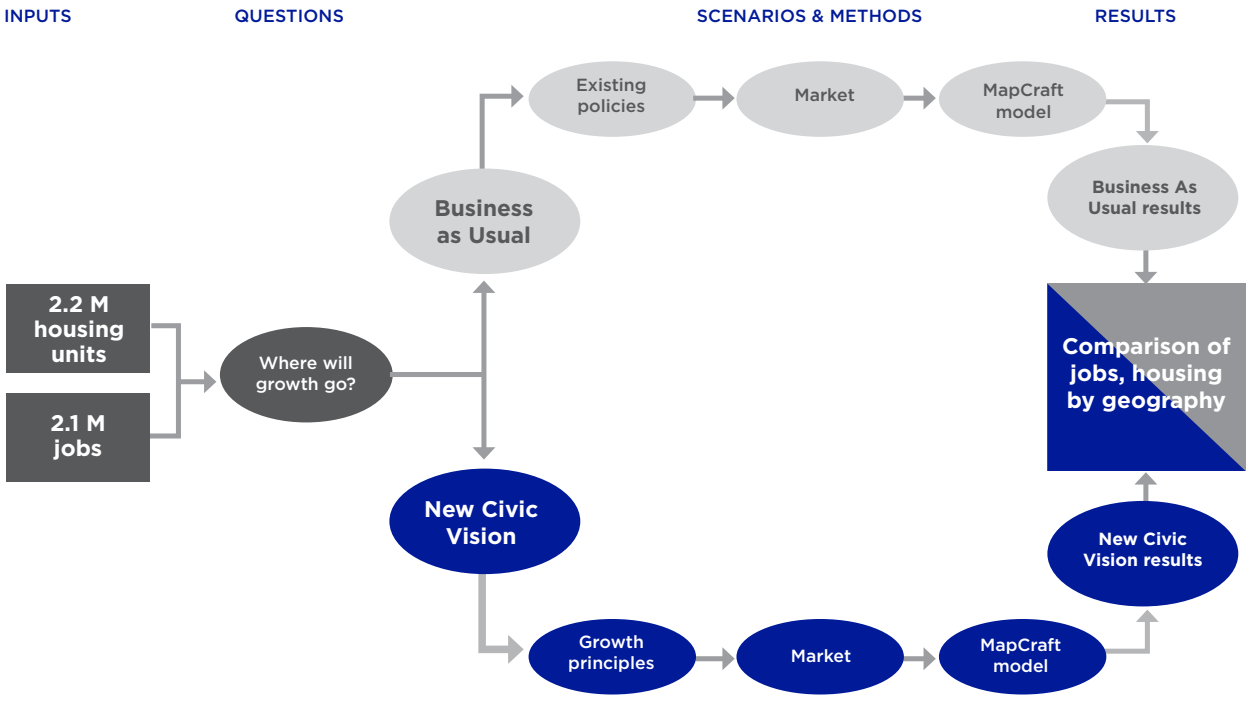
APPENDIX

MAY 2021

Technical Notes on A Civic Vision for Growth

SPUR modeled where housing and jobs are likely to go under current planning policies and where they should go in order to meet sustainability and equity goals. This work represents a major analytical undertaking involving workshops and partnerships with economic, demographic, housing and land use modeling experts, numerous phases of original research and constructive peer review. This appendix outlines the main partnerships, data sources, methods and assumptions behind this work.

An Overview of SPUR's Growth Allocation Model



Inputs Used in the Model

Housing projections. SPUR relied on an analysis by the Concord Group that aimed to answer how many housing units would be needed to moderate high housing prices in the region. In fact, over the last 20 years, the Bay Area has added more higher-income households and lost a significant amount of lower- and middle-income households, due in part to a lack of housing. The Concord Group's analysis included an estimate of how many housing units the Bay Area would have had to build between 2000 and 2018 to maintain an affordable housing stock for all levels of income present in 2000. This shortage totaled 699,000 units across the income spectrum. The Concord Group also projected that from today to 2070, the region would need 1,492,000 units to ensure no further erosion in housing affordability. Together, the region would need 2.2 million units by 2070.[1]

Job projections. SPUR's job projections rely on the above total housing estimate and analysis conducted by the Center for the Continuing Study of the California Economy. This analysis included both a low and high growth estimate based on national job and population projections, immigration patterns, growth rates in different economic sectors, and the expected proportion of people and jobs that would likely end up in the Bay Area.[2] For this analysis, SPUR chose to use just the high jobs estimate in order to err on the side of over-planning and building housing. SPUR perceived the risk of the undersupply of housing (greater housing unaffordability) as worse than oversupply (lowering of home values for some owners). It would also be easier to stop building if housing prices suddenly dropped, but harder to rapidly build more housing if they spiked. In addition, it is likely that the region will need 2.2 million new housing units at some point, even if it is beyond 2070, and planning for the growth now can help ensure better land use. In the end, the high projection for new jobs in the Bay Area by 2070 totaled 2.1 million.

Key Questions

Given the need to accommodate 2.2 million housing units and 2.1 million jobs, SPUR's modeling sets out to ask and answer three types of questions:

1. Scenarios: Where will such growth go if the region takes minimal policy action? Where *should* growth go if we take every action to ensure the best possible future for all who live and work in the region?
2. Performance of scenarios: In terms of housing units, job space and building types, what are the key differences between where growth is likely to go and where it should go?

1 For more information on the Concord Group's analysis, see: SPUR, "What It Will Really Take to Create an Affordable Bay Area," April 2021, https://www.spur.org/publications/spur-report/2021-04-19/what-it-will-really-take-create-affordable-bay-area

2 Center for the Continuing Study of the California Economy, "High and Low Projections of Jobs and Population for the Bay Area to 2070-Projection Framework, Specific Assumptions and Results," November 2019, https://www.ccsce.com/PDF/High-and-Low-Projections-of-Jobs-and-Population-for-the-Bay-Area-to-2070.pdf?nov2019

3. Policy implications of scenarios: What policies would be needed to achieve the better performing growth pattern?

The MapCraft Model

SPUR leveraged and adapted an existing land use model developed by MapCraft. Their model is well suited to answer *where* growth will go using a variety of existing development costs (land cost, construction and soft costs) in specific areas, the market prices for different kinds of development in different areas, and the parcel level zoning across the nine-county region. Essentially, the model calculates the expected financial feasibility of different kinds of development across the region and allocates growth to the places where development is most viable. One important note about this model is that it assesses all development at one point in time, so the conditions that determine viability do not change as growth is added. Given the uncertainty of conditions over the next 50 years, SPUR thought it less important to focus on this than to create two scenarios between which the region could draw valuable conclusions about long-term growth trajectories. Exactly how SPUR worked with MapCraft to adapt components of its model to suit this analysis is described in more detail below.

Scenarios

While SPUR ran various model runs and iterated on scenarios, in the end the modeling work relied on two main scenarios: the "Business as Usual" scenario, in which minimal land use policy is changed, and the "New Civic Vision" scenario, where zoning is changed systematically to best guide where growth should go.

Geographies Developed for the Model

SPUR developed numerous geographies for this modeling. Two spatial inputs were used across all scenarios and describe the expected future conditions of the Bay Area in all cases. These include:

Planned megaprojects. SPUR accounted for the growth that would likely come to the Bay Area by surveying existing large development plans and reports and by creating spatial and tabular data for almost 30 very large project plans across the region. These included but were not limited to planned developments around several BART and other transit stations, former military areas and large areas that were once dedicated to industrial or commercial uses.

Planned transit stops and stations. In addition, SPUR accounted for transit stops and stations that were planned and/or were under construction at the time of the analysis.

These include new BART, Caltrain, Amtrak and SMART rail stations, as well as SFMTA ferry terminals, light rail and bus rapid transit stops and VTA light rail stops. These points were taken from the Metropolitan Transportation Commissions (MTC) data on major transit stops.[3]

For the New Civic Vision, SPUR first developed a set of normative statements that served as a framework for defining modeling geographies. These are SPUR's growth principles and were drafted internally and workshopped with economists, land use and transportation planners and housing and other experts during the fall of 2019. They fit into three broad categories: protection, transit- and downtown-oriented growth and those that increase housing options.

Once growth principles were in place, SPUR created spatial boundaries and data for each to use as inputs in the modeling process. The sources and methods for constructing these data are listed by growth principle below. In total, growth principle geographies cover roughly 90% of the nine-county Bay Area.

Growth principles that protect people from hazards and preserve critical agriculture, habitat and open space

1. We should not add new housing in areas highly vulnerable to wildfire, flooding or sea level rise.

The area defined as hazardous combines three sources of risk data:

Fire risk was taken from maps developed for the SPUR report *Safety First: Improving Hazard Resilience in the Bay Area*. Areas designated as high or very high risk were included in this analysis.[4]

Riverine and creek flooding risk was derived using geospatial data from the Bay Area Aquatic Resources Inventory basemap created by the San Francisco Estuary Institute.[5] From this, SPUR created a boundary of 100 meters on either side of all streams and creeks of Strahler order of four or greater.

Flooding risk from sea level rise was defined using spatial data developed by the San Francisco Bay Conservation and Development Commission.[6] SPUR designated areas at risk of flooding from sea level rise as those that would be inundated by three feet of sea

3 Metropolitan Transportation Commission (MTC), Major Transit Stops (2017), see: https://opendata.mtc.ca.gov/datasets/561dc5b42fa9451b95faf615a3054260_0 (accessed October 1, 2019)

4 SPUR, "Safety First: Improving Hazard Resilience in the Bay Area," 2020, https://www.spur.org/publications/white-paper/2020-03-18/safety-first-improving-hazard-resilience-bay-area

5 San Francisco Estuary Institute, BAARI basemap, see https://www.sfei.org/data/baari-version-21-gis-data#sthash.1sQhtcyc.dpbs, (accessed on November 10, 2020)

6 Adapting to Rising Tides, a project by the San Francisco Bay Conservation and Development Commission (BCDC). See Bay Shoreline Flood Explorer data: https://explorer.adaptingtorisingtides.org/home (accessed on December 3, 2019)

level rise, as well as low-lying areas — those greater than one acre and below future sea levels, even if not hydraulically connected at the surface to the inundated areas.

These areas span every county in the region except for San Francisco, and total 2.2 million acres or 48% of the region's land area.

2. Growth should not go into agricultural or natural land open spaces, especially large, contiguous areas that contain high-quality farmland, ranch land, natural habitat, or that provide key ecosystem services.

The geographic extent of this growth principle was defined using two sources:

The California Protected Area Database includes federal, state, regional and local urban parks that are mostly open space, as well as land trust reserves and special district open spaces.[7]

The Bay Area Greenprint, a spatial tool that "identifies, maps, and measures the values that natural resources contribute to the ecosystem, the economy, and the local and regional community."[8] SPUR used areas designated as prime farmland, farmland of local importance, farmland of statewide importance, unique farmland and Bay Area critical linkages.

Together these areas represent land in every county of the Bay Area and cover 2.3 million acres, or 50% of the nine-county region.

Principles that concentrate growth around transit-centered areas and pre-war downtowns

3. Jobs and housing should concentrate close to existing and future regional rail stations, light rail stations and high-frequency bus stops.

For this growth principle, SPUR used existing and planned stations and stops for high frequency bus, light rail, ferries, BART, Caltrain, Amtrak and ACE train stations. In addition, SPUR projected where new transit would locate between now and 2070. SPUR also created a typology of stations for bus and rail. With this, SPUR represented station areas by drawing differently sized buffers around different kinds of stops and stations, as some would attract passengers from a wider geography than others. For example, a high frequency bus stop may have a smaller geographic draw compared to a train station serving as a transfer point for many different lines.

7 The Bay Area Greenprint was created by The Nature Conservancy, Bay Area Open Space Council, American Farmland Trust, Greenbelt Alliance and GreenInfo Network. See California Protected Area Database, https://www.calands.org/cpad/ (accessed on October 10, 2020)

8 See The Bay Area Greenprint, https://www.bayareagreenprint.org/download/ (accessed on October 38, 2020)

As seen in Figure 1 below, SPUR also sometimes drew multiple buffers around the same station, reflecting that building densities immediately near a regionally-significant station could be higher than at the edge of a station's area of influence.

Figure 1

SPUR designated concentric rings around different types of transit stops and stations as illustrated below.

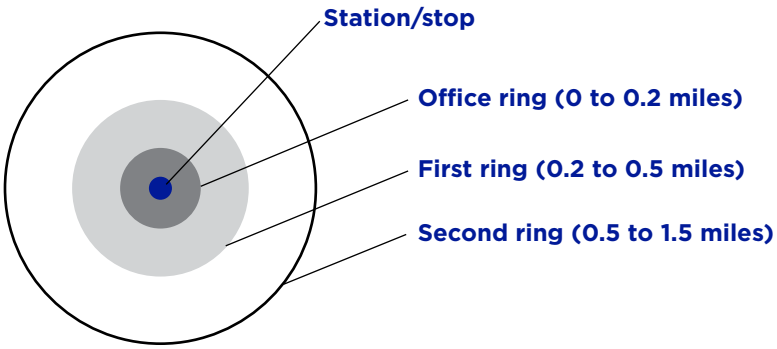


Figure 2 below lists the largest possible buffer that a transit type (e.g., rail) could have for a given stop or station type (e.g., transfer station). The buffer size listed is the radius of a circle drawn around the single center point of the station or stop. In other words, station area buffers were drawn using Euclidean distance.

FIGURE 2

Transit service areas for different transit and station types

TRANSIT TYPE	STOP OR STATION TYPE	TOTAL STATION AREA
Ferry	All terminals	Quarter mile
Bus and light rail	Most stops	Quarter mile
Bus and light rail	Transfer stops and stations	Half-mile
Light rail	Regional hubs and end-of-line stations	Half-mile
Bus Rapid Transit	All stops	Half-mile
Rail	Most stations	Half-mile
Regional Express Bus	Regional hubs	One mile**
Rail	Regional hubs	One mile**
Rail	Interregional hubs	One and a half miles**

**Indicates when an inner area was used to allow for intensified densities or a preference for job spaces over residential buildings nearer to stations.

To account for all transit stops and stations, SPUR used the following:

Existing and planned stops, stations and hubs were defined using two key point shapefiles from the MTC. The first contained existing and planned transit tops of all kinds across the

nine-county Bay Area, including all passenger train lines, ferries and light rail (as of 2017).[9] The second contained all the bus stops for the nine-county Bay Area with wait times between buses of 15 minutes or less during commute hours.[10]

Future stops, stations and hubs were defined through ongoing projects and conversations between transportation and regional planning policy staff at SPUR. In total, there are roughly 150 future stops, stations and hubs, five of which land outside the nine-county Bay Area but inside the mega region.[11] Additional stops and stations included bus rapid transit, light rail, rail and regional express bus. Some would extend existing lines, while many would serve as infill stations on existing lines.

These areas span all but Napa county and total 132,000 acres, or 3% of the region.

4. Jobs and housing should concentrate along major commercial corridors so that they can be served by high-frequency transit.

To define commercial corridors throughout the Bay Area, SPUR relied on the selection of corridors from Urban Footprint's Grand Boulevards project.[12] This project identified grand boulevards as those classified as highways or arterials, with some exceptions. For example, they excluded those without road-facing buildings or with rights-of-way with limited entrances and exits (e.g. Cabrillo Highway and Pacheco Pass Highway). Urban Footprint also manually included some corridors with more than four lanes such as Telegraph Avenue, MacArthur Boulevard and Willow Pass Road. With the list of commercial corridors from Urban Footprint, SPUR drew a buffer of 0.15 miles on either side of each corridor to define this geography.

These areas span Alameda, Contra Costa, San Francisco, San Mateo and Santa Clara counties and cover 130,000 acres or 3% of the region.

5. Jobs and housing should be added in pre-war downtowns, whose urban form, amenities and mixed uses can absorb new homes and businesses more seamlessly than many other areas.

SPUR designated pre-war downtowns as the urbanized areas in 1900, as drawn by researchers using historical data.[13] SPUR chose the year 1900 to capture legacy downtowns that sprang up around heavy rail stations, as opposed to the streetcar suburbs that followed later that century. In total, 112 polygons represent these areas across the nine-county Bay Area. Notable examples include parts

9 MTC, Major Transit Stops (2017), see: https://opendata.mtc.ca.gov/datasets/561dc5b42fa9451b95faf615a3054260_0 (accessed October 1, 2019)

10 MTC, Transit Stop Frequency (2016), see: https://opendata.mtc.ca.gov/ (accessed on November 9, 2016)

11 The megaregion encompasses 21 counties (including the nine of the Bay Area) and can be seen in: SPUR, "The Northern California Megaregion," 2007, https://www.spur.org/publications/urbanist-article/2007-11-01/northern-california-megaregion

12 While this spatial data was not publicly available at the time this was written, an example of a prominent Grand Boulevard is El Camino Real along the peninsula as documented by Urban Footprint's article, "Can One Street Solve the San Francisco Bay Area Housing Crisis?" See: https://urbanfootprint.com/can-one-street-solve-the-san-francisco-bay-area-housing-crisis/

13 Buchanan, J.T., and Acevedo, W., 1996, Studying Urban Sprawl Using a Temporal Database, Geo Info Systems, Vol. VI, No. VII, pp. 42-47.

of the current centers of Santa Rosa, Berkeley, Petaluma, Napa, Fairfield, San Jose, Oakland, San Francisco, Alameda, Mountain View, Livermore and Pleasanton. Overall, these pre-war downtowns are found in each of the nine counties and total 43,000 acres, or 1% of the region.

Growth principles that allow for more housing types in previously exclusive areas

6. Housing should be added in areas that encourage upward mobility such as those with good K-12 schools, access to high-quality jobs and freedom from environmental burdens, so that all people may benefit from these resources.

SPUR relied on the definition of Opportunity Maps prepared in 2019 by the Fair Housing Task Force jointly created by the California Tax Credit Allocation Committee and the California Department of Housing and Community Development.[14] These maps identify the census tracts and rural block groups across the state "...whose characteristics have been shown by research to support positive economic, educational, and health outcomes for low-income families—particularly long-term outcomes for children."[15] To create these maps, the task force first filters out block groups that are low income (30% or more of people living below the federal poverty line) and racially segregated (higher concentration of people of color compared to the overlying county). It then uses 21 economic, educational and environmental health variables to create an index of opportunity in the remaining census tracts. For this analysis, SPUR selected "Highest Resource" census tracts in the nine-county Bay Area to serve as areas of high opportunity. These census tracts were then clipped by the geographies drawn for the first two SPUR growth principles – those that would protect people from hazards and protect high quality agriculture, open space and ecological services. The remaining high opportunity areas span Alameda, Contra Costa, Marin, San Francisco, San Mateo and Santa Clara counties and total 172,000 acres, or 4% of the nine-county region.

7. More housing types should be allowed in single-family neighborhoods, including ADUs and two- to six-unit housing.

Single-family neighborhoods were defined as those with zoning that restricted all new housing to single-family structures (regardless of whether such neighborhoods also allowed commercial or other kinds of development). Zoning data were acquired by MapCraft from MTC. These areas are widespread across the region and overlapped a great deal with the areas drawn for the first two SPUR growth principles (protection of natural areas and from hazards). As such, single-family neighborhoods were clipped by the protection geographies, and additional growth would be encouraged only in areas where it is relatively safe and less environmentally impactful. These areas

14 See: https://www.treasurer.ca.gov/ctcac/opportunity.asp (accessed on November 5, 2019)

15 California Fair Housing Task Force "Methodology for the 2020 TCAC/HCD Opportunity Map," June 2020, Page 1, https://www.treasurer.ca.gov/ctcac/opportunity/2020-tcac-hcd-methodology.pdf

are found in all of the region's counties except for San Francisco, and total 491,000 acres or 11% of the region.

FIGURE 3

Summary of Land Area of SPUR Growth Principles

Because the boundaries of growth principles overlap at times, they do not add neatly. Growth principle boundaries cover roughly 90% of the Bay Area.

	GEOGRAPHY	TOTAL ACRES	PERCENT OF TOTAL BAY AREA ACREAGE
Hazards and protection	Hazards	2.2 million	48%
	Protection	2.3 million	50%
	SUBTOTAL	3.2 million	71%
Transit-centered and walkable	Grow around transit	132,000	3%
	Commercial corridors	130,000	3%
	Pre-war downtowns	43,000	1%
	SUBTOTAL	222,000	5%
Previously exclusive areas	High opportunity areas	172,000	4%
	Single-family only zoning	491,000	11%
	SUBTOTAL	633,000	14%

Model Runs

Using the core function of the MapCraft model to estimate where growth was most feasible subject to zoning constraints, SPUR adapted the zoning rules within the particular geographies created by the growth principles. Because there is some overlap between these geographies, SPUR modeled growth in a particular order. Where there was overlap, the growth principle first in line took precedent. SPUR used the following order:

1) Where not to grow
   a) Hazards and Protection growth principles combined
2) Where to grow
   a) Existing and future transit
   b) Commercial corridors
   c) High opportunity areas
   d) Single-family neighborhoods
   e) Pre-war downtowns

The changes to zoning made for the geographies of the SPUR growth principles can be interpreted as the policies needed to create the New Civic Vision and are summarized in Figure 4 below. While these are the final zoning changes, SPUR iterated on how much to emphasize growth in the transit-serving areas as opposed to the areas where additional housing types would be built in suburban neighborhoods. On the one hand, additional growth in transit-serving areas could help lower emissions from transportation and reduce the consumption of land and other resources. On the other hand, emphasizing new opportunities for growth in suburban areas, especially those associated with upward mobility, could lead to less displacement in transit serving areas and greater opportunity for all to benefit from well-resourced neighborhoods. In the end, SPUR chose to spread growth across these geographies to achieve all objectives and to ensure that no one type of neighborhood bears all the change between now and 2070.

Figure 4

How SPUR adjusted zoning rules within each growth principle boundary

While not listed here, in the Business as Usual scenario, growth was allowed as current zoning rules permitted.

	SPUR GROWTH PRINCIPLE	MAX HEIGHT (IN FEET)	MAX FLOOR AREA RATIO	MAX DWELLING UNITS PER ACRE	MAX DWELLING UNITS PER LOT	SINGLE- FAMILY DETACHED ALLOWED	SINGLE- FAMILY ATTACHED ALLOWED	MULTIFAMILY ALLOWED	OFFICE ALLOWED
Protection and hazards	Hazards	0	0	0	0	No	No	No	No
	Protection	0	0	0	0	No	No	No	No
Transit-centered and walkable	Growth around transit - office ring	240	No limit	0	0	No	No	No	Yes
	Growth around transit - first ring	200	No limit	No limit	No limit	No	No	Yes	Yes
	Growth around transit - second ring	150	No limit	No limit	No limit	No	No	Yes	Yes
	Commercial Corridors	80	3	No limit	No limit	No	No	Yes	Yes
	Pre-war downtowns	55	2	No limit	No limit	No change	No change	Yes	Yes
Previously exclusive	High opportunity areas	40	3	30	No limit	No change	Yes	Yes	No change
	Single-family neighborhoods	30	1.5	20	No limit	No change	Yes	Yes	No change

Critical Modeling Assumptions

The following assumptions were used in both the Business as Usual and New Civic Vision scenarios.

Preservation of industrial lands. To preserve scarce industrial lands throughout the region, SPUR did not allow currently zoned industrial land to be converted to housing or commercial uses. However, if industrial zoning allowed for a mix of uses, it was not changed to industrial only. And lastly, conversions to commercial and housing were allowed in the SPUR transit, commercial corridors and pre-war downtown areas. To spatially identify industrial lands SPUR relied on zoning data provided to MapCraft from MTC.

Cost reductions. SPUR assumed that between now and 2070, there would be a 20% cost reduction to all multi-family buildings below 85 feet (due to modular building techniques and technologies), and a 10% reduction for all buildings from 85 feet to 12 stories (based on modular technologies, including type IV-B timber).

Changes to parking supply. In the buffers around transit that only allowed for job spaces and the next ring that densified all kinds of development, SPUR assumed no parking supply for new construction. In the largest buffer ring around transit, commercial corridors and pre-war downtowns, SPUR assumed a 50% reduction in parking supply compared to existing construction. All other areas were assumed to maintain parking minimums.

Vehicle Miles Traveled (VMT) fee. For residential and commercial development outside of SPUR's transit-serving geographies (transit buffers of all sizes, commercial corridors and pre-war downtowns), SPUR applied a VMT fee on a per-square foot basis. The fee also rose for development in places with high VMT rates. For example, in Transportation Analysis Zones (TAZs) with VMT levels between the 50th and 80th percentile in the region, the fee was set at $20 per square foot of job space and $10,000 per residential unit. For development in TAZs between the 80th and 90th percentile, these were set at $30 per square foot of job space and $15,000 per unit, and for TAZs in the 90th to 100th percentile, they were set at $50 per square foot of job space and $25,000 per unit. These fees align with policies envisioned in Plan Bay Area modeling processes as well.[16]

16 For example, see Plan Bay Area 2040, "Land Use Modeling Report: Plan Bay Area 2040, Final Supplemental Report," July 2017, page 25, http://2040.planbayarea.org/sites/default/files/2017-07/Land_Use_Modeling_PBA2040_Supplemental%20Report_7-2017.pdf

Model Output

In any geographic analysis there is a tradeoff between the overall accuracy of results and the fineness of geographic scale. The finer the scale, the larger the error bounds around each local estimate. The MapCraft model is able to output accurate summaries of new buildings at a census block group geography. The output SPUR obtained from the model runs had multiple dimensions with which SPUR is able to continue conducting numerous analyses. Variables in the output are replicated across each scenario and include:

- US Census block group ID
- Total existing residential units as of 2018
- Counts of new residential units added by building type
- Total existing jobs as of 2018
- Counts of new job space buildings added by type of building
- Average building height for new housing and new job spaces respectively

FIGURE 5

Specified building types, descriptions and heights in the model output

TYPE OF BUILDING		DESCRIPTION	HEIGHT (IN FEET)
Residential	Single family	Detached	Not specified
	Small multifamily	2-6 units, including townhouses	25 to 35
	Multifamily	19-185 units, stick and podium construction	25 to 85
	Low Tower	180-240 units, type I construction	85 to 139
	Mid Tower	220-340 units, type I construction	140 to 199
	High Tower	300-600 units, type I construction	200 to 500
Job spaces	Residential**	Varies	Varies
	Low Rise	Typically with surface parking	20 to 45
	Mid-Rise	Typically with adjacent deck parking	45 to 120
	Small High Rise	Typically with vertically integrated deck parking	90 to 159
	Medium High Rise	Typically with vertically integrated deck and/or underground parking	160 to 319
	Large High Rise		320 to 500

**Includes work-from-home jobs as well as management and cleaning jobs in large residential buildings.

Post Model Analysis

Because the model output is geographic in nature, it can be related to other geographic data. While there are many possibilities for further analysis, SPUR initially took the model output and analyzed how growth patterns in each scenario affected "equity priority communities." SPUR used the definition for equity priority communities developed by MTC during their Plan Bay Area 2040 process.[17] This includes Bay Area census tracts that have a concentration of people of color and low-income households, or a concentration of households with lower incomes and a combination of disability, limited English proficiency, severe rent burden, single-parent households, seniors over 75 and zero vehicle households.

17 Documentation on how these were developed can be found in detail on MTC's GitHub page, see: https://bayareametro.github.io/Spatial-Analysis-Mapping-Projects/Project-Documentation/Equity-Priority-Communities/

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