We heard uniformly that we should focus on the millions who lack neighborhood parks.

On access to vehicles

Though virtually everyone in the states we studied lives within an easy driving distance of a park, not everyone has access to a vehicle. This concern was highlighted in our user research as an important consideration, both to support building parks within walking distance of more people and to support improved transit options to reach more distant parks.

Based on U.S. Census data, the portion of each state's population that lacks access to a vehicle ranges between 3% and 5%, with the lower number in Montana and Washington and the higher number uniform across the other four states we analyzed.

State	Limited access to car	Limited access to car and no park within half mile	Limited access to car Population (Estimate)	Limited access to car and no park within half mile Population (Estimate)
Arizona	5%	2%	352,515	141,006
California	5%	1%	1,964,169	392,834
Georgia	5%	3%	520,192	312,115
Montana	3%	2%	31,519	21,013
New Mexico	5%	2%	104,623	41,849
Washington	3%	1%	222,123	74,041
Total	**4.7%**	**1.5%**	**3,195,142**	**982,858**

Of the 3.2 million people who lack vehicle access, about a million also lack a park within walking distance of their homes. That's about 1.5% of the total population of the 6 states we studied.

On prioritization and scale using the PerSquareMile tool, which enables prioritizing areas for most impact

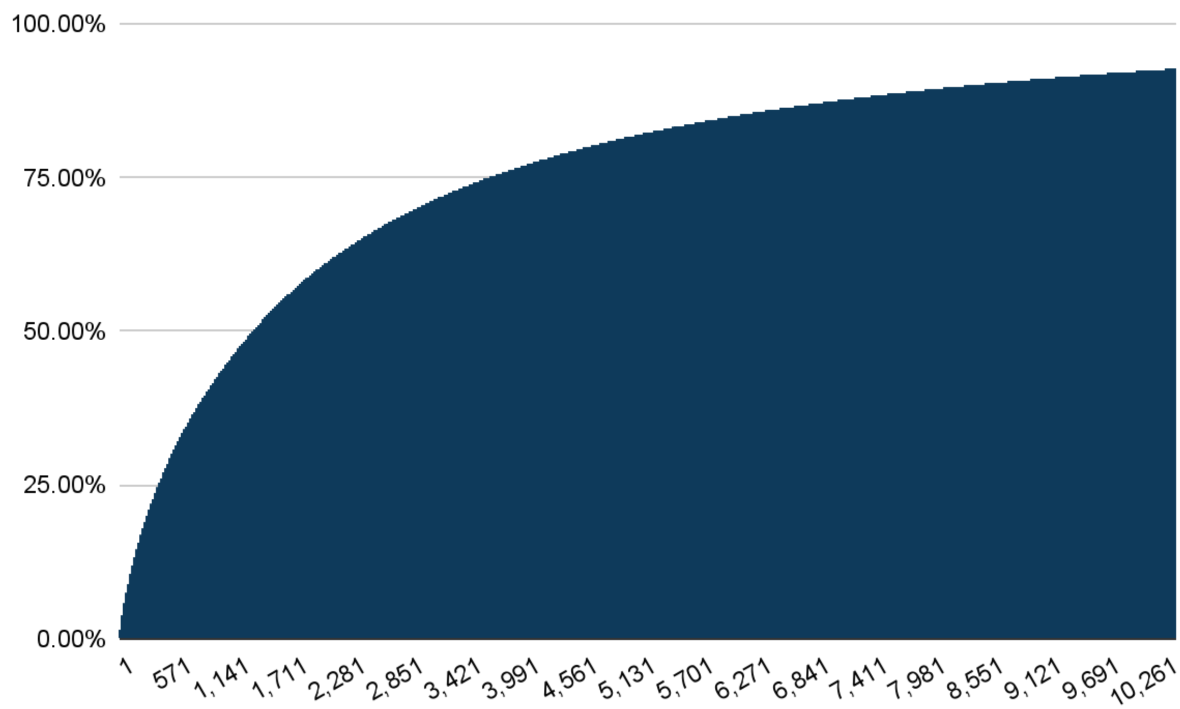
As an extension of our work on park access, we also did a pilot research project in California, at the request of the California Natural Resources Agency, to estimate the number of parks that would need to be built across the state to reduce by half the 8 million people who lack local park access.

This is a challenging question to answer, even at a schematic level, since it requires knowing how the population is distributed across the landscape and where new parks would reach the most people. If no-park populations are highly concentrated, then we need fewer parks that serve more people. If they are widely distributed, then we need more parks that serve fewer people.

To find an answer, we took the high-resolution population data we developed for ParkAccess.org and aggregated it into one-square-mile grid cells. We calculated the number of people in each grid cell who did not have a park within a half mile of their homes, and then we ranked the grid cells by no-park population. In theory, a park at the center of each grid cell would provide half mile access to the people in that cell.

It's important to note that we did not inspect the grid cells for whether it might be possible to build a park in that cell, much less at its center. This was an aggregate analysis to estimate the magnitude of effort that would be needed to reduce by half the number of Californians who lack a neighborhood park.

The following chart shows the outsize impact that the first few parks have, and then a long tail of additional parks to eventually reach everyone in California who lacks a neighborhood park.

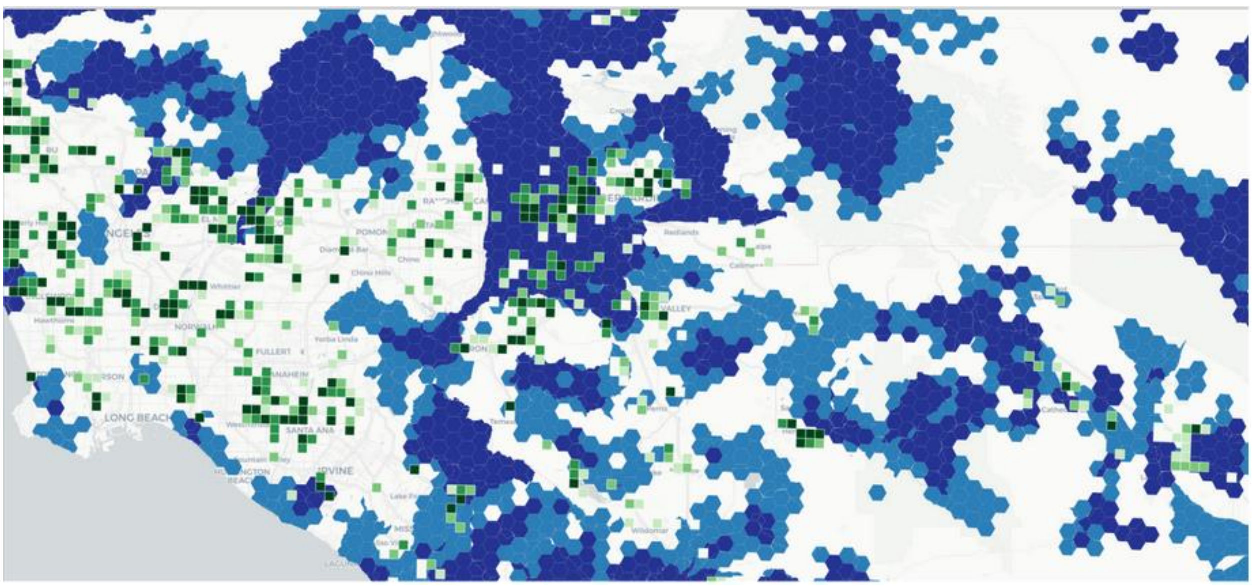


Parks in the most populous 385 grid cells would serve 2 million people (25% of the people who need parks), and another 928 parks would serve the next 25%. So with about 1,300 strategically located new parks, California could serve 4 million people who lack local parks. Beyond that, we see a long tail where 10,000 new parks would reach 93% of people lacking a local park, but the state would need another 40,000 parks to serve the last 7% of people who lack a local park. Focusing resources in areas with more people who lack parks is the best way to maximize impact on access.

On the overlap between the need for nearby parks and nature and biodiversity and natural area conservation priorities

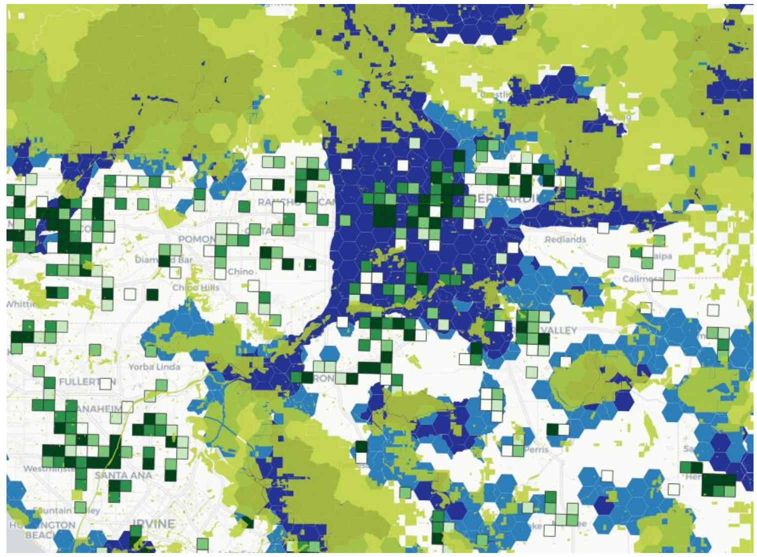
Access to parks is not the only priority in the states we studied. In California, we were asked to also assess the overlap between areas where people have no local park access and areas with higher than average biodiversity. It's often assumed that those areas overlap very little, if at all: Areas without local parks are presumed to be densely urban, possibly industrial, or perhaps full of intensive commercial agriculture.

That's true in many places, but in California, we also found surprising overlaps of high-priority areas for park access and areas the state identified as having above average biodiversity.



We used the square mile park access analysis described above (green in this map) along with the Department of Fish and Wildlife's Areas of Conservation Emphasis (ACE) index for terrestrial species biodiversity values (blue) and we can begin to see areas where the two correspond.

Here we've added existing parks (transparent green), and we can see a corridor running through San Bernardino between the Angeles National Forest complex to the north and the Cleveland National Forest to the southwest. In this corridor the highest biodiversity values in the ACE index (dark blue) correspond with some of the 1-mile square grid cells with the highest need for neighborhood parks in the state (dark green).



More than half of the highest need park sites are also in areas of above-average biodiversity.

Of the 1,313 sites where a new park is needed to reach the goal of reducing by 50% the number of Californians without a neighborhood park, 709 also have above average biodiversity with the highest ACE scores of 4 or 5.

User Testing and Research

We created an alpha version of a website to present our data and findings, and then we tested that with our target users and substantially redesigned and reframed the data to better support statewide park planners and advocates. The site at ParkAccess.org presents our findings in each state and also includes extensive documentation about our methods, including details on challenges around defining parks, determining likely entry points for driveshed analyses, and calculating demographics for highly .

To conduct the user research, we interviewed individuals in multiple states in two rounds, presenting the alpha site at first and then validating our redesigned application with the same group. Interviewees included individuals who worked in government agencies and advocacy organizations in California and New Mexico. In response to their feedback, we created a more

The alpha version attempted to make recommendations for regional park investments that, based on our interviews, distracted from the core importance of neighborhood parks, as shown here:

California

Statewide Policies

Invest in Programs and Infrastructure Improvements

8,479,403 people

Within walking distance: No neighborhood parks

Within driving distance: Regional parks and open spaces

In these areas, investing in programming and infrastructure improvements in regional parks and open spaces could improve equitable access to the outdoors. Building new neighborhood parks should also be a high priority in these areas.

Expand Access to Restricted Lands or Purchase New Lands

53,330 people

Within walking distance: No neighborhood parks

Within driving distance: No **open** regional parks or open spaces

In these areas, appropriately providing access to currently restricted public lands or purchasing new lands for regional parks and open spaces could improve equitable access to the outdoors.

Purchase Land for New Regional Parks and Open Spaces

15,019 people

Within walking distance: No neighborhood parks

Within driving distance: No **open or closed** regional parks or open spaces

In these areas, purchasing land to create new regional parks and open spaces could improve equitable access to the outdoors.

The next beta version much more clearly presented the impact of lack of neighborhood parks:

Who lacks access to neighborhood parks?

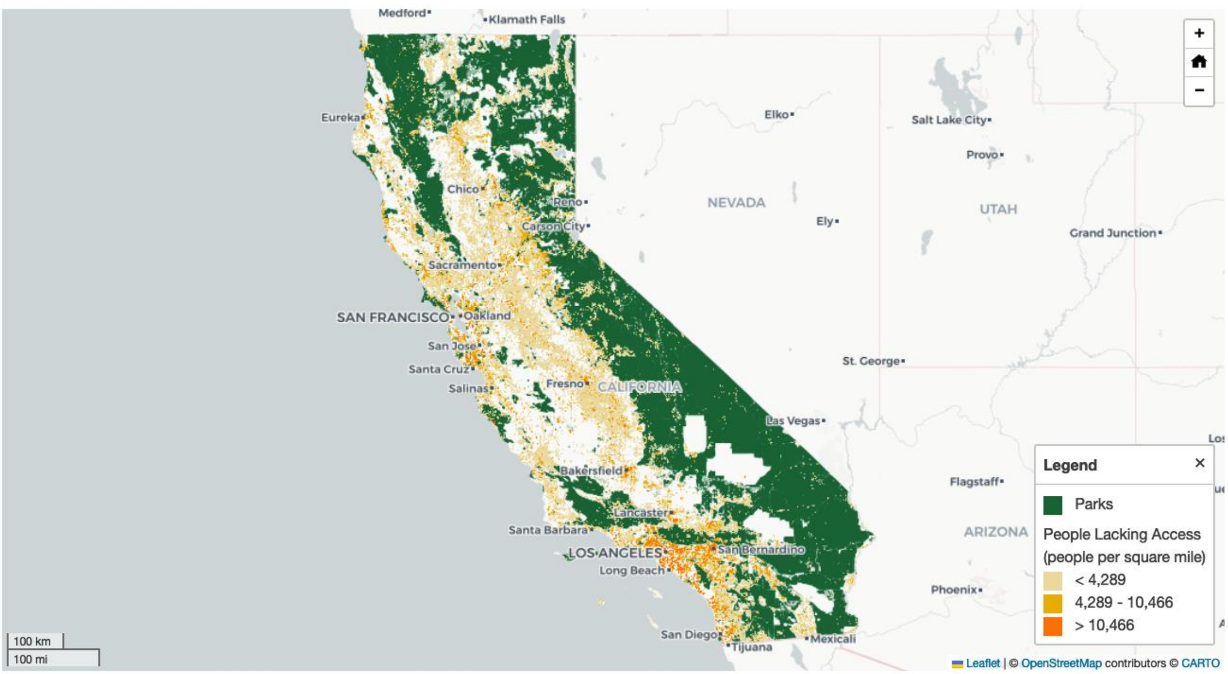
People who don't have a park within a half-mile walk of their homes

8,532,733 out of 39,283,388

% who don't have a park within a half-mile walk of their homes

22%

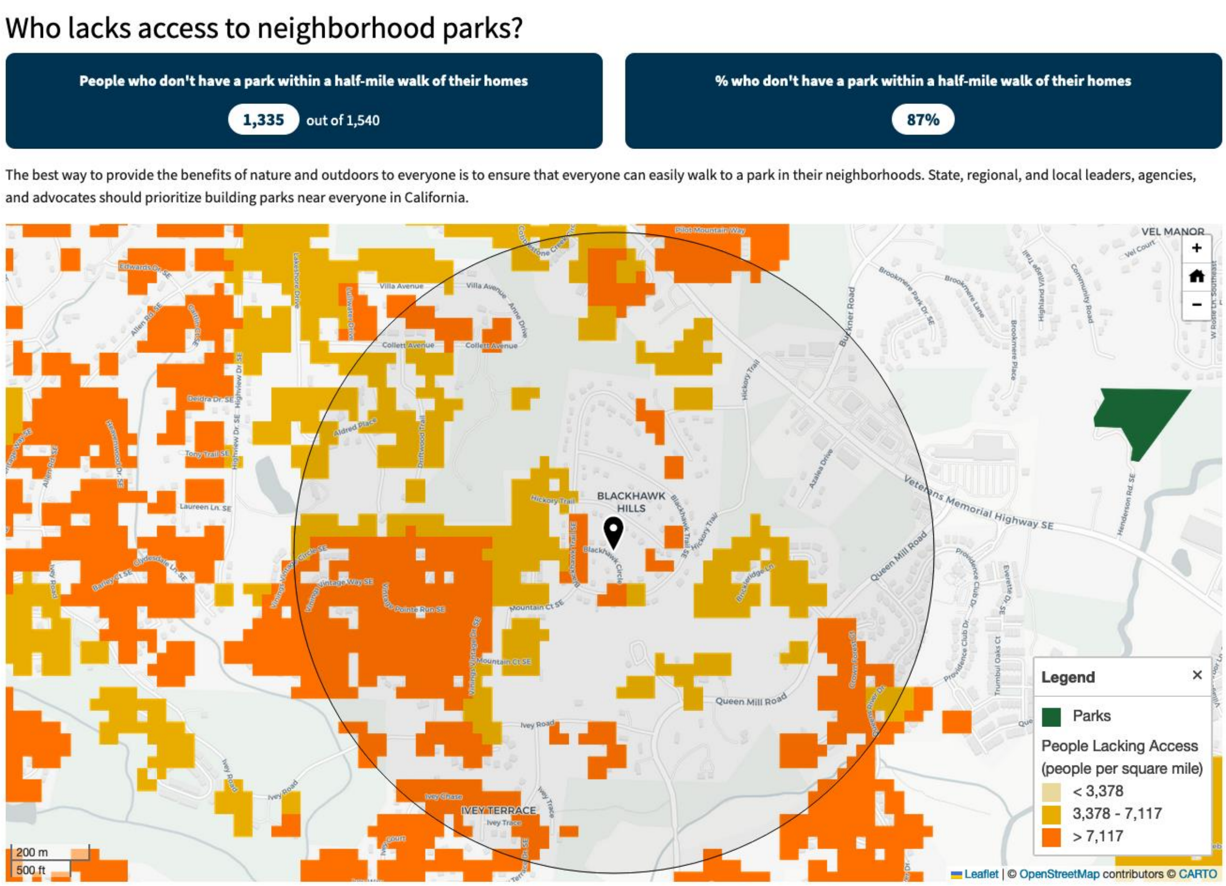
The best way to provide the benefits of nature and outdoors to everyone is to ensure that everyone can easily walk to a park in their neighborhoods. State, regional, and local leaders, agencies, and advocates should prioritize building parks near everyone in California.



From there, the page unfolds in a more narrative format that provides demographic information about people who lack parks, presents regional parks that might offer programs to fill access gaps until more local parks can be built, and highlights areas where people who lack vehicle access also lack parks within walking distance, presenting an especially acute access challenge.

The work overall took a smaller project that focused on just one agency and scaled it up massively to cover thousands of agencies across 6 states with a total population of almost 70 million people. Based on that robust set of data and methods, we then took the project through two rounds of design and development, substantially improving the interface and tailoring the narrative to the needs of our target users working on statewide park access across the nation.

The application provides not just state level data, but also detailed reports of park access within a half-mile of any location in the six states we analyzed. Here’s an example west of Atlanta:



The site provides shareable URLs, so the full report of the location shown above can be easily shared with [a simple link](#).

Next Steps

Research

In additional states

We hope to expand this research to other states. While we have found broad patterns that were fairly consistent across the states we studied, we also saw important differences. And, of course, the context for applying research to advance equitable access to parks and open spaces is quite different in each state.

On the overlap between biodiversity and park need

We continue to explore the overlap between biodiversity and park need in California. And we also hope to expand that research to additional states. One challenge we have identified is that biodiversity metrics at the national scale tend to be understandably biased toward undeveloped areas. So we continue to search for metrics, like those used in California, that also measure and model biodiversity for more developed suburban and urban areas.

Use cases for access tool

Agencies:

Park need
Park agencies can use the data and tools we developed to identify and prioritize areas of park need for investments in new parks.

Prioritization
Areas can also be prioritized by the number of people that would be served by a new park.

Biodiversity and park need
Areas can be identified where habitat for biodiversity and access to nature for people who lack nearby parks could be compatible.

Programming and transit
Areas where people who do not have access to nearby nature can be identified for special programming to attract them to more distant parks. And transit programs can prioritize areas where households without access to vehicles are concentrated.

Advocates:

Park need
Park advocates can use the data and tools we developed to identify and prioritize areas of park need for investments in new parks.

Programming
Park advocates can use the data and tools to identify areas where people who do not have access to nearby nature could benefit from special programming to attract them to more distant parks. They can advocate with park agencies to prioritize programming for those communities of highest need.

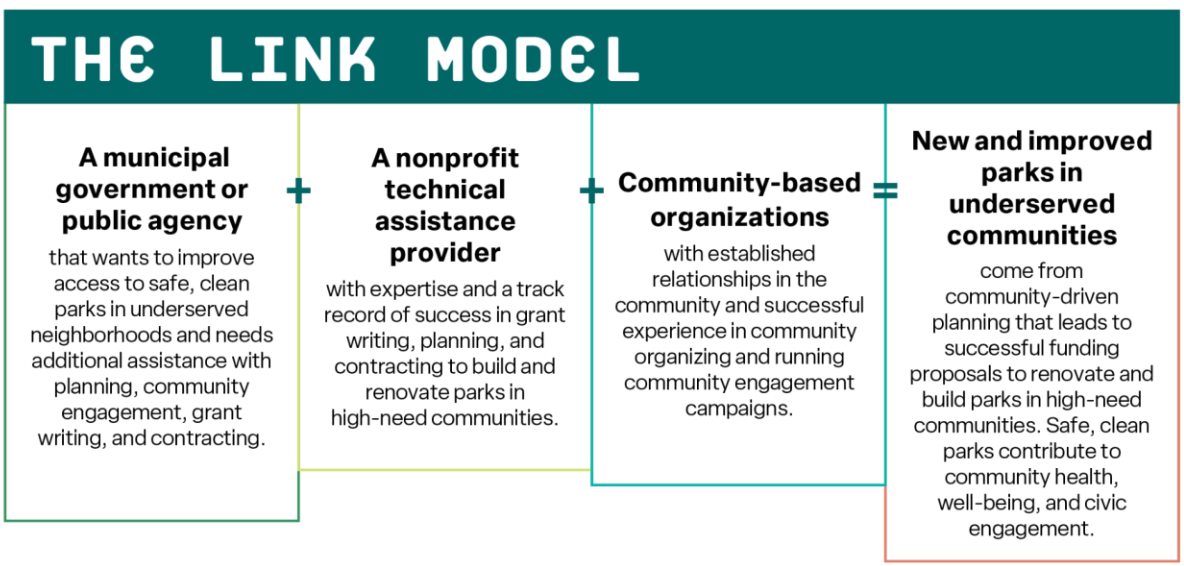
Transit
Park advocates can identify and advocate for transit programs in areas where households without access to vehicles are concentrated.

Biodiversity and high need
Park advocates can work with conservation advocates to identify areas where creating and protecting habitat could be compatible with public access in areas of high park need.

Funders:

Funders can use the tools we have developed to provide grants to organizations working to achieve their priority goals.

The "Link model" for implementation



We know that many under-resourced municipalities are challenged to pursue local, state, and federal funding that exists for parks and other urban greening projects. Even some bigger cities, like Los Angeles and Long Beach, urgently need help to plan projects and pursue funding.

But there is a way forward. Los Angeles is pioneering a new model for creating green spaces in low-income neighborhoods that don't have parks, good tree canopy, or adequate government capacity to build new parks. It is called the Link model because it involves linking a community-based organization rooted in the neighborhood, an experienced nonprofit park-building organization, residents, and local government.

Supported by a philanthropic partnership, in a separate research and evaluation project, we've been testing and studying this model with partners in six disadvantaged communities in Los Angeles County: Cudahy, El Monte, Long Beach, Maywood, Panorama City, and South L.A.

It works. A trusted, local community-based organization can do the robust community engagement necessary to identify needs and priorities. An experienced nonprofit can provide the technical assistance to design projects, write grant proposals, and manage construction contracts. Working with willing municipal agencies they can get the job done.

Partners in these communities are successfully drawing on local, state, and federal funds to build new parks and renovate badly deteriorated existing parks.

When we first started working on Link, we thought that municipal agencies might gain the experience and capacity to do this work on their own in the future. But as one administrator in a small city told us, "This is the model." The city will continue to need the essential services of the Link partners. It literally takes a village.

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Appendix – Technical Methods

The project uses public data and open source tools to produce a layered analysis of:

- Regional parks and open spaces of 100 acres or more.
  - Potential entry points to regional parks and open spaces
  - Drivesheds from those entry points
- Neighborhood parks of less than 100 acres
  - Half-mile walkshed buffers for neighborhood parks
- High-resolution data representing where people live, key demographics, and access to neighborhood parks and regional parks and open space

Defining parks: regional parks and open spaces and neighborhood parks

The most common measure of open space access has been the half-mile distance to a park. This remains the bedrock of park equity, since being able to walk or roll to a park without a car or bus fare is the best way to ensure everyone has access to green space. This is often referred to as a neighborhood park and ideally offers appropriate amenities for the local community it is intended to serve.

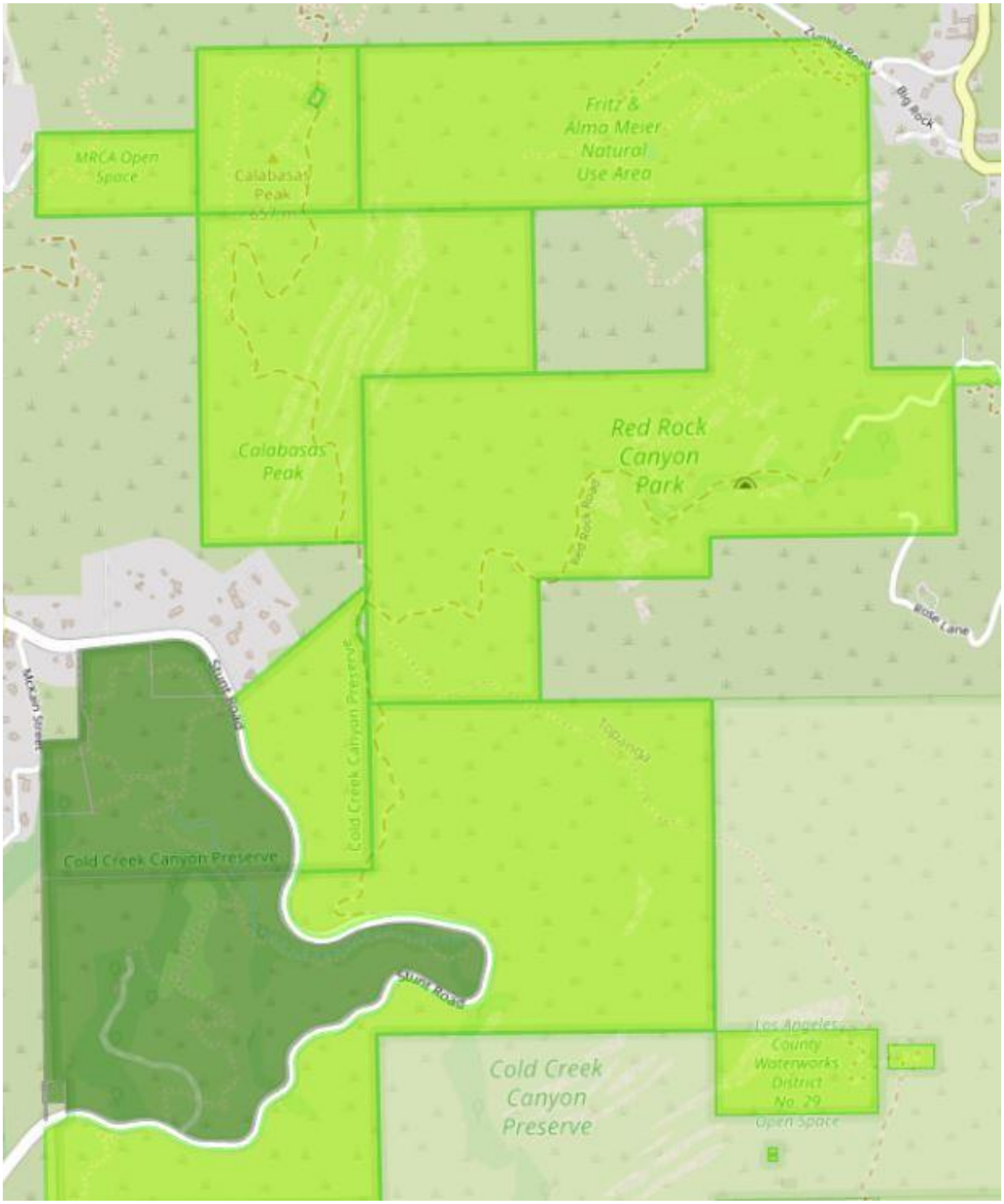
For larger regional parks, it makes sense to look at how people can access those lands from farther away. To accomplish this, one needs to distinguish between Neighborhood and Regional Parks. This project uses a size threshold of 100 acres to make this determination, based on Los Angeles County's regional recreation study, one of the few workable standards we found of defining regional parks. Other options included local agency designations and the use of "regional" in names, which are both highly variable in availability and quality.

Once a size threshold is defined, one also needs to define a "park" to which once can apply that threshold. Because this project spans several states, and will expand in the future, we are using the best available national dataset for parks and protected areas — the Protected Areas Database of the United States (PAD-US).

In terms of spatial coverage, this data is of very high quality nationwide for federal lands, reasonably high for state lands, and of variable quality for local parks, depending on location. Thanks to work undertaken in the past by the Trust for Public Lands, local parks data in cities and towns across the nation is quite good. In some remote areas, however, lands at all levels (local, state, federal) can be poorly attributed, with areas vaguely named or grouped together in unexpected ways. For example, there are areas with collections of hundreds or even thousands of polygons across hundreds of miles, all grouped into a single "park" with the same generic name.

Even when high quality park data is available, defining what is a “park” data is much more complex than you might expect. For a simple city park that covers a rectangle of land or an iconic national park like Yosemite, there’s usually a simple, single recognizable polygon that is “that park.”

But in many cases, what people experience as a single park is actually a patchwork of lands owned and/or managed by multiple agencies. This is true in many areas around Los Angeles and San Diego, where local, state, and federal lands intermix but trail users experience them as single open spaces. In other cases, such as the Golden Gate National Recreation Area in the San Francisco Bay Area, a single unit according to a park agency is actually experienced as multiple disjunct parks, like the Marin Headlands and Crissy Field.



Because of these issues, we could not simply take the objects provided by PAD-US and call them "parks" for our analysis. Instead, we developed a series of geoprocessing steps to more consistently represent lands as parks. Our initial step was to explode the PAD-US data, converting all multi-part polygons into single parts. Using the individual park polygon pieces, we then rebuilt "clusters" based on adjacency, creating clusters of contiguous public lands that might be experienced as one "park." When those clusters are over 100 acres, all parts are considered regional parks or open spaces for our analysis. This does not resolve all of the complexity because PAD-US is inconsistent in how records in the database are defined. Parks range from being a collection of hundreds of detailed parcels to massive multi-part polygons that cover hundreds of thousands of acres. In some states, U.S. Forest Service and BLM lands are highly detailed and broken down into small pieces. In others, they are one large polygon that is not broken apart unless it is multi-part.

But overall, the results were meaningful and our approach worked in the vast majority of cases. It still created some enormous single clusters, such as all of the Eastern Sierra in California, from Mexico to Oregon. That's much too large to experience as a single park. To rectify this, we split lands when they were: in the same cluster and had the same manager, name, and public access. In testing on some known areas, including several large national forests, this produced the best outputs and is our final methodology for analyzing regional parks and open spaces.

Even so, there are some edge cases in all our states:

- In some places, public lands data is messy and poorly attributed, so we still have "parks" that span large areas and multiple polygons. Although this results in discontiguous parks and visitorsheds, we are still able to count these in our analysis of regional park access, since they do provide public lands access, but we treat them as exceptions in our web application when a user requests a single visitorshed report for such lands, since the result would be highly scattered and difficult to compute dynamically.
- Areas that locals might perceive as one large park could be counted as multiple regional parks if the polygons were not contiguous. These large park could get split into both neighborhood parks (small polygons) and regional parks (large polygons) if they were discontiguous, and depending on their polygon sizes
- Note also that we didn't define a minimum size for a park in this analysis. PAD-US includes slivers (tiny edges) but also legitimate pocket parks. These slivers tend to occur along state lines where geoprocessing can produce noise where layers do not align precisely along borders. Further complicating the issue of trying to define a minimum size is that fact that some regions of PAD-US include lands such as right-of-ways, landscaped medians, vacant/undeveloped city lots, utility corridors, and other "public" land that is classified as open but may not be a "park".

A few other notes on park definitions:

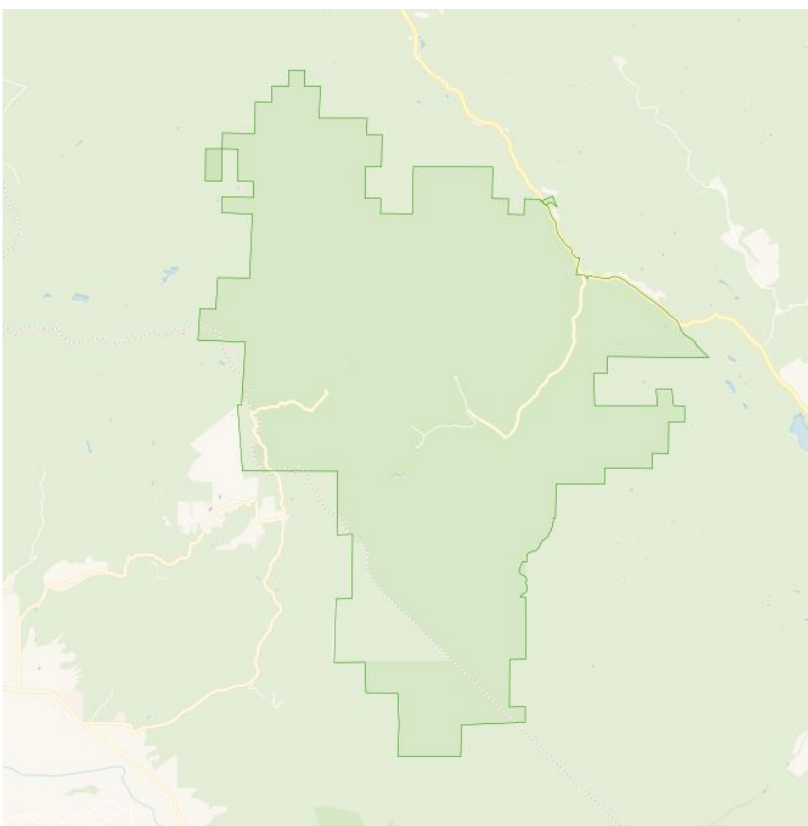
- We treat all golf courses as restricted access, regardless of their classification in PADUS.

- PADUS contains some lands that are not fee-title parks. These are excluded from our analysis.
- Lands in PADUS can overlap. This can lead to minor overcounts in the number of parks people can access in a specific location, though in our review did not impact the most important locations (no park access) and did not materially impact whether areas were "low" or "high" relative to other locations.

Defining entry points

After using the methods described above to define regional parks and open spaces, we then moved to calculating "visitorsheds" of those parks. To do this, one must first determine how the public is able to physically enter public lands. We make an important distinction between neighborhood and regional parks. Neighborhood parks are considered to have predominantly permeable borders and thus we do not assign specific entry points. Regional parks more commonly have points of entry (parking lots, trailheads, etc) that can be used for routing estimates.

For example, Pinnacles National Park has very limited points of entry:



Unfortunately, there is no database of every trailhead, parking lot, ticket kiosk, roadside pullout, or sidewalk entry for the thousands of parks in any one state, much less multiple states. Lacking such a data source, we had to derive one that was sufficiently accurate for our purposes, knowing that it would not be completely accurate for all purposes.

To do this, we used OpenStreetMap, a volunteer-created open source map of the world, to intersect drivable roads with our park boundaries and create potential entry points. We refined this method by excluding certain classes of roads, such as divided highways and freeways, which often pass through public lands without providing access, unless there is an off-ramp (which would appear under a different class of roads). In many cases, a drivable road comes close to but does not actually intersect the edge of a park, but it still provides access via a connecting walkable pathway. To account for this, we also intersected non-drivable roads with parks, but only retained the entry points if they were within 1,000 feet of a drivable road. As in other cases, we still have seen edge cases where a road skirts or surrounds a park but does not intersect it in the data. In that case, we can't produce an entry point, and therefore can't produce a driveshed, and therefore don't count this park in our access metrics, though someone might still be able to walk into it from the surrounding road.

We knew that this dataset would be only an approximation of access, and we would never recommend using it to give anyone directions to a park. But in our testing and review, the approach produces results sufficient for local, regional, and statewide analysis when taking into account other mitigating factors we implemented when combining isochrones (areas within a defined driving distance of a single point) into drivesheds and then distributing demographic data based on where people live. Those items are explained in more detail in the following sections.

Defining Walking Visitorsheds

For Neighborhood Parks, we used a simple half-mile Euclidean buffer distance to define the walkshed for each park. By using Euclidean buffers we are able to assume that neighborhood parks are not entry point specific and instead buffer the full boundary of a park.

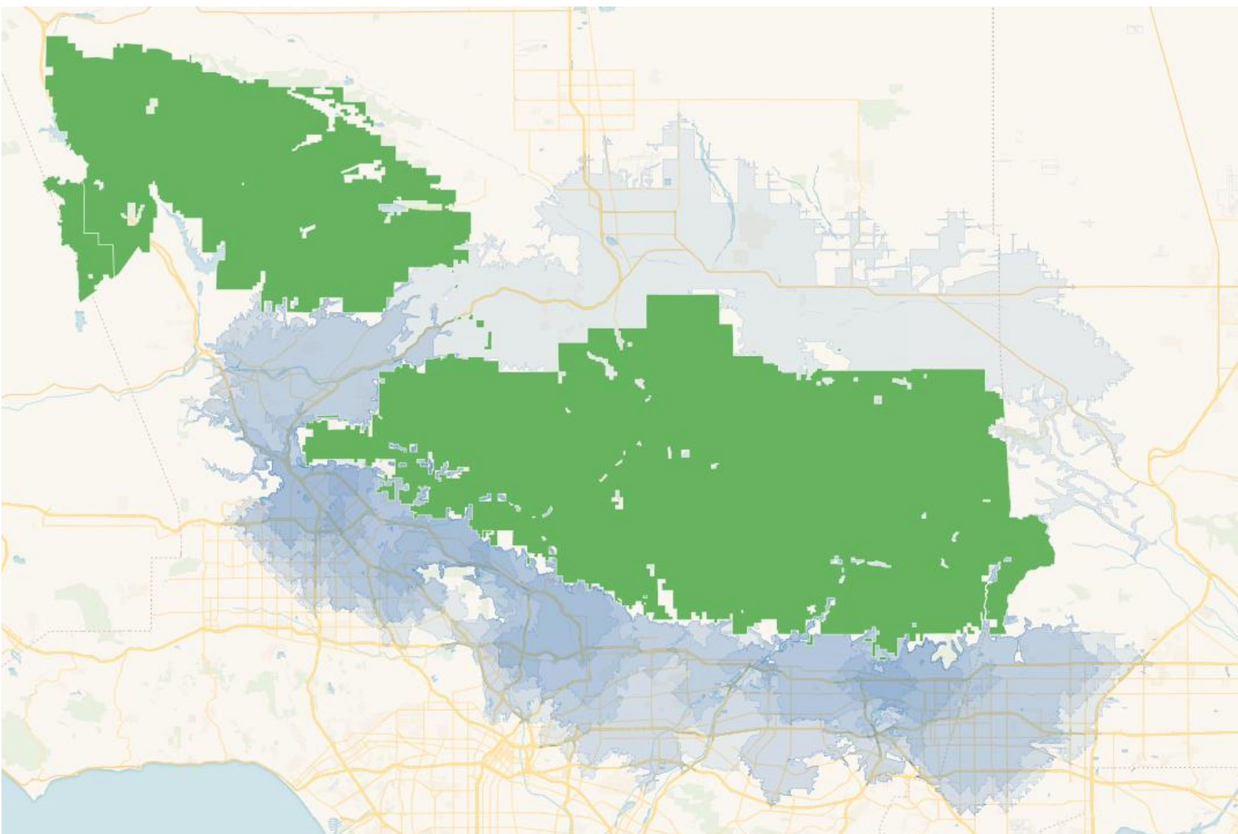
Also, we have found that network analysis for such small areas is of limited value. Network data for driving is much better than for walking. Accurate walkshed routing would require extensive improvements to data about sidewalks, crosswalks, and trails. In testing, we found hyperlocal network distance across both urban and rural landscapes often produces as many errors as it solves.

There is precedent for the Euclidean buffer method: It is the one used by the California Department of Parks and Recreation at parksforcalifornia.org. We took the proven approach here of a simple half-mile buffer from the park edge.

Defining Driving Visitorsheds

As described above, access to regional parks is most accurately represented by entry points. Entry points are also necessary to generate a network analysis that estimates the way people get to a park when using the road network. Network analysis is done using a technique of creating isochrones (areas within a defined network distance of a single point). We did this using an open source routing engine called Valhalla.

Using the entry points for each park (as described above), we were able to calculate the isochrones for each point where one could potentially enter a regional park. Each individual entry point isochrone could then be merged with other isochrones for that park or open space, and with the parent park, to produce a driving visitorhed.



To determine the distance people are willing to travel to visit a park we located a national survey about travel patterns. According to the National Household Travel Survey, the average recreational or social trip by car is 13 miles in urban areas and 23 miles in rural areas.

Because many of the states in this project have distinct urban and rural areas, we felt it was important to distinguish which parks were urban and which were rural. The following methods were used:

- Each park entry point was used to create 13-mile isochrone and then merged to a respective park visitorshed.
- The 13-mile visitorsheds were evaluated to determine what percentage of the area was classified as urban or rural, according to the latest decennial Census block data (this was 2010 at the time of our analysis in 2022, since the 2020 version of this data had not been released yet). If a visitorshed was 50% or more urban, the park was considered urban and assigned a 13-mile visitorshed.
- If the 13 mile visitorshed was less than 50% urban, a second test was run. The second test produced a 23-mile visitorshed and again looked at the percent urban versus rural. Those that were at least 50% urban also had their associated parks marked urban and assigned 13-mile visitorsheds.
- All remaining parks were defined as rural and assigned 23-mile visitorsheds.

Once each park has been defined as urban or rural, the visitorsheds for associated groups of parks are merged to a single larger polygon that represents the visitorshed of one regional park or open space. That visitorshed is our estimated extent that people would travel for an average recreational trip.

Every park visitorshed is the combination of many single point isochrones, and offers the additional benefit of diluting many potential issues with inaccurate entry points. In areas we surveyed that had some inaccurate entry points, we noticed that we also had nearby accurate points that covered the same area. When the isochrones were combined, the additional area covered by inaccurate points was negligible.

A note about transit

An obvious question for this project is why we are looking at walking distance for neighborhood parks and driving distance for regional parks, but not transit access for either one. There are a few reasons for this: First, the same National Household Travel Survey we used to understand typical driving distances also tells us that the typical recreational transit trip is 11 minutes, with no transfers. In the vast majority of locations, the number of regional parks and open spaces accessible that way is vanishingly small. Second, data availability for transit providers, while much better than in the past, remains challenging to assemble across entire states. Third, we do include demographic information about limited car access in our analysis, so in areas with limited car access, park advocates and decision makers can use that information to argue for improved transit services to parks and open spaces. And certainly, this project could be enhanced in the future by adding transit analysis to the work, though that is likely to be useful only in metro areas with already robust transit systems.

Understanding where people live

Based on all of the above, we knew not just where the regional parks and open spaces are, but also the areas from which they would most likely draw their regular visitors. But we didn't yet know who lived in those areas — was this a dense urban neighborhood or a sparsely populated hinterland?

Typically, we use data from the American Community Survey (ACS) for this. The ACS provides an incredibly rich array of data about people in every part of the United States, usually at the Census Block Group level (and above). Each of those shapes have somewhere between 600 and 3,000 people in them. In urban areas, they are small but in rural areas they can be quite large.

Visitorsheds often cover large areas and have complex edges created by the road network analysis. To improve demographic reporting, we wanted to optimize our spatial analysis to more accurately account for where people do (and do not) live.

Several years ago, Meta (formerly Facebook) worked with academic and government patterns to develop the High-resolution Human Settlements Layer as a contribution to global humanitarian mapping and emergency response. The dataset uses high resolution satellite imagery combined with complex statistical analysis to estimate the population within each 30 meter grid cell across the Earth's surface. The data is remarkably fine in detail, showing not only unpopulated forests and deserts but also allowing population estimates to account for the fact that that people don't live on roads, at factories, or in malls or cemeteries, all areas where traditional census polygon boundaries would say that populations might be found, within some larger geometry.

Using these "People Points" allows us to estimate with much greater precision the populations and levels of park access for each 30m grid point across our pilot states.

This high-resolution data also helped us mitigate potential issues with inaccuracies in our entry point data (described above). In some areas where we estimated access would exist where it does not (for example, a road crossing a park boundary where you are not allowed to park or enter), we noticed the population was sparse or entirely absent in many of these same areas. So in that case, we didn't actually overestimate access in those locations, because we only estimate access in places where people actually live.

The high-resolution data does have limitations, but the limitations did not outweigh the added value of more precise locations of population. Limitations include:

- Currently, the Human Settlements Layer people-points location data is from 2016. While this does mark a point in time for how the population is geographically distributed, we were able to use updated American Community Survey (ACS) 2019 demographics data allocated to the points. These methods are discussed in more detail in the next section.
- Limited demographic data is available from the Meta population data. Again, we are able to apply methods to improve this, as discussed below.
- Population totals for states tend to be shy of the official Census estimates, though most are within 5% of the population reported by the Census Bureau in 2016.

Assigning demographics

The Human Settlements Layer is highly detailed in its resolution but has two main limitations we aimed to improve. First we wanted more recent data, accomplished by factoring ACS 2019 population attributes to the 2016 distribution. Second, we wanted to include multiple topics such as race/ethnicity, educational attainment, income, and vehicle accessibility. Again, these data variables were possible to include by distributing 2019 data to the 2016 locations.

Recent population data was downloaded from the American Community Survey 2015-2019 block group data via the Census API. (While 2016-2020 data had been released, we were hesitant to accept the potential inaccuracies within the data due to COVID.) Once obtained, we were able to distribute population counts within block groups as follows:

For each population point, mark the block group it falls within

- Add the population points up, by block group - determining the number of people in the block group according to the population point data.
- For each population point, determine the percentage of the block group it represents
- Attached the ACS 2019 block group population data to each population point
- Derive the updated population for the point, by multiplying the percentage of the block group population from 2016 data, the ACS 2019 population.

In the image below, the blue outline represents a Census block group, the smallest shape available for many Census metrics. We know that the polygon has 894 people inside it. With this image, we also see that it is visually obvious that the population is not evenly distributed. There are concentrations in the south and others sprinkled in the northern half. In urban areas the population concentrations are somewhat regular, though commercial areas can be skewed.

In the second image below, the Human Settlements Layer is more spatially detailed, showing the distribution of population on a 30 x 30 meter grid. In the same block group polygon, you can see the points are located where people live. In rural and suburban areas this can help highlight population concentrations and non-populated areas. Each point is attributed with the number of people at the location.

The second issue was the need to provide a wide range of attributes such as race/ethnicity, education, vehicle access, or any other number of things we can derive from the American Community Survey. This was possible by crosswalking the two datasets. Similar to the methods used to provide more current population totals, we were able to aggregate the population total from the Human Settlements Layer within a Census block group, and compute the relative number of other demographics. This method does have limitations. For example, if the 600 to 3,000 people within a block Group are themselves unevenly distributed among populated points, we won't capture that in our analysis. This could occur if one side of a Block Group is dominated by one racial or ethnic group while the other is dominated by another. This means one should not use the data for neighborhood level outreach, but at that point talking to people on the ground is always better than using data. For initial planning and analysis, our data is the most detailed we have seen on such a wide spatial scale.

The other limitation is that we are distributing population to areas as mapped in the Human Settlement Layer, which could be missing areas with very recent construction. Because we are using the most recent ACS data, overall population estimates are the best available but in locations with rapid development or decline, spatial distribution of those populations might vary slightly at a local level. The example below highlights an area where housing has been built between 2017 and 2019, and is therefore not reflected in the points from 2016.

Estimating Park Access

Our final and perhaps most important step is to take our Park Visitorsheds, both Regional drivesheds and Neighborhood walksheds, and overlap them with our People Points. For every point, we calculated each of the following:

- How many Open Access Regional Parks or Open Spaces are accessible from this point
- How many Open Access Neighborhood Parks are accessible from this point
- How many Restricted/Closed Regional Parks or Open Spaces are accessible from this point
- How many Restricted/Closed Neighborhood Parks are accessible from this point

These numbers in turn support our overall policy recommendations of where investing in programs, opening restricted lands, or acquiring new lands would improve access for people who currently lack it.

Because our visitorsheds have noise at the edges of the road network, we use the data above only as an overall indicator of relative access, rather than a precise indicator of exactly how many parks one can reach from one 30 meter square vs the one next door.

Note that our metrics do not currently include a measure of what is often called park pressure, which attempts to measure the park "supply" compared to the number of people living nearby. This is often expressed as park acres per thousand people, and in California, the state set a threshold of at least 3 acres per thousand. We hope to add this measure to our data in the near future.