Methodology for Opportunity and High-Poverty & Segregated Area Mapping Tools

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Background and Purpose

About affirmatively furthering fair housing

As defined in state law,[1] affirmatively furthering fair housing (AFFH) means taking meaningful actions, in addition to combating discrimination, that overcome patterns of segregation and foster inclusive communities free from barriers that restrict access to opportunity based on protected characteristics. Specifically, affirmatively furthering fair housing means taking meaningful actions that, taken together:

- Address significant disparities in housing needs and in access to opportunity,
- Replacing segregated living patterns with truly integrated and balanced living patterns,
- Transforming racially and ethnically concentrated areas of poverty into areas of opportunity, and
- Fostering and maintaining compliance with civil rights and fair housing laws.

Purpose of the mapping tools

Each mapping tool described in this methodology documentation is intended to be used to advance specific AFFH objectives. A summary of each mapping tool's purpose is included below.

Opportunity: The opportunity map identifies areas in every region of the state whose characteristics have been shown by research to be associated with positive economic, educational, and health outcomes for low-income families—particularly long-term outcomes for children.[2] As such, the map is intended to inform efforts to advance the AFFH objective of increasing access to opportunity. CTCAC adopted this map into its regulations in December 2017, accompanying new policies aimed at increasing access to high-opportunity areas for families with children in housing financed with 9% Low Income Housing Tax Credits (LIHTCs). For this reason, the research partners aligned this map and the methodology behind it with the competitive funding infrastructure for the 9% LIHTC program (e.g., geographic competition). The map has also since been used to inform similar policies in other state affordable housing funding programs, such as HCD's Multifamily Finance Super NOFA and the California Debt Limit Allocation Committee's regulations. However, some methodological adjustments may be called for if the map is applied to broader contexts and different application processes.

High-Poverty & Segregated Areas: The high-poverty and segregated overlay identifies areas that meet standards for both high or "concentrated" poverty rates (30% or more of the population below the federal poverty line) and racial segregation (overrepresentation of individual non-white racial/ethnic groups and/or people of color as a whole relative to the

[1] For more information on HCD's approach to advancing AFFH objectives, see: https://www.hcd.ca.gov/planning-and-community-development/affirmatively-furthering-fair-housing.

[2] The mapping methodology is narrowly tailored towards upward mobility for children of low-income families. Although the methodology includes indicators relevant to other populations, some indicators associated with positive outcomes for those populations may not be included.

county). The use of this overlay is grounded in two guiding AFFH objectives: to avoid further segregation and poverty concentration, and to increase access to opportunity for low-income families.

About the research partners

In February 2017, the Department of Housing and Community Development (HCD) and the California Tax Credit Allocation Committee (CTCAC) convened a group of independent organizations and research centers, referred to henceforth as the "research partners," to provide research support and develop evidence-based approaches – including the mapping tools described in this methodology documentation – to help advance AFFH objectives.[3]

[3] The research partners currently include representation from the Othering & Belonging Institute at UC Berkeley, the Terner Center for Housing Innovation at UC Berkeley, and the California Housing Partnership.

Opportunity Methodology

Rationale for methodology changes in the 2024 Opportunity Map

In 2023, the research partners undertook an in-depth review of the Opportunity Map's indicators and methodology, including reviewing the supporting academic literature as well as analyzing how the indicators interact with each other in the overall methodology. This work resulted in four major changes:

1. *Updating the scoring approach to count the number of economic and educational indicators above the regional median*: The revised approach is intended to increase transparency of the map's underlying methodology. This new approach clearly identifies which indicators are below or above the regional median – as well the value of the median itself – making it possible to identify which neighborhood characteristics are responsible for its designation in the map, as well as the reasons behind any changes in designation over time. This approach represents a substantial increase in transparency relative to the previous approach, which combined indicators into numerical indices that are difficult to interpret and where indicators' underlying values were obscured.

2. *Using a subset of four CalEnviroScreen (CES) indicators to create a single indicator that identifies the census tracts that rank as having the highest regional concentration of environmental burdens*: The full CES pollution burden dataset used in previous versions of the Opportunity Map includes a number of indicators that obscure the interpretation of environmental burden within a given region. For example, a number of CES variables that measure air quality (Ozone, PM2.5, and toxic releases) are modeled from either sensors or computer-generated estimates and do not show a great deal of variability within any given region. As a result, they do not meaningfully differentiate conditions at a census tract level for the purpose of housing siting decisions. For the purpose of protecting affordable housing residents from nearby environmental threats, data that measure the concentration of point sources of pollution are more relevant for maintaining a spatial buffer between affordable housing and environmental hazards than data that are either modeled or measure factors that are more dispersed on average.

   A subset of CES indicators – solid waste sites, groundwater threats, cleanup sites, and hazardous waste facilities – can be used to identify places that have relatively high concentrations of point sources of pollution. Averaging values for these 4 indicators and flagging the top 5% of tracts regionally identifies the places with the highest potential to expose vulnerable populations to nearby health and safety threats. In the revised scoring approach, the opportunity score is reduced for places with this "environmental burden flag"; in other words, environmental hazards factor into scoring only for places with the highest regional concentration of localized pollution burden. This protocol is intended to more appropriately use CES data within the Opportunity Map, as explained in more detail below.

3. *Transitioning the identification of high-poverty and segregated places from a filter in the CTCAC/HCD Opportunity Map to a separate overlay*. The revised approach allows stakeholders to see both whether a tract is in a High-Poverty & Segregated area as well as its underlying opportunity score and indicator values. The purpose of this change is to increase transparency by communicating the underlying opportunity-related characteristics of segregated areas of concentrated poverty. Stakeholders have raised concerns that gentrifying neighborhoods could be caught in the filter if they successfully preserve affordable housing and prevent displacement. The research partner's analysis found that the vast majority of segregated areas of poverty were low resource, but in rare cases, gentrifying, Moderate-to-High resource neighborhoods were caught in the filter. The overlay approach allows state housing agencies to make explicit policy decisions about how to treat neighborhoods that are both segregated and high poverty, in accordance with their AFFH strategies.

4. *Removing the proximity to jobs indicator*. The proximity to jobs indicator was removed from the Opportunity Map for multiple reasons. First, the literature on spatial mismatch suggests that while proximity to employment opportunities may be important for certain groups and in certain contexts, often the more significant factors influencing employment access are the form of transportation people have access to and the travel time to work *given that form of transportation*. As a result, a measure of employment proximity alone may not be sufficient in measuring employment accessibility. Second, an exploratory factor analysis found that the proximity to jobs indicator was not strongly correlated with the other eight economic and educational indicators and did not contribute nearly as much to explaining the variation in opportunity between neighborhoods. Finally, the research partners uncovered methodological issues with the indicator, with the number of proximate jobs varying widely across tracts and block groups, from zero to over a million. Without accounting for differences in population, it is difficult to derive meaning from these figures.

Rather than predetermining a fixed share of 40 percent of neighborhoods falling within the Highest and High Resource categories, as with prior versions of the map, the new threshold-based approach described above is adaptive to how place-based opportunity and resources are distributed within each region and does not predetermine this share. However, the new approach produces similar results, with 46 percent of neighborhoods falling into these categories statewide; this share varies modestly across regions, ranging from 43 percent to 48 percent in urban (non-rural) regions and 53 percent in rural areas.

Overview of the mapping approach

One of the challenges in creating an opportunity map to inform statewide housing policy is that California contains significant regional variation – from Central Valley cities and towns, to Los Angeles, to the San Francisco Bay Area, to rural areas throughout the state.

Using absolute thresholds for place-based opportunity could introduce comparisons between very different areas of the state that make little sense from a policy perspective—in effect, holding a farming community to the same standard as a dense, urbanized neighborhood in one of the state's coastal cities. Deriving opportunity scores through comparison to the entirety of the state would align neither with realistic moving patterns of families, nor with the infrastructure for affordable housing funding programs—where applicants for family-targeted affordable housing typically compete with other applicants in the same region, and rural applicants compete in a separate funding pool.

To allow state housing agencies to incentivize equitable development patterns within each part of the state, the Opportunity Map identifies the neighborhoods that score better across nine economic, educational, and environmental indicators relative to other neighborhoods in the same region. These indicators are described in detail below.

A neighborhood's score for each economic and educational indicator (described later in this document) is determined by whether it falls above or below the median (50th percentile) tract or block group value within each region. Each indicator that falls above the regional median adds 1 point to the final score.

The opportunity score also reflects local environmental conditions. The Opportunity Map uses a subset of data from the CalEnviroScreen 4.0 tool to identify the geographies that have the highest potential – defined here as ranking in the highest 5% of regional environmental burden – to expose vulnerable populations to nearby health and safety threats. Places with this "hazard flag" have 1 point subtracted from the final score. This approach is described in more detail below.

Regional median and top 5% values are calculated based on urban tracts and/or rural block groups within each region.[4] For counties outside of the 8 urban regions, defined below, regional medians are calculated separately for each county. To account for the presence of missing values for indicators in certain tracts or block groups, any tracts or rural block groups for which more than 2 of the indicators are missing are removed from consideration and receive no designation.

Using this method, the final scores are divided into four primary categories:

- 8 or 9 = "Highest Resource"
- 6 or 7 = "High Resource"
- 4 or 5 = "Moderate Resource"
- 3 or lower = "Low Resource"

[4] For rural geographies, the regional medians for economic and educational indicators are calculated at the block group level. However, because CalEnvrioScreen data are not available at the block group level, environmental hazard percentile ranks are calculated at the census tract level. The environmental hazard percentile rank calculated at the census tract level is assigned to each of the block groups within a given rural census tract.

Excluding tracts or block groups

The tool also excludes certain census areas from being categorized. To improve the accuracy of the mapping, tracts and rural block groups with the following characteristics are excluded from categorization based on indicator scores:

- Areas with unreliable data, as defined earlier in this document;
- Areas where people residing in institutionalized facilities make up at least 75 percent of the population;[5]
- Areas with population density below 25 people per square mile and total population below 750; and
- Areas where at least half of the age 16+ population is employed by the armed forces, in order to exclude military base areas where it is not possible to develop non-military affordable housing.[6]

Excluded tracts and rural block groups are identified as "Missing/Insufficient Information" on the mapping tool or "N/A" in the public data file.

Regional boundaries

To determine the regional definitions, the Opportunity Map mostly mirrors the geographic apportionments designated within CTCAC's regulations but bundles some of these apportionments to create more accurate regions, with guidance from CTCAC and HCD. Following is a list of the opportunity map regions with the respective geographic apportionment(s) captured in that region:

Opportunity Mapping Region	Geographic Apportionment in CTCAC Regulations
Los Angeles Region	City of Los Angeles
	Balance of Los Angeles County
Bay Area Region	East Bay Region
	South and West Bay Region
	San Francisco County
	Marin, Napa, Solano, and Sonoma Counties (from the Northern Region)
Central Valley Region	Central Valley Region
San Diego County	San Diego County
Capital Region	Capital Region minus Sutter and Yuba Counties
Inland Empire Region	Inland Empire Region

[5] Institutionalized facilities include adult correctional facilities, juvenile facilities, skilled-nursing facilities, and other institutional facilities such as mental (psychiatric) hospitals and in-patient hospice facilities.

[6] Prisoner population taken from 2020 Census table P5_002N; armed forces data from ACS table B23025_006.

Orange County	Orange County
Central Coast Region	Central Coast Region
Rural Areas	Non-metropolitan counties, plus Butte, Shasta, Sutter, and Yuba Counties, as well as tracts that are eligible for Section 515

Please refer to the CTCAC regulations for a list of counties included in each geographic apportionment.

Identifying and categorizing opportunity in rural tracts

The Opportunity Map measures opportunity in rural parts of the state at the block group level, rather than at the tract level as in the rest of the state. Since tracts in rural areas of California are approximately 37 times larger in land area than tracts in non-rural areas, tract-level data in rural areas may mask over variation in opportunity and resources within these tracts. Assessing opportunity at the block group level in rural areas reduces this difference by 90 percent (each rural tract contains approximately three block groups), and thus allows for finer-grained analysis.

Although rural areas are evaluated at the block group level, the rural designation is assigned by Census tract, rather than block group, to maintain consistency with urban and rural evaluation, i.e. to avoid a scenario in which a tract is split between rural and urban areas, the latter of which are evaluated by tract. To capture the diverse array of rural communities across the state—both within and outside of designated metropolitan statistical areas—this methodology takes a three tiered approach to identifying rural census tracts. For mapping purposes, tracts that fall in the "Rural Areas" category include:

1. All tracts in the following Non-Metropolitan counties: Alpine, Amador, Calaveras, Colusa, Del Norte, Glenn, Humboldt, Inyo, Lake, Lassen, Mariposa, Mendocino, Modoc, Mono, Nevada, Plumas, Sierra, Siskiyou, Tehama, Trinity, and Tuolumne;
2. All tracts in Butte, Shasta, Sutter, and Yuba Counties;
3. Any other non-urbanized block group with at least half its population in an area deemed as rural on the U.S. Department of Agriculture's online multifamily mapping application.

Any tract that falls within the 25 counties listed above is designated as a "Rural Area." Beyond those counties, the research partners identified areas in the state that correspond with rural areas on the U.S. Department of Agriculture's online multifamily maps.

These areas were then overlaid with census tract boundaries to identify what share of the population within a tract falls within the rural area. If at least 50 percent of a tract's population is located within census blocks which have their population-weighted centroid within the rural area, that census tract was allocated to the "Rural Areas" designation. [7]

[7] Blocks are the smallest geographic unit available in the U.S. Census.

For block groups that fall within the rural designation, the maps take a slightly different approach to allocating resource categories. Because rural areas span the state (including both poorer and wealthier regions), rural block groups are ranked in comparison to other rural block groups within the same county, as long as there are at least two observations for any given indicator.

Indicators

Indicators used in the CTCAC/HCD Opportunity Map are selected based on the following criteria:

- Evidence from peer-reviewed research that the indicator is linked to improved life outcomes for low-income families, particularly children
- Reliable data
- Publicly available data
- Statewide data coverage
- Fine geographic detail[8]

See below for the full list of opportunity indicators, measures, and data sources.

Indicator	Measure	Data Source	Table
Above 200 Percent of Poverty	Percent of population with income above 200% of federal poverty line	2017-2021 ACS	Table C17002
Adult Education	Percent of adults with a bachelor's degree or above	2017-2021 ACS	Table B15003
Employment	Percent of adults aged 20-64 who are employed in the civilian labor force or in the armed forces	2017-2021 ACS	Table B23024
Median Home Value	Value of owner-occupied units	2017-2021 ACS	Table B25077
Environmental Burden	CalEnviroScreen 4.0 Site-Based Pollution Indicators	CalEnviroScreen 4.0	Variables: solid waste sites, groundwater threats, cleanup sites, hazardous waste facilities

[8] Data include point source coordinates or are aggregated into small-area geographies such as Census tracts and block groups.

Math proficiency	Percentage of 4th graders who meet or exceed math proficiency standards	2021-2022 California Department of Education (DOE)	
Reading proficiency	Percentage of 4th graders who meet or exceed literacy standards	2021-2022 CA DOE	
High school graduation rate	Percentage of high school cohort that graduated on time	2021-2022 CA DOE	
Student poverty rate	Percentage of students not receiving free or reduced-price lunch	2022-2023 CA DOE	

It should also be acknowledged that an opportunity map's accuracy in measuring place-based resources is limited by the accuracy of the data underlying it. Data may be derived from self-reported surveys of subsets of an area's population, and sometimes may not be recorded or reliable in some areas. Further, even the most recent publicly available datasets typically lag by two years, meaning they may not reflect the most recent conditions in areas undergoing very rapid change. The methodology described in this document attempts to address each of these limitations to the degree possible. In addition, the research partners update the data contained within the mapping tool annually and review the methodology to make improvements over time.[9]

The rationale and metric for each indicator is described in more detail below.

Poverty Rate. Neighborhood poverty rates have been shown through numerous studies to be a strong indicator of an area's level of resources, risk, and opportunity, and predictor of key life outcomes for low income children in particular. Living in high-poverty areas increases exposure to localized risks—such as violent crime, low-quality and underfunded schools, and pollution—that have been shown to contribute to toxic stress, poor physical and mental health, low educational attainment, and impaired cognitive development in children. On the other hand, living in low poverty areas has been shown to be associated with substantial benefits such as

[9] The code used to calculate the opportunity scores also goes through an annual review process for quality assurance. Year over year changes in opportunity designations are also reviewed on an annual basis.

higher educational attainment and long-term earnings increases for low-income children, as well as improved mental and physical health for both children and adults.[101112]

This indicator is measured using two hundred percent of the poverty line to reflect the higher cost of living in California. Because each indicator is designed to measure opportunity in a positive sense, this indicator is measured as the percent of a tract's or rural block group's residents who live above 200 percent of the federal poverty line.[13]

To prevent college towns from negatively impacting an area's resource score, college and graduate students are removed from the above 200 percent of poverty calculation in areas where they comprise at least 25% of the population. An internal analysis found that without this adjustment, most tracts with high proportions of college students have lower than typical scores relative to the region, many of which are high resource according to other indicators, likely due to the Census classifying many unemployed and partially employed students living off-campus up as poor.

Adult Education Rate. The tract-level share of adults that have earned a bachelor's degree has been shown to be highly correlated with rates of upward economic mobility for low-income children.[14] Higher rates of post-secondary attainment are also predictive of higher wages and improved work opportunities for adults, meaning that families are less likely to be economically insecure.[15] Research has indicated that children living in neighborhoods with a higher average socioeconomic status (SES) are more likely to graduate from high school. Additionally, starting at age three, children living in higher SES neighborhoods and/or with a greater percentage of managerial or professional residents begin to perform better on IQ tests than their peers who live in lower SES neighborhoods.[16] Additional research has shown that an increasing supply of college graduates is associated with higher earnings for other labor force participants. These findings are especially noteworthy because they show that these "spillover" effects are even more pronounced for less skilled workers; a more highly educated labor force leads to higher

[10] For a summary of this research, see "Evidence Shows that Neighborhoods Affect Children's Well-Being and Long-Term Success" in Sard, B., & Rice, D. (2016). Realizing the Housing Voucher Program's potential to enable families to move to better neighborhoods. Washington, DC: Center on Budget and Policy Priorities.
[11] Chetty, R., Hendren, N., & Katz, L.F. (2015). The Effects of Exposure to Better Neighborhoods on Children: New Evidence from the Moving to Opportunity Experiment. Cambridge, MA: Harvard University and National Bureau of Economic Research. http://www.equality-of-opportunity.org/assets/documents/mto_paper.pdf
[12] Chetty, R., Friedman, J., Hendren, N., Jones, M., Porter, S. (2018). The Opportunity Atlas: Mapping the Childhood Roots of Social Mobility. Opportunity Insights. NBER Working Paper No. 25147.
[13] In 2023, the federal poverty line for a family of four is $30,000.
[14] Chetty, R., Friedman, J., Hendren, N., Jones, M., Porter, S. (2018).
[15] See Bureau of Labor Statistics (2016), "Unemployment Rates and Educational Attainment." Accessed at https://www.bls.gov/emp/ep_chart_001.htm.
[16] For a full review of the literature on how living in neighborhoods with high socio-economic statuses and/or high adult education rates, see Leventhal, T., & Brooks-Gunn, J. (2000). The neighborhoods they live in: The effects of neighborhood residence on child and adolescent outcomes. Psychological Bulletin, 126(2), 309–337. https://doi.org/10.1037//0033- 2909.126.2.309.

wage gains for high school dropouts and high school graduates than those with college degrees.[17]

This indicator is measured by calculating the percent of adults 25 years and older who have earned at least a bachelor's degree in each tract and rural block group.

Employment Rate. The tract-level share of employed adults has been shown to be highly correlated with rates of upward economic mobility for low-income children.[18] Adult unemployment is commonly considered to be an indicator of neighborhood disadvantage that affects not just the individuals who do not have jobs, but members of the entire community.[19] Areas with low levels of employment see outcomes similar to those with high poverty rates, including poor health outcomes, low birthweight babies, and violent crime.[20]

The employment rate is calculated as the percent of individuals in each tract and rural block group age 20-64 who are employed in either the civilian labor force or the armed forces. The employment rate is used because the unemployment rate does not account for individuals who have dropped out of the labor force due to disillusionment with their job prospects.

Home Value. Home value is a strong proxy for neighborhood quality and community resources. Research suggests that neighborhood characteristics, such as school quality, public resources, crime rates, environmental quality and even perceived social benefits are all reflected in home values. For example, research has demonstrated a link between school quality and house prices.[21] Conversely, disruption of schools (such as school closings and redistricting) can be reflected in declining home values.[22] Crime, too, has been shown to negatively impact house prices, especially the prevalence of violent crime.[23] Researchers have quantified the extent to which factors such as clean air, open spaces, and even well-educated neighbors can all capitalize into house prices.[24][25][26] Collectively, home prices are directly impacted by a variety of

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[17] Moretti, E. (2004). Estimating the social return to higher education: evidence from longitudinal and repeated cross-sectional data. Journal of Econometrics, 121(1), 175–212. https://doi.org/10.1016/j.jeconom.2003.10.015.

[18] Chetty, R., Friedman, J., Hendren, N., Jones, M., Porter, S. (2018).

[19] 1 Santiago, C. D., Wadsworth, M. E., & Stump, J. (2011). Socioeconomic status, neighborhood disadvantage, and povertyrelated stress: Prospective effects on psychological syndromes among diverse low-income families. Journal of Economic Psychology, 32(2), 218–230. https://doi.org/10.1016/j.joep.2009.10.008.

[20] Pearl, M., Braveman, P., & Abrams, B. (2001). The Relationship of Neighborhood Socioeconomic Characteristics to Birthweight Among 5 Ethnic Groups in California. American Journal of Public Health, 91(11), 1808–1814.

[21] Nguyen-Hoang, P., & Yinger, J. (2011). The capitalization of school quality into house values: A review. Journal of Housing Economics, 20(1), 30–48. https://doi.org/10.1016/j.jhe.2011.02.001.

[22] Bogart, W. & Cromwell, B. (2000). How Much is a Neighborhood School Worth? Journal of Urban Economics 47, 280-305.

[23] Gibbons, S. (2004). The costs of urban property crime. The Economic Journal, 114(499).

[24] Smith, V. K., & Huang, J.-C. (1995). Can Markets Value Air Quality? A Meta-Analysis of Hedonic Property Value Models. Journal of Political Economy, 103(1), 209–227. https://doi.org/10.1086/261981.

[25] Bolitzer, B., & Netusil, N. (2000). The impact of open spaces on property values in Portland, Oregon. Journal of Environmental Management, 59(3), 185–193. https://doi.org/10.1006/jema.2000.0351.

[26] Gibbons, S. (2003). Paying for Good Neighbours: Estimating the Value of an Implied Educated Community. Urban Studies, 40(4), 809–833. https://doi.org/10.1080/0042098032000065317.

neighborhood characteristics, and are to a large extent a bellwether of the quality of the neighborhood itself.

This indicator is calculated as the median home value (dollars) of owner-occupied housing units for every Census tract and rural block group.

Math and Reading Proficiency. Elementary school test scores from 3rd and 4th grade are considered in the literature to be strong proxies for the level of resources and opportunity during early childhood both in local schools and more broadly in communities.[27] Indeed, studies have shown that test scores should be understood as an output of students' neighborhood conditions—such as whether they live in a high-poverty or high-crime area—and not only of students' individual abilities and family backgrounds, or the quality of the schools they attend.[28][29]Further, test scores and other measures of school quality are highly correlated with upward mobility for low-income children.[30] Proficiency on elementary school-age standardized tests is also a strong predictor of whether individual children will eventually graduate high school,[31] which itself is associated with higher long-term earnings and other social benefits compared to dropping out.[32]

"Proficiency" is defined as the percent of students that are performing at grade-level in the 4th grade in each school. Math and reading proficiency scores are calculated as the enrollment weighted average proficiency level of students at the three closest schools, within the same county, to each census tract's centroid. The average value from three schools is used because the methodology does not account for school assignment boundaries, which are different from census tract boundaries.

This approach does have limitations, including that students will attend only one of the three closest schools, so the quality of the school they attend may differ somewhat from the average score that is calculated in each census tract. In addition, this approach does not account for school district assignment policies due to data limitations. However, the academic literature suggests that low-income students are more likely to attend their neighborhood schools even

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[27] See, for example: Reardon, Sean F. 2017. Educational Opportunity in Early and Middle Childhood: Variation by Place and Age. Stanford Center for Education Policy Analysis. Working Paper No. 17-12.

[28] Burdick-Will, J., Ludwig, J., Raudenbush, S. W., Sampson, R. J., Sanbonmatsu, L., & Sharkey, P. (2011). "Converging evidence for neighborhood effects on children's test scores: An experimental, quasi-experimental, and observational comparison." In G.J. Duncan & R.J. Murnane (Eds.) Whither Opportunity: Rising Inequality, Schools, and Children's Life Chances (255- 276). New York: Russell Sage Foundation.

[29] Schwartz, H. (2012). "Housing Policy is School Policy: Economically Integrative Housing Promotes Academic Success in Montgomery County, Maryland," in Khalenberg, R.D. (ed.), The Future of School Integration. New York City: The Century Foundation).

[30] Chetty, R., Friedman, J., Hendren, N., Jones, M., Porter, S. (2018)

[31] Fiester, L. (2013). Early Warning Confirmed: A Research Update on Third-Grade Reading. The Annie E. Casey Foundation. http://www.aecf.org/m/resourcedoc/AECF-EarlyWarningConfirmed-2013.pdf.

[32] Sum, A. et al. (2009). The Consequences of Dropping Out of High School: Joblessness and Jailing for High School Dropouts and the High Cost for Taxpayers. Northeastern University Center for Labor Market Studies. http://www.issuelab.org/resources/14510/14510.pdf.

when they have a choice to go elsewhere,[33] and that choice-based assignment policies can have the effect of worsening school segregation.[34] Further, experts and researchers consulted as part of a review of education indicators and measurements used in the Opportunity Map expressed that it was not essential to account for assignment boundaries, and that using data from either the closest school or the three closest schools would serve as an accurate proxy for attendance.

High School Graduation Rate. Low graduation rates indicate that schools are not preparing students for the workforce. Students who do not graduate from high school face a variety of challenges later in life, including an increased risk of going to prison and lower wages than their classmates who graduate.[35,36] In addition, high schools with lower graduation rates have also been found to have disciplinary practices that negatively impact low-income and minority youth as well as lower levels of teacher engagement.[37]

The high school graduation rate indicator is calculated based on the cohort-weighted average of the three high schools nearest to the tract or rural block group centroid, using California Department of Education data on the percent of students who graduate in four years.[38]

Student Poverty. Studies have consistently shown that attending low-poverty and economically integrated schools boosts educational achievement for low-income students, when compared to attending higher poverty schools.[39] Recent research has concluded that the disparity in school poverty rates that Black and white children experience is the primary mechanism through which racial segregation in schools translates to Black-white academic achievement gaps.[40][41]

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[33] Vernez, G. et al. (2009). State and Local Implementation of the No Child Left Behind Act: Volume VII -- Title I School Choice and Supplemental Educational Services: Final Report. Santa Monica, CA: RAND Corporation, 2009. https://www.rand.org/pubs/reprints/RP1383.html. Gill, B., et al. (2008). State and Local Implementation of the No Child Left Behind Act: Volume IV -- Title I School Choice and Supplemental Educational Services: Interim Report. Santa Monica, CA: RAND Corporation, 2008. https://www.rand.org/pubs/reprints/RP1332.html.

[34] See, for example: Goldstein, D. (2019, April 25). San Francisco Had an Ambitious Plan to Tackle School Segregation. It Made It Worse. The New York Times. Retrieved from https://www.nytimes.com/2019/04/25/us/san-francisco-school-segregation.html.

[35] 1 Martin, E. J., Tobin, T. J., & Sugai, G. M. (2003). Current Information on Dropout Prevention: Ideas From Practitioners and the Literature. Preventing School Failure: Alternative Education for Children and Youth, 47(1), 10–17. https://doi.org/10.1080/10459880309604423.

[36] Campbell, L. (2004). As Strong as the Weakest Link: Urban High School Dropout. High School Journal, 87(2), 16–24.

[37] Christle, C. A., Jolivette, K., & Nelson, C. M. (2007). School Characteristics Related to High School Dropout Rates. Remedial and Special Education, 28(6), 325–339. https://doi.org/10.1177/07419325070280060201.

[38] Other graduation indicators exist, such as the percent of 12th graders who graduate within one academic year, but this indicator obscures whether students are repeating grades or dropping out during the first three years of high school.

[39] Ayscue, J., Frankenberg, E., & Siegel-Hawley, G. (2017). Research Brief: The Complementary Benefits of Racial and Socioeconomic Diversity in Schools. The National Coalition on School Diversity: Brief No. 10. http://schooldiversity.org/pdf/DiversityResearchBriefNo10.pdf.

[40] Reardon, S.F., et al. (2019). Is Separate Still Unequal? New Evidence on School Segregation and Racial Academic Achievement Gaps. Stanford Center for Education Policy Analysis Working Paper No. 19-06.

[41] Reardon, S. F. (2016). School Segregation and Racial Academic Achievement Gaps. The Russell Sage Foundation Journal of the Social Sciences, 2(5), 34-57.

To the extent that accounting for student poverty also to some extent accounts for race and ethnicity due to their historical and ongoing links, , racial integration in schools provides benefits for low-income students and students of color that both overlap and complement the benefits of economic integration in the classroom—including higher levels of educational attainment, reductions in prejudice and negative attitudes across racial groups, and long-term improvements in earnings, health, and rates of incarceration—all while producing no detrimental effects for white children.[42]

As with the math and reading proficiency indicators, student poverty is calculated by averaging the attribute, weighted by school enrollment, from the three closest schools to the population-weighted centroid of each census tract or rural block group. And similar to the poverty indicator, school poverty rates are measured as the percent of students that do not receive free and reduced price lunch, to better align with the opportunity-oriented constructions of the other variables.

Environmental Burden. Local environmental burden adversely affects community-level opportunity. A long history of research on environmental justice has made clear that environmental and health hazards have tended to accumulate in, and continue to disproportionately impact, low-income communities and communities of color which, for a variety of reasons, show higher levels of vulnerability to these hazards.[43] Environmental hazard data are included in the Opportunity Map in order to identify geographies with high environmental burden and disincentivize new affordable housing development in these areas.

The environmental burden indicator relies on a composite of four indicators that are used in the California Office of Environmental Health Hazard Assessment (OEHHA)'s CalEnviroScreen 4.0 tool (CES) under the "environmental effects" subcomponent of the "pollution burden" domain of CES. These indicators - solid waste sites, groundwater threats, cleanup sites, and hazardous waste facilities - measure the presence and concentration of localized sources of pollution; the indicators are built from data that account for both the number of point sources of pollution within a census tract as well as the distance of a pollution source from populated census blocks within that tract.[44] While other environmental hazard data remain available via CES, they are no longer included in the Opportunity Map either because they are not measured at a scale that is relevant for differentiating conditions at a census tract level or because they include features that complicate their interpretation.

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[42] Ayscue, J., Frankenberg, E., & Siegel-Hawley, G. (2017).

[43] See, for example, Kreig, E. et al. (2004). Not so Black and White: environmental justice and cumulative impact assessments. Environmental Impact Assessment Review 24(7-8). https://doi.org/10.1016/j.eiar.2004.06.008; Morello-Frosch, R. et al. (2011). Understanding The Cumulative Impacts Of Inequalities In Environmental Health: Implications For Policy. Health Affairs, 30(5). https://doi.org/10.1377/hlthaff.2011.0153; Mohai, P. et al. (2015). Which came first, people or pollution? Assessing the disparate siting and post-siting demographic change hypotheses of environmental injustice. Environmental Research Letters, 10(11). https://doi.org/10.1088/1748-9326/10/11/115008; Chakraborty, J. et al. (2016). Environmental Justice Research: Contemporary Issues and Emerging Topics. Int. J. Environ. Res. Public Health, 13(11). https://doi.org/10.3390/ijerph13111072.

[44] See the CalEnviroScreen 4.0 report for additional details and documentation: https://oehha.ca.gov/media/downloads/calenviroscreen/report/calenviroscreen40reportf2021.pdf

The environmental burden indicator scores work differently than the economic and education indicators. Instead of being used individually, the CES indicator scores for solid waste sites, groundwater threats, cleanup sites, and hazardous waste facilities are averaged for each census tract. The scores are averaged to mirror CES's method of accounting for the cumulative environmental burden that arises when people and places are simultaneously exposed to multiple contaminants from multiple sources. Once averaged, the top 5% of tracts regionally are flagged to identify the places with the highest potential to expose vulnerable populations to nearby health and safety threats.[45] The flagged geographies receive a one point deduction in their opportunity score, which operationalizes the concept that local environmental burden can be a drag on community-level opportunity.

Functionally, opportunity is defined by the eight economic and educational indicators, and the environmental burden indicator only affects overall scores when environmental burden is most severe. This protocol reflects a degree of caution in using CES's environmental effects data. While the data are good proxies for measuring the concentration of nearby environmental hazards, there can be variation within a census tract in terms of how close a proposed affordable housing development might be to particular sources of pollution. Also of note is that this map update uses 2020 census tract boundaries, while CalEnviroScreen indicators are currently available only for 2010 census tract boundaries. 2010 CES data had to be transformed to 2020 boundaries; for this version of the methodology, all 2020 census tracts for which at least 80% of the total land area overlaps with a 2010 tract designated as having a high environmental burden is also assigned as having a high environmental burden.[46] This data transformation approach is approximate, and will be used only until OEHHA issues updated environmental data that aligns with 2020 geographies. These limitations mean that the CES data are not a perfect match for the task of generating an exact spatial buffer around a given set of pollution sources. Additionally, CES data do not measure the level of exposure to those hazards or indicate the level and type of risk they might generate. As noted in CES documentation, "risk assessment requires extensive characterization of the chemicals present, the routes and levels of exposure, and the dose-response relationship for hundreds of chemicals for which data are neither currently available nor likely to be generated in the foreseeable future."[47] CES does not aim to tackle this set of complex risk pathways; rather, it is designed to more generally identify those places that are relatively more burdened by compounding pollutants than others. The data use protocol outlined here aims to ensure that CES data only impact opportunity scores for those places where the regional environmental burden is highest.

[45] Note that for rural geographies, block group level data are used for economic and educational indicators. However, because CalEnvrioScreen data are not available at the block group level, environmental burden percentile ranks are calculated at the census tract level. The environmental burden percentile rank calculated at the census tract level is assigned to each of the block groups within a given rural census tract.

[46] The 80% overlap threshold was selected after testing for a cutoff point that includes the majority of 2010 geographies while also ensuring that 2020 tracts are not misclassified as having high environmental burden. Note that this is a custom transformation of CalEnviroScreen data to 2020 geographies for the purpose of this mapping tool.

[47] https://oehha.ca.gov/media/downloads/calenviroscreen/report/calenviroscreen40reportf2021.pdf

Finally, since the environmental burden indicator identifies geographies with the top 5% of hazards in each region or rural county, it is only calculated if there are at least 20 tracts within that region or rural county (since the indicator is calculated at the tract level in both urban and rural contexts). In rural counties with fewer than 20 tracts, tracts and the block groups they contain are identified as having high environmental burden if they are in the top 5% of the state.

High-Poverty & Segregated Area Methodology

A high-poverty and segregated area overlay identifies areas that meet standards for both concentrated poverty (defined as 30% of the population below the federal poverty line) and racial segregation (overrepresentation of people of color relative to the county).

This overlay is intended to be used to support multiple AFFH objectives, including place-based efforts which seek to transform racially and ethnically concentrated areas of poverty into areas of opportunity, as well as policies which seek to replace segregated living patterns with truly integrated and balanced living patterns.

The high-poverty and racial segregation overlay also aligns with the intent of the federal designation of Racially/Ethnically Concentrated Areas of Poverty (RECAPs). However, the federal RECAP standard—which categorizes all areas where more than half the population people of color as areas of racial or ethnic concentration[48] – is not adapted to the racial and ethnic demographics in many parts of California.

Racial segregation has functioned as a powerful mechanism for unequal distribution of resources and access to opportunity by jurisdiction and neighborhood—resulting, over time, in racially segregated neighborhoods with many predominantly Black and Latinx neighborhoods, in particular, characterized by concentrated poverty, higher levels of environmental and social risk, and fewer resources or opportunities for educational and economic advancement.[49] An extensive body of research has documented the harms of racial segregation and concentrated poverty, both independently and in combination—controlling for family background, income, and housing affordability—on children's educational attainment and long-term economic prospects, as well as on the mental and physical health of both children and adults.[50]

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[48] More information on R/ECAPs, including a visualization tool, can be found on the U.S. Department of Housing and Urban Development website: https://egis-hud.opendata.arcgis.com/datasets/320b8ab5d0304daaa7f1b8c03ff01256_0.

[49] For a history of racial segregation in metropolitan America and the creation of segregated areas of concentrated poverty, see, for example: Rothstein, R. (2017). The Color of Law: A Forgotten History of How Our Government Segregated America. Liveright Publishing Corporation

[50] See, for example: Chetty, R., Friedman, J., Hendren, N., Jones, M., Porter, S. (2018); Chetty, R., Hendren, N., & Katz, L.F. (2015); Ayscue, J., Frankenberg, E., & Siegel-Hawley, G. (2017); Johnson, R. (2011). Long-Run Impacts of School Desegregation & School Quality on Adult Attainment. National Bureau of Economic Research. Working Paper 16664; Sanbonmatsu, et al. (2011). Moving to Opportunity for Fair Housing Demonstration Program: Final Impacts Evaluation. Prepared for: U.S. Department of Housing and Urban Development, Office of Policy Development & Research. November; Ludwig, et al. 2011. Neighborhoods, Obesity, and Diabetes—A Randomized Social Experiment. New England Journal of Medicine. 365:1509-1519. October 20; and Kershaw, K. et al. (2017); Association of Changes in Neighborhood-Level Racial Residential Segregation With Changes in Blood Pressure Among Black Adults: The CARDIA Study. JAMA Internal Medicine, 177(7), 996–1002; Krieger, N., Feldman, J. M., Waterman, P. D., Chen, J. T., Coull, B. A., & Hemenway, D. (2017). Local Residential Segregation Matters: Stronger Association of Census Tract Compared to Conventional City-Level Measures with Fatal and Non-Fatal Assaults (Total and Firearm Related), Using the Index of Concentration at the Extremes (ICE) for Racial, Economic, and Racialized Economic Segregation, Massachusetts (US), 1995-2010. Journal of urban health: bulletin of the New York Academy of Medicine, 94(2), 244–258. https://doi.org/10.1007/s11524-016-0116-z; Osypuk, T. L., & Acevedo-Garcia, D. (2010). Beyond individual neighborhoods: a geography of opportunity perspective for understanding racial/ethnic health disparities. Health &

The overlay uses a two-stage approach for identifying high-poverty and segregated areas.

High-Poverty: First, the overlay identifies tracts and rural block groups where at least 30 percent of the population is living below the poverty line. Research has found that the impact of neighborhood poverty rates in producing negative outcomes for individuals begin to appear after an area exceeds approximately 20 percent poverty, whereupon the externality effects grow rapidly until the neighborhood reaches approximately 40 percent poverty.[51]

Similar to the above 200 percent poverty indicator, college and graduate students are removed from the poverty calculation in the overlay in tracts where they comprise at least 25% of the population, in this case to prevent college towns from distorting the overlay's concentrated poverty measure. An internal analysis found that without this adjustment, some tracts with high proportions of college students—many of which have high opportunity scores—are shown as having poverty rates exceeding 30 percent. The total population living in areas of extreme poverty declined in the 1990s, following government action designed to affirmatively counteract intentionally segregationist public policy.[52] Following national trends, however, concentrated poverty has risen dramatically in California since 2000.[53]

Racial Segregation: Second, the overlay relies on a measure of racial segregation to capture which tracts and rural block groups have a disproportionate share of households of color. Setting an absolute threshold (as the federal RECAP metric does) does not account for substantial variation in the racial and ethnic population across California's counties. To properly account for the features of inequality operating on individuals at the neighborhood level, a relative segregation measure is more appropriate to reflect the experience of residents.[54] The overlay relies on the location quotient of residential racial segregation (LQ), which is increasingly being used in studies that seek to assess the impact of racial segregation on individual and community outcomes[55] and has been used to examine, for example, linkages between

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place, 16(6), 1113–1123. https://doi.org/10.1016/j.healthplace.2010.07.002; Williams, D. and Collins, C. (2001). Racial Residential Segregation: A Fundamental Cause of Racial Disparities in Health. Public Health Reports. Volume 116. the literature review in Sard, B. & Rice, D. (2016); and the literature review in Menendian, S., Gailes, A. (2019). The Harmful Effects of Segregation (Racial Segregation in the San Francisco Bay Area, Part 4). The Othering & Belonging Institute at UC Berkeley

[51] Galster, George C. (2010). "The Mechanism(s) of Neighborhood Effects: Theory, Evidence, and Policy Implications." Presentation at the ESRC Seminar, St. Andrews University, Scotland, UK, 4–5 February 2010.

[52] Berube, A., & Katz, B. (2005). Katrina's window: Confronting poverty across America. Brookings Institution.

[53] California Housing Partnership Corporation (CHPC) tabulation of data provided in Kneebone, E. and Holmes, N. (2016). U.S. concentrated poverty in the wake of the Great Recession. Brookings. https://www.brookings.edu/research/u-s-concentratedpoverty-in-the-wake-of-the-great-recession/.

[54] Wong, D. W. S. (2002). Modeling Local Segregation: A Spatial Interaction Approach. Geographical and Environmental Modelling, 6(1), 81–97. https://doi.org/10.1080/13615930220127305

[55] Sudano, J. J., Perzynski, A., Wong, D. W., Colabianchi, N., & Litaker, D. (2013). Neighborhood racial residential segregation and changes in health or death among older adults. Health & Place, 19(Supplement C), 80–88. https://doi.org/10.1016/j.healthplace.2012.09.015.

residential segregation and public health outcomes.[56] The LQ is a small-area measure of relative segregation calculated at the residential census tract level that represents how much more segregated an area (e.g., a census tract or block group) is relative to the larger area (in this case, the county).[57] For the overlay, tracts that have an LQ higher than 1.25 for Black, Hispanic, Asian, or all people of color are flagged as being racially segregated in comparison to the county.

Census tracts and rural block groups that have both a poverty rate of over 30 percent and that are designated as being racially segregated are identified in the high-poverty and segregated overlay. Due to data unreliability at the block group level in the poverty indicator, "High-Poverty and Segregated" is designated at the tract level in rural areas.

HCD and CTCAC do not see the AFFH objectives of reducing segregation and promoting integration as conceptually fitting within the context of Tribal lands, which are the territories of sovereign politically entities. For this reason, the High-Poverty & Segregated Area methodology does not apply to Tribal lands, including land held in trust, where at least 25 percent of the geography's land area is within federally recognized Tribal lands as provided by the Census.

See below for the list of measures and data sources for the high-poverty and racial segregation layer.

Measure	Data Source	Table
Poverty: Tracts with at least 30% of the population falling under the federal poverty line	2017-2021 ACS	ACS Table B17020
Racial Segregation: Tracts with a racial/ethnic Location Quotient of higher than 1.25 for Black, Hispanic, Asian, or all people of color in comparison to the county	2017-2021 ACS	ACS Table B03002

[56] Pruitt, S. L., Lee, S. J. C., Tiro, J. A., Xuan, L., Ruiz, J. M., & Inrig, S. (2015). Residential racial segregation and mortality among black, white, and Hispanic urban breast cancer patients in Texas, 1995 to 2009. Cancer, 121(11), 1845–1855. https://doi.org/10.1002/cncr.29282.

[57] Brown, L. A., & Chung, S.-Y. (2006). Spatial segregation, segregation indices and the geographical perspective. Population, Space and Place, 12(2), 125–143. https://doi.org/10.1002/psp.403.