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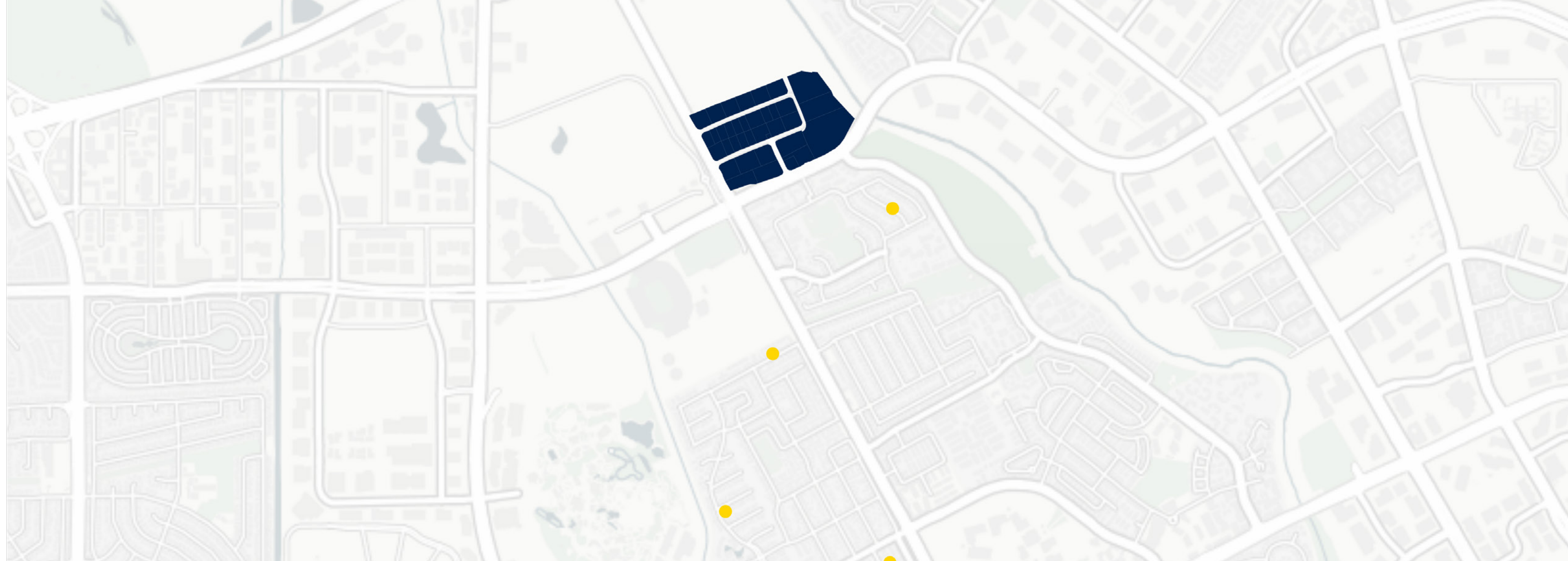
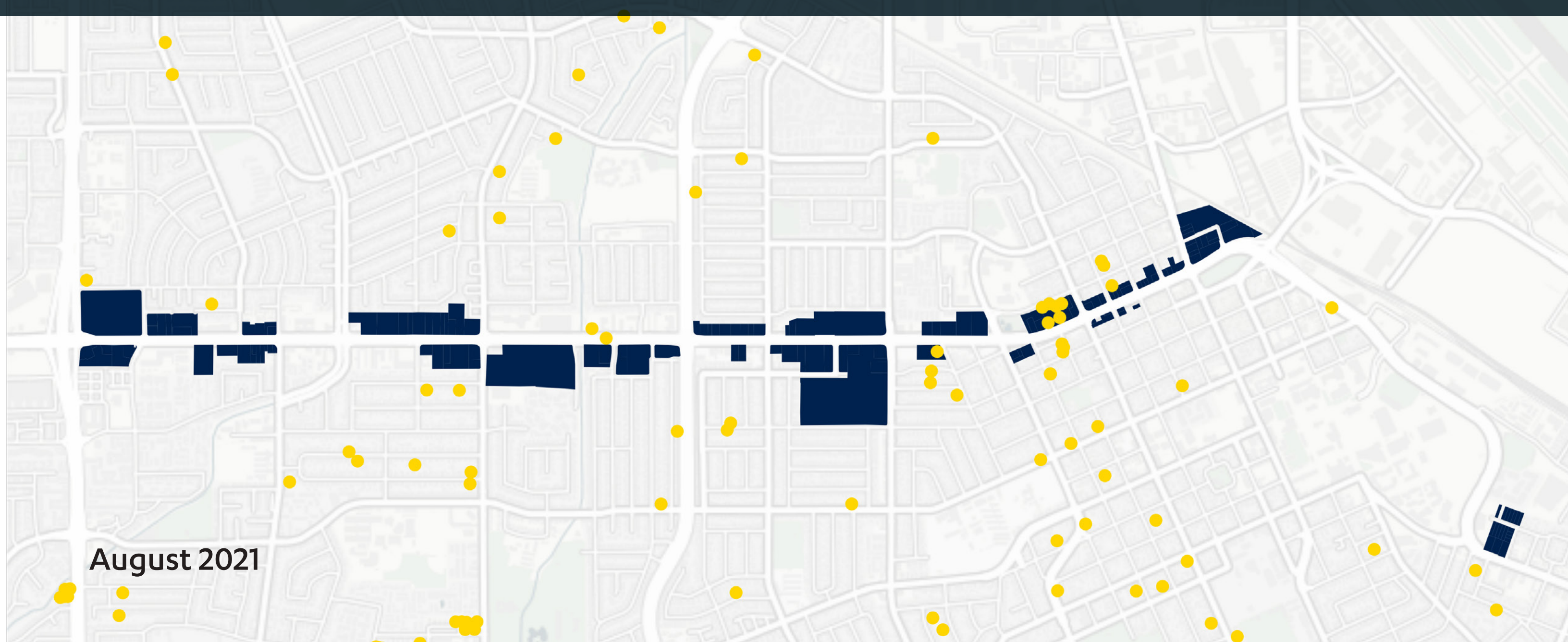


UCLA Lewis Center for Regional Policy Studies

WHAT GETS BUILT ON SITES THAT CITIES "MAKE AVAILABLE" FOR HOUSING?

Evidence and Implications for California's Housing Element Law



August 2021

Acknowledgments

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The Ralph & Goldy Lewis Center for Regional Policy Studies is a research center in the UCLA Luskin School of Public Affairs. The Lewis Center advances research on how people live, move, and work in the Los Angeles region, with a focus on policies and interventions that provide paths out of poverty. Since 1989, Lewis Center scholars and staff have produced high-quality research on transportation access, housing affordability, labor, immigration, and many other topics, with a focus on the policy impact on vulnerable populations. **lewis.ucla.edu**

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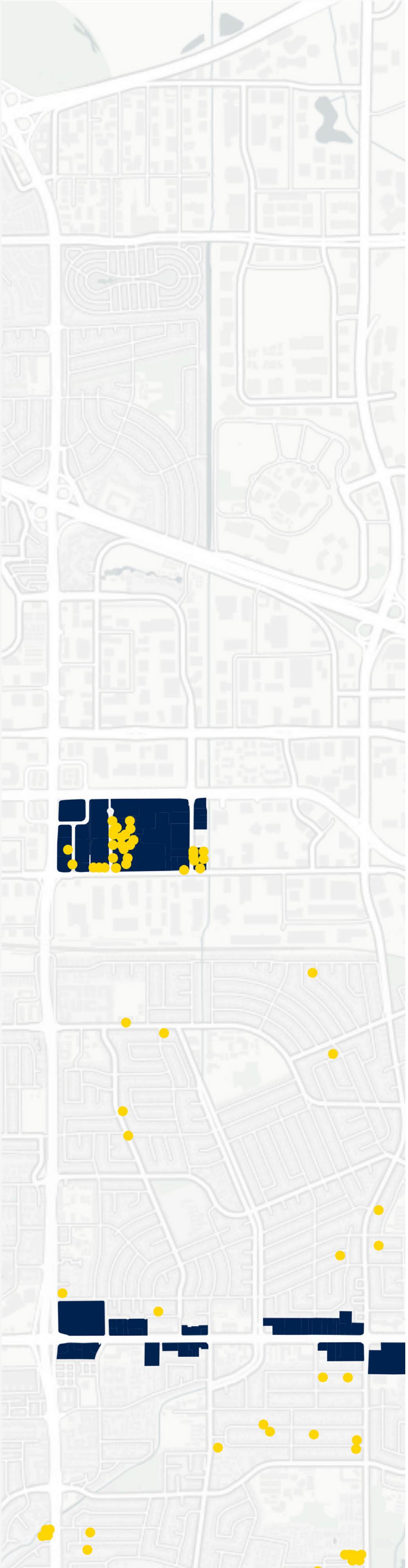

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Executive Summary

California's housing planning system seeks to accommodate regionally needed housing and advance fair housing principles. The system has become increasingly oriented towards getting results, and recent reforms have generated substantially larger targets for housing production. As cities across the state begin updating their local housing plans, attention is turning to whether plans will lead to needed housing development.

In this report, we analyze local plans and housing development rates in nearly 100 cities in the San Francisco Bay Area. We assess production on sites presented by cities to the state government as apt for housing, as well as elsewhere in the city. Our analysis relies on datasets of housing-plan site inventories from 2014-2015 (the start of the last planning period), and housing permits between 2015 and 2019. After matching the two datasets, we estimate (1) the share of sites listed in a city's housing plan that will be built out during the planning period, (2) the share of a city's housing development that happened on those sites, and (3) the share of a city's ostensible capacity for housing development that the city is on track to realize. We use the observed pattern of development from 2015-2019 to make projections for the full eight-year planning period.

The median Bay Area city is on track to approve housing projects on less than 10% of the sites listed in its housing plan. On average, however, cities are achieving a substantial portion of their (too low) housing targets – nearly 60% for the median city – just not on the sites they had selected and presented to the state as likely or apt for development. Across the Bay Area as whole, nearly 70% of housing built during this period was on sites *not* listed in housing plans.

Our findings demonstrate a fundamental flaw with California's traditional approach to planning for housing, but also suggest a clear and simple way to address this problem. First, the flaw. The traditional approach requires cities to select and present to the state a list of specific sites whose total zoned capacity for housing exceeds the target the city was given. Yet housing development occurs in a way that is hard to anticipate. In spite of planners' efforts to select imminently viable sites, they do not. A majority of housing is not built on 'officially' selected sites, which themselves only have a one in 10 chance of being developed. And while state law encourages cities to select vacant sites for their housing plans, we find that vacant sites are only a few percentage points more likely to get developed than nonvacant sites.

The solution has two parts. First, housing plans' assessment of the capacity of the chosen sites must discount the number of units a site can hold (under applicable zoning) by a rough proxy for its likelihood of development during the planning period. In the absence of other information, the share of inventory sites developed during the previous planning period is a reasonable starting point. The Department of Housing and Community Development recently issued some good guidance on this point, and our results show how it can be implemented. (This change may require cities to include many more sites in their housing plan.) Second, we propose that cities receive preemptive credit for housing they expect to be built on sites not listed in their plan. The credit would be tied to production on non-inventory sites during the previous period, giving cities an incentive to accommodate much-needed development when it is proposed, even if they can't anticipate exactly where or what developers will want to build. However, cities that claim credit for anticipated production on non-inventory sites should be required to make mid-cycle adjustments (such as rezoning for greater density on inventory sites) if the production doesn't materialize.

Looking to the future – the next planning cycle starts in the late 2020s – a more fundamental rethinking of the site inventory is in order. The Legislature should stop proliferating ever more detailed requirements for a site to be included in the inventory, and instead require cities to consider every parcel on which residential use is allowed. Since cities aren't very good at picking the sites where developers want to build, the focus should shift to estimating how much housing is likely to be built during the planning period on the entire stock of residentially zoned land in a city. Modeling parcels' likelihood of development during the planning period will be central to this effort, and will actually simplify the housing element update process.

Introduction

California cities must periodically adopt a state-approved plan, called a housing element, to accommodate the city's share of regionally needed housing, called the regional housing needs allocation, or "RHNA". The centerpiece of a housing element is an inventory of sites with near-term development potential. Cities are expected to demonstrate that these sites collectively have realistic capacity for new housing, over an eight-year planning period,[1] that's at least equal to the city's RHNA.[2]

In previous planning periods, housing elements' assessments of site capacity had a fatal flaw: they effectively presumed that each site in the inventory *would* be developed during the period (Elmendorf et al. 2020, pp. 990-991). This was a recipe for failure. It's like a university that wants 1000 students in its freshman class deciding to admit just 1000 students, even though the university knows from past experience that only about a quarter of admitted students will enroll. Given a 25% yield, the university needs to admit 4000 students, not 1000, to fill a class of 1000. Similarly, if a city knows from past experience that only about a quarter of developable sites tend to get built out during an eight-year period, the city needs to zone for four times its RHNA in order to accommodate it.

Since the last planning cycle, the Legislature has enacted various new requirements for realistically assessing site capacity, and has authorized the Department of Housing and Community Development (HCD) to issue "standards, forms, and definitions" to implement them. Elmendorf et al. (2020) argue the new laws are best implemented by adopting an **expected-yield definition of site capacity**. That is, a site's "realistic capacity" to accommodate a portion of the city's RHNA during the period is equal to its probability of development during the period, multiplied by the number of units that would be built on the site if it were developed.[3]

1 For a small number of jurisdictions outside of major metro areas, the planning period is 5 years rather than 8 years.

2 More specifically, the capacity of the site inventory must equal the RHNA less any credits the city claims for pending projects, anticipated ADU production, or "committed assistance" for preserving existing subsidized units that might otherwise be lost (Department of Housing and Community Development 2020, pp. 30-33).

3 For brevity, we will occasionally use "P(dev)" as shorthand for an inventory site's probablity of development during the planning period.

In keeping with the expected-yield definition of capacity, HCD's new Site Inventory Guidebook (June 2020) and Housing Element Completeness Checklist (Jan. 2021) prompt cities to apply a "likelihood of development" discount factor when gauging the capacity of nonvacant sites (Checklist, p. 9; Guidebook, pp. 19-22). "If no information about the rate of development of similar parcels is available," the Guidebook states, "report the proportion of parcels in the previous housing element's site inventory that were developed during the previous planning period" (p. 21). However, the Guidebook also lists various other factors that "may" be used for assessing realistic development capacity, leaving somewhat unclear what is actually required (pp. 19-21).

We also understand from HCD staffers that the Department typically uses the statutory term "realistic capacity" to refer to the number of units expected to be built on a site **if the site gets developed**. This may be very different from the site's expected yield. Imagine a site that's zoned for 150 units, that's subject to setback and other design requirements make 100 units the most plausible development scenario, and that has only a 10% chance of getting developed during the planning period. This site's expected yield is roughly 10 units (0.10 * 100), whereas its capacity if developed is roughly 100 units, which in turn is less than its nominal zoned capacity of 150 units.

The staffers with whom we spoke also confirmed that "capacity if developed" is not sufficient as a measure of the capacity of nonvacant sites. It's pretty clear from the statute – and very clear from the Guidebook – that the analysis of nonvacant sites must go beyond capacity if developed and also account for sites' likelihood of development during the planning period.[4] As to vacant sites, by contrast, the Guidebook and the Completeness Checklist arguably imply that cites may assume a development likelihood of one.

In this report, we estimate what we take to be the Guidebook's critical quantity of interest for 97 cities in the San Francisco Bay Area: "the proportion of parcels in the previous housing element's site inventory that were developed during the previous planning period." We provide separate results for vacant and nonvacant sites.

We agree with HCD that in the absence of other information, this is a reasonable, incentive-compatible proxy for the average likelihood of development of sites in a city's next housing element. Although changes to municipal policy, state law, housing markets, or a city's criteria for site selection may well result in sites in the city's new housing element having a substantially

4 The relevant statutory provisions are Gov't Code 65583.2(g)(1) (requiring local government to "specify the additional development potential for each [nonvacant] site within the planning period," using a methodology that accounts for, inter alia, development trends, current market conditions, and the city's "past experience with converting existing uses to higher density residential development"), and Gov't Code 65583.2(g)(2) (requiring specific findings about likelihood of development if a city assigns more than 50% of its lower income RHNA to nonvacant sites).

higher, or lower, average probability of development than that implied by the rate of development of sites in the city's last housing element, the last-cycle rate of development is a reasonable starting point for analysis of capacity in the new housing element. Using it as a proxy for the new inventory sites' likelihood of development rewards cities that have done a good job getting projects entitled on their inventory sites, while putting pressure on laggard cities to rezone for a lot more capacity. However imperfect the proxy might be, it's certainly better than the old assumption that the probability of an inventory site's development is equal to one – regardless of a city's track record. That assumption was wrong and invited abuse. Some cities intentionally assigned their RHNA to sites that were poor candidates for development, and there were no consequences for doing so (Dillon 2017).

We find that the Bay Area cities are on track to develop – at best – only about one in 10 of the inventory parcels in their 5th cycle housing elements. However, the median city is also on track to permit new dwelling units totalling almost 60% of the asserted dwelling-unit capacity of the sites in the city's housing element. The latter figure is substantially better than what one would expect based on the inventory sites' rate of development. What accounts for the discrepancy? It turns out that more than 70% of new Bay Area homes during our study period were built on non-inventory sites. Also, in larger cities, projects that were proposed and approved on inventory sites tended to have more units than what the housing element assumed for the site.

We also find considerable variation across cities in the degree to which projects on inventory sites achieve the density anticipated for the site in the housing element. While the median city hit the bullseye, in some cities the typical project yielded twice as many units as the housing element said the site could accommodate, and in other cities it yielded well under half. This likely reflects variation across cities in the use of density bonus law, variances, and site-specific rezonings.

Our findings dovetail with a recent study commissioned by the City of Los Angeles (Romem 2021). Romem fit an econometric model to estimate the likelihood of development of residentially zoned parcels in Los Angeles from 2015 to 2019, and then used the fitted model to predict the likelihood of development (during the 6th planning period) of sites the city has identified as candidates for its 6th cycle housing element. He found that the average parcel's likelihood of development was less than 3% (Romem 2021, pp. 4.6-22 - 4.6-23).[5] Romem further discovered that more than a quarter of the new residential units developed in Los Angeles between 2010 and 2020 were constructed on parcels that city staff did not believe to be candidates for inclusion in a housing element.[6] He also

5 The average parcel's probability of development over the 5-year projection period was 0.0149. Multiplying by 8/5 to obtain the 8-year equivalent, it's 0.0238, or about 2.4%.

6 This figure isn't directly stated in Romem (2021). We infer it from the total number of building housing units permitted by the city from 2010-2020 (Romem 2021, p. 4.6-1) and the number permitted by year on sites in the "2010" and

showed that within the subset of identified, residential-use-allowing parcels that were developed for housing during this period, the total number of new housing units exceeded not only the aggregate "base" zoning of the sites but even their "density bonus" zoning – by about 80%. In sum, housing development in Los Angeles is a rare event; when it does occur, the number of new units typically exceeds by a large margin what the site's base zoning and density bonus allows; and a substantial share of new development isn't even on sites that the city knew to be zoned for housing. This implies that housing development is more of an ad-hoc than a planned process, with lots of project-specific variances and rezonings.

Our results have several important implications for housing element law and policy. First, it is imperative that cities adjust for development probabilities when assessing sites' capacity to accommodate a portion of the city's RHNA during the planning period. The vast majority of sites with enough development potential to make it into a housing element almost certainly will not be developed during the cycle. **A city whose plan to accommodate its RHNA relies on sites and a regulatory regime similar to those of the last cycle may need to provide 10 times as much nominal zoned capacity as its RHNA.**

Second, our results suggest that the capacity of vacant and nonvacant sites can and should be analyzed in the same way. This might seem like common sense, but the statute and HCD's guidance treat vacant and nonvacant sites differently. Cities may presume that vacant sites are *certain* to be developed during the planning period, provided that the city also assumes conservatively that the sites will yield only the minimum number of units allowed under the zoning code (Department of Housing and Community Development 2020, p. 19). The vacant sites in our sample were developed at a slightly faster clip than the nonvacant sites, but the difference is small in absolute terms and certainly does not warrant a statutory presumption that the probability of a vacant site's development equals one.

Third, our results suggest that estimates of the capacity of inventory sites should account for the city's actual track record of permitting projects at more, or less, than nominal zoned density. (The housing elements we've reviewed applied ad-hoc discount factors to account for site constraints, rather than adjustments grounded in outcomes on inventory sites during the last planning period.)

"2020" populations of sites zoned to allow residential use (Romem 2021, p. 4.6-9). The finding is striking because the inclusion criterion for a parcel in Romem's study was just that city staff believed its zoning circa 2010 or 2020 allowed residential use. In other words, a quarter of the new housing units developed in Los Angeles between 2010 and 2020 were developed on parcels that the city either hadn't zoned to allow residential use, or didn't know that it had zoned for residential use.

Looking to the future – the next planning cycle starts in the late 2020s – a more fundamental rethinking of the housing element site inventory is in order. The Legislature has tried to crack down on municipal abuses by creating ever more detailed requirements for sites to be included in the inventory. Our results imply that this may be a fool's errand, given that the vast majority of development is occurring elsewhere. A better way for the state to check gamesmanship would be to require cities to include in their inventory every parcel on which residential use is allowed. The regional councils of government could be charged with modeling sites' likelihood of development during the planning period. This would remove cities from the process of site selection and capacity estimation. Cities would focus their energies instead on the legitimately political question of where to upzone and remove constraints in order to make up shortfalls of capacity.

Background

The central premise of California's housing element law is that the state can bring about the production of regionally needed housing by directing cities to identify developable sites, to zone them at appropriate densities, and to remove unnecessary constraints to their development. Critics have long argued that anti-housing cities game the system by assigning their housing targets to sites that are impractical to develop, say, because of high-value existing uses, environmental contamination, lack of infrastructure, or other factors (Dillon 2017). The Legislature has answered this critique by repeatedly tightening the criteria for which sites may be included in the inventory, especially for sites that are supposed to be able to accommodate lower-income housing (Legislative Analyst's Office 2017) .

Both the "gaming" critique and the Legislative response have developed in an evidentiary vacuum. There have been virtually no transparent, replicable studies that compare development outcomes on inventory vs. non-inventory sites, or that compare the number of units in projects on inventory sites with the number of units that the housing element represented the site as capable of accommodating. Prior to the present study and Romem (2021), the closest anyone has come is a 2017 study of 10 cities by the Legislative Analyst's Office (LAO), which found that most multifamily housing development during the Fourth Cycle occurred on sites that had not been included in the city's housing element (Legislative Analyst's Office 2017). However, the LAO did not calculate the share of inventory sites that were developed, nor did the LAO release the data or replication files for its study.

The reason for the evidentiary vacuum is that there does not exist in California a centralized, statewide database that uniquely identifies all parcels of real property in the state, and which can easily be linked to local development-permitting records. Although cities have long been required to file annual reports about housing development, it was not until 2017 that the Legislature made cities include a parcel identifier, the so-called "assessor parcel number," in these reports. This reform should make it easier to track site-specific development outcomes during the upcoming cycle (the 6th).[7] But looking backwards at the 5th Cycle, we're at the mercy of cities and regional councils of governments.

7 Easier, but not easy. Unlike its sister state to the north (Oregon), California produces no statewide parcel map with unique identifiers for each parcel. Assessor parcel numbers are generated at the county level, counties have their own maps, and formatting of parcel numbers sometimes changes between cities' site inventories and their annual production reports submitted to the state. See Part III.B and Appendix B for details on how we dealt with these issues.

Data and Methods

Data Sources

Our study relies on data collected by the Association of Bay Area Governments (ABAG) and the Department of Housing and Community Development.

The site inventory dataset, compiled by ABAG and hosted by the Metropolitan Transportation Commission, includes housing element site inventories for member jurisdictions and covers the 4th and 5th RHNA cycles (Metropolitan Transportation Commission 2018a). It provides the size, shape, location, and assessor parcel numbers of inventory sites, and the ostensible "realistic" capacity for housing of each site. During the 4th and 5th cycles, cities did not account for sites' likelihood of development, so the difference between nominal and "realistic" capacity reflects the application of small discount factors to adjust for the expected commercial share of projects on mixed-use sites, or the difference between allowable density under the zoning code and what the city thought was feasible on the site given other constraints (Elmendorf et al. 2020, pp. 987-995).

We assembled a dataset of residential building permits by combining data from the Metropolitan Transportation Commission for the years 2014-2017 (Metropolitan Transportation Commission 2018b) and Annual Progress Reports submitted by cities to HCD for 2018 and 2019.[8] Together, the two datasets give us a complete picture of all building permits for new residential units that Bay Area cities have reported to state and regional agencies from 2014-2019.[9]

Ascertaining Which Inventory Sites Were Developed

It should be straightforward to match building permits to inventory sites, but it is not. Each city has its own record keeping systems, which may not even be linked across departments. There is no common, statewide database of parcels with unique identifiers. Counties assign assessor parcel numbers (APNs) for tax purposes, but these numbers change when parcels are combined or split as part of a development project, and they're encoded in slightly different formats in different

8 The Annual Progress Reports include data on planning entitlements, new construction permits, and certificates of occupancy. We use only the new-construction permits in this paper. The full Annual Progress Reports, in Excel format, are available by request from APR@hcd.ca.gov. We have also published them online at https://github.com/YIMBYdata/housing-elements/tree/main/data/raw_data/APRs.

9 Senate Bill 35 (2017) requires HCD to measure cities progress toward their RHNA and compels cities that are not making sufficient progress to permit certain projects ministerially. The MTC permits data, and the APR data, include the permits that cities reported in their progress reports.

datasets. Fortunately, the ABAG sites dataset includes a geographically encoded shape file for each parcel, and the building permits dataset has a spatial identifier for each permit.

We classify an inventory parcel as developed if it matches a building permit by APN or by geocoding. See **Appendix B** for details. We assume, conservatively, that if a building permit was geocoded to within 25 feet of one or more site inventory parcels, then the permit was actually issued for development on the nearest inventory parcel. This is a way of accounting for small errors in the geographical data.

Readers who want details on our matching procedure and robustness checks are referred to **Appendix B**.

Study Years and Planning-Period Projection

To ensure that our results are not distorted by the temporary effects of the COVID-19 pandemic on housing construction, we restrict the analysis to the 5-year period from 2015-2019. We project development rates observed during this period to the full, 8-year planning period by assuming that the inventory sites remaining after 2019 would be developed (absent a pandemic) during the rest of the planning period at the same rate as sites were developed from 2015-2019. See **Appendix B** for details.

Results

Inventory Sites' Likelihood of Development During the 5th Cycle Planning Period

Across the entire ABAG region, we estimate that about 9% of inventory sites in 5th cycle housing elements were or will be developed from 2015 to 2023. In other words, the average site has about a 1-in-10 chance of getting developed during the planning period.

One might wonder whether this low estimated probability of development is an artifact of false negatives in the matching of building permits to housing element sites. In **Appendix B** (**Table B.1**), we show that our central result holds across a wide range of assumptions about whether a permit observed "near" a housing element inventory site was actually issued for development of that site. Even under the assumption that permits geocoded up to 100 feet away were actually issued for development of an inventory site, the inferred average probability of development for the median city's sites only reaches 0.11.

Table 1 breaks down development rates by site type (vacant vs. nonvacant), and shows how the mean and median city in the region compare to the region as a whole. The histogram in **Figure 1** depicts the distribution of cities per the probability of development of their vacant and nonvacant sites.

A couple of lessons are apparent. First, cities that are on track to develop more than 40% of their sites (vacant or nonvacant) are extremely rare. The top performer is Colma, which developed all of its inventory sites. However, Colma had only one site in its inventory, so the inferred probability of development (p=1) for its inventory sites is very noisy.[10] The next best are Cotati and San Bruno, which are projected to develop 66% and 53% of their sites. At the bottom of the list, there are 13 cities where not a single housing element site was developed, including Antioch, East Palo Alto, Hercules, Millbrae, Saratoga, and Los Gatos. Full results by city are reported in **Appendix A**.

Another important lesson is that vacant inventory sites do have a higher likelihood of development than nonvacant sites, but the difference is small. For every 100 nonvacant inventory sites in ABAG as a whole, about 7.5 will be developed during the planning period; for vacant sites, it's about 10 out of 100. These differences are large enough to justify the application of separate likelihood-

10 Colma's strong performance may also be an artifact of small errors in reporting. The city's paper housing element actually shows three sites, but only one of these sites appears in the ABAG database of housing element inventory sites.

of-development adjustments for vacant and nonvacant sites, but they certainly do not warrant assuming that vacant sites have a probability of development equal to one. (As noted above, the housing element law lets cities calculate the capacity of vacant sites as if they were certain to be developed during the planning period, provided that the city only counts each site at its minimum zoned density.)

Figure 2 provides a heat map showing how probabilities of inventory-site development vary spatially across the Bay Area. No clear pattern is apparent. The image on the cover of this report depicts an arbitrarily chosen neighborhood in Santa Clara.[11] Blue parcels are housing element inventory sites. Yellow dots show the location of building permits. The vast majority of the permits were not issued for inventory sites.

Table 1. Housing element sites' likelihood of development in Bay Area cities (5th cycle).

	P(dev) for all sites, over 8 years[12]	P(dev) for vacant sites, over 8 years	P(dev) for nonvacant sites, over 8 years
Median Bay Area city	0.08	0.084	0.033
Mean Bay Area city	0.124 (sd. 0.15)	0.153 (sd. 0.20)	0.083 (sd. 0.12)
25th percentile city	0.029	0	0
75th percentile city	0.15	0.202	0.132
Bay Area as a whole	0.09	0.1	0.076

11 Both **Figure 2** and the image on the cover of this report use the unlabeled Positron basemap created by CARTO and OpenStreetMap contributors. https://carto.com/help/building-maps/basemap-list/

12 Note that the "all sites" calculations include vacant sites, nonvacant sites, and sites we could not classify. (See Appendix B for details.) This explains why the 25th percentile probability of development for "all sites" is greater than zero, even though it is zero for both vacant and nonvacant sites.

FIgure 1. Distribution of Bay Area cities (n = 97) by probability of development of their 5th cycle inventory sites.

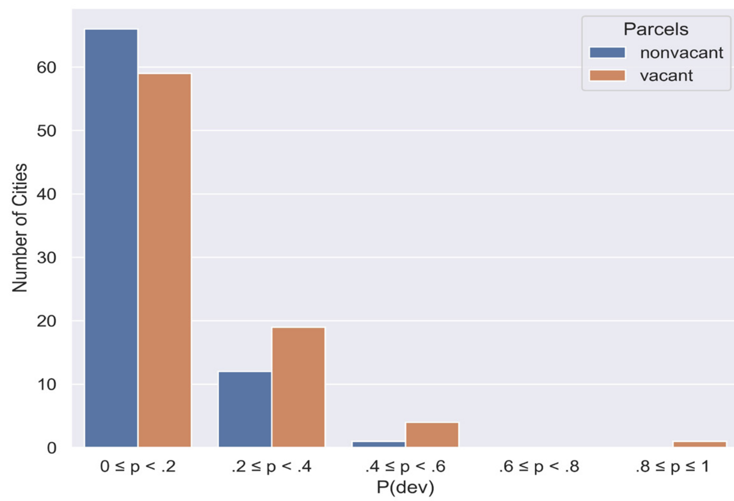
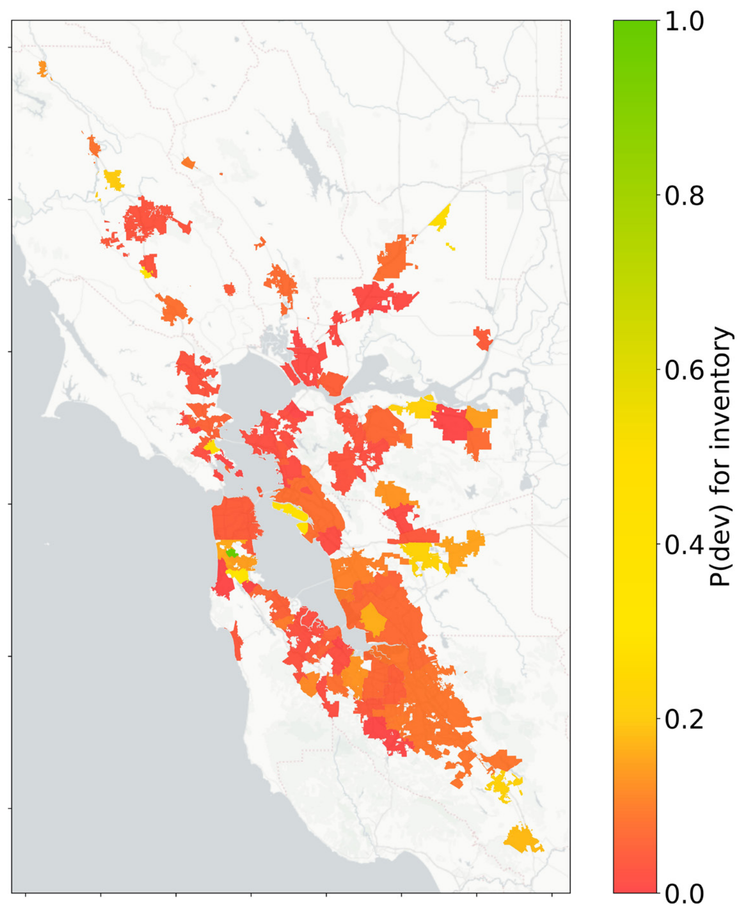


Figure 2. Heat map of Bay Area cities by probability of development of their 5th cycle inventory sites. (Interactive version at this link.)



Citywide Production Relative to the Housing Element's "Claimed Capacity"

Because of geocoding or other errors in the matching of building permits to parcels, the estimates reported in the last section may *somewhat* underestimate the true fraction of inventory sites that received building permits (although our lenient criteria for a match cut against this, as do the robustness checks reported in **Appendix B**). In this section, we use a complementary strategy to generate an upper bound estimate. Specifically, for each jurisdiction, we divide the total projected number of building permits during the planning period by the total "realistic" site capacity claimed in the city's housing element. This is tantamount to assuming that all development occurs on inventory sites. (Because 5th cycle housing elements did not account for sites' probability of development, the capacity reported in the housing element can be thought of as "if developed" capacity: the number of units the city thought the site would accommodate, conditional on development.)

To illustrate, if a city said the sites in its housing element inventory were or would be zoned for 1000 units, and the city issued building permits for 400 units during the period, one could infer that a "potential housing element unit" reported by the city in its housing element had a 4-in-10 chance of being realized (permitted) during the period.

The probabilities of development implied by this method are much higher than the actual rate of development of inventory sites, and for some cities, the implied probability of development is impossible ($p > 1$). See **Table 2**. What's going on? As we'll see in the next sections, a lot of development occurs on non-inventory sites. Also, in larger cities, when development does occur on an inventory site, the project usually includes more units than the housing element anticipated.

Table 2. Total permitted units citywide divided by total housing element capacity (2015-2019, extrapolated to 8 years)

	Citywide permits as fraction of housing element's claimed capacity
Median Bay Area city	0.58
Mean Bay Area city	0.87 (sd. 1.06)
25th percentIle city	0.31
75th percentile city	0.91
Bay Area as a whole	0.75

The Distribution of New Development Across Inventory and Non-inventory Sites

Although we estimate that the typical inventory parcel had a likelihood of development during the 5th cycle planning period of less than 0.10, we saw in the last section that the median Bay Area city is on track to permit new housing units totalling almost 60% of what it claimed was the capacity of its housing element inventory sites.

Where are these new units getting built? Mostly not on housing element sites.

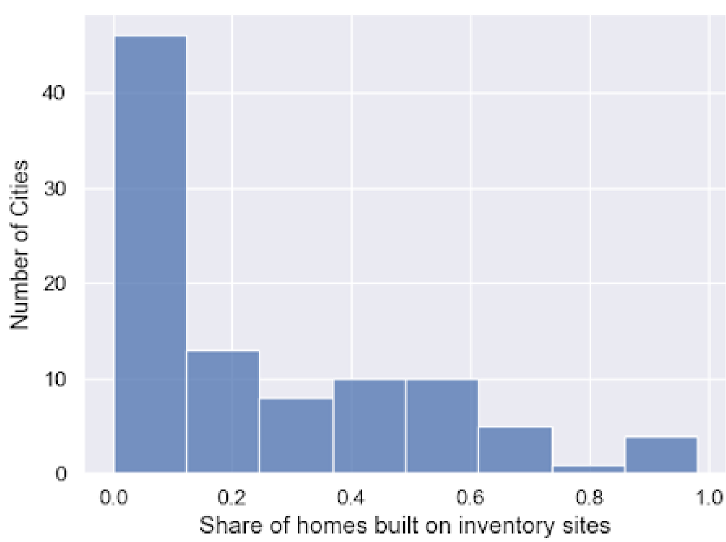
As **Table 3** shows, only about 17% of new housing projects (28% of new housing units) in the Bay Area were developed on inventory sites during the 2015-2019 study period. Even more striking is that for the median city in the region, a scant 7% of projects (13% of units) are on inventory sites. The large gaps between the Bay Area averages and those of the median city imply that in the cities where the most development is occurring, development tends to be more concentrated on inventory sites. Indeed, as **Figure 3** shows, there are a handful of cities where half or more of the new housing units were built on inventory sites.

Our results also imply that higher-density projects tend to be concentrated on inventory sites. In the median city, the share of new *units* on housing element inventory sites is almost twice as large as the share of new *projects* on such sites. This is likely due to the statutory requirement that cities accommodate their lower-income RHNA on sites that are suitable for multifamily housing (Gov't Code 65583.2). However, as we show in **Appendix B**, most development of deed-restricted housing is not on inventory sites. Across the Bay Area as a whole, about 31% of all affordable deed-restricted units and 30% of all 100% deed-restricted projects were permitted on inventory sites. Just like market-rate housing, the vast majority of new affordable housing gets built on non-inventory sites.

Table 3. **Percentage of a city's total building permits for new construction, and total permitted units, that were issued for projects on housing element inventory sites.**

	Projects on sites in inventory, as fraction of all projects issued permits	Permitted units on inventory sites, as fraction of all permitted units
Median Bay Area city	7%	13%
Mean Bay Area city	15% (sd. 19 percentage points)	24% (sd. 26 percentage points)
25th percentile city	1.90%	2.50%
75th percentile city	21%	40%
Bay Area as a whole	17%	28%

Figure 3. **Distribution of Bay Area cities by their share of new dwelling units on housing element inventory sites, as a fraction of all new units permitted in the city (2015-2019).**



Realized vs. Anticipated Residential Density of Projects on Inventory Sites

Our final analysis benchmarks the average number of units on inventory sites that were developed against the housing element's projection of how many units the sites could accommodate. As noted above, cities often discount the nominal zoned density of their sites by a small amount to account for constraints such as setbacks and parking requirements, which may make it infeasible for a development to achieve the density for which the site is zoned. Sites zoned for mixed commercial and residential use sometimes receive a further discount to account for the expected commercial share of projects on such sites.

On the other hand, some projects may achieve greater density than a site's zoning allows. A project may qualify for a density bonus, or the developer may apply for and receive a variance or even a site-specific rezoning to accommodate more units.

Table 4 shows that the number of units realized on inventory sites that were developed is, in the average or median city, very close to what the city anticipated in its housing element. However, this central tendency conceals a large amount of variation from one city to the next. Consider a hypothetical site which is represented in a 5th cycle housing element as accommodating 100 units. In a 75th percentile city, that site, if developed, would probably yield more than 140 units. By contrast, in a 25th percentile city, it would yield only 70 units. This confirms the value of applying adjustment factors to the nominal zoned density of a site that are grounded in the city's actual track record of approving development at greater or lesser densities, rather than making ad-hoc assumptions (cf. Department of Housing and Community Development 2020, pp. 21-22).

Note that the average inventory parcel in the Bay Area as a whole yields many more units (relative to what the housing element anticipated) than the average parcel in the median city or even the mean city. This indicates that the region's largest cities are atypical. Their housing elements greatly underestimate the number of new housing units that will be built on a site, conditional on the site's development.

Table 4. Average number of units in projects on inventory sites, as share of capacity (potential units) the housing element claimed for the site.

	Average ratio of units permitted on an inventory site / “realistic” capacity claimed for the site
Median Bay Area city	1
Mean Bay Area city	1.37 (sd. 1.33)
25th percentile city	0.7
75th percentile city	1.44
Bay Area as a whole	2.31

Policy Implications

We found that in a sample of 97 California cities, a site included in a 2013/2014 (5th cycle) housing element had around a 1-in-10 chance of being developed within the planning period, with significant variation depending on the city. How should cities, HCD, and housing advocates use this information?

The simplest conclusion is this: To the extent that a city's plan to accommodate its RHNA depends on housing element inventory sites, the city ought to zone those sites for a lot more nominal capacity – on the order of 10 times more – than the RHNA assigned to those sites.

That said, we also observe great variation across cities with respect to the share of 5th cycle inventory sites that the city is on track to develop. For some cities, it's more than half. For others, it's zero. (**Appendix A** provides the full breakdown of results by city.) Similarly, within the city of Los Angeles, Romem (2021, pp. 4.6-22 - 4.6-23) finds substantial variation in the predicted 8-year probability of development for candidate housing element sites, ranging from effectively 0 to nearly 0.20.

A good response to this variation would be for regional councils of governments to develop and maintain geocoded databases of every land parcel in the region, with at least rudimentary information about existing uses and zoning. Then analysts could develop regional models of site development similar to what Romem did for Los Angeles, and the regional councils could provide probability-of-development predictions for every parcel in every city. Cities would use these predictions in their housing element updates. This is not a pipe dream: both the Southern California Association of Governments and the Association of Bay Area Governments have already made significant investments in parcel-level databases.

But until such parcel-level estimates are broadly available, cities need a workable rule of thumb. One reasonable option would be for HCD to tell cities it will accept capacity projections that assume either that inventory parcels will be developed at the average rate of the region (about 9 out of 100 for the Bay Area), or at the rate actually realized by the city during the previous planning period. This would let cities that did an exceptionally good job during the 5th cycle claim higher probabilities of development for the 6th cycle, while limiting the burden on cities which may have realized very low rates of inventory-site development due to chance factors or locally adverse market conditions. Cities whose assessments of site capacity rely on regional averages rather than the city's own performance should be required to include in their housing element a program for mid-cycle review of development rates, and, if necessary, further rezoning.

This would be similar to how HCD has handled the question of how many potential accessory dwelling units may be counted toward a city's RHNA. The department's guidance establishes a generous safe harbor, under which cities may assume that their ADU production will increase at the same rate that ADU production has increased statewide since the passage of major state-law reforms in 2017 and 2018 (Department of Housing and Community Development 2020, p. 31). However, cities that avail themselves of the safe harbor must include a program for mid-cycle review and, if ADU production has fallen short of projections, rezoning to make up the shortfall (*Ibid*.).

Similarly, HCD has allowed cities in Southern California to rely on regional averages when projecting the affordability of new ADU units. An ADU affordability study conducted by the council of governments lumps cities into one of five geographic areas, and provides different affordability estimates for each area (Southern California Association of Governments, n.d.)

Development likelihoods aren't fixed quantities. Changes to parking requirements, impact fees, discretionary review, and other municipal rules can make development more or less likely to happen. Cities may undertake to accommodate their RHNA by modifying such constraints, rather than focusing on zoned-density alone. For example, Sacramento recently voted to abolish parking minimums and made housing projects of up to 200 units subject to ministerial review (Herriges 2021). If a city makes serious commitments to constraint removal in its housing element, HCD should let the city make optimistic assumptions about sites' likelihood of development, provided that the housing element includes a program for mid-cycle review and course correction.

A further and very important takeaway from our study is that most development occurs on non-inventory sites. Indeed, in the median Bay Area city, more than 70% of the new housing units were not on inventory sites. This finding casts considerable doubt on a central premise of the RHNA / housing element framework, namely, that the way to get cities to accommodate their fair share of regionally needed housing is to make them identify and zone specific sites which are "good candidates" for development. The state ought to be equally if not more attentive to what is happening beyond the traditional inventory sites.

Here too, the ADU model is instructive. HCD lets cities count forecasted ADU production on non-inventory sites toward their RHNA (Site Inventory Guidebook, pp. 30-32). The more ADU production a city shows is likely to occur, the less zoned capacity the city needs to provide on its inventory sites. However, just because a city permitted, say, 1000 new homes on non-inventory sites during the 5th planning period does not mean that HCD should automatically credit the city with 1000 units of "non-site-inventory production" for the 6th period. Cities' site inventories for the 6th cycle site are likely to be substantially larger than their 5th cycle inventories,[13] so there will be fewer non-inventory parcels on which development may occur.

13 Because the RHNAs are larger, and because cities are now expected to make some accounting for sites' likelihood of development in their capacity assessments for nonvacant sites.

A reasonable solution would be to invite cities to apply their site selection criteria for the 6th cycle retrospectively, to the parcels that existed in the city at the start of the 5th cycle. The city would then calculate how many housing units were permitted during the 5th cycle on sites that did not meet the criteria for 6th-cycle inclusion. This number of units would be credited toward the city's 6th cycle RHNA as anticipated "non-site inventory production."[14] If, by the midpoint of the 6th cycle, the city hasn't permitted at least half of the projected number of non-site-inventory units, the city would have to rezone its inventory sites to make up the shortfall.

A third clear lesson from our study is that the Legislature ought to remove the safe harbor that allows cities to count vacant sites toward the RHNA as if the sites were certain to be developed. We found that vacant housing element sites were more likely than their nonvacant counterparts to be developed during the 5th cycle, but the difference is just a few percentage points: 10% for the average vacant site vs. 7.6% for the average nonvacant site in the Bay Area as a whole. This warrants applying different likelihood-of-development adjustments to vacant and nonvacant sites, but it does not justify the wildly off-base assumption that a vacant site's probability of development during the cycle is approximately equal to one. Moreover, a state policy that allowed cities to treat vacant sites as certain to be developed while requiring probability-of-development discounting for nonvacant sites would give cities a strong incentive to assign their RHNA to vacant sites. This would foster sprawl-type patterns of development, undermining the state's climate-policy objectives and exposing more people and homes to wildfire.

Finally, our results suggest that the Legislature should revisit the role of the site inventory before the 7th cycle. To date, the Legislature has tried to check abuses by creating ever more detailed requirements for a site to be included in the inventory (Elmendorf et al. 2020, pp. 1005-1008). But the reality is that most development occurs on non-inventory sites. A better check on gamesmanship would be to make cities include in their inventory every parcel on which residential use is allowed. Regional councils of government could be charged with modeling sites' likelihood of development during the planning period. This would remove cities from the process of site selection and capacity estimation. Cities would focus their energies instead on the legitimately political question of where to upzone and remove constraints in order to achieve sufficient capacity. This approach would build on Los Angeles's draft housing element for the 6th cycle, which includes nearly all parcels on which residential use is allowed, and which employs a parcel-level statistical model to project each site's likelihood of development during the planning period (City of Los Angeles 2021).

14 A further question is how to allocate this projected non-inventory-site production across the affordability bands. A conservative approach would be to credit it only toward the city's "above moderate income" RHNA, unless the city demonstrates with surveys or otherwise the actual shares of non-inventory-site units from the previous cycle that are affordable to lower-income or moderate-income households.

No matter how HCD and local governments incorporate estimates of development probabilities into the housing element update process, the most important thing is that they do it. If jurisdictions are allowed to continue assuming every inventory site will be developed during the next eight years, it is almost guaranteed that the 6th cycle housing production targets – which for many cities increased several fold – will not be met.

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Appendix A. Results for Each Bay Area City

Our dataset spans 97 of the 101 cities in the Bay Area. Orinda and Foster City are excluded because ABAG's compilation of site inventories does not include any sites for Orinda in the fifth housing element cycle, and Foster City's fifth cycle sites were all already entitled before the start of the cycle. Hillsborough did not submit a 2019 Annual Progress Report, so Hillsborough was dropped from our analysis. Saint Helena was also excluded, because the ABAG permits dataset did not include any permits from this city. (It's possible that Saint Helena simply didn't permit any housing in this period, but we omit it out of caution.) Our dataset also excludes unincorporated county areas in the Bay Area.

Table A.1 provides, for each city, the projected probabilities of development for inventory sites – including a breakdown by site type, viz. vacant or nonvacant – in the 5th cycle housing element. For each city and site type, we provide two estimates: the first estimate is our recommended estimate with a 25' geomatching buffer, and the second is a generous estimate with a 100' geomatching buffer. (See "Matching by Geocodes" in **Appendix B** for a discussion on the choice of buffer size.) The latter estimate with a 100' buffer may be thought of as an upper bound.

Table A.2 provides, for each city, (1) the projected share of the 5th cycle housing element's total site capacity that the city is on track to develop; (2) for inventory sites that were developed, the average ratio of the number of units permitted on the site to what the housing element claimed as the site's realistic capacity; and (3) the ratio of total number of new units on inventory sites to the total number of new units citywide.

Table A.1. Projected probability of development of inventory sites for each Bay Area city.[15]

City	P(dev) for all sites	P(dev) for all sites (100 ft buffer)	P(dev) for nonvacant sites	P(dev) for nonvacant sites (100 ft buffer)	P(dev) for vacant sites	P(dev) for vacant sites (100 ft buffer)
Alameda	44.4%	44.4%	45.7%	45.7%	43.6%	43.6%
Albany	7.8%	15.6%	9.4%	9.4%	20.0%	40.0%
American Canyon	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Antioch	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Atherton	6.7%	11.1%	6.7%	11.1%	N/A	N/A
Belmont	15.6%	17.0%	14.5%	14.5%	27.2%	30.2%
Belvedere	9.4%	9.4%	N/A	N/A	9.4%	9.4%

15 For summary statistics for the recommended (25' buffer) probability of development figures in this table, see **Table 1**.

City	P(dev) for all sites	P(dev) for all sites (100 ft buffer)	P(dev) for nonvacant sites	P(dev) for nonvacant sites (100 ft buffer)	P(dev) for vacant sites	P(dev) for vacant sites (100 ft buffer)
Benicia	8.1%	9.7%	N/A	N/A	8.2%	9.8%
Berkeley	2.4%	5.5%	1.9%	4.8%	2.7%	6.1%
Brentwood	11.8%	16.0%	6.4%	6.4%	12.6%	17.5%
Brisbane	6.5%	7.3%	5.2%	6.3%	9.8%	9.8%
Burlingame	10.5%	12.6%	8.6%	10.8%	N/A	N/A
Calistoga	15.0%	20.0%	0.0%	80.0%	10.7%	10.7%
Campbell	15.1%	15.1%	14.7%	14.7%	26.7%	26.7%
Clayton	13.9%	13.9%	29.1%	29.1%	0.0%	0.0%
Cloverdale	20.6%	25.8%	14.5%	29.1%	38.6%	44.1%
Colma	160.0%	160.0%	N/A	N/A	N/A	N/A
Concord	10.4%	12.6%	3.3%	6.7%	20.5%	22.6%
Corte Madera	43.6%	43.6%	0.0%	0.0%	48.0%	48.0%
Cotati	65.9%	67.8%	0.0%	0.0%	0.0%	0.0%
Cupertino	5.7%	11.4%	N/A	N/A	N/A	N/A
Daly City	25.5%	32.7%	0.0%	0.0%	26.7%	26.7%
Danville	21.0%	26.7%	32.0%	44.8%	0.0%	0.0%
Dixon	42.1%	50.5%	0.0%	0.0%	58.2%	58.2%
Dublin	6.2%	10.3%	5.9%	5.9%	6.7%	20.0%
East Palo Alto	0.0%	8.2%	0.0%	11.9%	0.0%	0.0%
El Cerrito	5.4%	9.4%	0.0%	0.0%	6.2%	12.5%
Emeryville	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Fairfax	3.1%	3.1%	4.2%	4.2%	0.0%	0.0%
Fairfield	1.9%	3.7%	0.0%	0.0%	2.1%	2.1%
Fremont	10.9%	16.8%	10.2%	17.0%	15.2%	15.2%
Gilroy	28.7%	32.8%	0.0%	0.0%	0.0%	32.0%
Half Moon Bay	5.9%	7.1%	13.3%	26.7%	10.3%	11.7%
Hayward	16.6%	20.1%	28.1%	33.7%	8.4%	12.6%
Healdsburg	13.3%	24.0%	15.2%	22.9%	13.3%	26.7%
Hercules	0.0%	11.4%	N/A	N/A	0.0%	11.4%
Lafayette	4.4%	6.7%	10.0%	10.0%	53.3%	53.3%
Larkspur	8.4%	8.4%	0.0%	0.0%	N/A	N/A
Livermore	23.8%	26.9%	13.6%	15.3%	34.2%	38.8%
Los Altos	19.6%	33.7%	4.7%	18.8%	41.7%	55.7%

City	P(dev) for all sites	P(dev) for all sites (100 ft buffer)	P(dev) for nonvacant sites	P(dev) for nonvacant sites (100 ft buffer)	P(dev) for vacant sites	P(dev) for vacant sites (100 ft buffer)
Los Altos Hills	12.7%	16.1%	6.7%	10.8%	42.7%	42.7%
Los Gatos	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Martinez	4.8%	5.4%	0.0%	0.0%	5.3%	6.0%
Menlo Park	9.1%	11.1%	9.2%	10.8%	8.6%	13.0%
Mill Valley	2.9%	5.7%	0.0%	0.0%	5.3%	10.7%
Millbrae	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Milpitas	11.2%	12.2%	26.7%	26.7%	0.0%	0.0%
Monte Sereno	0.0%	0.0%	0.0%	0.0%	N/A	N/A
Moraga	3.9%	11.7%	0.0%	0.0%	4.7%	9.4%
Morgan Hill	34.0%	42.0%	N/A	N/A	34.0%	42.0%
Mountain View	20.6%	22.4%	32.0%	32.0%	45.7%	45.7%
Napa	11.3%	14.5%	13.0%	17.3%	15.2%	19.0%
Newark	26.1%	27.2%	17.8%	35.6%	40.0%	40.0%
Novato	4.7%	7.1%	N/A	N/A	N/A	N/A
Oakland	12.1%	20.9%	N/A	N/A	N/A	N/A
Oakley	22.9%	22.9%	0.0%	0.0%	160.0%	160.0%
Pacifica	0.0%	3.7%	0.0%	8.9%	0.0%	0.0%
Palo Alto	2.8%	5.7%	2.9%	5.8%	0.0%	0.0%
Petaluma	13.0%	18.6%	N/A	N/A	N/A	N/A
Piedmont	2.8%	11.0%	N/A	N/A	2.8%	11.0%
Pinole	2.7%	8.0%	0.0%	0.0%	5.2%	10.3%
Pittsburg	34.3%	40.0%	22.9%	45.7%	47.1%	47.1%
Pleasant Hill	5.5%	11.0%	N/A	N/A	N/A	N/A
Pleasanton	35.3%	40.0%	40.0%	53.3%	49.7%	49.7%
Portola Valley	18.5%	22.6%	N/A	N/A	14.7%	18.9%
Redwood City	2.9%	5.7%	0.0%	0.0%	12.3%	12.3%
Richmond	2.9%	8.6%	N/A	N/A	2.9%	8.6%
Rio Vista	7.0%	7.0%	N/A	N/A	7.0%	7.0%
Rohnert Park	4.6%	4.6%	0.0%	0.0%	0.0%	0.0%
Ross	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

City	P(dev) for all sites	P(dev) for all sites (100 ft buffer)	P(dev) for nonvacant sites	P(dev) for nonvacant sites (100 ft buffer)	P(dev) for vacant sites	P(dev) for vacant sites (100 ft buffer)
San Anselmo	8.6%	10.7%	7.0%	13.9%	N/A	N/A
San Bruno	53.3%	53.3%	53.3%	53.3%	N/A	N/A
San Carlos	4.1%	5.0%	3.6%	4.6%	8.6%	8.6%
San Francisco	7.3%	13.8%	7.1%	13.9%	8.0%	13.6%
San Jose	13.9%	17.7%	14.3%	17.6%	13.4%	17.9%
San Leandro	2.3%	6.9%	0.0%	6.0%	9.4%	18.8%
San Mateo	8.5%	10.2%	10.7%	10.7%	16.0%	16.0%
San Pablo	1.3%	2.6%	0.0%	2.6%	4.2%	4.2%
San Rafael	9.3%	23.2%	20.0%	40.0%	9.4%	37.6%
San Ramon	1.7%	1.7%	0.0%	0.0%	0.0%	0.0%
Santa Clara	8.0%	9.4%	8.5%	10.0%	0.0%	0.0%
Santa Rosa	4.7%	4.7%	N/A	N/A	N/A	N/A
Saratoga	0.0%	0.0%	0.0%	0.0%	N/A	N/A
Sausalito	1.8%	7.4%	2.7%	5.3%	0.0%	11.9%
Sebastopol	6.5%	6.5%	N/A	N/A	7.1%	7.1%
Sonoma	7.0%	7.0%	0.0%	0.0%	32.0%	32.0%
South San Francisco	22.9%	22.9%	19.2%	19.2%	32.0%	32.0%
Suisun City	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Sunnyvale	10.1%	13.3%	10.4%	13.7%	0.0%	0.0%
Tiburon	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Union City	9.1%	9.1%	26.7%	26.7%	10.7%	10.7%
Vacaville	12.3%	14.8%	0.0%	0.0%	18.3%	22.9%
Vallejo	1.6%	3.7%	N/A	N/A	1.6%	3.7%
Walnut Creek	2.6%	6.5%	1.3%	5.3%	80.0%	80.0%
Windsor	31.4%	31.4%	0.0%	0.0%	0.0%	0.0%
Woodside	4.2%	4.8%	N/A	N/A	4.2%	4.8%
Yountville	11.4%	34.3%	0.0%	32.0%	17.8%	35.6%
Overall	9.0%	13.2%	7.6%	12.4%	10.0%	13.9%

Table A.2. Comparing housing production and site inventory development.[16]

City	Units permitted citywide as share of housing element's claimed capacity	Units permitted on inventory site / "realistic" capacity claimed for site	Units permitted on inventory sites as share of all permitted units
Alameda	82.7%	64.9%	50.3%
Albany	101.4%	54.2%	68.2%
American Canyon	105.1%	N/A	0.0%
Antioch	53.1%	N/A	0.0%
Atherton	86.4%	83.3%	3.0%
Belmont	46.9%	100.3%	76.5%
Belvedere	37.6%	100.0%	25.0%
Benicia	5.9%	95.1%	45.5%
Berkeley	47.5%	157.2%	5.3%
Brentwood	341.6%	166.5%	12.5%
Brisbane	8.6%	143.8%	65.9%
Burlingame	65.9%	402.7%	89.2%
Calistoga	32.3%	272.7%	37.2%
Campbell	57.9%	304.0%	70.5%
Clayton	6.1%	34.5%	50.0%
Cloverdale	32.9%	114.7%	35.1%
Colma	461.5%	253.8%	88.0%
Concord	9.1%	65.6%	13.3%
Corte Madera	86.6%	100.0%	54.5%
Cotati	14.4%	N/A	53.8%
Cupertino	26.5%	172.7%	7.2%
Daly City	214.7%	412.0%	37.9%
Danville	106.3%	109.4%	69.4%
Dixon	30.0%	34.2%	39.5%
Dublin	182.3%	92.9%	1.5%
East Palo Alto	49.4%	N/A	0.0%
El Cerrito	65.7%	N/A	1.1%

16 For summary statistics, see **Table 2** (which summarizes, "Units permitted citywide as share of housing element's claimed capacity"), **Table 3** (which summarizes, "Units permitted on inventory sites as share of all permitted units"), and **Table 4** (which summarizes, "Units permitted on inventory site / "realistic" capacity claimed for site").

City	Units permitted citywide as share of housing element's claimed capacity	Units permitted on inventory site / "realistic" capacity claimed for site	Units permitted on inventory sites as share of all permitted units
Emeryville	26.5%	N/A	0.0%
Fairfax	91.1%	135.0%	65.9%
Fairfield	43.2%	25.3%	4.4%
Fremont	137.2%	105.5%	19.4%
Gilroy	352.6%	N/A	11.5%
Half Moon Bay	9.4%	89.3%	50.9%
Hayward	107.2%	47.4%	25.1%
Healdsburg	78.9%	27.5%	2.9%
Hercules	43.5%	N/A	0.0%
Lafayette	79.4%	87.5%	23.0%
Larkspur	41.0%	N/A	5.0%
Livermore	87.8%	123.5%	58.3%
Los Altos	194.5%	92.9%	4.2%
Los Altos Hills	51.2%	68.1%	20.2%
Los Gatos	23.9%	N/A	0.0%
Martinez	8.2%	83.1%	52.9%
Menlo Park	93.5%	356.7%	39.5%
Mill Valley	68.8%	100.0%	1.2%
Millbrae	1.9%	N/A	0.0%
Milpitas	40.3%	37.2%	89.5%
Monte Sereno	203.6%	N/A	0.0%
Moraga	15.1%	80.0%	5.1%
Morgan Hill	220.7%	167.1%	23.0%
Mountain View	143.4%	829.6%	54.4%
Napa	107.9%	112.6%	21.7%
Newark	115.7%	57.2%	98.2%
Novato	62.6%	327.8%	21.6%
Oakland	285.2%	300.5%	27.1%
Oakley	478.4%	10.0%	0.7%
Pacifica	31.0%	N/A	0.0%
Palo Alto	49.9%	80.8%	5.3%
Petaluma	32.4%	70.4%	52.0%
Piedmont	113.9%	100.0%	2.4%
Pinole	4.2%	100.0%	7.7%

City	Units permitted citywide as share of housing element's claimed capacity	Units permitted on inventory site / "realistic" capacity claimed for site	Units permitted on inventory sites as share of all permitted units
Pittsburg	54.2%	107.7%	37.0%
Pleasant Hill	52.9%	N/A	0.6%
Pleasanton	82.6%	81.8%	45.7%
Portola Valley	77.0%	128.6%	18.5%
Redwood City	84.7%	240.0%	1.4%
Richmond	63.5%	103.0%	0.6%
Rio Vista	12.1%	55.7%	40.0%
Rohnert Park	669.5%	N/A	7.1%
Ross	58.2%	N/A	0.0%
San Anselmo	34.3%	100.0%	33.3%
San Bruno	73.6%	85.5%	12.9%
San Carlos	58.2%	202.8%	13.9%
San Francisco	75.3%	396.0%	28.8%
San Jose	89.0%	94.6%	33.4%
San Leandro	11.1%	83.3%	3.6%
San Mateo	56.7%	145.3%	61.2%
San Pablo	11.0%	100.0%	1.9%
San Rafael	67.2%	16.7%	6.8%
San Ramon	62.5%	85.7%	1.7%
Santa Clara	104.4%	195.0%	21.0%
Santa Rosa	174.3%	10.0%	0.1%
Saratoga	49.2%	N/A	0.0%
Sausalito	17.9%	50.0%	5.0%
Sebastopol	13.9%	75.0%	7.4%
Sonoma	23.1%	10.3%	3.6%
South San Francisco	80.0%	578.8%	43.7%
Suisun City	35.4%	N/A	0.0%
Sunnyvale	12.4%	75.1%	44.1%
Tiburon	62.0%	N/A	0.0%
Union City	68.8%	80.0%	7.0%
Vacaville	49.4%	66.4%	32.0%
Vallejo	15.1%	125.0%	2.5%
Walnut Creek	124.7%	142.4%	4.9%
Windsor	24.4%	N/A	9.5%

City	Units permitted citywide as share of housing element's claimed capacity	Units permitted on inventory site / "realistic" capacity claimed for site	Units permitted on inventory sites as share of all permitted units
Woodside	38.2%	N/A	12.3%
Yountville	22.5%	50.0%	10.0%
Overall	75.3%	230.6%	27.8%

Appendix B. Methodological Details and Robustness Checks

MATCHING BY ASSESSOR PARCEL NUMBER (APN)

Typically, an assessor parcel number is a string of 10 to 15 digits, divided into groups separated by hyphens. Usually, the first group denotes the tax assessor's relevant map book, the second group denotes the page in the map book, and the third group denotes the specific parcel.

Unfortunately, APNs are not represented consistently across the ABAG site inventory dataset, the ABAG permits dataset, city APRs, and the alternative permit datasets we obtained for San Francisco, San Jose, and Los Altos. The parcel numbers sometimes contain extraneous characters such as commas, periods, question marks, or plus signs. The numbers may or may not have leading zeros. The map book, page, and parcel number are sometimes separated by hyphens, forward slashes, or spaces, and at other times represented as an unbroken string of digits.

Using the APNs as-is, we were able to match 270 inventory sites with at least one building permit. To correct for the formatting variations discussed above, we standardized the formatting of APNs by removing all non-digit characters and converting the resulting strings to integers (so that, for example, "033" and "33" map to the same value).[17] This enabled us to identify 249 additional matches between inventory sites and permits (see **Table B.1**).

MATCHING BY GEOCODES

As noted above, we count a site as developed if it matches a permit by APN or by geocode. The ABAG site inventory dataset includes a shapefile which encodes the area of each site as a polygon expressed in geographic coordinates. The ABAG permits dataset (2013-2017) encodes each permit as a geographic point (not polygon). It's not clear whether this location data was provided by cities for each building permit, or inferred by ABAG using the address provided by the city. For permits in 2018 and 2019, obtained from HCD's Annual Progress Report forms, we encoded each building permit's address as a coordinate using a geocoding service, Geocodio.[18]

17 For example, the Ryan Terrace project in San Ramon had a hyphenated APN, viz. "208-280-017," in the site inventory, but a non-hyphenated APN in the ABAG permits dataset. By removing non-digit characters like hyphens in the APNs, we identified 18 permits tied to the Ryan Terrace project where before none were identifiable.

18 https://www.geocod.io/

Once all sites and permits are encoded in coordinates, we match them by checking if any permit (encoded as a point) falls inside a housing element site (encoded as a polygon), using Geopandas's "intersection" feature.[19] We also add a buffer, so that if a permit point is within a few feet of the boundaries of a housing site, it is considered a match. To ensure that the buffer doesn't result in one permit being matched to multiple sites, we assign each permit only to the nearest site that falls within the buffer range.

Choosing an appropriate buffer requires some discretion. If the buffer is too big, there will be false positives, where a permit on a neighboring parcel is incorrectly counted as development of an inventory site. We checked for false positives on an ad-hoc sample of sites by comparing the address on the building permit with the addresses of the matched parcel and nearby parcels. Increasing the buffer from 5 feet to 50 feet more than doubles the match rate in San Francisco, with almost all of the increase due to false positives. Conversely, too small a buffer can cause false negatives. For two sites in Mountain View, the geocoded permit was about 23 feet outside the site, although the permit has the same address as the site. These two sites would be incorrectly identified as not matching (that is, as not-developed) for any buffer shorter than 25 feet. (See **Figure B.1.**) In principle, we could deem a permit in the buffer to match the target site only if it has the same address as the site, but because addresses, like APNs, sometimes change with development, and because address encoding is often inconsistent across datasets, we opted not to impose this restriction.

Because the optimal buffer is unknown, we analyzed the data using multiple buffer standards, between five feet and 100 feet. As mentioned above, our ad-hoc inspection suggested that the 25 feet generates marginally more accurate results in Mountain View, and the 5 feet standard was marginally better in San Francisco. See **Figure B.1.** (The effect of the buffer size can also be explored using the webapp.) Since we believe that the optimal buffer is somewhere between 5 feet and 25 feet, to be lenient the results throughout this report use the 25 feet standard. The important point, though, is that the overall results aren't very sensitive to the choice of buffer: between the most conservative standard and the most lenient standard, the median-city probability of development ("P(dev)") increases by only about 4 percent. It's also worth emphasizing that the 100 feet standard is far more lenient than we believe is needed: under a 100 feet standard, a building permit across the street, or 3 houses down the block, from a housing inventory site, could be matched.

Tables B.1 and B.2 show how our results would vary under alternative matching assumptions.

19 https://geopandas.org/

Table B.1. Implications of alternative matching assumptions for P(dev) estimate. (Our chosen method is in bold.)

Method	Number and fraction of sites matched to at least one permit (out of 15,750)	P(dev) for median city	P(dev) for ABAG as a whole
Raw APN only	270 (1.7%)	0.013	0.027
APN only	519 (3.3%)	0.038	0.053
APN and geocoding (no buffer)	777 (4.9%)	0.070	0.079
APN and geocoding (5 ft buffer)	782 (5.0%)	0.070	0.079
APN and geocoding (10 ft buffer)	797 (5.1%)	0.075	0.081
APN and geocoding (25 ft buffer)	**886 (5.6%)**	**0.080**	**0.090**
APN and geocoding (50 ft buffer)	1014 (6.4%)	0.090	0.103
APN and geocoding (75 ft buffer)	1145 (7.3%)	0.103	0.116
APN and geocoding (100 ft buffer)	1297 (8.2%)	0.110	0.132

Table B.2. Implications of alternative matching assumptions for share of development on inventory sites. (Our chosen method is in bold.)

Method	Projects on sites in inventory, as fraction of all projects issued permits for median Bay Area city	Projects on sites in inventory, as fraction of all projects issued permits for Bay Area overall	Permitted units on inventory sites, as fraction of all permitted units for median Bay Area city	Permitted units on inventory sites, as fraction of all permitted units for for Bay Area overall
Raw APN only	1.0%	1.9%	0.7%	6.9%
APN only	2.0%	3.0%	4.2%	16.2%
APN and geocoding (no buffer)	7.0%	15.7%	11.6%	25.6%
APN and geocoding (5 ft buffer)	7.0%	15.8%	12.1%	25.7%
APN and geocoding (10 ft buffer)	7.1%	15.9%	12.3%	26.1%
APN and geocoding (25 ft buffer)	**7.1%**	**16.8%**	**12.9%**	**27.8%**
APN and geocoding (50 ft buffer)	9.5%	17.6%	19.1%	30.0%
APN and geocoding (75 ft buffer)	9.5%	18.5%	19.8%	32.4%
APN and geocoding (100 ft buffer)	12.4%	19.6%	22.0%	35.8%

Figure B.1: Examples of conservative vs. lenient geomatching.

Example from San Francisco: three sites are (correctly) not matched with a buffer of 5 ft (left), but are spuriously matched with a buffer of 25 ft (right).

Example from Mountain View: two sites are not matched with a buffer of 5 ft (left), but are matched correctly with a buffer of 25 ft (right).

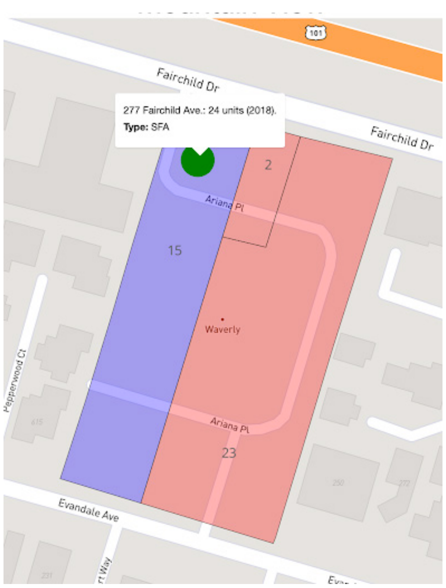
There are a couple of other potential sources of bias in the geocoded data which should be acknowledged. First, while the sites dataset consists of discrete parcels, it appears that some “sites” as conceptualized by the city actually consist of multiple parcels. If the parcels for such a site are consolidated prior to issuance of the building permit, there would be no permit-to-site match by APN (because the consolidated parcel would have a new APN), and by geocoding the permit would match to a single parcel within the site rather than to the site as a whole (because permits are encoded as points, not polygons). This could bias downward the estimate of parcels’ likelihood of development, and bias upward the estimate of the average number of units on a parcel conditional on development.

Figure B.2. Examples of other geomatching issues.

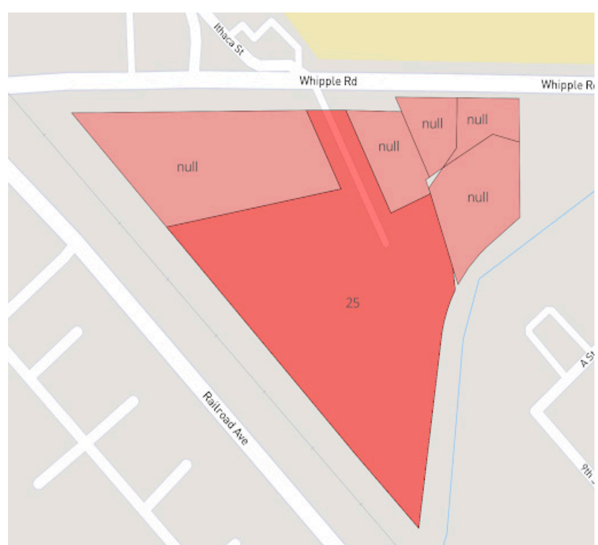
B.2a: Example from Lafayette: the completed project here was built on all three sites assembled together. Only one of the three sites was matched with a permit.

B.2b: Example from Sunnyvale: this site was divided into 10 parcels. Only 5 were matched with permits.

B.2c: Example from Mountain View:
The townhouse project here was actually built across all three parcels here, so all three should be matched.



B.2d: Example of Duplicated Sites (Union City). Part of the polygon is a darker shade of red, because there are two overlapping semi-transparent parcels on top of each other.



SITE TYPES

We disaggregated sites into "vacant" and "nonvacant" categories, and excluded sites that had already received planning entitlements before the start of the 2015-2023 planning period. For this purpose, we relied on the "site type" field in the ABAG dataset. See **Table B.3**. Approximately 9% of the sites in ABAG's database had planning entitlements. These sites are counted toward the city's RHNA based on the number of entitled units by income category, rather than realistic-capacity assumptions (Department of Housing and Community Development 2020, pp. 5-6), and so they are not relevant to our analysis.

As noted in the Introduction, housing element law establishes special requirements for assessing the capacity of nonvacant sites, so we were particularly interested in how the development outcomes of vacant and nonvacant sites differed. We were able to classify 32% of sites as vacant sites and 39% as nonvacant sites based on the "site type" column. Nineteen percent of sites could not be classified. See **Table B.3**. These unclassified rows are excluded from the parts of the analysis that are confined to vacant or nonvacant sites only. Since we didn't detect any noticeable pattern in the kinds of sites that were unclassifiable, it seems plausible that a site being unclassifiable is independent of its development likelihood, and therefore excluding these rows should not bias the results of the vacant or nonvacant sites analysis.

Table B.3. Classifying site types in the ABAG site inventory dataset

<table>
<tr><th>Site type in ABAG dataset</th><th>Share of sites</th><th>Classification</th></tr>
<tr><td>'Approved', 'Built', 'Entitled', 'Planned and Approved', 'Under Construction'</td><td>9%</td><td>Considered as entitled before the start of the planning period. Excluded from all analysis.</td></tr>
<tr><td>'Vacant', 'Underutilized and Va', 'Undeveloped', 'Open Space', 'Vacant and Underutil', 'Un-derutilized & Vaca'</td><td>32%</td><td>Classified as "vacant". Included in analysis.</td></tr>
<tr><td>'Underutilized', 'Opportunity', 'Non-Vacant', 'Infill', 'Underused site', 'Underutilized, margi', 'un-derutilize'</td><td>39%</td><td>Classified as "nonvacant". Included in analysis.</td></tr>
<tr><td>'Under Consideration', 'Pending', 'Proposed', 'Planned', 'Limited access', 'Under consideration', 'PDA'</td><td>0.5%</td><td rowspan="2">Included in analysis, but not counted as "vacant" or "nonvacant" since it's not clear which one it falls under.</td></tr>
<tr><td>null</td><td>19%</td></tr>
</table>

CLAIMED SITE CAPACITY

In the ABAG site inventory dataset, 83% of the sites have their estimated capacity clearly readable as a string of digits representing the number of units. Another 2% of sites have their capacity described in simple natural language that we were able to parse. For example, one city uses “2 primary and 2 acce” to describe a site that allows two single family homes and two accessory dwelling units. In other cases, the capacity is a range like “10-15” or “10 to 15” (in which case we use the maximum), or is a number followed by the word “units” or “SFR.” We were successful in parsing realistic capacity estimates for the 2% of sites that included units, ranges, or natural language.

Unfortunately, estimated capacity is simply missing in the dataset for 15% of sites. These sites were excluded when we compared estimated site capacity to the number of units actually built.

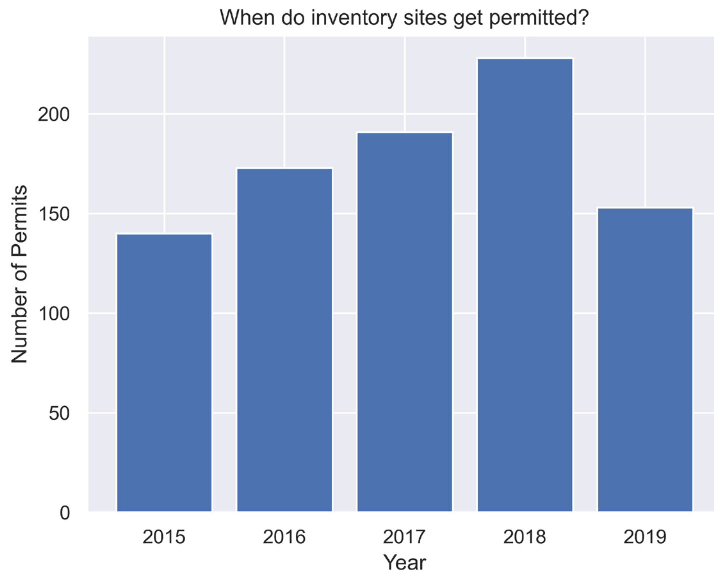
ESTIMATING P(DEV) OVER EIGHT YEARS

Because the data in our study period covers only the first five years of the housing element cycle (2015 to 2019), some care is required to estimate the portion of a city’s site inventory that will be permitted by the end of the full eight-year period.

We chose to model the year in which a site is developed as follows. For a given city, we assume that any parcel in the site inventory will be developed within the eight-year RHNA cycle with the same probability, P(dev), as independent Bernoulli trials. Conditional on being developed within eight years, we assume that the year in which a parcel is developed follows a uniform distribution over years 1 to 8. With this model specification, the maximum likelihood estimator for P(dev) is $P(dev) = \min(8/5 \cdot k/n, 1)$, where n is the size of the city’s site inventory and k is the number of inventory sites developed within five years.[20]

20 The proof that this estimator is the maximum likelihood estimator is given here: https://github.com/YIMBYdata/housing-elements/blob/30ca9a5c3520a0213b2ace1906ed9b5fc23860fb/mle_proof_pdev_projection.pdf

Figure B.3. Yearly distribution of inventory site development



The observed distribution of when each site was developed, conditional on being developed by 2019, suggests that the uniform distribution assumption is reasonable. (See **Figure B.3**.)

We also considered using a survival analysis model, in which each year a constant fraction of the remaining, not-yet-built sites in a city receive building permits. However, if that were the case, we would have expected fewer inventory sites to get permitted in each subsequent year of the cycle. Instead, permitting appears to be approximately constant over time.

ROBUSTNESS CHECK WITH DIRECT-SOURCING OF PERMITS DATA FROM CITIES

As a robustness check of the ABAG and APR permits dataset, we sought to validate our results with alternative data sources. We requested building permit data for the fifth-cycle period from San Francisco, Oakland, San Jose, Palo Alto, San Ramon, Berkeley, Mountain View, and Los Altos. Of these cities, only three ultimately provided the data that we requested: San Francisco,[21] San Jose,[22] and Los Altos.[23] These datasets include all

21 San Francisco's dataset of permits came by way of the City and County of San Francisco's open data platform DataSF. This dataset spans from January 2013 to today. It is available at https://data.sfgov.org/Housing-and-Buildings/Building-Permits/i98e-djp9.

22 San Jose's dataset of building permits is available at https://csj.maps.arcgis.com/apps/webappviewer/index.html?id=18fb93164e184b9babc4ae6f891cb879.

23 We thank Anne Paulson of the Los Altos Affordable Housing Alliance for securing and sharing with us a dataset containing building permits for Los Altos. This dataset spans from March 1995 to October 2020, and so contains permits from most of the 5th RHNA cycle. Los Altos relies on the company eTRAKiT to host their permits database, and eTRAKiT's customer service graciously supplied Paulson with this dataset.

building permits, including commercial construction as well as residential renovations. We filtered these for new construction housing permits (single family, multifamily, and accessory dwelling units) during the study period, 2015 to 2019. We then replicated our analyses with the city-sourced building permits data.

Table B.4: Comparison of results using main ABAG permits dataset to city-sourced permits data for San Francisco, San Jose, and Los Altos.

	Results from ABAG + APR dataset				Results from city-sourced dataset			
	Units permitted 2015-2019	P(dev) over 8 years	Share of projects built on housing element sites	Share of units built on housing element sites	Units permitted 2015-2019	P(dev) over 8 years	Share of projects built on housing element sites	Share of units built on housing element sites
San Francisco	22,225	0.073	17%	29%	36,018[24]	0.097	15%	33%
San Jose	12,602	0.138	24%	35%	11,314	0.094	26%	32%
Los Altos	313	0.196	4%	4%	113	0.253	30%[25]	45%

For San Francisco and San Jose, our results with city-sourced permits data are very similar to our main results using the ABAG permits dataset. The estimates of probability of development differ by only three to five percentage points. The share of development happening on housing inventory sites is also within two to four percentage points of the main estimate for both cities.[26]

However, the results with city-sourced data are quite different for Los Altos. While the probability of development on inventory sites is similar (within three percentage points), the number of units permitted and the share of development occurring on housing element sites are very different. This discrepancy is fully explained by reporting errors. HCD requires that Annual Progress Reports only include projects that create a net increase in housing units. The ABAG permits dataset was made with this assumption as well. However, Los

24 This value is probably higher than the units permitted in the ABAG dataset because of duplicate permits that we were unable to identify and remove, and possibly renovation permits that were incorrectly labelled as new construction. However, the duplication errors seem uncorrelated with whether the permit was for a housing element site, because our estimates for P(dev) and the share of development on inventory sites are very similar between the two datasets.

25 This value is inflated compared to the ABAG dataset because the alternative dataset for Los Altos often included one permit per unit in condo projects, and our calculations assume that there is only one permit per project.

26 We did find small inconsistencies between the city-sourced and ABAG permits data for San Francisco and San Jose. Sometimes projects are present in one source but not the other, or the same project exists in both sources but is labelled with the wrong APN or the wrong permit type in one of the sources. Yet overall, this check confirms that planners attempted to be faithful and accurate in reporting their housing permitting data to ABAG and to HCD.

Altos erroneously reported single-family "rebuilds" (1-to-1 demolition and replacement of single-family homes) in ABAG's permits dataset. The inclusion of rebuild projects inflated the number of units permitted by 127 units, and decreased the share of development occurring on housing inventory sites. The remaining discrepancy is explained by three non-inventory-site projects that were present in the ABAG permits dataset, but were erroneously missing from Los Altos's permits database.[27] These three projects sum to 73 units, which together with the 127 rebuilds explain the full difference in units permitted between the two datasets (see "Units permitted" columns in **Table B.4**). The inclusion of these three projects in the ABAG permits dataset further deflated the share of development on housing inventory sites in the ABAG dataset estimate.

The difficulty of completing this robustness check, as well as the issues we found in Los Altos, underscores the value of state-mandated data reporting standards. Obtaining and cleaning the city-sourced permits data was the most painful and challenging data preparation step in this project. Determining which rows correspond to new residential construction and the number of units in each project was nontrivial. Often the city permits databases contain multiple rows with very similar data, which might mean that the same project applied for a building permit multiple times, or that multiple buildings on the same parcel all started construction at the same time (e.g. a townhouse project).

Because of these ambiguities, and because of other potential nuances that we may not have noticed, we remain less confident in the results using city-sourced permits data than in our main results. Without the extraordinary effort that must have gone into the preparation of ABAG's permits datasets, and the new standards enacted by HCD for standardized, Excel-based annual progress reports, the analysis completed in this report would likely not have been possible. In parts of the state outside of the San Francisco Bay Area, we may have to wait several years before enough APR data becomes available to reach solid conclusions about the development outcomes of housing inventory sites.

ROBUSTNESS CHECK WITH PERMITS DATA FROM THE U.S. CENSUS (BUILDING PERMIT SURVEY)

As a further robustness check of the ABAG and APR permits dataset, we sought to replicate our Citywide Production Relative to the Housing Element's "Claimed Capacity" results using data from U.S. Census Building Permits Survey.[28] Every month, the Census Bureau surveys local governments on the number of housing units for which they issued building permits. Unlike for Annual Progress Reports, there is no legal requirement for cities to participate, and indeed the incentive for cities to participate in this survey and to submit accurate data is much smaller. As a result, four of the cities in our study did not participate in this survey: Clayton, Lafayette, Moraga, and Saint Helena. However, data was available for the other 93 cities.

As shown in **Table B.5**, the estimates are similar between the two data sources. The BPS data estimates are uniformly a few points lower than those from the ABAG and APR dataset. This might reflect the fact that cities have a stronger incentive to report every building in their APRs than in the BPS, as state law (SB 35) provides a direct policy lever to encourage cities to report progress towards meeting their RHNA. It may also reflect the

27 These projects are 5150 El Camino Real, 4898 El Camino Real, and 440 La Prenda Road.

28 https://www.census.gov/construction/bps/

fact that the BPS is collected on a monthly basis, allowing cities less time to prepare a high-quality, accurate result.

Table B.5. Total permitted units citywide divided by total housing element capacity (2015-2019, extrapolated to 8 years)[29]

	Citywide permits as fraction of housing element’s claimed capacity (ABAG dataset)	Citywide permits as fraction of housing element’s claimed capacity (Census BPS dataset)
Median Bay Area city	0.58	0.52
Mean Bay Area city	0.88 (sd. 1.07)	0.82 (sd. 1.04)
25th percentile city	0.32	0.21
75th percentile city	0.93	0.87
Bay Area as a whole	0.76	0.72

ROBUSTNESS CHECK WITH DEED-RESTRICTED UNITS ONLY (SHARE OF CONSTRUCTION ON HOUSING INVENTORY SITES)

Our results in **Table 3** show that most housing construction occurs outside of housing inventory sites. Yet this finding is not sufficient to conclude that California housing element law fails in accomplishing its goals. In addition to requiring cities to plan for their overall RHNA, the housing element law also requires cities to plan for low-income housing needs by providing inventory sites that meet certain requirements to count as “low-income sites.” Is deed-restricted affordable housing in fact concentrated on the inventory sites?

To answer this question, we replicated **Table 3**, which shows the fraction of all new housing development that occurred on inventory sites, using data for deed-restricted affordable units only. The results are in **Table B.6**. Evidently, cities are not much better at predicting where below-market-rate units will be built than they are at predicting where housing development, in general, will happen. In the median city, the share of deed-restricted affordable housing on inventory sites is 16%, only slightly higher than the 13% for all housing units. Across the Bay Area as a whole, 31% of deed-restricted affordable housing units were permitted on inventory sites, as compared to 30% of all housing units.

29 This table excludes the four cities for which BPS data is not available (Clayton, Lafayette, Moraga, and Saint Helena) from the results of both columns. As a result, the ABAG dataset results in this table are close to, but not identical, to the results in Table 2.

Table B.6. Percentage of a city's deed-restricted below-market-rate units that were issued for projects on housing element inventory sites.[30]

	Projects on sites in inventory, as fraction of all projects issued permits
Median Bay Area city	16%
Mean Bay Area city	38% (sd. 43 percentage points)
25th percentile city	0%
75th percentile city	98%
Bay Area as a whole	31%

30 Out of 98 cities in our study, this table includes only the 56 cities that permitted at least one below-market-rate deed-restricted unit.

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