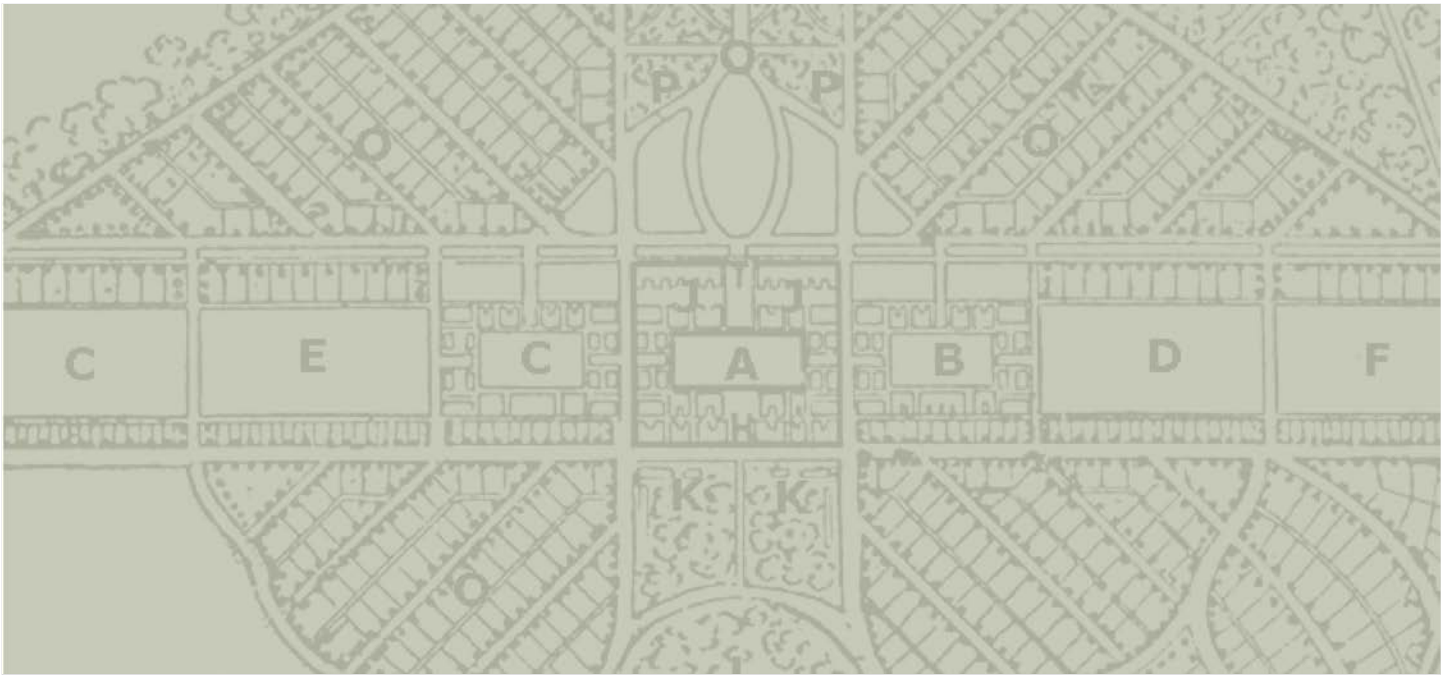
Santa Clara County
California

Stanford University Sustainable Development Study Supplement

September 1, 2018



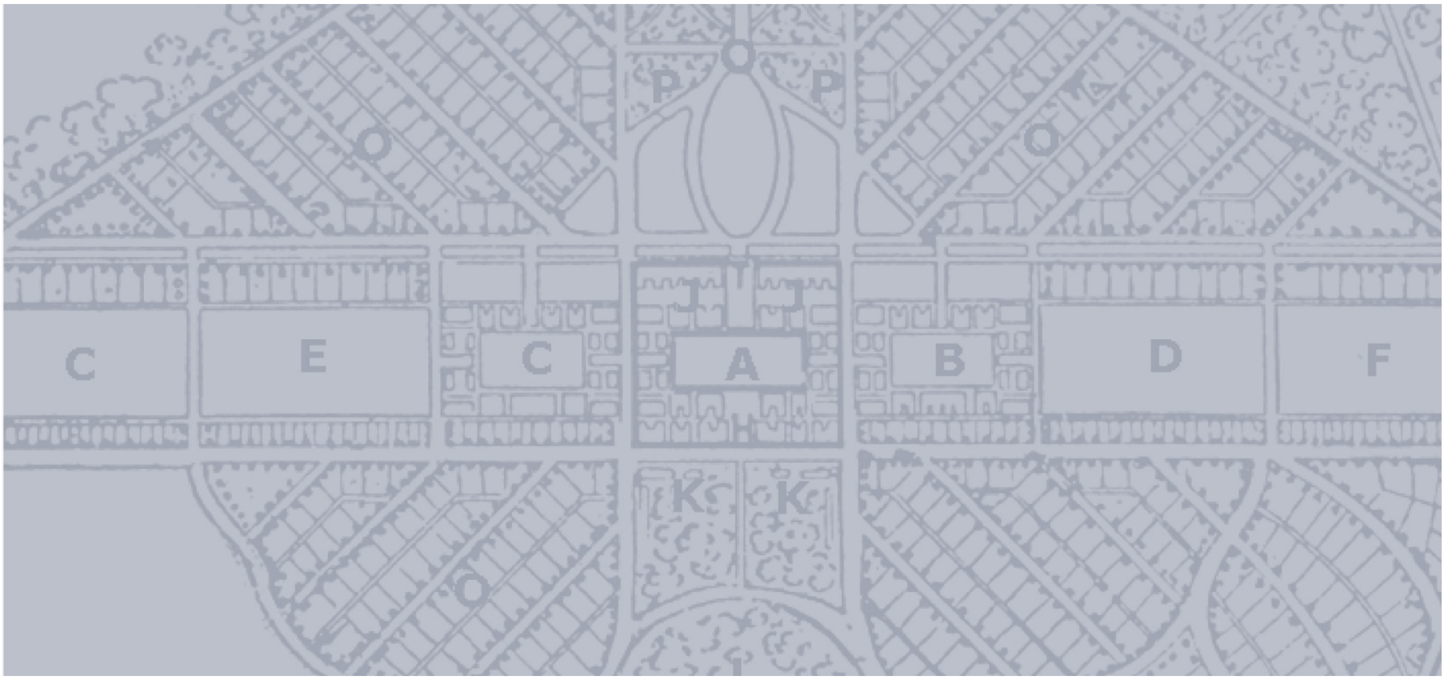
Contents

List of Figures

List of Tables

List of Tables (continued)

List of Tables (continued)



Executive Summary

While the 2009 Sustainable Development Study (SDS) demonstrated sufficient capacity of lands within Stanford's Academic Growth Boundary (AGB) to accommodate future campus growth through 2035, current planning needs require a longer-term assessment. This SDS Supplement assesses the long-term development capacity of the Stanford campus based on benchmark data from other research universities, anticipated development in surrounding communities, and resource constraints and other factors that may limit future growth.

Beyond 2035, more than 500 acres of the Stanford campus have been identified that could theoretically be developed using a variety of land use intensification strategies, allowing up to 44 million square feet of total development on the campus over a period of 100 years or more. This would nearly triple the existing density of the campus, demonstrating that campus development can be contained within the Academic Growth Boundary over the foreseeable future.

However, a variety of physical, environmental and societal constraints could limit future development on the campus. The ability for Stanford to manage these constraints will be affected by new technologies, legal and regulatory developments, societal trends, and the success of the University's sustainability programs.

Over the very long-term, it is reasonable to expect that societal and technological change will extend the carrying capacity of existing levels of resources, potentially alter the rates of development and population growth on the campus, and push further out the point at which resource limitations physically constrain campus development.

Background

Land use and development at Stanford University is regulated by a Community Plan (an element of the County General Plan) and a General Use Permit (GUP) subject to the approval of the County of Santa Clara Board of Supervisors. The GUP is a programmatic use permit allowing incremental construction of academic facilities and housing up to defined limits on Stanford lands located in unincorporated Santa Clara County. The most recent GUP was approved in 2000 and allows Stanford to develop approximately 4.8 million additional square feet (sf), and Stanford is expected to reach this development milestone by 2020.

The 2000 Community Plan and GUP included policies and a condition of approval requiring Stanford to prepare a Sustainable Development Study (SDS) to "identify the maximum planned buildout potential for all of Stanford's unincorporated Santa Clara County land, demonstrate how development will be sited to prevent sprawl into the hillsides, contain development in clustered areas, and provide long-term assurance of compact urban development." (County of Santa Clara, 2000a)

2009 Sustainable Development Study

The 2009 SDS demonstrated sufficient capacity of lands within Stanford's Academic Growth Boundary (AGB) to accommodate a high growth rate scenario through 2035 without the need to adjust the AGB.

The Stanford Community Plan required the SDS to address resource protection with a view beyond the 2025 timeframe of the Academic Growth Boundary (AGB), which separates the Central Campus from the Foothills Development District, promoting compact urban development patterns and preventing sprawl into the foothills. 2035 was chosen as the planning horizon for the SDS, striking a balance between the desire to provide a long-term planning framework and to produce a study that was useful. The County Board of Supervisors approved the SDS in 2009.

The SDS presents planning principles to promote compact urban development, ensure efficient and environmentally responsible circulation networks, and preserve the historic quality of the campus. Consistent with the 2000 GUP, the SDS promotes increasing the overall density of the campus through infill and redevelopment, while protecting sensitive resources located in the Stanford Foothills. The SDS applied these principles to the development authorized by the 2000 General Use Permit to assess potential additional growth through a 2035 planning horizon.

The SDS considered three theoretical development scenarios, representing a range of potential growth rates that could be accommodated on Stanford's Central Campus within the AGB:

- *Low Growth Scenario A*, representing an average growth rate of 115,000 square feet per year, reflecting the amount of academic and student housing square footage that the University historically had built during slower growth periods;
- *Moderate Growth Scenario B,* representing an average growth rate of 200,000 academic and student housing square feet per year, consistent with the average annual rate of growth that had occurred at the University since the 1960s and during the first half of development under the 2000 GUP, and that was expected to occur through buildout under the 2000 GUP; and

- *High Growth Scenario C,* representing an average growth rate of 300,000 academic and student housing square feet per year.

The SDS demonstrated that maximum planned buildout through 2035 could be accommodated within the central campus inside the existing AGB through continued use of existing campus planning principles regarding the location and manner of development, even under the high growth scenario. The SDS concluded that continuation of the current trends in campus development were likely to result in increased density without adversely affecting Stanford's academic learning environment and without creating undue pressure to expand campus development into the Foothills Development District. The SDS also concluded that the central campus has the capacity to add development beyond the growth scenarios considered, by further increasing density with redevelopment, renovation, and infill projects.

SDS Supplement: Purpose and Methodology

The SDS Supplement assesses the hypothetical long-term development capacity of Stanford lands within the AGB beyond 2035 based on benchmark data from other research universities, anticipated development in surrounding communities, and resource constraints and other factors that may limit future growth.

As stated in the Stanford Community Plan, the County may at its discretion complete additional work to supplement the SDS prepared by Stanford. The need for this SDS Supplement was triggered in 2016, when in anticipation of full buildout under the 2000 GUP, Stanford applied to the County for a new GUP that would authorize an additional increment of campus growth and development, anticipated to take place from 2018 through 2035. During public outreach related to the proposed 2018 GUP, and in response to public circulation of the Draft EIR for the proposed 2018 GUP, commenters asked questions about development on the campus beyond the 2035 planning horizon, including "what is the maximum buildout?"

In response to these questions, this SDS Supplement provides a land capacity and constraints analysis for Stanford's lands within the unincorporated Santa Clara County beyond what is considered in the SDS. The SDS Supplement considers the long-term development potential of Stanford lands based on general plan land use designations, land capacity, benchmark data from other research universities, anticipated development in surrounding communities, and resource constraints and other factors that may limit future growth.

The SDS Supplement is a planning and feasibility study prepared by the County of Santa Clara Department of Planning and Development that contains information about possible long-term future development capacity at Stanford and related environmental and infrastructure constraints. Its consideration and acceptance by the County does not constitute an approval of any development or growth on the Stanford campus. As such, pursuant to the California Environmental Quality Act (CEQA) Guidelines section 15262, the SDS Supplement is statutorily exempt from CEQA.

Campus Development

The Stanford Community Plan and 2000 GUP were designed to provide Stanford flexibility in its use of its land within an agreed-upon framework and with accountability to the County and neighboring communities. The Stanford Community Plan defines the allowable development for areas of the campus within the unincorporated County inside and outside the AGB.

Land use designations within the AGB include Academic Campus; Campus Residential (both Low and Medium Density); and Campus Open Space. Land use designations outside the AGB include Open Space and Field Research; and Special Conservation Areas. In general, uses associated with the educational and residential function of the campus are directed inside the AGB (i.e., within the central campus), while areas outside the boundary (i.e., within the foothills) are reserved for open space and academic activities that require the foothill setting for their basic functions.

The majority of the land within the AGB is zoned “A1”, which is a County base district that requires a conditional use permit for university-related uses. The A1 zone represents the portion of the campus that is developed with academic and support facilities and student housing. It also includes the Arboretum and Lagunita areas, which are designated as Campus Open Space in the Community Plan.

Past Growth Rates

Campus development at Stanford has steadily increased over time. In the six decades from 1961 to 2020, Stanford will have constructed a net increase of nearly 12.6 million sf over its pre-1961 development footprint of 4.3 million sf. The average annual growth during this period is 210,600 sf; however, the growth rates of housing and academic building area vary considerably year-to-year.

Stanford’s population has also steadily grown, but with a decreasing rate over time. Prior to 1960, Stanford experienced an average 10-year growth rate of 4.4 percent for its academic population (students and faculty); since 1960 the average 10-year growth rate has been approximately 1.0 percent. Over the 17-year period since approval of the 2000 GUP, Stanford’s academic population growth has tracked closely with the resident population growth rate of Santa Clara County and the two neighboring cities of Palo Alto and Menlo Park, while exceeding the growth rate of the smaller neighboring cities of Woodside, Los Altos Hills, and the County of San Mateo.

Anticipated Development under the Proposed 2018 General Use Permit

The proposed 2018 GUP, if approved, would authorize an additional increment of campus growth and land use development, including 2,275,000 net new sf of academic and academic support facilities, and 3,150 net new housing units/beds, anticipated to take place over a period that would extend from approximately 2018 through 2035. Anticipated growth over this period would amount to the net addition of 3.5 million square feet, equivalent to the Moderate Growth Scenario used in the SDS of 200,000 additional square feet per year.

The proposed 2018 GUP would apply only to the 4,017 acres of Stanford lands that are located within unincorporated Santa Clara County. In addition, all development adding square footage under the 2018 GUP would be located within the AGB, and development within the Foothills District would be limited to infrastructure improvements and habitat restoration projects.

Future Development Capacity

The acreage of the Stanford campus provides opportunities for additional development while maintaining a low density relative to much smaller campuses. More than 500 acres of the Stanford campus have been identified that could theoretically be developed using a variety of land use intensification strategies, more than doubling the existing density of the campus by 2100. This demonstrates the ability of the campus to continue to grow but within the limits of the Academic Growth Boundary.

The development capacity analysis describes the hypothetical maximum development capacity of Stanford's lands in unincorporated Santa Clara County over a long-term future, beyond the 2035 planning horizon included in the proposed 2018 General Use Permit and the SDS, and beyond the current planning horizon of nearby local communities, the Bay Area region, and the state.

The development capacity analysis does not represent a forecast or prediction of future development, and, importantly, does not reflect any specific or proposed plans by Stanford or the County. Rather, it is a description of the potential capacity of Stanford's lands in unincorporated Santa Clara County to accommodate different levels of development intensity, and provides a basis to further assess and understand the potential implications of, and constraints on, such development.

The development capacity analysis focuses on the portion of the AGB located within the 1,018-acre Academic Campus, on the assumption that the low- and medium-density residential use zones (R1S and R3S) will retain their current zoning status and residential density into the future, and will not be subject to future intensification or changes in land use without zoning amendments. The analysis assumes that future development in the Arboretum and Lagunita areas – which like the foothills are designated as Open Space – will not intensify and remain as open space unless the Community Plan is amended.

In establishing potential future development density within the Academic Campus, the County identified a number of comparable benchmark universities in terms of their teaching and research mission, commitment to on-campus housing, and other relevant factors. The benchmarked universities demonstrate a range of densities as measured in floor area ratio (FAR, the ratio of built development to land area).

Stanford's current Academic Campus FAR is 0.34. FARs at comparable universities range from 0.9 to 2.64. Campuses with relatively low FARs tend to have large amounts of developable land while those with higher FARs (i.e., FARs of 0.86 and above) are smaller campuses located in urban areas with land constraints. Comparable campuses with an FAR of 1.5 or above can be generalized as very small, dense campuses set in the highly urbanized core of major cities (New York, Boston, and Washington DC.), an environment not reasonably foreseeable for Stanford even in the distant future.

The campus benchmarking indicates that Stanford has a very large amount of potentially developable acreage at over 1,000 acres, while the majority of comparable campuses have land areas of less than 500 acres, with many having 200 acres or fewer. The acreage of the Stanford campus provides opportunities for additional development while maintaining a low density relative to much smaller campuses.

Appreciable increases in densities on the Stanford campus would occur over a very long period of time. Current development within the Academic Campus portion of the A-1 zone of Stanford's lands is comprised of approximately 15.2 million square feet (sf) of academic and student housing uses, and would grow to approximately 20.4 sf under the proposed 2018 GUP, resulting in a campus FAR of 0.46. **Table ES-1** summarizes the hypothetical timeline for reaching campus FARs of 0.5, 0.75, and 1.0, assuming the expected rate of development under the proposed 2018 GUP (200,000 sf per year) continues beyond 2035.

Table ES-1: Moderate Growth Timeline for Attaining Higher Densities on the Academic Campus[a]

FAR	Year	Total Development
0.34	2018	15.2 million sf
0.46	2035	20.4 million sf
0.5	2044	22.2 million sf
0.75	2100	33.3 million sf
1.0	2155	44.4 million sf

[a] *Based on moderate growth rate of* 200,000 sf/year

In support of the preparation of this SDS Supplement, the Stanford Land Use and Environmental Planning Office identified a variety of intensification strategies that could be used to increase campus density within the A-1 zone, including (1) redevelopment of existing parking facilities, (2) redevelopment of existing lower density areas of the campus, (3) relocation of campus agricultural lands and facilities, and (4) relocation of existing athletic fields and facilities.

Stanford identified a combined area of 536 acres that over the long term could theoretically be developed at higher density using these strategies. The future average density of the campus will be determined by both the rate of new development and the density of individual development projects. By adding square footage at the moderate growth rate, an overall FAR of 0.75 would be achieved by the end of the century, more than doubling the current campus density. Analysis of the four strategies indicates that if each was pursued at an average project density of 1.0 FAR, approximately 23 million sf would be added to the campus, which is nearly enough to achieve a 1.0 FAR for the overall campus. At the moderate growth rate, that campus density would be achieved in approximately 2155.

While campus population is not directly related to development square footage, over time it has had a tendency to track with development growth. The total population (faculty, staff and students) at the Stanford campus, approximately 32,000 in 2018, is estimated to rise to about 39,500 in 2035. Assuming that the relationship between campus development and population remains consistent over time, the total campus population could approach 45,000 by the time the campus reaches an FAR of 0.5, and would continue to increase if the campus developed to higher densities in future years.

Development Constraints

Extrapolating from today's levels of resource availability and consumption, available technology, and regulatory conditions, continued growth at Stanford may be limited by a variety of resource constraints in the future. Of the resources examined in this report, water supply appears to be the only one representing a potential constraint before the campus develops much past an FAR of 0.5. The ability for Stanford to manage constraints will be affected by new technologies, legal and regulatory developments, societal trends, and the success of the University's sustainability programs.

While the development capacity analysis indicates that there is sufficient land capacity within the Academic Campus to support growth well into the future, over long periods of time Stanford is likely to face a variety of resource and infrastructure constraints related to housing, transportation, public services, natural resources, and supporting infrastructure.

Some potential constraints are physical, such as limits in available potable water supply or capacity in the wastewater system; other constraints are based on policies or regulations, such as targets for reducing greenhouse gases. Still others are based on local community acceptability of such conditions as traffic congestion or noise, visual conditions related to building height, and preservation of historical resources. And finally, some constraints are associated with the ability to maintain educational quality and manage the university, such as ensuring availability of housing for faculty and staff.

The degree to which these constraints limit growth on the campus will be affected by the ability of Stanford, the local and regional community, and the larger society to manage future resource consumption and environmental impacts, which in turn will be affected by the rate and intensity of future development, as well as by the availability of new technologies, legal and regulatory developments, societal trends, and uptake of sustainability programs. Together, such changing conditions could extend considerably the point in time or the eventuality that such factors materially constrain Stanford's ability to grow. Ultimate limits on growth at the Stanford campus may also come from forces internal to the Stanford campus, such as programmatic limitations, funding limitations, and the university's decisions about the appropriate size of the campus community.

Energy

Energy does not appear to represent a constraint to future development of Stanford's campus.

If Stanford continues to grow at its historical rate after 2035, it is reasonably foreseeable that its energy needs will be met through a combination of new technologies and efficiencies, more stringent efficiency standards, and ongoing implementation of campus energy programs. Through its sustainability efforts, Stanford has successfully reduced energy demand from existing buildings while maximizing the efficiency of its campus energy supply. On the supply side, over time it is reasonable to expect new technologies and other innovations to greatly enhance the region's ability to sustainably supply and manage energy.

Greenhouse Gas Emissions

Due to Stanford's sustainability efforts and California's stringent regulations, combined with market- and technology-driven changes, GHG emissions do not appear to represent a constraint to future development of the Stanford campus.

The primary development constraint related to greenhouse gas (GHG) emissions is compliance with California's policies and regulations designed to reduce emissions below the economy-wide limits established by Assembly Bill (AB) 32, Senate Bill (SB) 32, and the Governor's Executive Order S-3-05. Considering these limits, the Draft EIR for the proposed 2018 GUP found that future development under the 2018 GUP would not generate GHG emissions, either directly or indirectly, that would make a cumulatively considerable contribution to a significant impact on global climate change. Beyond the horizon of the 2018 GUP, regulatory, market, and technology driven changes are likely to result in increased energy efficiency and cleaner electricity supplies that would further reduce Stanford's energy use and GHG emissions.

The Community Plan establishes goals and policies for achieving higher-density, walkable and bikeable development within the AGB, with access to transit and transportation management programs. This type of development typically lowers GHG emissions on a per capita basis. Adding new campus buildings to increase density within the AGB helps implement the efficient, compact infill development sought in California's Climate Change Scoping Plan. In concert with Stanford's efforts at reducing emissions from its buildings and transportation systems, this type of growth on the Stanford campus is unlikely to impede progress toward the State's climate goals.

Water Supply

Water supply could become a constraint to Stanford's growth as soon as 2038 if drought conditions become more prevalent (as expected with climate change) and the Stanford campus continues to grow beyond 2035 at the pace projected under the proposed 2018 GUP.

Under current consumption rates, the currently available supply of potable water represents a constraint under normal conditions when the campus square footage reaches approximately 25,400,000 sf and the average FAR is 0.57.

Under drought conditions the available supply of potable water represents a potential constraint when the campus reaches 21,000,000 and the average FAR is 0.47. It is equally plausible that water supply will not become a constraint by these dates if campus growth slows, conservation increases, or new supplies are developed through water recycling and/or new contractual agreements with water wholesalers.

Wastewater

Stanford's current wastewater treatment capacity could become a constraint to growth by approximately 2060 if the Stanford campus continues to grow beyond 2035 at the pace anticipated by the proposed 2018 GUP.

Based on today's wastewater generation rates, the existing capacity for wastewater treatment represents a constraint when the campus square footage reaches approximately 25,400,000 sf and the average FAR is 0.57. That said, if funds are available then additional treatment capacity and conveyance capacity could be provided through capital projects to enlarge the Regional Water Quality Control Plant and sewers that serve the university. If longer and more severe droughts become the "new normal" due to climate change or other factors, decreased wastewater flows could be expected due to less water use, thus extending the available treatment and conveyance capacity.

Solid Waste

It appears that Stanford could continue developing its campus for the foreseeable future without landfill capacity becoming a constraint.

Policies and regulatory constraints at the state and regional level, combined with Stanford's waste diversion programs, are designed to increase diversion of solid waste from landfill, and extend the remaining capacity of existing landfills. There are challenges to overcome in terms of finding markets and developing manufacturing process that can accommodate the expanding volume of recycled materials, but it can be expected that future innovation, regulation and market forces will combine to prevent land use capacity from being a real constraint to the long-term future growth of the Stanford campus.

Housing

The primary campus development constraints related to housing are regional housing shortages that could result in a lack of housing near the campus that is affordable to the Stanford population.

The Housing Linkage policy in the Community Plan stipulates that "*increases in academic space may be granted only on condition that a specified amount and type of housing supply has been or will be constructed concurrently*" (County of Santa Clara, 2000a). This policy allows for both on-campus and off-campus housing to be considered as meeting the requirement.

As Stanford grows, demand for both on-campus and off-campus housing will grow. The land use capacity analysis herein indicates there is space for more on-campus housing within the AGB. Irrespective of on-campus housing, however, Stanford depends upon availability of housing in the region to attract and retain high-quality faculty and staff.

Housing availability will be a high priority planning issue for the university and surrounding communities for the foreseeable future. Should regional housing shortages persist or worsen, Stanford could see adverse effects on its ability to grow over the long term. Regional housing shortages are unlikely to negatively affect Stanford's ability to continue to attract a diverse and highly qualified student body, as Stanford provides a large amount of on-campus housing for its students, and likely would continue doing so in the future. However, long-term shortages of off-campus housing that is affordable and located in reasonable proximity to the campus, could make it more difficult for Stanford to attract and retain faculty and key staff over the long term.

Transportation

If local and regional transportation and transit infrastructure improvements do not materialize, traffic and transit congestion could worsen and become a constraint to future growth of the Stanford campus.

The primary development constraints related to transportation include the capacity of the local circulation networks and transportation systems to accommodate traffic during commute hours and special events, and the capacity of the regional transportation infrastructure to support those who commute from distant jurisdictions.

The Bay Area is faced with worsening traffic congestion and growing needs for transportation infrastructure improvements. Transit improvements are being implemented with varying success across regional transit agencies, and will continue to be planned for in the future, but ridership is generally not keeping pace with regional growth. Technological innovations are rapidly occurring that have the potential to increase roadway capacity and relieve traffic congestion; however, radical innovations such as autonomous vehicles may require additional infrastructure that requires new legislative policies and coordinated regional planning efforts.

Stanford has reduced drive-alone trips in and around the campus with its transportation demand management (TDM) program and the “No Net New Commute Trips” standard. Additionally, Stanford’s vehicle miles traveled (VMT) per capita is low compared to the regional average due to its TDM program and the provision of on-campus housing for faculty and students. Stanford is continuing to add transportation programs, while also exploring programs, such as remote work locations, and other technological innovations that can enable employees to reduce the number of days they must travel to the campus.

Transportation conditions in and of themselves do not represent a physical constraint to development on the Stanford campus. Rather, the acceptability of levels of congestion, and the comfort and convenience of different modes of travel are the real constraints. Societal norms related to these factors have and likely will continue to evolve over time. It is unknown to what extent the surrounding community could accept higher congestion levels and whether social norms would represent a future constraint to campus growth.

Envisioning the Distant Future

Over the very long-term, it is reasonable to expect that societal and technological change will extend the carrying capacity of existing levels of resources, potentially alter the rates of development and population growth on the campus, and push further out the point at which resource limitations physically constrain campus development.

At current rates of development, doubling the current density of the Stanford campus would take 50 to 100 or more years, well beyond the planning horizon for even the most long-range land use plans. Five decades is about the limit of anyone’s ability to accurately predict future development and land use patterns. Most General Plan horizons do not exceed two or three decades. Extrapolating the present to the distant future through the lens of the current environment is invariably uncertain and speculative.

Looking out 50 to 100 years or more, it is reasonable to expect that continued social and technological innovation will shape much of the urban infrastructure that affects and is affected by the growth of the Stanford campus. The lack of affordable and proximate housing, increased levels of congestion, availability of water supply and other public utilities, and concerns about climate change all influence the evolution of our urban landscapes. All of these constraints can and will be altered due to evolving technologies and social norms.

Over the very long-term, it is reasonable to expect transformative changes in buildings, transportation infrastructure and energy supply as fossil fuel vehicles become obsolete and renewable energy sources become an increasing and perhaps exclusive source for utility-scale energy. Increases in water efficiency and expansion of wastewater reuse can also be expected. Further changes in communication technology and the delivery of education may alter the travel patterns and even the nature of the campus community.

Barring extreme societal or environmental disasters, such changes would likely extend the carrying capacity of existing levels of resources, potentially alter the rates of development and population growth on the campus, and push further out the point at which resource limitations physically constrain the campus' ability to add square footage and increase student, faculty, and staff/worker population.

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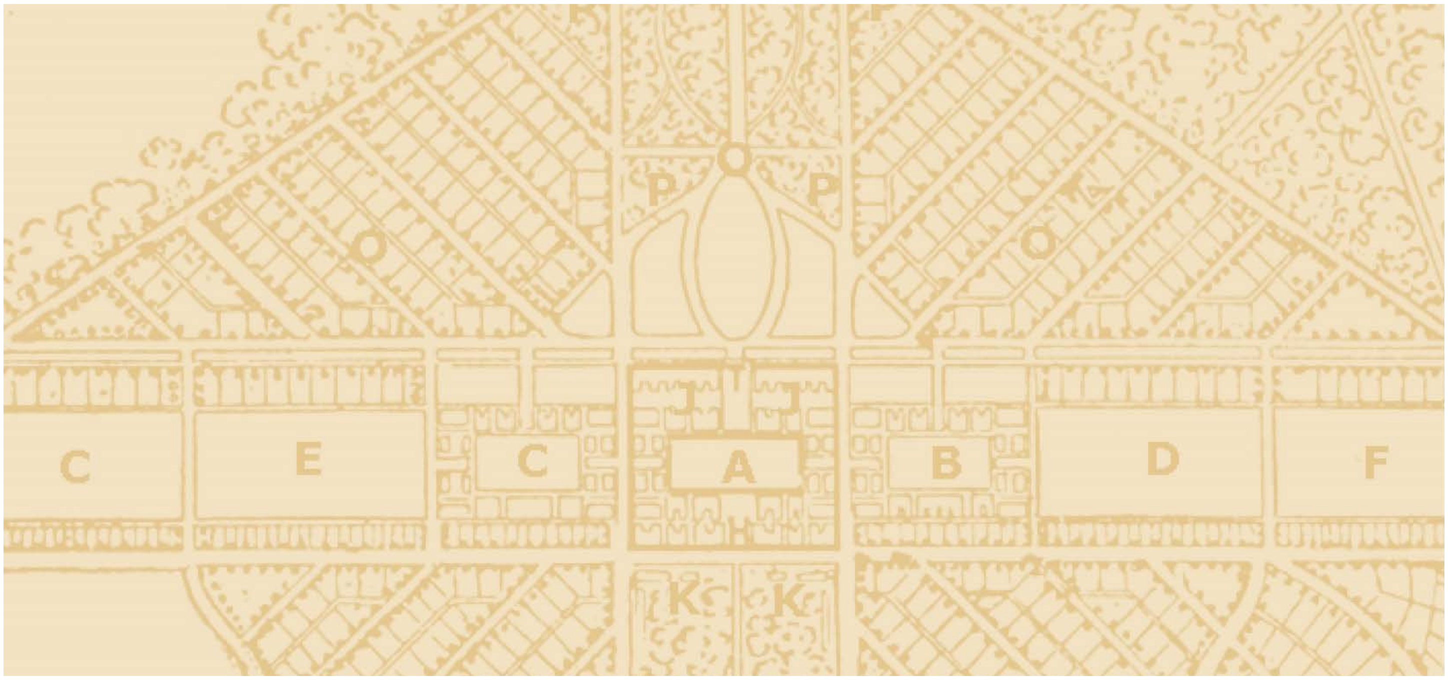

1. Introduction

Land use and development at Stanford University is regulated by a Community Plan (an element of the County General Plan) and a General Use Permit (GUP) subject to the approval of the County of Santa Clara Board of Supervisors. The GUP is a programmatic use permit allowing incremental construction of academic facilities and housing up to defined limits on unincorporated Santa Clara County land. The most recent GUP was approved in 2000 and allows Stanford to develop approximately 4.8 million additional square feet (sf), and Stanford is expected to reach this development milestone by 2020.

The 2000 GUP included a condition requiring Stanford to prepare a Sustainable Development Study (SDS) to understand and articulate the University's long-term development plans beyond the planning horizon and approved limits of the 2000 GUP, in relation to adopted planning principles and criteria in the Stanford Community Plan. The County Board of Supervisors approved the required SDS in 2009 (heretofore referred to as the SDS).

As outlined in the Stanford Community Plan, the SDS was required to cover all of Stanford's unincorporated lands in Santa Clara County, and to be based on planning principles and criteria that protect important natural resources and sensitive species. A key objective of the SDS as identified under the Stanford Community Plan was to "identify the maximum planned buildout potential for all of Stanford's unincorporated Santa Clara County land, demonstrate how development will be sited to prevent sprawl into the hillsides, contain development in clustered areas, and provide long-term assurance of compact urban development." (County of Santa Clara, 2000a)

To accomplish this objective, the SDS identified a year 2035 planning horizon and considered whether there was sufficient capacity within the Academic Growth Boundary (AGB) of the campus to accommodate development of academic facilities and housing under three (3) theoretical growth scenarios from 2018 to 2035. Specifically, these included a Minimal Growth Scenario of

115,000 sf/year for a total net growth of 2 million square feet, a Moderate Growth Scenario of 200,000 sf/year for a total net growth of 3.5 million square feet, and an Aggressive Growth Scenario of 300,000 sf/year for a total net growth of 5 million square feet by 2035. The SDS assumed a development density for future development comparable to the density achieved in projects that had been recently completed on the Stanford campus. The SDS demonstrated sufficient capacity of lands within the AGB to accommodate the highest growth rate scenario through 2035 without creating a pressure to adjust the AGB (Stanford, 2009).

Development within the AGB from 2000 to 2018 has generally conformed to the Moderate Growth Scenario included in the SDS. Under the 2000 GUP, by the end of 2018 a total of 15.2 million sf of combined academic use and student housing is expected on campus, resulting in an average annual growth of approximately 174,000 sf between 2001 through 2018. However, by 2020, total campus development is expected to be approximately 16.9 million sf with the addition of the Escondido Village Graduate Student Residences, representing a notable short-term increase in Stanford's historic growth rates.[1] Additional detail on Stanford's growth over time is discussed under *Campus Development and Population Trends* in Chapter 2.

In 2016, in anticipation of full buildout under the 2000 GUP, Stanford applied to the County for a new GUP that would authorize an additional increment of campus growth and development, anticipated to take place from 2019 through 2035. During public outreach related to the proposed 2018 GUP, and in response to public circulation of the Draft EIR for the proposed 2018 GUP, commenters asked questions about development on the campus beyond the 2035 planning horizon, including "what is the maximum buildout?" In response to these questions, the County Department of Planning and Development has undertaken this SDS Supplement to consider the long-term development capacity of Stanford lands within unincorporated County ("Capacity Analysis").

The purpose of this SDS Supplement is to provide a land capacity and constraints analysis for Stanford's lands within the unincorporated Santa Clara County beyond what is considered in the SDS. It has been prepared to assist the public and decision makers in reviewing the 2018 GUP application that is pending before the County Board of Supervisors.

Addressing development and environmental and community conditions over a planning horizon beyond 2035 years is inherently difficult because it extends beyond the land use and infrastructure planning of local jurisdictions and agencies. The SDS Supplement describes the hypothetical long-term development capacity of Stanford lands within the AGB beyond 2035 based on benchmark data from other research universities, anticipated development in surrounding communities, and resource constraints and other factors that may limit future growth. The SDS Supplement is s intended to provide the public and decision makers long-term contextual information that may assist in decisions related to the current proposed application.

The SDS Supplement is a planning and feasibility study that contains information about possible long-term future development capacity at Stanford and related environmental and infrastructure constraints. Its consideration and acceptance by the County does not constitute an approval of any development or growth on the Stanford campus. As such, pursuant to the California Environmental Quality Act (CEQA) Guidelines section 15262, the SDS Supplement statutorily exempt from CEQA.

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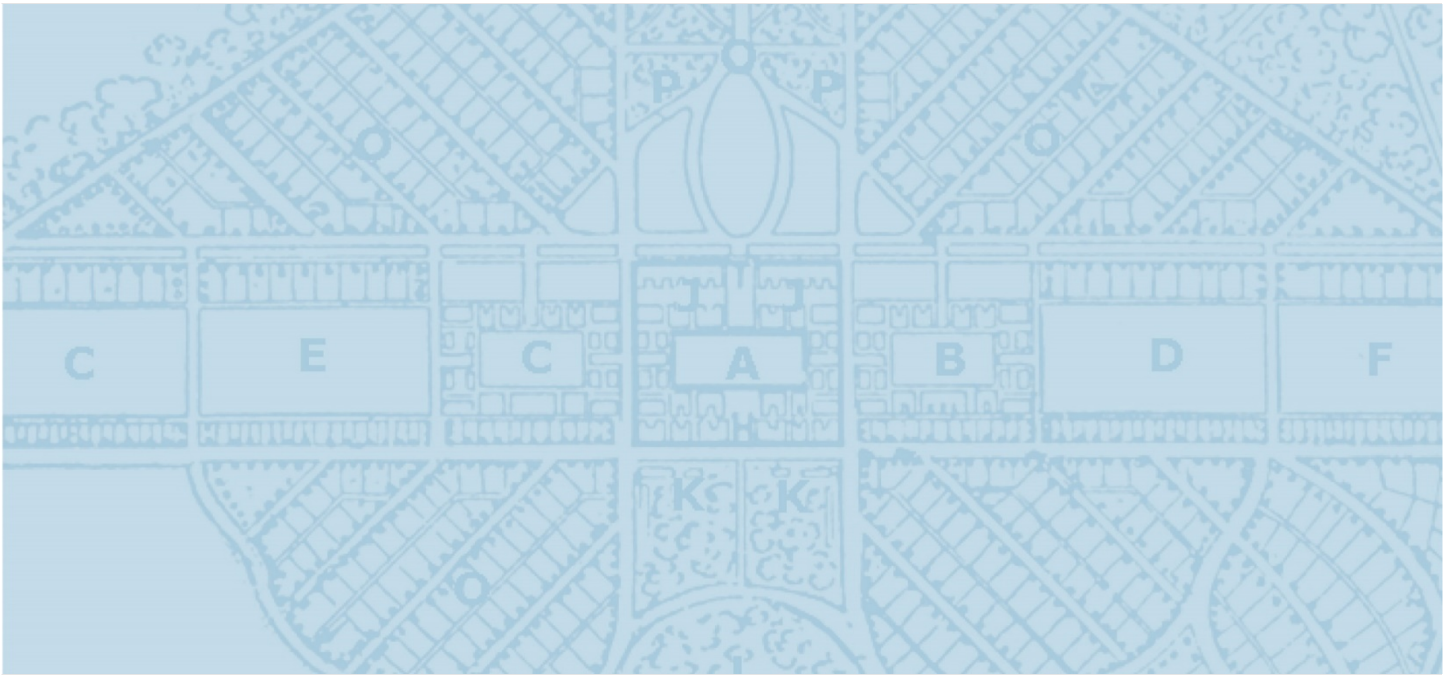
[1] For the Escondido Village Graduate Student Residences project, the Santa Clara County Planning Commission authorized 1,450 housing units/student beds beyond the 3,018 housing units initially authorized by the 2000 General Use Permit.



2. Campus Development

2.1 Stanford Community Plan and General Use Permit

Stanford University's lands within unincorporated Santa Clara County are subject to the land use jurisdiction and regulatory authority of the County of Santa Clara. Development on the unincorporated lands is currently regulated pursuant to the Stanford Community Plan, an element of the Santa Clara County General Plan, and the 2000 General Use Permit (GUP). The Community Plan and 2000 GUP were designed to provide Stanford flexibility in its use of its land within an agreed-upon framework and with accountability to the County and neighboring communities. Stanford is currently seeking approval of a proposed new 2018 GUP with a planning horizon that extends to approximately 2035 based on historical campus growth rates.

The 2000 GUP allows Stanford to develop approximately 4.8 million additional sf, including 2,035,000 net new sf of new academic and academic support uses, and initially authorized 3,018 net new housing units/beds for students, faculty and staff. In May 2016, the County authorized an additional 1,450 housing units to be constructed under the 2000 GUP, for a total of 4,468 housing units/beds authorized under the 2000 GUP (Santa Clara County, 2017).

The proposed 2018 GUP would authorize an additional increment of campus growth and land use development, including 2,275,000 net new sf of academic and academic support facilities, and 3,150 net new housing units/beds, anticipated to take place over a period that would extend from approximately 2018 through 2035. The proposed 2018 GUP would apply only to the 4,017 acres of Stanford lands that are located within unincorporated Santa Clara County. In addition, all new square footage developed under the 2018 GUP would be located within the Academic Growth Boundary (AGB), and development within the Foothills District would be limited to infrastructure improvements and habitat restoration projects.

As shown in **Figure 2-1**, Stanford lands in Santa Clara County are generally located southeast of Sand Hill Road, southwest of El Camino Real, northwest of Stanford Avenue and Page Mill Road, north of Arastradero Road, and east of Alpine Road. Regional freeway access is provided by U.S. Highway 101 (U.S. 101), Interstate 280 (I-280), El Camino Real [State Route 82 (SR 82)], and Foothill Expressway. The local routes from U.S. 101 to the Stanford campus include Embarcadero Road, Oregon Expressway and University Avenue. Access to the campus from I-280 is primarily provided by Sand Hill Road, Alpine Road, and Page Mill Road.

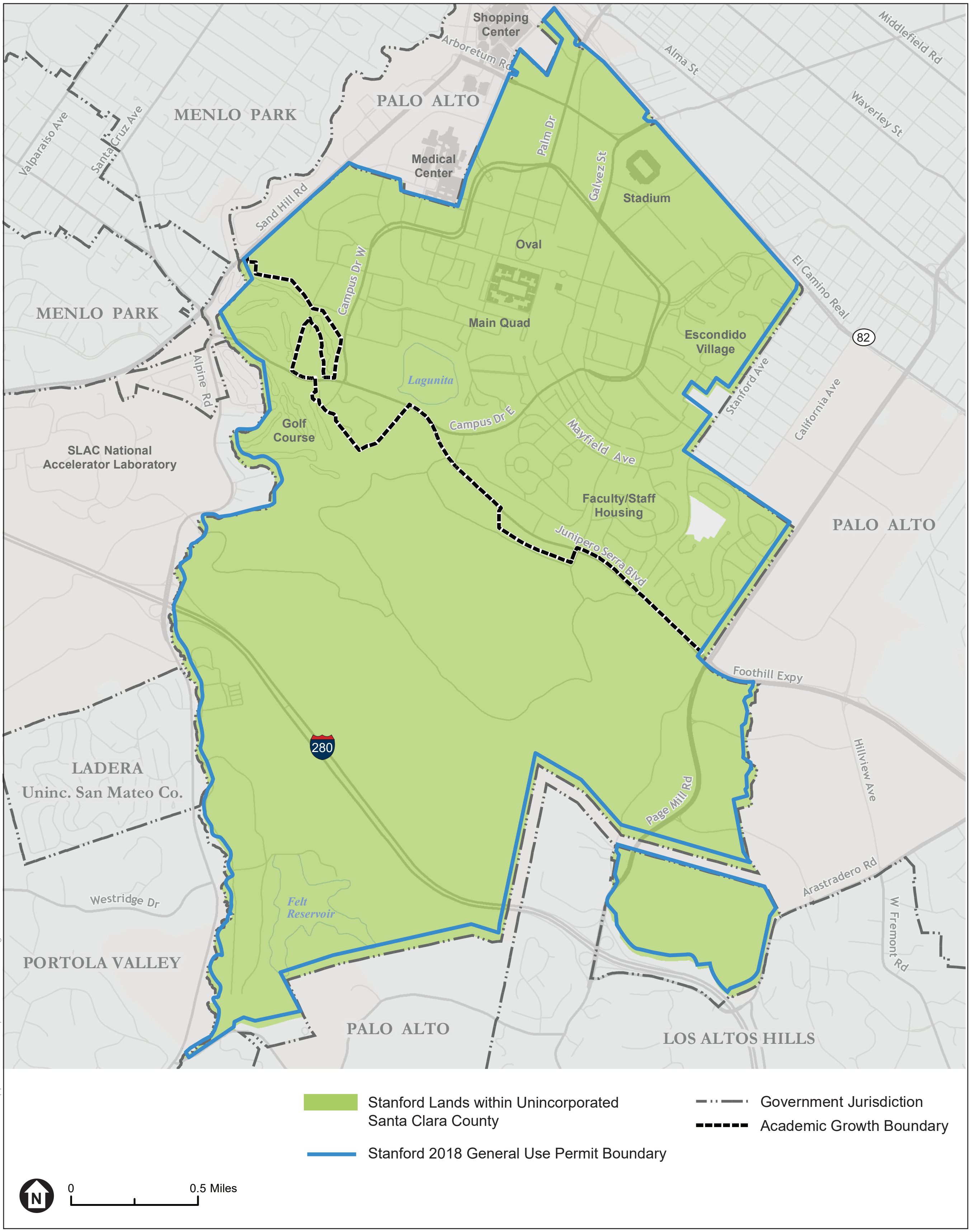
Development Districts and the Academic Growth Boundary

The 2000 GUP divides Stanford lands in the unincorporated County into ten development districts, as illustrated in **Figure 2-2**. Under the 2000 GUP, new academic and academic support space was permitted in any of the development districts except the Arboretum Development District. New development in the Lathrop Development District was limited to 20,000 sf, plus an additional 21,000 sf pursuant to a separate use permit application that was filed prior to approval of the 2000 GUP. New development in the Foothills Development District was limited to 15,000 sf with no individual building or facility exceeding 5,000 sf.

The approved Community Plan includes an AGB that promotes compact urban development patterns and protects open space resources. As shown on **Figure 2-3**, the AGB is located approximately along Junipero Serra Boulevard, separating the Central Campus from the Foothills.

Just as the Santa Clara County General Plan includes mechanisms for review of cities' urban growth boundaries, the Stanford Community Plan recognizes that the AGB is not a permanent demarcation. Rather, the Community Plan states that the AGB should be in place for a long enough period to promote increased growth within the Central Campus rather than unnecessary development of land in the Foothills (County of Santa Clara, 2000a p. 13). The specific policy in the Stanford Community Plan is that the AGB will remain in place until at least 2025 and until the University reaches 17.3 million sf of academic, support, and student housing facilities within the AGB. Pursuant to the Community Plan, the AGB can be modified earlier than 2025 by an affirmative vote of four (4) of the County of Santa Clara Supervisors. The proposed 2018 GUP does not include any requested provisions for changes to the AGB or development in the Foothills Development District.

Within the AGB, the Stanford campus includes a diverse mix of land use development, including classrooms, academic offices, laboratory space, athletic venues, museums, performance and arts venues, lands for outdoor learning, student housing, and faculty/staff housing. The athletics facilities include a football stadium (Stanford Stadium), gymnasiums, an aquatic center, basketball arena, sports courts, golf driving range, and several outdoor fields to accommodate field hockey, lacrosse, soccer, and other field sports. Cultural facilities on campus including Bing Concert Hall, Cantor Arts Center, the Anderson Collection, Memorial Auditorium, Frost Amphitheater and other smaller spaces supporting lectures, concerts, and other cultural events. The Arboretum is a large landscaped open space area bisected by Palm Drive between Campus Drive and El Camino Real.



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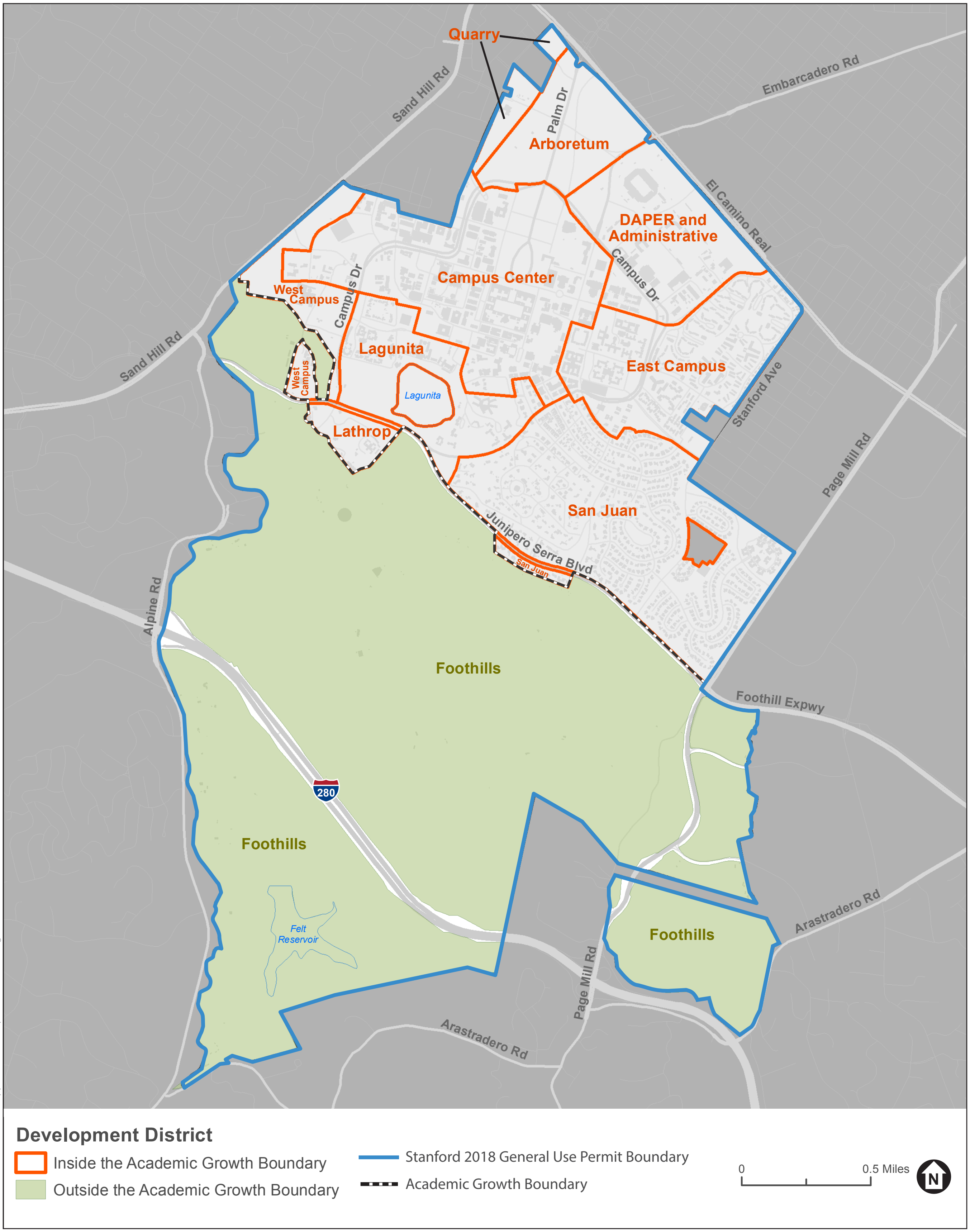
SOURCE: Stanford LBRE LUEP; ESA

Stanford SDS Supplement

Figure 2-1
Stanford Lands in Unincorporated Santa Clara County

ESA



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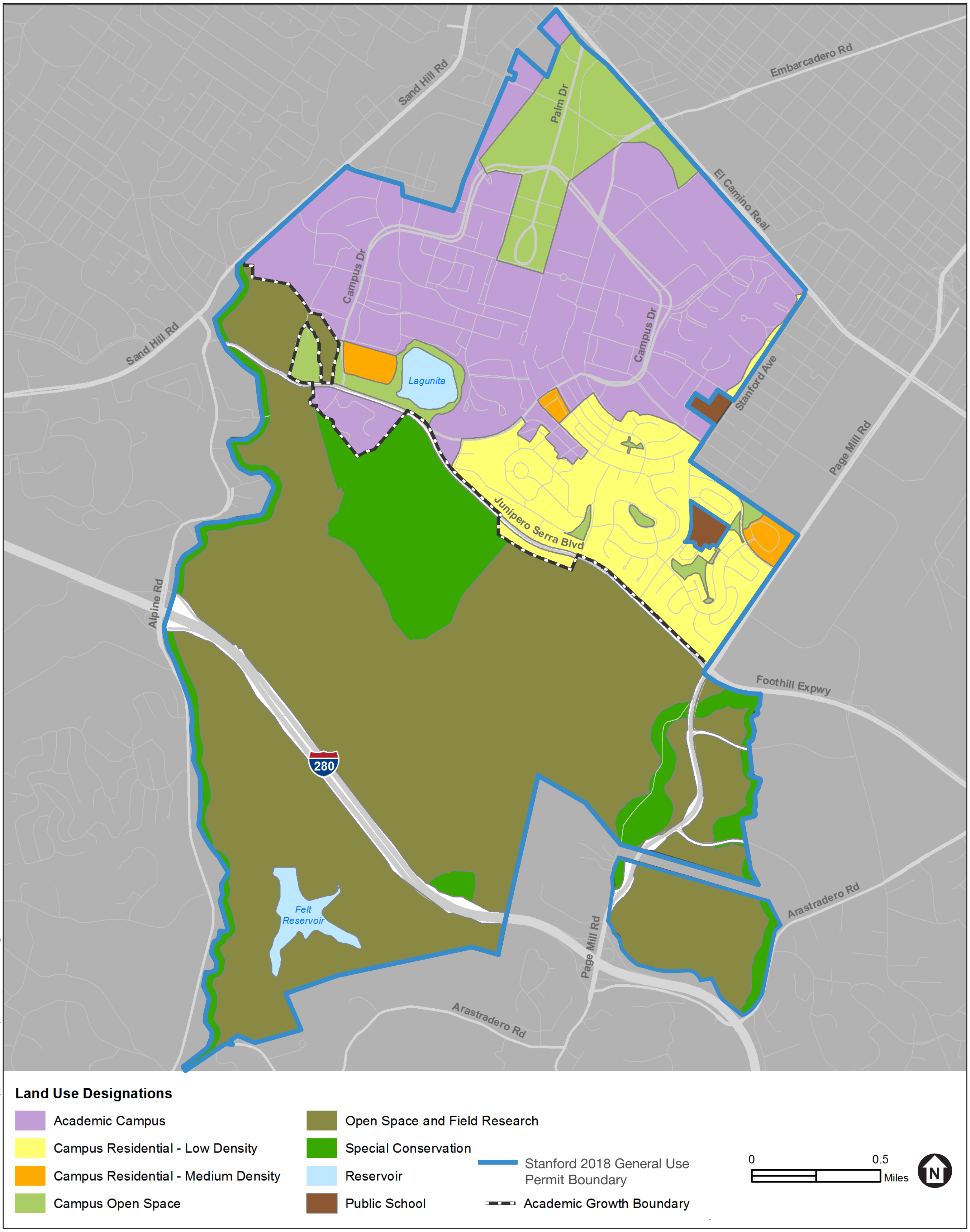
SOURCE: Stanford LBRE LUEP; ESA

Figure 2-2
Existing Development Districts under the 2000 General Use Permit

ESA



SOURCE: Stanford LBRE LUEP; ESA

Stanford SDS Supplement

Figure 2-3
Existing Land Use Designations

ESA

Allowable Land Uses and Zoning

The Stanford Community Plan defines the allowable development for areas of the campus within the unincorporated County inside and outside the AGB. As shown in Figure 2-3, the Community Plan land use designations within the AGB include Academic Campus; Campus Residential (both Low and Medium Density); and Campus Open Space. Land use designations outside the AGB include Open Space and Field Research; and Special Conservation Areas. In general, uses associated with the educational and residential function of the campus are directed inside the AGB (i.e., within the central campus), while areas outside the boundary (i.e., within the foothills) are reserved for open space and academic activities that require the foothill setting for their basic functions.

Table 2-1 provides more detail regarding the uses allowed within each of the land use designations specified by the Community Plan.

Table 2-1: Stanford Community Plan Land Use Designations

Land Use Designation	Allowable Uses
Within the Academic Growth Boundary	
Academic Campus	Instruction/Research; Administrative Facilities; Student Housing; High Density Faculty/Staff Housing (more than 15 units per acre); Athletics, Physical Education and Recreation Facilities; Support Services (child care, bookstore, etc.); Infrastructure, Storage and Maintenance Facilities; University-affiliated Cultural Facilities; University-affiliated Nonprofit Research Institutions
Campus Open Space	Open Space uses consistent with the individual character of each area, Temporary Activities, Limited Duration Special Events, Recreation
Campus Residential – Low Density	Single-family Housing, Duplexes, and Townhouses for faculty/staff (up to 8 units per acre), Residential Support Services (child care or convenience commercial facilities at a neighborhood-serving level)
Campus Residential – Medium Density	Single-family Housing, Duplexes, Townhouses, Flats, Condominiums and Apartments for faculty/staff (8-15 units per acre); Residential Support Services (child care, recreation services or convenience commercial facilities)
Outside the Academic Growth Boundary	
Open Space and Field Research	Field Study, Utility Infrastructure in keeping with natural appearance, Grazing and Agriculture, Recreation activities consistent with environmental resources, Specialized Facilities and Installations that require a remote or natural setting, Environmental Restoration, Existing Uses may continue, including nonconforming uses.
Special Conservation Areas	Conservation Activities, Habitat Management, Field Environmental Studies, appropriate Agriculture, Recreation consistent with environmental constraints

Source: Stanford Community Plan (County of Santa Clara, 2000a)

The current zoning districts on Stanford lands in the unincorporated County are presented in **Table 2-2**, and depicted in **Figure 2-4**. The majority of the land within the AGB is zoned “A1”, which is a County base district that requires a conditional use permit for university-related uses. The A1 zone represents the portion of the campus that is developed with academic and support facilities and student housing. In 2001, the County established R1S and R3S zoning districts for the faculty/staff neighborhoods designated by the Stanford Community Plan as “Campus Residential – Medium Density” and “Campus Residential – Low Density.” These zoning districts establish setbacks and other building standards specific to these neighborhoods and identify the County approval processes that apply to each type of potential development proposal.

Table 2-2: Zoning Districts

Land Use	Code	Allowable Uses
Within the Academic Growth Boundary		
General Use	A1	Agriculture, commercial, residential, schools, colleges and vocational schools, recycling, retail with a use permit
Campus Residential – Low Density	R1S	Residential up to 8 units/acre, institutional, hospital, religious, parks, schools
Campus Residential – Medium Density	R3S	Residential 8-15 units/acre, institutional, hospital, religious, parks, schools
Outside the Academic Growth Boundary		
Open Space and Field Research	OS/F	Field research
Special Conservation Areas	SCA	Open space, conservation, habitat preservation and management, field environmental studies, appropriate agricultural and utility uses, and limited recreational uses

Source: County of Santa Clara Zoning Ordinance (County of Santa Clara, 2017).

In 2003, the County established an OS/F zoning district for the largely undeveloped lands outside the AGB designated by the Community Plan as "Open Space and Field Research." The OS/F zoning district requires a comprehensive viewshed analysis and specifies unique County approval processes for new structures within this district. Zoning for the Special Conservation Areas (SCAs) was approved in December 2017.

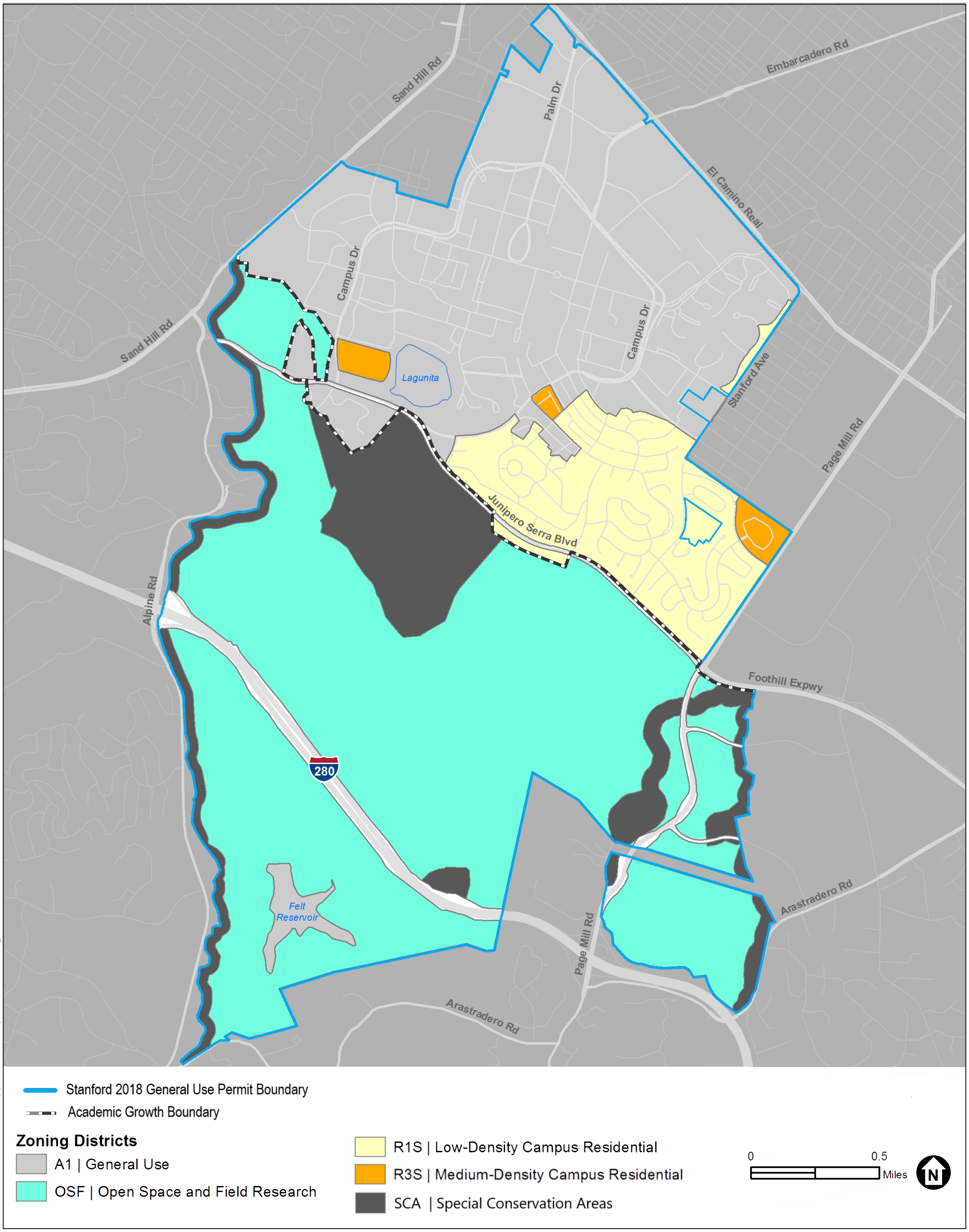
2.2 Sustainable Development Study (SDS)

The Stanford Community Plan required the preparation of a Sustainable Development Study to:

- Demonstrate how future development will be sited to prevent sprawl into the hillsides, contain development in clustered areas, and provide long-term assurance of compact urban development.
- Provide for protection and/or avoidance of sensitive plant and animal species and their habitats, creeks and riparian areas, drainage areas, watersheds, scenic view sheds and geologic features such as steep or unstable slopes and faults.

The SDS was intended to describe how the University's long-term growth and development could proceed in a manner consistent with policies developed by the County in the Stanford University Community Plan. As required by 2000 GUP Condition E.5, the SDS provided a mechanism to understand the location and manner for future development before proceeding with the second half of allowable development, and addressed concerns that development at a low density might consume land within the AGB too quickly, resulting in pressure to place academic development into the Foothills.

The SDS presented campus planning principles and theoretical development scenarios, and analyzed a range of potential growth rates that could be accommodated on Stanford's Central Campus. It also presented foothills planning principles and included a sensitivity assessment intended to recognize and protect the sensitive resources located in the Stanford Foothills (see **Figure 2-5**). The SDS applied these principles to the development authorized by the 2000 GUP and beyond the 25-year timeframe of the AGB to assess potential additional growth through a 2035 planning horizon.

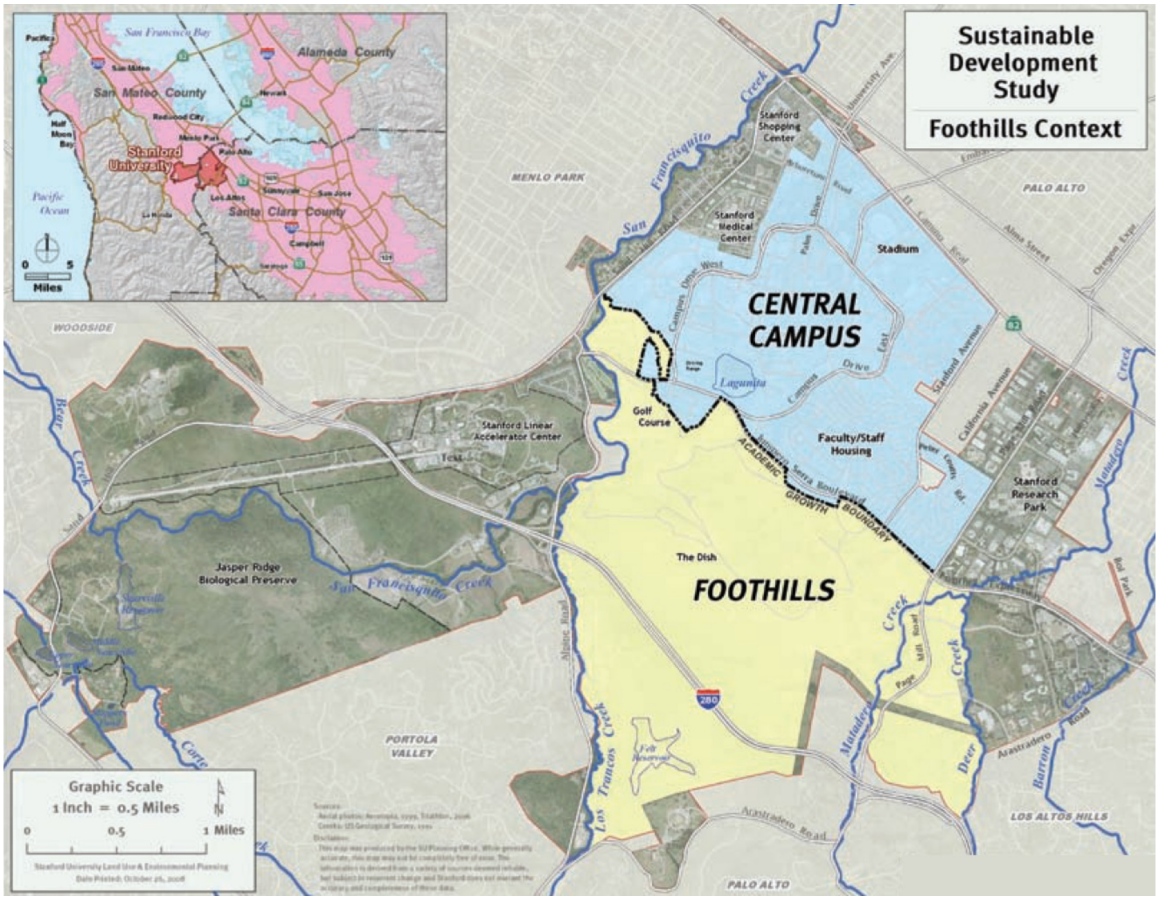


SOURCE: Stanford LBRE LUEP; ESA

Figure 2-4
Existing Zoning Districts

ESA

Figure 2-5: Stanford Lands under the Sustainable Development Study



Source: SDS (Stanford University, 2009)

The guiding principles of the SDS are a synthesis of the County's Goals for Livable Communities as expressed in the Santa Clara County General Plan (County of Santa Clara,1994, page A-11) and Stanford's own planning principles. These guiding principles include:

- Educational Excellence
- Managed, Balanced Growth
- Responsible Resource Conservation
- Managing for Uncertainty by Maintaining Flexibility

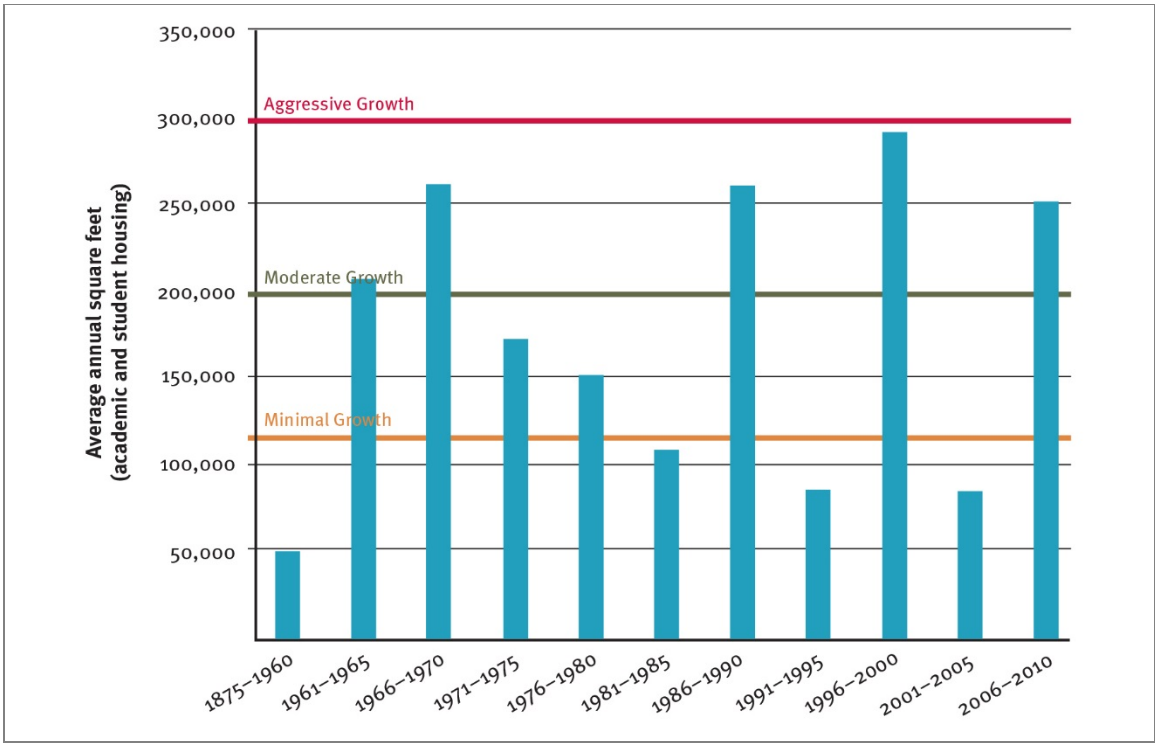
A key objective of the SDS was demonstrating how future development could be sited within the AGB to prevent sprawl into the foothills. The SDS considered a range of growth rates to model three theoretical scenarios of future development between the anticipated completion of the 2000 GUP in 2018 and the planning horizon of 2035 (see **Figure 2-6**):

- *Low Growth Scenario A* - 2 million additional square feet (academic and student housing), which averages to about 115,000 additional square feet per year. The Minimal Growth Scenario reflected the amount of square footage that the University historically had built during slower growth periods of 10 to 15-years;

- *Moderate Growth Scenario B* - 3.5 million additional square feet (academic and student housing), which averages to about 200,000 additional square feet per year; the Moderate Growth Scenario was consistent with the average annual rate of growth that had occurred at the University since the 1960s and during the first half of development under the 2000 GUP, and that was expected to occur through buildout under the 2000 GUP; and

- *High Growth Scenario C* - 5 million additional square feet (academic and student housing), which averages to about 300,000 additional square feet per year; the Aggressive Growth Scenario was considered to be unlikely in that it reflected more growth than would likely occur by 2035, based upon historic 10 to 15-year growth rates.

Figure 2-6: Stanford University Growth Scenarios



Source: SDS (Stanford University, 2009)

Through analysis of these three growth scenarios, the SDS demonstrated that maximum planned buildout through 2035 could be accommodated within the Central Campus inside the existing AGB through continued use of existing campus planning principles regarding the location and manner of development. The SDS concluded that continuation of the current trends in campus development were likely to result in increased density without adversely affecting Stanford's academic learning environment and without creating undue pressure to expand campus development into the Foothills Development District. The SDS also concluded that the Central Campus has the capacity to add development beyond the growth scenarios considered, by further increasing density with redevelopment, renovation, and infill projects.

2.3 Campus Development and Population Trends

Historical Development

Under the existing 2000 GUP, as noted above, Stanford is allowed to develop approximately 4.8 million additional sf, including 2,035,000 net new sf of new academic and academic support uses, and 4,468 net new housing units/beds for students, faculty and staff, including the additional 2,020 graduate student beds to be constructed at Escondido Village by 2020.

Table 2-3 presents an historical summary of development on Stanford lands within unincorporated Santa Clara County. As of Fall 2015, there was an estimated 9.62 million sf of academic and academic support development, and 4.78 million sf of student housing within the AGB.[1] By the end of 2018 it is anticipated that there will be a total of 10.26 million sf of academic and academic support development, 4.98 million sf of student housing.[2] By 2020, it is estimated that the number of student beds will increase by 2,020 net additional beds, with the completion of Escondido Village Graduate Student Housing, for 6.64 million sf of student housing building area (Stanford, 2017 p. 4.2).

Table 2-3: Stanford's Academic Campus Development over Time

Decade	Academic Building Area Added (SF)	Cumulative Academic Area	Student Housing Area Added (SF)	Cumulative Student Housing Building Area	Academic SF as Percent of Total	Total Cumulative Growth (SF)	5-year Average SF Constructed Per Year
1875-1960	2,790,913	2,790,913	1,466,041	1,466,041	65.6%	4,256,954	
1961-1965	510,754	3,301,667	554,410	2,020,451	62.0%	5,322,118	213,033
1966-1970	1,036,559	4,338,226	286,374	2,306,825	65.3%	6,645,051	264,587
1971-1975	509,589	4,847,815	374,402	2,681,227	64.4%	7,529,042	176,798
1976-1980	713,250	5,561,065	45,620	2,726,847	67.1%	8,287,912	151,774
1981-1985	323,925	5,884,990	238,786	2,965,633	66.5%	8,850,623	112,542
1986-1990	985,735	6,870,725	294,626	3,260,259	67.8%	10,130,984	256,072
1991-1995	322,388	7,193,113	130,897	3,391,156	68.0%	10,584,269	90,657
1996-2000	1,027,278	8,220,391	495,360	3,886,516	67.9%	12,106,907	304,528
2001-2005	187,491	8,407,882	140,854	4,027,370	67.6%	12,435,252	65,669
2006-2010	638,953	9,046,835	488,924	4,516,294	66.7%	13,563,129	225,575
2011-2015	571,096	9,617,931	263,007	4,779,301	66.8%	14,397,232	166,821
2016-2018[a]	637,460	10,255,391	203,769	4,983,070	67.3%	15,238,461	NA
2018-2020[b]	0	10,255,391	1,655,000	6,638,070	60.7%	*16,893,461*	NA
2016-2020	*637,460*	*10,255,391*	*1,858,769*	*6,638,070*	*60.7%*	*16,893,461*	*499,245*

Notes:

[a] Development under GUP, which includes the New Residences at Lagunita, GSB Residences (Highland Hall), and two Row House renovations, but not Escondido Village.

[b] Considers 2,020 net additional beds at Escondido Village Graduate Student Residences, of which 1,450 are beyond the amount of housing initially authorized by the 2000 GUP.

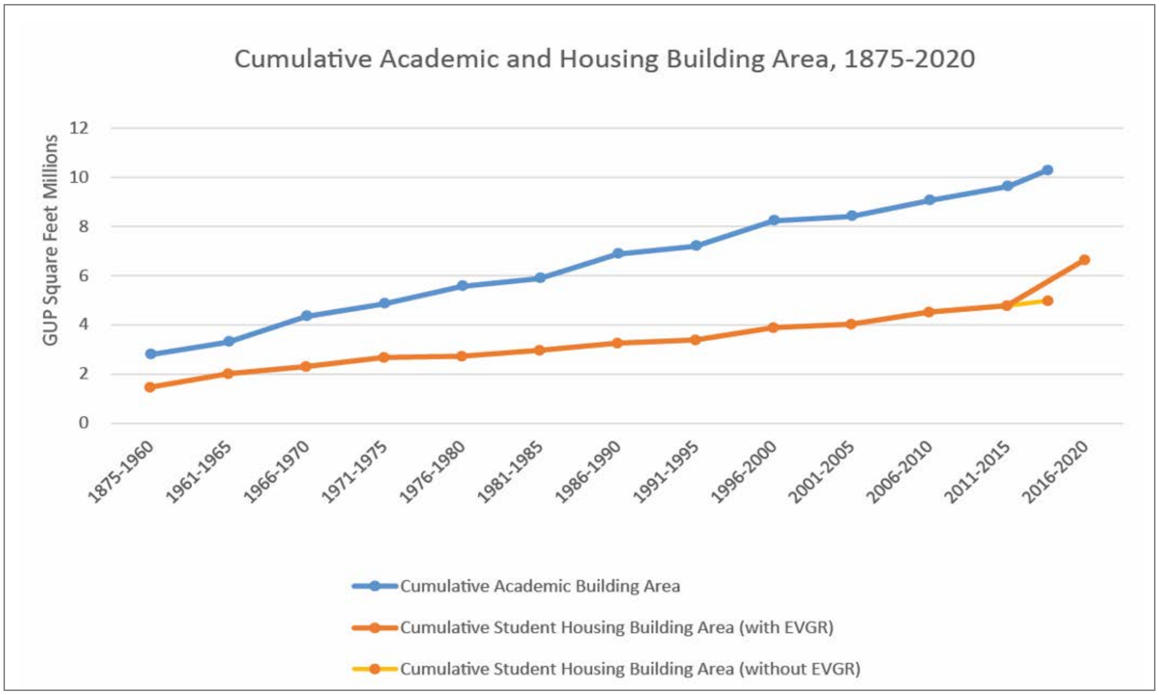
Source: Stanford University Land Use and Environmental Planning Office, 2001-2015 data obtained from 2000 GUP Annual Reports as cited in Stanford's Sustainable Development Study: Housing (Stanford, 2018b)

[1] Student housing as of Fall 2015 totaled approximately 11,300 occupied beds, and there were 937 faculty/staff housing units on Stanford lands located within unincorporated Santa Clara County.

[2] The student housing building area added from 2016-2018 includes the New Residences at Lagunita, GSB Residences (Highland Hall), and two Row House renovations. The square footage figures do not include faculty/staff housing.

Figure 2-7 presents the cumulative development of academic buildings and student housing on the Stanford campus in 5-year increments from 1960 through 2015, and projected to 2020. The graph shows that the rate of growth of academic development has been relatively steady, with increased rates of growth in the 1966-1970, 1986-1990, 1996-2000, and 2016-2020 periods. Growth in housing development has been relatively steady over time, with increased rates of growth in the 1960-1965 and 1996-2000 periods, and with the anticipated addition of the Escondido Village Graduate Residences project resulting in a considerable uptick in on-campus housing for the 2016-2020 period, compared to historical trends.

Figure 2-7: Cumulative Academic and Housing Building Area, 1875-2020



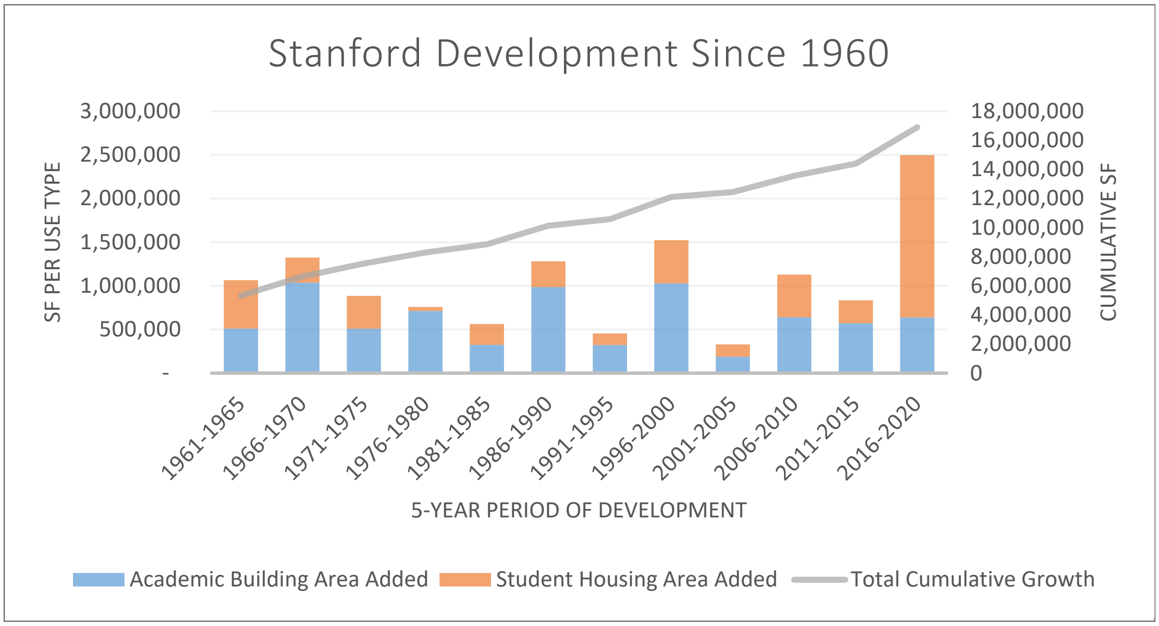
Source: Stanford University Land Use and Environmental Planning Office, 2001-2015 data obtained from 2000 GUP Annual Reports as cited in Stanford's Sustainable Development Study: Housing (Stanford, 2018b)

As shown in both Figure 2-7 and Table 2-3 the total square footage of on-campus development at Stanford has steadily increased over time. In the six decades from 1961 to 2020 Stanford will have constructed a net increase of nearly 12.6 million sf over its pre-1961 development footprint of 4.3 million sf.[3] The average annual growth during this period is 210,600 sf; however, this rate varies considerably year-to-year as shown in the 5-year average rates of Table 2-3, ranging from a low of about 90,700 sf per year from 1991 to 1995 to a high of nearly 500,000 sf per year from 2016 to 2020, to reach a total of 16.9 million sf of Stanford development.

Stanford's variation in growth and cumulative growth over the past 60 years can also be observed in **Figure 2-8**. The growth curve indicates that campus development has been sustained since 1960, including during the recessions in early 80s, early 90s and the most recent recession of the early 2000s.

[3] 4,256,954 sf represents estimated campus development from its 1875 inception to 1960.

Figure 2-8: Stanford Development Since 1960



Source: Stanford University Land Use and Environmental Planning Office, 2001-2015 data obtained from 2000 GUP Annual Reports as cited in Stanford's Sustainable Development Study: Housing (Stanford, 2018b)

Stanford Population Trends

As of Fall 2015 Stanford had an estimated total of 30,943 students, faculty and staff, and by 2018, this number is anticipated to reach 32,051. **Table 2-4** provides a breakdown of the campus population, as reported in the 2018 GUP DEIR (County of Santa Clara, 2018, p. 3-9 and 5.12-7).

Table 2-4: Stanford Student, Faculty, and Staff Population

Affiliation	2015	2018
Undergraduate Students	6,994	7,085
Graduate Students, including PhDs	9,196	9,528
Postdoctoral Students[a]	2,264	2,403
Faculty[b]	2,959	3,073
On-Campus Staff[c]	8,612	8,985
Other (Non-Matriculated Students)[d]	918	977
Total	**30,943**	**32,051**

Notes:

[a] Postdoctoral students are academics with doctoral degrees who are involved in research projects and who have appointments for the purpose of advanced studies and training under mentorship of a Stanford faculty member.

[b] Faculty refers to professorate faculty members and regular benefits-eligible employees in academic/instructor positions.

[c] Staff refer to regular benefits-eligible employees generally in non-academic positions. Refers only to staff working within the area governed by the GUP.

[d] Non-matriculated students are students taking courses or engaged in graduate-level research or training but who are not seeking a degree.

Source: Stanford University Land Use and Environmental Planning Office, 2016; Stanford University Land Use and Environmental Planning Office, in consultation with the Stanford Office of Institutional Research and Decision Support, as cited in the DEIR for the 2018 GUP (Santa Clara County, 2018 p. 3-9 and 5.12-7).

Table 2-5 provides an estimated breakdown of the campus population that currently lives on-campus, and also accounts for family members of those graduate students and faculty/staff who live on-campus. By Fall 2018, it is estimated that the on-campus residential population will be 15,338, including 12,787 students, faculty and staff, and 2,551 family members of graduate students and faculty/staff.

Table 2-5: Residential Population Residing on Campus in 2018

Affiliation	Residential Population within Academic Boundary
Undergraduates	6,617
Graduate Students	5,205
Non Student Spouses	660
Children	420
Postdoctoral Students[a]	28
Faculty and Staff[b,c]	937
Other Family Members	1,471
Total	**15,338**

Notes:

[a] Postdoctoral students are academics with doctoral degrees who are involved in research projects and who have appointments for the purpose of advanced studies and training under mentorship of a Stanford faculty member.

[b] Faculty refers to professorate faculty members and regular benefits-eligible employees in academic/instructor positions.

[c] Staff refer to regular benefits-eligible employees generally in non-academic positions. Refers only to staff working within the area governed by the GUP.

Source: Stanford University Land Use and Environmental Planning Office, in consultation with the Stanford Office of Institutional Research and Decision Support as cited in Santa Clara County, 2018, p. 3-9 and 5.12-8.

Table 2-6 provides data showing the historical growth of Stanford's academic population, which includes the student body population and Stanford's Academic Council consisting of tenure-line faculty, non-tenure-line faculty, and senior fellows at specified policy centers and institutes.[4] **Figure 2-9** shows how Stanford's academic population has grown over time. From 1960 through 2016 the annual growth rate of the academic population has averaged approximately 1.0 percent.

Stanford, like other universities, may go through periods of limited development due to lack of capital funds or other constraints, and during such times may need to accommodate a growing number of students. Over the short-term at least, population increases can be accommodated by intensifying the use of existing campus buildings. For example, academic use of buildings can be intensified through use of staggered and extended class times; office space can be intensified through sharing of offices by faculty or staff; and housing can be intensified through increased sharing of bedrooms by students. Periods of compression may be followed by periods of decompression associated with construction of new and expanded space.

Stanford's academic population (students and faculty) has increased over time; however, the rate of growth has varied. Over the first three decades on the 20th Century, Stanford's 10-year growth rate was relatively high, reaching nearly 9 percent from 1920 to 1930, then falling to 1.3 percent in the following decade, which encompassed the Great Depression and the onset of World War II. During the two decades following the war, academic population growth picked up again, exceeding 3 percent. Since 1960 no decade has seen more than 1.9 percent growth, with the current 10-year academic population growth rate at about 0.8 percent.

[4] Academic staff — teaching, center fellows and Medical Center-line faculty — are not members of the Academic Council.

Table 2-6: Stanford Academic Population Growth

Year	Undergrad Students	Graduate Students	Academic Council Faculty [a]	Total Academic Population	Average Annual Increment over 10 year period [b]	Previous 10-year Growth Rate
1900	1,055	114	75	1,244	83	NA
1910	1,498	157	112	1,767	52	4.2%
1920	2,165	283	150	2,598	83	4.7%
1930	3,103	1,530	271	4,904	231	8.9%
1940	3,460	1,782	309	5,551	65	1.3%
1950	4,805	2,907	372	8,084	253	4.6%
1960	5,648	4,208	619	10,475	239	3.0%
1970	6,221	5,217	1,029	12,467	199	1.9%
1980	6,630	6,236	1,230	14,096	163	1.3%
1990	6,555	6,886	1,340	14,781	69	0.5%
2000	6,548	7,700	1,368	15,616	84	0.6%
2010	6,887	8,779	1,468	17,134	152	1.0%
2016	7,032	9,304	1,659	17,995	222	0.8%

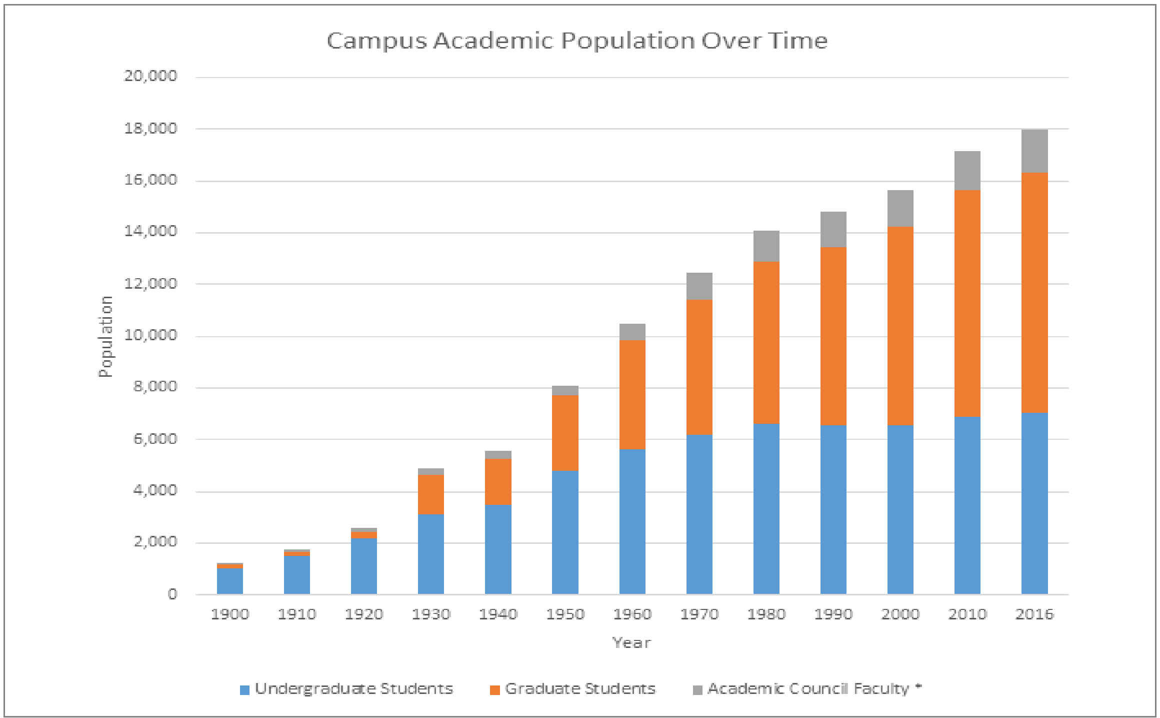
Notes:

[a] Includes tenure-line faculty, non-tenure-line faculty and senior fellows at specified policy centers and institutes. Academic staff — teaching, center fellows and Medical Center-line faculty — are not members of the Academic Council

[b] Based on these numbers, the annual growth rate of the academic population has averaged approximately 1.0 percent

Source: Stanford, *2017b.* Most recent data available is 2016.

Figure 2-9: Stanford Academic Population Growth



Source: Stanford, *2017b.* Most recent data available is 2016.

Regional Population Trends

Table 2-7 compares the 10-year increases in Stanford's academic population since 1960 with the corresponding residential populations in neighboring jurisdictions, including totals for Santa Clara and San Mateo counties. **Figure 2-10** provides a visual comparison of academic population growth to residential population growth in neighboring cities, which shows that Stanford's academic population growth is occurring faster than highly residential neighboring communities of Woodside, Los Altos Hills, and Portola Valley, but slower than more urbanized Menlo Park and Palo Alto. See Table 3-18 in the next chapter for a comparison of Stanford's residential population to residential populations in neighboring jurisdictions.

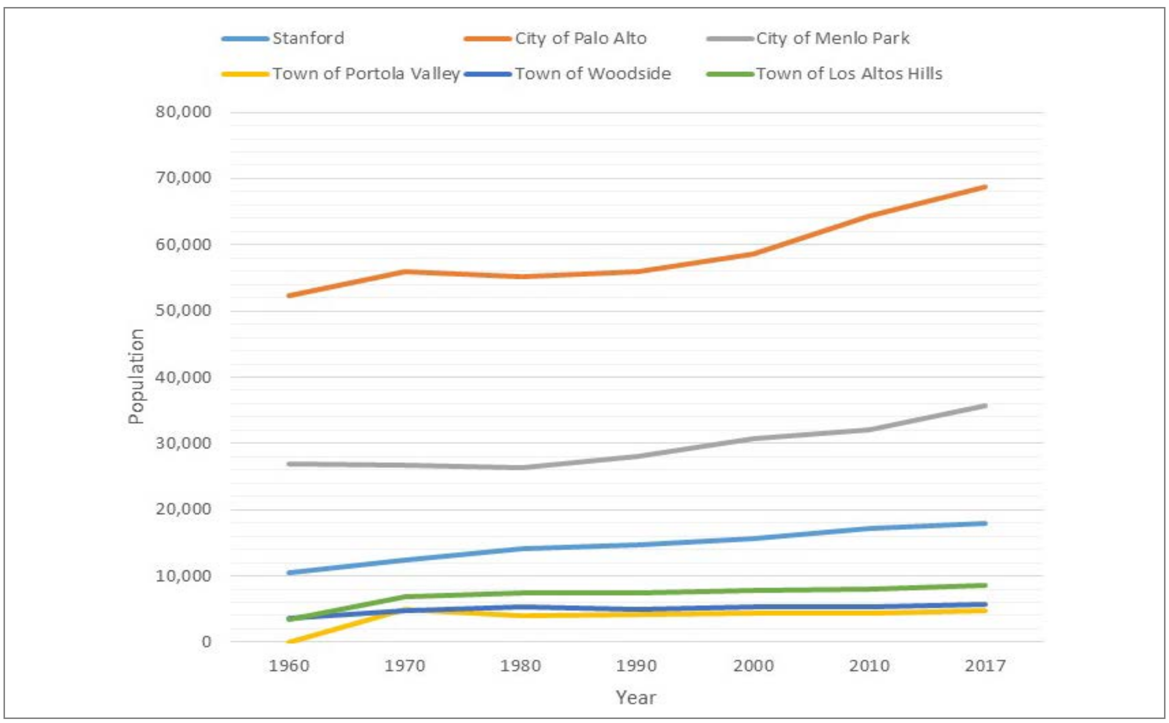
Table 2-7: Residential Population of Local and Regional Jurisdictions Compared to Stanford's Academic (non-residential) Population

	1960	1970	1980	1990	2000	2010	2017
Stanford CDP	-	-	-	-	13,315	13,809	N/A
Stanford academic population	10,475	12,467	14,781	14,781	15,616	17,134	17,995
City of Palo Alto	52,287	55,966	55,225	55,900	58,598	64,403	68,691
City of Menlo Park	26,957	26,734	26,369	28,001	30,785	32,026	35,670
Town of Woodside	3,592	4,731	5,291	5,035	5,352	5,287	5,666
Town of Los Altos Hills	3,412	6,865	7,421	7,514	7,902	7,922	8,634
Santa Clara County (Total)	1,064,714	1,295,071	1,497,577	1,682,585	1,938,180	1,781,642	1,938,180
San Mateo County (Total)	444,387	556,234	587,329	649,623	707,161	718,451	770,203

Note: CDP = Census-Designated Place

Source: U.S. Census Bureau, 2010; California Department of Finance, 2017; and MTC and ABAG, 2018.

Figure 2-10: Comparison of Stanford Academic Population Growth with Residential Population Growth in Nearby Cities Since 1960



Source: U.S. Census Bureau, 2010; California Department of Finance, 2017; and MTC and ABAG, 2018.

Using the population figures in Table 2-7 above, the growth rates for Stanford's academic population are compared to growth rates in neighboring jurisdictions and the two counties, from 1960 to 2017, and from 1990 to 2017. The results, shown in **Table 2-8**, show that over the past 17 years Stanford's academic population growth rate has tracked closely with the resident population growth rate of Santa Clara County and the two neighboring cities of Palo Alto and Menlo Park, while exceeding the growth rate of the smaller neighboring cities of Woodside, Los Altos Hills, and the County of San Mateo. Over the longer period since 1960, Stanford's academic population growth rate has tracked closely with the population growth rates of San Mateo County, while exceeding the rates of Palo Alto, Menlo Park, and Woodside, and falling well short of the rates observed in Los Altos Hills and the County of Santa Clara.

Table 2-8: Comparisons of Stanford Academic Population Growth to Residential Population Growth in Local and Regional Jurisdictions

Jurisdiction	Growth from 1960 - 2017	Growth from 2000 - 2017
Stanford academic population	72%	15%
City of Palo Alto	31%	17%
City of Menlo Park	32%	16%
Town of Woodside	58%	6%
Town of Los Altos Hills	153%	9%
Santa Clara County (Total)	202%	15%
San Mateo County (Total)	73%	9%

Source: U.S. Census Bureau, 2010; California Department of Finance, 2017; and ABAG/MTC, 2018.

In general, population growth in the surrounding cities reflects changes to their respective general plans. City growth is regulated through the land use and zoning regulations. Along with population growth, land use densities have increased over the past several decades. San Jose's General Plan 1975 – the City's first "modern" General Plan – was used to formalize restrictions on growth to address traffic congestion, flooding issues, hillside development and school crowding. Subsequent general plans have demonstrated increased focus on land use based densification, such as under the 1984 General Plan (Horizon 2000 General Plan), with sections on Growth Management, Downtown Revitalization, and Economic Development. The most recent plan, Envision San Jose 2040, contains land use designation to encourage very high densities (FARs ranging from 10 to 30) in central locations. (City of San Jose, 2011). Other cities, including Palo Alto are also considering or have recently approved general plans to permit increased density (City of Palo Alto, 2017).

Anticipated Development under the Proposed 2018 General Use Permit

The 2018 GUP would authorize an additional increment of campus growth and land use development, including 2,275,000 net new square feet of academic and academic support facilities, and 3,150 net new housing units/beds, anticipated to take place over a period that would extend from 2018 through 2035. As with the 2000 GUP, the proposed 2018 GUP, if approved, would apply only to those Stanford lands that are located within unincorporated Santa Clara County, and thus, are subject to the land use jurisdiction and regulatory authority of the County of Santa Clara. The County is preparing a Program Environmental Impact Report (EIR) for the proposed 2018 GUP pursuant to CEQA Guidelines Section 15168.

Under the proposed 2018 GUP, the anticipated increment of future development would accommodate a growth rate that corresponds to the 2035 Moderate Growth Scenario included in SDS (i.e., 200,000 additional square feet per year).

The proposed 2018 GUP would allow:

- 2,275,000 net new square feet of academic and academic support facilities (plus any square footage remaining under the 2000 GUP);
- 3,150 net new housing units/beds, of which up to 550 units would be available for faculty, staff, postdoctoral scholars, and medical residents;
- 40,000 net new square feet of childcare center space and other space that reduces vehicle trips (e.g., transit hub);
- utilization of up to 50,000 square feet of construction surge space authorized under the 2000 GUP;
- utilization of the remaining unbuilt parking authorized under the 2000 GUP (estimated at 1,480 spaces remaining after completion of the Escondido Village Graduate Residences and associated parking in 2020);[5]
- creation of a parking reserve for up to 2,000 net new parking spaces (with Planning Commission approval); and
- associated infrastructure.

New building square footage and housing, as well as most infrastructure subject to the proposed 2018 GUP would be constructed on vacant land, infill sites and redevelopment sites within the AGB.

Under the 2018 GUP, the population of student, faculty, and staff is expected to increase by approximately 23 percent to 39,560 by 2035, a rate of 1.2 percent per year, as explained further in Chapter 3.

No site-specific projects and locations have been identified for development under the proposed 2018 GUP. Each individual building or project that would be developed pursuant to the proposed 2018 GUP would require submittal of an application to the County at the time proposed, and subject to additional discretionary review prior to consideration of approval by the County.

Stanford estimates that almost all remaining academic and academic support development, and nearly all remaining housing, authorized under the 2000 GUP will be built and occupied at the time of the County's consideration of the proposed 2018 GUP. The notable exception is the planned Escondido Village (EV) Graduate Residences, which are currently under construction; this housing is not expected to be completed and occupied until approximately 2020. The proposed 2018 GUP includes a provision to allow any remaining academic and academic support square footage authorized under the 2000 GUP to be carried over to the 2018 GUP.

[5] There are an estimated 3,156 remaining unbuilt parking spaces as of Fall 2015.

2.4 Stanford's Longer Term Growth

Although it has no concrete plans for growth beyond its current planning horizon of the proposed 2018 GUP, Stanford has indicated to the County that it believes its research and residential education programs will continue to thrive for many years beyond 2035, though they are sure to be affected by societal, technological, and environmental dynamics (Stanford 2018d). The capacity of the Stanford campus to accommodate longer term growth beyond the planning horizon of the proposed 2018 GUP is examined in the next chapter.

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3. Development Capacity Analysis

3.1 Introduction

This development capacity analysis is intended to consider and describe the hypothetical maximum buildout of Stanford's lands in unincorporated Santa Clara County over a long-term future, beyond the 2035 planning horizon included in the proposed 2018 General Use Permit and the 2009 SDS. It presents an assessment of development that *could* occur on the Stanford campus over a very long-term future, beyond the current planning horizon of Stanford, local communities, the Bay Area region, and the state.

It is not a forecast or prediction of future development, and, importantly, does not reflect any specific plans by Stanford or the County. Rather, in response to public inquiries, it is a description of the potential capacity of Stanford's lands in unincorporated Santa Clara County to accommodate different levels of development intensity, and provides a basis to further assess and understand the potential implications of, and constraints on, such development.

The development capacity analysis focuses on the portion of the AGB located within the Academic Campus. The analysis assumes that the low- and medium-residential use zones (R1S and R3S) will retain their current zoning status and residential density into the future, and will not be subject to future intensification or changes in land use without zoning amendments. The analysis also assumes that future development in areas designated as Campus Open Space in the Community Plan – notably the Arboretum and Lagunita (see Figure 2-3) – will not intensify and remain as open space unless the Community Plan is amended. The development capacity analysis has been prepared in the context of the 2009 SDS core objectives of preventing sprawl into the hillsides, containing development in clustered areas, and providing long-term assurance of compact urban development. The analysis also reflects land use constraints represented in the proposed 2018 General Use Permit.

3.2 Development Densities

Development Density at Stanford

The intensity of land development within the Academic Campus is analyzed for two categories: Academic (including Academic support) and Housing. Development density is commonly defined as the Floor Area Ratio (FAR) determined by comparing a building's total floor area [gross floor area or gross sf][1] to the size of the piece of land upon which it is built. Because college campuses tend to represent a unique mix of land uses at varying densities, the overall campus FAR is considered the most appropriate tool for evaluating relative development density and intensity, and overall potential land capacity for future development.

The land area of the Academic Campus is approximately 1,018 acres. This area includes the academic campus, student housing, and a small number of faculty/staff housing units, while the majority of the faculty/staff housing lies within adjacent residential zoning districts (Stanford, 2018b, p.3). The campus FAR addressed in this analysis is calculated by dividing the total academic/academic support/student housing square footage by the acreage of the Academic Campus.

The increasing FAR for the Stanford Academic Campus as measured since 1990 and forecasted to 2035 is summarized in **Table 3-1** below. Total development at Stanford in 1990 was 10.13 million sf, with an overall FAR of 0.23; by 2015, the FAR was 0.32. The FAR anticipated upon completion of the 2000 GUP will be 0.38. The FAR would increase to 0.46 with Stanford's full implementation of the proposed 2018 GUP, which would expand total campus development to 20,393,461 sf.

Table 3-1: Development Density (FAR) of Stanford Academic Campus – 1990 to 2035

Year	Academic gsf	Student Housing gsf[a]	Total	Development (gsf) per Acre[b]	FAR
1990	6,870,725	3,260,259	10,130,984	9,952	0.23
2000	8,220,391	3,886,516	12,106,907	11,893	0.27
2010	9,046,835	4,516,294	13,563,129	13,323	0.31
2015	9,617,931	4,779,301	14,397,232	14,143	0.32
2018	10,255,391	4,983,070	15,238,461	14,969	0.34
2020 (+ EVGR)	10,255,391	6,638,070	16,893,461	16,595	0.38
Proposed 2018 GUP	+ 2,275,000	+ 1,225,000			
2035 (Estimated)	*12,530,391*	*7,863,070*	*20,393,461*	20,033	*0.46*

Notes:

[a] There are 38 faculty/staff housing units within the Academic Campus. Of those 38 units, 13 are single-family houses located in the Searsville Block area and 25 are detached units located at the Olmsted Staff Rental Housing site along El Camino Real. The Searsville Block units are approximately 2,500 square feet each, for a total of about 32,500 square feet. The Olmsted Staff Rental Housing units total 53,831 square feet. These faculty/staff units are not included in the student housing gsf totals.

[b] Academic Campus = 1,018 acres; One acre = 43,560 sf.

Source: Stanford University, 2017a and 2018b

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[1] The gross area or gross sf is the sum of all areas on all floors of a building included within the outside faces of its exterior walls, including all vertical penetration areas, for circulation and shaft areas that connect one floor to another.

Chapter 3 of the 2009 SDS provided a detailed historic presentation of campus planning and development along with strategies and specific examples for how increased development could be achieved. The 2009 SDS identified six campus-planning principles for guiding land use decisions for the central campus that are rooted in 100-year-old Olmsted Plan and Stanford's vision for the next 100 years:

- *Implement the Olmsted Plan* – This involves developing quads along the primary east-west axis and associated connective elements, and clustering academic programs by affinity and collaboration.
- *Develop in a compact manner* – This redevelops underutilized sites, such as parking lots or low-density buildings. This principle also involves providing housing at a pace commensurate with academic growth development to maintain Stanford as a "residential University (Stanford, 2008 p. 32).
- *Provide appropriate density transitions from the core to the edges* – This requires development of higher-density academic facilities concentrated toward the center of the Central Campus with lower density neighborhoods along the edge of campus. This is a context-based design strategy intended to promote land use compatibility with the surrounding area.
- *Preserve campus character, including natural, landscape, and circulation systems* – This involves the development of open quads, restoration and development of axial malls and connections, and siting of new buildings to capitalize on view corridors and vistas that provide both reference and inspiration.
- *Allocate and use existing space responsibly* – In 2003, Stanford established parameters for schools and departments to use as planning tools, including space guidelines for sizes of offices and open work areas. One technique to encourage more efficient building-use requires schools pay a charge for underutilized office space.
- *Optimize site planning to take advantage of climatic conditions* – Structures and landscaping are carefully sited to incorporate principles of harvesting daylight and natural ventilation.

Development Densities at Comparable University Campuses

To illustrate hypothetical future densities at Stanford, this section provides an analysis of development at *comparable* university campuses – i.e., other large California research universities as well as universities nationwide that are similarly research-oriented and characterized by a high on-campus residential population or are otherwise comparable to Stanford. The analysis also considers nearby institutions that may be more familiar to those living in the Bay Area, including Cal State East Bay, Santa Clara University, and San Jose State University. Information for comparable campuses is sourced from available campus land-use plans, information provided in the Carnegie Classification,[2] and the Ayers Saint Gross *Comparing Campus* study.[3]

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[2] The Carnegie Commission on Higher Education developed a classification of colleges and universities to support its program of research and policy analysis in 1970. Derived from empirical data on colleges and universities, this classification, originally published in 1973, is regularly updated (in 1976, 1987, 1994, 2000, 2005, 2010, and 2015), to reflect changes among colleges and universities. This framework is widely used in the study of higher education, both as a way to represent and control for institutional differences, and in the design of research studies to ensure adequate representation of sampled institutions, students, or faculty.

[3] Since 1998, Ayers Saint Gross has annually published a Comparing Campuses poster that features campus plans from institutions around the world. The data is assembled by Ayers Saint Gross as a tool for institutional planners to contribute to creating better campuses. See Carnegie Classification of Institutions of Higher Education, 2017.

FAR Comparison: Carnegie Classification and Ayers Saint Gross Study

Comparable universities are identified using the Carnegie Classification tool that allows users to identify and list institutions of higher education according to basic classification (e.g., doctoral university) and selected sub-classifications (e.g., enrollment size). Within the Carnegie custom classification-listing tool, Stanford falls within the categories of "doctoral; highest research activity" and "four-year, highly residential." By expanding the criteria to include "four-year, primarily residential" institutions, the Carnegie Classification tool identifies 27 "doctoral; highest research activity" universities that could be considered comparable to Stanford, including several within California. These include such notable campuses as Northwestern University, Pennsylvania State University-Main Campus, University of California-Berkeley, University of California-Los Angeles, University of California-San Diego, University of Colorado Boulder, University of Michigan-Ann Arbor, and Michigan State University (Carnegie Classification of Institutions of Higher Education, 2017).

Using the list of comparable universities generated by the Carnegie Classification tool, data on university populations and development intensities was aggregated from the Ayers Saint Gross study, *Comparing Campuses* (Ayres Saint Gross, 2018) and used to develop the population and density comparisons shown in **Table 3-2** and **Figure 3-1**. The information provided by the *Comparing Campuses* study varies in its currency (i.e., does not necessarily represent current conditions), as it is based upon existing campus master plans and available land use data, but it provides a general basis for comparing campus densities. In some cases, it was necessary to modify the data to make it useful for comparison. For example, the study includes large undevelopable land within the campus areas for Stanford and UC Berkeley, while for the purposes of FAR comparison, only developable land is considered.

The data show that Stanford currently has a relatively low development density (FAR) of 0.34 compared to the other universities. It also has one of the largest developable acreages across comparable universities.

The data reveal an inverse relationship between campus size and FAR. On the low end of the FAR range is Texas A&M and University of Michigan, which both have more than 3,000 acres of developable campus land along with protected open spaces, allowing for low density development. UC Santa Cruz (FAR 0.18) and Syracuse (FAR 0.2) have 514 acres and 963 acres of developable land, respectively, which is adequate to support their smaller student bodies with very low campus densities. Most similar in density to Stanford are University of Colorado Boulder (FAR 0.23), Emory University (FAR 0.27), UC San Diego (FAR 0.27) and Yale University (0.33). These campuses also have amounts of developable land similar to Stanford, ranging from 631 acres of developable land at Emory University to 1,152 acres at Yale.

Hovering around an FAR of 0.5 are Washington University in St. Louis, San Diego State University, Cornell University, University of North Carolina-Chapel Hill, and Georgia Tech. These campuses are smaller than Stanford, ranging from ranging from 182 acres of developable land at Washington University at St. Louis to 775 acres at UNC-Chapel Hill.

There is a notable jump in density to a next tier of universities with FARs around 1.0, including Case Western, Carnegie Mellon, UCLA, Johns Hopkins, Boston College, Vanderbilt University, and UC Berkeley. With their FARs ranging from 0.86 to 1.11, these universities represent even smaller developable acreages, from a low of 103 acres at Carnegie Mellon to a high of 415 acres at UCLA.

Table 3-2: Campus Populations, and Development Densities at Universities Comparable to Stanford

		Population						Campus Dev/Housing						
University	Data Year	Undergrad	Grad	Total Student	Faculty	Staff	Total	Undergrad Housing Units	Grad Housing Units	Faculty Housing Units	Student Housing Units/Total Population	Buildings gsf	Developable Acres	FAR
Texas A&M	2001	36,229	5,308	44,026	2123	6,837	52,986	10,432	650	0	0.21	12,153,842	3093	0.09
University of Michigan	1998	24,015	10,097	37,197	3,269	10,871	51,337	8,720	2,306	0	0.21	23,155,152	3070	0.17
UC Santa Cruz	2001	10,869	994	11,863	434	3,319	15,616	5,148	279	50	0.35	4,000,000	514	0.18
Syracuse	1999	11,365	4,001	15,366	1002	3,718	20,086	6,893	446	0	0.37	8,410,000	963	0.20
University of Colorado, at Boulder	2010	25,759	4,900	30,659	3,594	3,223	37,476	6,954	851	0	0.21	10,437,951	1034	0.23
Emory University	1998	6,316	5,037	11,353	2,500	12,991	26,844	300	500	5	0.03	7,400,000	631	0.27
UC San Diego	2010	23,140	5,970	29,110	2,320	13,860	45,290	8,010	2,490	170	0.24	13,522,840	1,152	0.27
Yale	2000	5,257	5,550	10,807	3,196	7,122	21,125	5,400	1,000	25	0.3	12,100,000	835	0.33
Stanford [a]	2018	7,085	11,931	19,016	3,073	8,985	31,074	6,617	5,092	937	0.41	15,238,461	1,018	0.34
Washington University in St Louis	1999	6,328	4,321	10,649	1167	1,400	13,216	3,000	0	3	0.23	3,968,468	182	0.50
San Diego State University	2003	25,368	5,987	31,355	2302	1,793	35,630	3,600	0	7	0.1	6,600,000	300	0.51
Cornell University	1999	13,590	4,537	18,127	1520	8,018	27,665	5,535	936	10	0.23	17,265,780	745	0.53
UNC Chapel Hill	2010	17,981	8,386	28,916	358	12,204	44,628	8,403	550	0	0.2	18,700,000	775	0.55
Georgia Tech	2000	10,257	3818	14,075	681	3,377	18,133	6,500	0	0	0.36	8,778,298	360	0.56
Case Western Reserve University	2000	3,057	2,068	5,125	555	2,707	8,387	2,185	52	0	0.27	5,600,000	150	0.86
Carnegie Mellon University	1998	5,050	2,507	7,557	778	3,309	11,644	3,611	0	0	0.31	4,121,863	103	0.92

Table 3-2: Campus Populations, and Development Densities at Universities Comparable to Stanford (continued)

		Population						Campus Dev/Housing						
University	Data Year	Undergrad	Grad.	Total Student	Faculty	Staff	Total	Undergrad Housing Units	Grad Housing Units	Faculty Housing Units	Student Housing Units/Total Population	Buildings gsf	Developable Acres	FAR
UCLA	2000	24,000	11000	35,000	6500	18,500	60,000	6,000	1,100	0	0.12	17,000,000	415	0.94
Johns Hopkins University	1998	3,743	1,384	5,127	445	6,000	11,527	2,112	0	0	0.18	5,790,000	140	0.95
Boston College	2001	9,188	2,293	11,481	641	1,848	13,970	6,500	0	0	0.47	4,942,049	116	0.98
Vanderbilt University	1999	5,818	4,292	10,110	1,828	11,848	23,786	4,629	165	5	0.2	14,000,000	317	1.01
UC Berkeley	1999	22,386	8,625	30,011	1309	11,881	43,201	5,049	1,126	27	0.14	8,591,167	178	1.11
University of Chicago	1999	3,756	6,346	10,102	1,237	8,261	19,600	1,532	204	204	0.1	12,326,000	203	1.39
Georgetown University	2004	6,400	6,400	12,800	1,100	-	13,900	5,064	0	0	0.36	6,500,886	104	1.43
MIT	2000	4,300	5,672	9,972	931	7,067	17,970	2,735	1,474	0	0.23	9,800,000	154	1.46
Boston University	2002	14,861	7,341	22,202	2,377	4,845	29,424	9,662	0	14	0.33	10,042,877	132	1.75
Columbia University	2004	17,784	5,838	23,422	3,145	5,497	32,061	5,000	5,800	0	0.34	6,699,181	59	2.61
George Washington University	1998	7,420	10,124	19,481	4,627	2,873	26,980	0	0	0	0	4,938,107	43	2.64

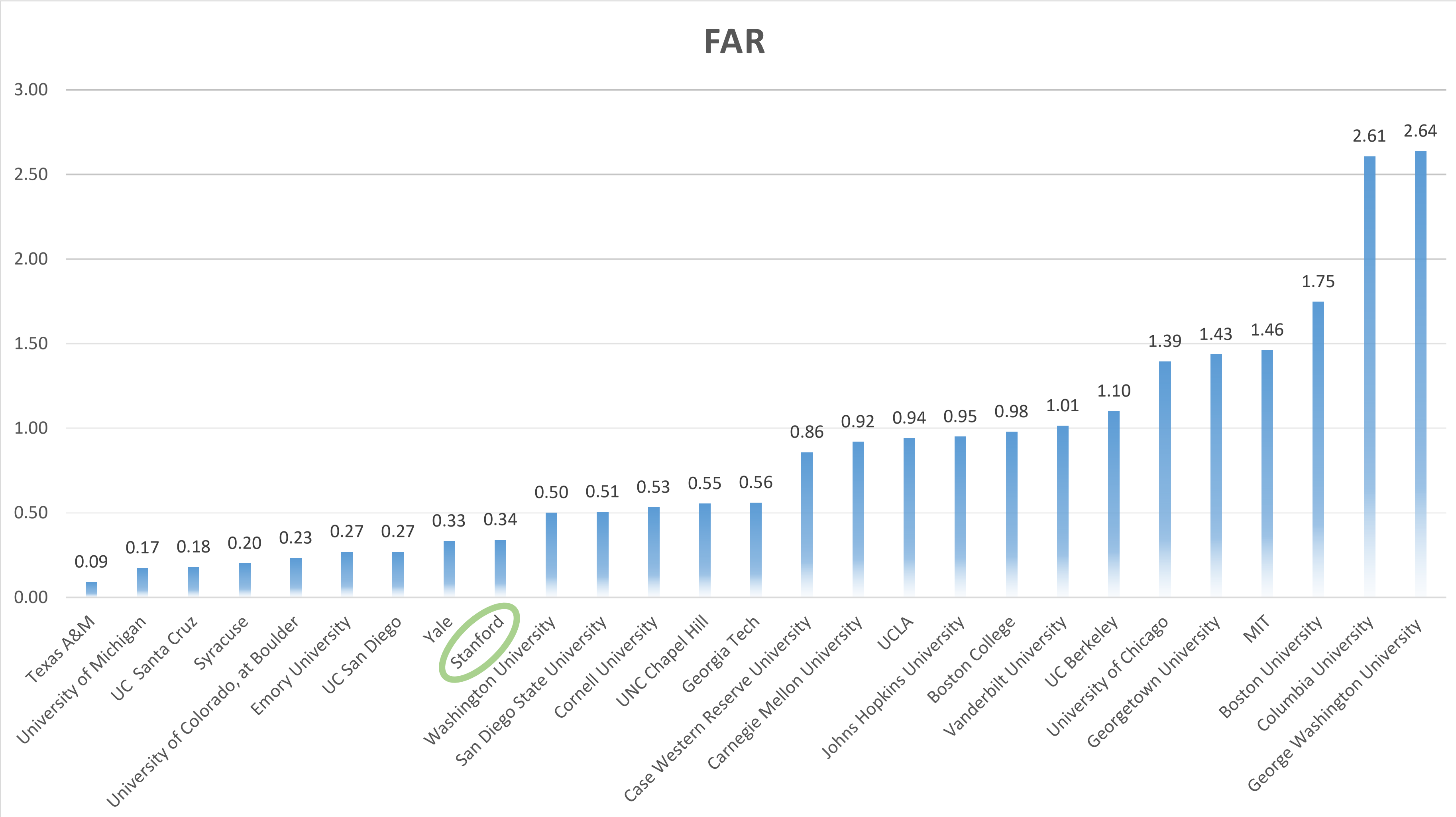
Notes:

[a] For the purpose of this table comparison, Stanford Data is provided by the 2018 GUP application, Stanford University, 2017a. Stanford building square footage data does not include faculty/staff housing.

[b] UC Berkeley, also has a large campus of over 1,200 acres, however, based on current UC Berkeley data (UC Police Department Berkeley, 2018), only 178 acres compose the central developable campus.

Source: Carnegie Classification of Institutions of Higher Education, 2017; and Ayres Saint Gross, 2018.

Figure 3-1: Floor-to-Area (FAR) Ratios at Universities Comparable to Stanford



Source: Carnegie Classification of Institutions of Higher Education, 2017; and Ayres Saint Gross, 2018.

Another distinct grouping of universities occurs around an FAR of 1.5, including University of Chicago, Georgetown, and Massachusetts Institute of Technology (MIT). The highest density institutions shown in Figure 3-1 – Boston University, George Washington University, and Columbia University – occur in the dense urban core of large cities. All of the benchmarked universities with FARs over 1.11 have developable land of 154 acres or less.

FAR Comparison: Local University Campuses

Local stakeholders are likely to be most familiar with Bay Area institutions of higher education, several of which were not identified using the Carnegie criteria. To provide a local context to the density comparisons, campus development data for UC Berkeley (included in the Carnegie list), Cal State East Bay, Santa Clara University, and San Jose State University are also analyzed.

FAR data for these local universities was gathered from current growth plans, including: Stanford's 2018 GUP Application for the university's core campus (2017-2035 18-year planning horizon); Cal State East Bay (2008- 2020 12-year planning horizon, Cal State East Bay, 2009 p. 3.0-24), Santa Clara University (2017 to 2022 5-year planning horizon, Santa Clara University, 2018; and 2016 p. 5); UC Berkeley (2002- 2020 18-year planning horizon; UC Berkeley, 2003 p. 24; and UC Berkeley, 2004 p 4.8-7); and San Jose State University (2001 to 2008 7-year planning horizon; San Jose State University, 2001 p. 3-2 and 3-12).

Table 3-3 shows that the inverse relationship between FAR and developable land generally holds true for the local universities, however dissimilar they may be to the "comparable" universities examined in the benchmarking exercise above. San Jose State University at 88.5 aces of developable space, has the highest FAR at 1.3; UC Berkeley at 180 acres of developable space has an FAR of 1.06; and Santa Clara University at 110 acres has a current FAR of 0.5. These universities, with the exception of Cal State East Bay (which when considering surrounding at-grade parking land is a lower density than the 0.4 FAR identified in their Master Plan), are all substantially smaller campuses, with higher FARs that are expected to increase over time, in some cases substantially.

Table 3-3: Regional Campus Data Comparison over Time

Year	Core Developable Area (Acre / SF)	Starting Campus Size (SF)	Planned Campus Size (SF)	Starting FAR	Planned FAR
Stanford University (2018-2035) [a]	1,018 / 44,344,080	15,238,461	20,393,461	0.34	0.46
Cal State East Bay (2008-2020) [b]	78 / 3,397,680	1,363,758	3,663,736	0.40	1.08
Santa Clara University (2017-2022) [c]	110 / 4,791,600	2,409,309	2,895,503	0.50	0.60
UC Berkeley (2002-2020) [d]	180 / 7,840,800	8,325,202	9,325,202	1.06	1.19
San Jose State University (2001-2008)	88.5 / 3,856,630	4,998,166	6,337,265	1.30	1.64

Notes:

a Considers growth under 2018 GUP.

b As reported by Cal State East Bay in their Master Plan; FAR may not include surface parking and other low density areas on the periphery of the.

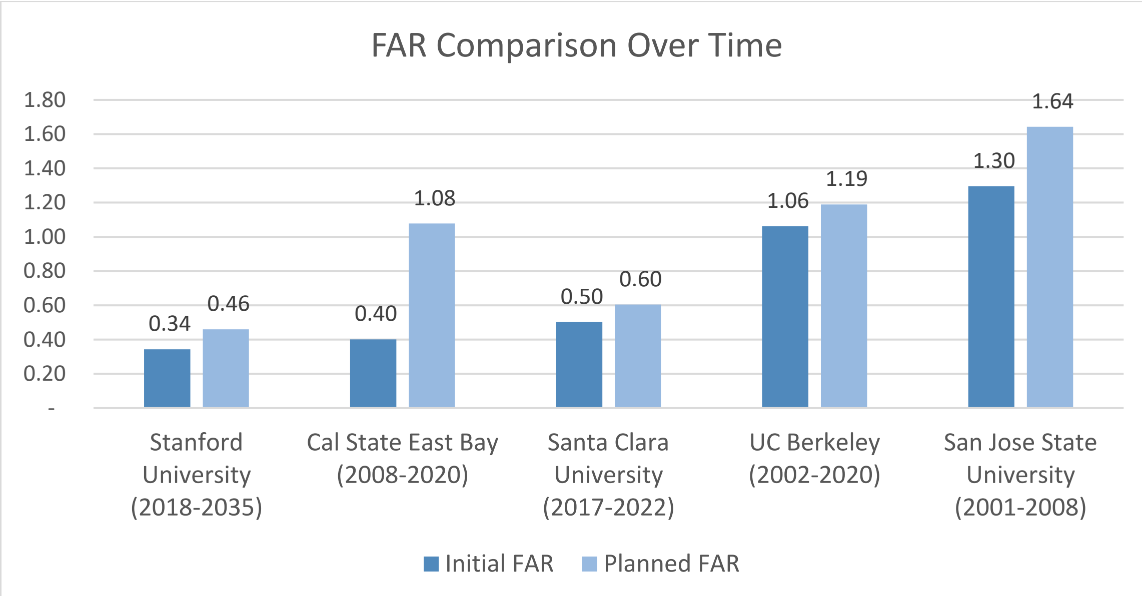
c The Master Plan considers 276,194 sf of new academic building space and 600 student beds, by applying the 2018 GUP assumption of 350 sf per bed, the net growth under the plan is 486,194 sf.

d The core campus area considers the Campus Park area of UC Berkeley, as this comprises the majority the developable space.

Source: Impact Sciences, Inc., 2008; City of Santa Clara, 2016; U.C. Berkeley, 2004; San Jose State University, 2001.

As shown in **Figure 3-2** below, Stanford, with by far the largest developable acreage of these Bay Area campuses, also has the lowest current and planned FAR.

Figure 3-2: Regional Campus Data Trends



Source: Cal State East Bay, 2009 p. 3.0-24; Santa Clara University, 2018; and 2016 p. 5; UC Berkeley, 2003 p. 24; and UC Berkeley, 2004 p 4.8-7; San Jose State University, 2001 p. 3-2 and 3-12.

Future Density Ranges for Stanford

Based on the development densities observed at the benchmarked teaching and research campuses across California and the nation, it is apparent that Stanford could grow its campus to a much higher FAR and remain well within the range of these universities.

As described above, after completion of Escondido Village Graduate Residences, the FAR of the Stanford Academic Campus will be 0.38. If the proposed 2018 GUP is approved and fully implemented, development within the Academic Campus area at the Stanford campus would reach an FAR of 0.46. This density remains relatively low in the context of comparable universities. However, the intent of the land capacity analysis is to look past the 2018 GUP horizon and consider the “maximum” development capacity of the Stanford campus over a very long time horizon.

As demonstrated above, there is a distinct inverse relationship between FAR and developable campus land that is remarkably consistent across the benchmarked universities. Campuses with FARs of 0.86 and above have much smaller areas of developable land than does Stanford, and those at a FAR of 1.5 or above can be generalized as very small, dense campuses set in the highly urbanized core of major cities (New York, Boston, and Washington DC.), an environment not reasonably foreseeable for Stanford even in the distant future.

Based on the analysis of comparable research universities, 1.0 appears to be an appropriate planning maximum FAR to consider for the Stanford campus, however unlikely it could be attained in the foreseeable future. Even at a density of 1.0, Stanford’s total development would be more than 44 million sf, which is nearly three times the development on campus in 2018, and well beyond the total square footage of any benchmarked campus.

Future Development Capacity at Stanford

To assess the potential future development capacity at Stanford, this analysis considers the consequences of developing the Academic Campus to FARs of 0.5, 0.75, and 1.0. The capacity analysis also investigates potential development intensification strategies and assesses the feasibly of applying these strategies to the campus.

Potential Campus FARs

The total acreage of the Academic Campus is 1,018 acres (44.3 million square feet of land). Proposed development through 2035 under the 2018 GUP would increase campus square footage by 3,500,000 square feet, resulting in total academic and student housing development of 20.4 million square feet and an FAR of 0.46. To illustrate the magnitude of development at each of the three considered densities, FARs are multiplied by the acreage of the Academic Campus:

- At a FAR of 0.5, the Academic Campus would contain approximately 22.2 million square feet of development, an increase of 5.3 million sf greater than 2020 conditions (+31 percent), and 1.8 million sf over the proposed 2035 level of development (+9 percent);
- At a FAR of 0.75, the Academic Campus would contain 33.3 million square feet of development, an increase of 16.4 million sf greater than 2020 conditions (+97 percent), and 12.9 million sf over the proposed 2035 level of development (+63 percent); and
- At a FAR of 1.0, Academic Campus would contain 44.4 million square feet of development, an increase of 27.5 million sf greater than 2020 conditions (+163 percent), and 24.0 million sf over the proposed 2035 level of development (+118 percent).

Potential Development Intensification Strategies

Development on university campuses does not simply expand to cover every last acre of land. Even in the more densely developed campuses, open space and other low intensity uses are key elements of the physical form of the campus. In addition, key considerations such as the walking time between buildings tend to result in the intensification of the campus core. At the same time, university campuses strive to maintain a form that provides for the array of uses and functions that support the academic experience for the student and broader campus community.

For universities where land availability is an issue, growth in core academic campus uses (classrooms, libraries, laboratories, offices, student housing) often displaces functions with less land use intensity, such as athletic facilities and agricultural fields, that are less essential to be located in the core of campus.[4]

Strategies for increasing campus density, along with public opinion regarding appropriate density, have changed over time. For example, a few decades ago Stanford might not have considered accommodating academic programs in basements two levels below ground, as

4 For example, at Cornell University, growth in core academic campus uses is displacing athletic facilities and agricultural fields to sites more distant from the campus center. UC Berkeley plans to build student housing at Edwards Stadium. Redevelopment of obsolete or low density uses is common: San Jose State University's master plan relies almost entirely upon this strategy (Stanford, 2018c, p. 3).

occurred recently with the new Science and Engineering Quad; and the university may not have constructed parking under recreational fields, as is the case at the Wilbur Field. These examples of subterranean development and parking infill with use of mixed-use athletic fields above represent techniques Stanford has implemented over the last two general use permits to increase development density within the Academic Campus.

In support of the preparation of this SDS Supplement, the Stanford Land Use and Environmental Planning Office analyzed various intensification strategies for their potential to increase campus density within the A-1 zone. Stanford conducted a literature review to identify land intensification strategies by other university campuses to achieve compact growth. The review included local campuses such as San Jose State, Santa Clara University, CSU East Bay and UC Berkeley in addition to similar out of state campuses. In a white paper entitled *Sustainable Development Study: Land Intensification Studies* (Stanford, 2018c), Stanford identifies the following five densification strategies and analyzes their potential for increasing the overall FAR of the A-1 zone.[5]

- Redevelop Parking Facilities
- Redevelop Lower Density Areas.
- Relocate Agricultural Lands and Facilities
- Relocate Athletic Facilities
- Develop Open Space Lands

The first four strategies above were analyzed for increasing density within the Academic Campus. The fifth was not analyzed because Campus Open Space areas at Stanford University – namely the Arboretum and the open space in the Lagunita district – cannot be developed without modifying the existing Community Plan. For this reason, development of these open space areas is considered here only conceptually for future densification beyond the maximum that could be achieved by the other strategies.

The Stanford densification study considers how the strategies have been applied at the Stanford campus and other campuses in the past and how they could be applied in the future.[6] Stanford's analysis was used to estimate the theoretical additional square footage that could be added through maximum employment of each strategy, recognizing that academic and other considerations could affect the extent to which they are applied in the future. Since the average campus FAR accounts for a wide range of densities across a campus, the analysis considered each strategy using site specific FARs up to 2.0 to balance open space within the Academic Campus and other very low-density areas such as recreation areas, green spaces and pathways. Stanford's analysis was reviewed and found to be accurate with respect to available land areas and the potential to apply the strategies within the Academic Campus.

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5 Campus expansion strategies, such as purchase of land or buildings adjacent to the existing campus boundaries, implemented by some constrained campuses, were not considered as part of Stanford's analysis. UC Santa Barbara and Santa Clara University, for example, have purchased properties near the campus for academic redevelopment.

6 It should be emphasized that Stanford presents the strategies on a conceptual level and states that it has no plans to employ any of these strategies at the maximum levels assumed in this analysis, nor are there specific proposals that would result in an elimination of a current land use under this analysis. Further, implementation of any one of these identified strategies would involve additional planning factors and approvals not considered in this assessment.

Strategy 1: Redevelop Parking Facilities

This strategy uses "infill" development on underutilized parcels, such as surface parking lots or low-level parking structures, to replace the parking in multi-level parking structures, including below-grade parking. Stanford identified recent projects at Villanova University, UC Santa Barbara, UC San Diego, and Texas A&M.

In many cases, densification by redeveloping parking facilities has been maximized by placing buildings or recreational fields over underground parking structures. Stanford notes that future developments in transportation, such as ride sharing and lower rates of car ownership, could substantially reduce demand for parking, freeing up more land for redevelopment. Stanford has previously employed this strategy on the Academic Campus, largely through consolidation of surface parking spaces into aboveground and underground parking structures that allow the surface parking lots to be used as building sites. Recently examples include Highland Hall, the Center for Academic Medicine and Denning House (under construction).

Denning House, under construction on a former parking lot site.

Stanford has approximately 99 acres of land currently occupied by parking facilities. In the short-term, land use densification can be accomplished through replacement of surface parking with multi-level structures (either above- or below-ground), while in the future replacement parking may not be as important if car ownership and use on campus declines due to reasons stated above.

Based on the approximate acreage of land within the Academic Campus primarily dedicated to parking, the theoretical capacity for additional development is summarized in **Table 3-4**, showing the range of building square footage that could be added to the campus if some or all of those parking areas were redeveloped. If all available parking areas were developed to a maximum density of 2.0 FAR, the strategy could add more than 8.5 million sf to the campus.

Table 3-4: Land Use Intensification Potential through Parking Facility Redevelopment

Parking	Acres	0.50 FAR	1.0 FAR	1.5 FAR	2.0 FAR
Stadium/Galvez	17	370,000 GSF	741,000 GSF	1,111,000 GSF	1,481,000 GSF
Serra Street/Campus Drive	4	87,000 GSF	174,000 GSF	261,000 GSF	348,000 GSF
Bowdoin/Campus Drive	14	283,000 GSF	566,000 GSF	849,000 GSF	1,133,000 GSF
Quarry Rd/Campus Drive	20	436,000 GSF	871,000 GSF	1,307,000 GSF	1,742,000 GSF
Stock Farm/Campus Drive	33	719,000 GSF	1,438,000 GSF	2,156,000 GSF	2,875,000 GSF
Santa Teresa/Lomita	11	240,000 GSF	479,000 GSF	719,000 GSF	958,000 GSF
All	**98**	**2,134,000 GSF**	**4,269,000 GSF**	**6,403,000 GSF**	**8,538,000 GSF**

Source: Stanford, 2018c p. 6.

Strategy 2: Redevelop Lower Density Areas

For some older urban campuses, like San Jose State and UC Berkeley, the only remaining strategy for future intensification involves tearing down older, lower-density development on the campus and redeveloping with newer, higher-density buildings. Stanford identified a multitude of campus redevelopment projects that target lower density areas including Corporation/Facilities Maintenance Yards, low shop buildings surrounded by large fleet parking lots, outdated science and engineering laboratory buildings, and low-density student housing areas in need of major capital investment.

Villanova, UCSB, Clemson, and Texas A&M have all replaced aging student housing with new, higher density residential complexes (UC Santa Barbara Office of Campus Planning & Design, 2014, Clemson University Facilities, 2017, and Texas A&M, 2017).

Stanford has long redeveloped lower density areas to accommodate growth. Recent examples include the replacement of outdated, low-density science and engineering facilities with the Science and Engineering Quad over nearly a 20-year period between 1995 and 2015 and the replacement of Escondido Village Graduate Residences over older lower density housing to be completed by 2020.

Cramped, low-density science and engineering facilities were redeveloped into a new Science and Engineering Quad. Substantial basements in these buildings allow for even greater land use intensity.

The 330,000 gsf Knight Management Center in 2015, incorporating underground parking, and increasing density on the site replaced an 84,000 gsf administrative building complex surrounded by surface parking.

In the near-term, Stanford could continue to redevelop lower density academic, academic support, and student residential areas into higher density areas. Longer-term, Stanford could redevelop areas that are currently moderately dense into even higher density; however, only the lower density areas are considered for redevelopment in this analysis.

To analyze land use intensification capacity under this strategy, areas with 1-2 story buildings and buildings of relatively low design and construction quality were considered as theoretical candidates for future redevelopment.[7] For the purposes of this analysis, new building capacity was considered without considering the “net” increase over existing development on these lower density sites. As shown in **Table 3-5**, below, this strategy, if fully implemented at the highest site density of 2.0, could support more than 20 million square feet of new development.

Table 3-5: Land Use Intensification Potential by Redeveloping Lower Density Areas

Low Density	Acres	0.50 FAR	1.0 FAR	1.5 FAR	2.0 FAR
Serra St/ Escondido Village	60	1,307,000 GSF	2,614,000 GSF	3,920,000 GSF	5,227,000 GSF
Escondido Rd/ Bowdoin	41	893,000 GSF	1,786,000 GSF	2,679,000 GSF	3,572,000 GSF
Knoll/Campus Dr	32	697,000 GSF	1,394,000 GSF	2,091,000 GSF	2,788,000 GSF
Santa Teresa/ Panama	54	1,176,000 GSF	2,352,000 GSF	3,528,000 GSF	4,704,000 GSF
Oak Rd	18	392,000 GSF	784,000 GSF	1,176,000 GSF	1,568,000 GSF
Escondido Rd/ Campus Dr	23	501,000 GSF	1,002,000 GSF	1,503,000 GSF	2,004,000 GSF
Lathrop Area	34	741,000 GSF	1,481,000 GSF	2,222,000 GSF	2,962,000 GSF
All	**262**	**5,706,000 GSF**	**11,413,000 GSF**	**17,119,000 GSF**	**22,825,000 GSF**

Source: Stanford, 2018c p. 9.

While Stanford acknowledges that it is likely to pursue redevelopment of some of its lower density sites as a strategy in the future, it does not anticipate redeveloping all of its lower density areas, as a mix of low-, medium- and high-density is appropriate and desirable to a campus setting.

Strategy 3: Relocate Agricultural Lands and Facilities

Campuses with substantial agricultural lands and facilities are displacing some of these extremely low-density uses to accommodate campus growth, particularly new student housing. UC Davis for example, while retaining its substantial engagement in agricultural research, plans to relocate and consolidate greenhouse facilities to accommodate higher density housing projects (UC Davis, 2018). Cornell University similarly plans to retain some agricultural uses near the campus center while relocating others to make room for denser new buildings close to the campus core (Cornell, 2008).

Uses such as agricultural fields and equestrian uses are typically very low density and some of these facilities have the potential to be relocated to sites outside the core academic campus. In the past Stanford has relocated some research fields from the central campus; however, the university recently completed construction of a new Educational Farm on the campus, as an outdoor classroom for students interested in sustainable food production and is adding more greenhouses to the campus as well.

To calculate land capacity for this strategy, Stanford identified their equestrian uses and research fields and greenhouses within the Academic Campus as theoretical sites for future

[7] Note that any the buildings considered in the analysis remain in service at present and Stanford has not proposed to replace them.

redevelopment.[8] Fully implemented at medium and high densities, Stanford estimates that this strategy could support additional building square footage of between 0.76 and 3.0 million GSF, as shown in **Table 3-6**. Given that Stanford's School of Earth, Energy and Environmental Sciences constructed its Educational Farm only one year ago, and plans to build an additional greenhouse on its campus during the remainder of the 2000 GUP, it does not appear that this implementation strategy is likely to be employed in the foreseeable future. However, over the very long term, it is theoretically possible that some agricultural facilities might be replaced on building rooftops or in "vertical farms".

Table 3-6: Land Use Intensification Potential by Relocating Agricultural Lands and Facilities

Agricultural	Acres	0.50 FAR	1.0 FAR	1.5 FAR	2.0 FAR
Academic Farm	8	175,000 GSF	349,000 GSF	524,000 GSF	698,000 GSF
Research fields and greenhouses	10	218,000 GSF	436,000 GSF	653,000 GSF	871,000 GSF
Equestrian Center	10	218,000 GSF	436,000 GSF	653,000 GSF	871,000 GSF
Stock Farm	8	174,000 GSF	348,000 GSF	523,000 GSF	697,000 GSF
All	**36**	**762,000 GSF**	**1,524,000 GSF**	**2,287,000 GSF**	**3,049,000 GSF**

Source: Stanford, 2018c p. 10.

Aerofarms is building vertical farms in Newark, New Jersey; indoor agriculture is an innovative and expanding research area (Aerofarms, 2017).

Strategy 4: Relocate Athletic Facilities

Athletic fields, often originally located at the edge of the campus which over time has become part of the campus core, can over time become potential sites for infill development as a campus expands. Considering the importance of athletic and recreation fields to the academic community and experience, most campuses are careful to relocate and replace these facilities in areas that are proximate to the campus core and readily accessible to campus population. UC Davis for example, is replacing a two-acre recreation field near the campus center with a three-acre recreation field complex on a site further from the campus core (UC Davis, 2018).

Stanford's Department of Athletics and Physical Recreation currently supports 36 varsity sports teams, 32 club sports teams and fitness and recreation facilities for the general campus population. While no major athletic facilities within the Academic Campus have been recently displaced, Stanford has created new multi-use facilities that combine athletic fields and

[8] Note that these areas remain in service at present and Stanford has not proposed to replace them.

underground parking such as at Wilbur and Roble. Additionally, Stanford has reconstructed athletic fields to serve as detention basins on the west campus and at Serra Street.

Oak Road recreational field/stormwater retention basin; Roble Field recreational field/underground parking structure.

Athletic and recreational facilities are considered low density uses, occupying large areas of the campus. In the future athletics and recreation might also be accommodated on building rooftops or by sharing of community recreational facilities for more efficient land use. If that were to occur, some of the existing fields could be redeveloped. Stanford's analysis of its outdoor fields and courts as potential sites for future development (sites of less than one acre directly adjacent to student housing are excluded) indicates that this strategy, fully implemented at high density, could theoretically yield between 3 and 12 million GSF, as shown in **Table 3-7**.

Table 3-7: Land Use Intensification Potential by Relocating Athletic Facilities

Athletics	Acres	0.50 FAR	1.0 FAR	1.5 FAR	2.0 FAR
Stadium	27	586,000 GSF	1,176,000 GSF	1,764,000 GSF	2,352,000 GSF
Track	15	327,000 GSF	653,000 GSF	980,000 GSF	1,3072,000 GSF
Sports fields	92	2,004,000 GSF	4,008,000 GSF	6,011,000 GSF	8,015,000 GSF
Tennis court complexes	7	1529,000 GSF	304,000 GSF	457,000 GSF	610,000 GSF
All	**141**	**3,071,000 GSF**	**6,142,000 GSF**	**9,213,000 GSF**	**12,284,000 GSF**

Source: Stanford, 2018c p. 12.

Developing Open Space Lands

While 65 percent of Stanford-owned land (2,558 acres) in unincorporated Santa Clara County is designated as Campus Open Space or Open Space and Field Research, the vast majority of this land is outside the AGB. However, the Arboretum and Lagunita Open Space areas, which are located outside the Academic Campus but within the AGB, could conceivably be developed in the very distant future to place new uses next to existing uses and transit, or to avoid building in portions of the Open Space and Field Research area outside the AGB. Although the Community Plan does not allow densification of these areas, the Stanford Land Use and Environmental Planning Office analyzed their development potential as a hypothetical exercise and found that between 5 and 23 million GSF could be added if they were developed at medium- and high-density (up to 2.0 FAR).

Green roof at Nanyang Technical University in Singapore, Forest in the Sky apartment building in Hanoi planted with 50,000 trees (Inhabit 2015, and 2017)

Conclusion

Stanford's campus FAR will be 0.38 in 2020 assuming full buildout of the 2000 GUP (17 million square feet). **Table 3-8** presents the additional square footage of development within the Academic Campus to reach the hypothetical FARs of 0.5, 0.75 and 1.0.

Table 3-8: Additional Square Footage Needed to Achieve a Range of Academic Campus FARs

2020 w/EVGR (0.38 FAR)	2018 GUP (0.46 FAR)	0.50 FAR	0.75 FAR	1.0 FAR
16,900,000 GSF	20,400,000 GSF	22,200,000 GSF	33,300,000 GSF	44,400,000 GSF
		+1,800,000 GSF over 2018 GUP	+12,900,000 GSF over 2018 GUP	+24,000,000 GSF over 2018 GUP

Source: Stanford University, 2018c p. 15.

Stanford identified 98 acres of parking area, 262 acres of low density areas, 27 acres of agricultural facility land, and 141 acres of athletic and recreation facilities, for a combined area of 536 acres that over the long term could theoretically be developed at higher density. If all four strategies were pursued at the maximum development intensity of 2.0 FAR, more than 46 million sf could be added to the campus. Realistically, there will be a mix of densities represented by any new development that occurs beyond the horizon of the proposed 2018 GUP. As **Table 3-9** shows, if all new development using these strategies resulted in an average of 1.0 FAR, it would add approximately 23 million sf over the development anticipated under the 2018 GUP, which is nearly enough to achieve a 1.0 FAR for the overall campus, as shown in Table 3-8.

Table 3-9: Stanford Land Capacity for Future Development under Four Densification Strategies

Land Use	Acres	0.50 FAR	1.0 FAR	1.5 FAR	2.0 FAR
Parking	98	2,134,000 GSF	4,269,000 GSF	6,403,000 GSF	8,538,000 GSF
Low Density	262	5,706,000 GSF	11,413,000 GSF	17,119,000 GSF	22,825,000 GSF
Agricultural	36	762,000 GSF	1,524,000 GSF	2,287,000 GSF	3,049,000 GSF
Athletics	141	3,071,000 GSF	6,142,000 GSF	9,213,000 GSF	12,284,000 GSF
All	**536**	**11,673,000 GSF**	**23,348,000 GSF**	**35,022,000 GSF**	**46,696,000 GSF**

Source: Stanford University, 2018c p. 15.

3.3 Hypothetical Development Timelines

Table 3-10 provides estimates of the timelines needed for the Stanford campus to reach the FARs of 0.5, 0.75 and 1.0 based on the minimal, moderate and aggressive growth rates as described by the 2009 SDS. Under the moderate growth rate of 200,000 sf per year, it would take nine years beyond 2035 to add 1.8 million sf and achieve a 0.5 FAR by 2044. With the same rate of growth, the 0.75 FAR would be achieved in 2100, and the 1.0 FAR in 2155.

It is important to note that university campuses, including Stanford, as shown in Table 2-3, have not historically exhibited a constant steady rate of development growth over time; rather they go through periods of more intense development followed by period of relatively slow growth.

Table 3-10: Hypothetical Development Horizons under 2009 SDS Growth Rates

	Growth Rate		
FAR	Low[a] (115,000 sf/year)	Moderate (200,000 sf/year)	High (300,000 sf/year)
0.5	2051	2044	2041
0.75	2147	2100	2078
1.0	2244	2155	2115

Note:

[a] *Low* refers to 2009 SDS "Minimal Growth Scenario", while *High* refers to the "Maximum Growth Scenario."

3.4 Population Growth Forecasts

Along with land use it is important to consider population in assessing campus growth at Stanford, as increased human activity has a direct impact on available resources, public services, housing, and transportation that must be provided in order to accommodate that growth. Similar to forecasting the future development growth rates, there are numerous factors that may affect population growth on the Stanford campus. The availability of square footage for academic and housing uses creates capacity for population increases, but those increases are also affected by the pace of hiring of qualified faculty, funding, programmatic development and needs, and other factors. As a result, there is no singular method to use for estimating long-term population changes on the campus. This section applies three different approaches to estimating the population of Stanford beyond 2018:

- Applying the proposed 2018 GUP population growth rate to future years;
- Applying a student generation factor per sf of academic use space; and
- Applying population densities from similar institutions with comparable development density (FAR).

Extrapolating Future Population from the 2018 GUP Forecast

As summarized in Chapter 2, the population of Stanford's students, faculty, and staff is expected to increase by approximately 7,500 by 2035 under the 2018 GUP, a rate of 1.2 percent per year. **Table 3-11** provides a breakdown of the total campus population growth forecast, as presented in the 2018 GUP Application, Tab 5 (Stanford, 2017a).

Table 3-11: 2035 Growth Forecast for Stanford Student, Faculty, and Staff Populations

Affiliation	Anticipated Population in Fall 2018	Anticipated Population in Fall 2035	Change in Population	Growth Rate (CAGR)[b]
Undergraduates	7,085	8,785	1,700	1.3%
Graduate Students, including PhDs	9,528	10,728	1,200	0.7%
Postdoctoral Students	2,403	3,364	961	2.0%
Faculty	3,073	3,862	789	1.4%
Staff[a]	8,985	11,423	2,438	1.4%
Nonmatriculated Students	977	1,397	420	2.1%
Total	**32,051**	**39,560**	**7,509**	**1.2%**

Notes:

[a] Refers only to staff working within the area governed by the 2018 General Use Permit.

[b] Compound Annual Growth Rate

Source: Stanford University Land Use and Environmental Planning Office, in consultation with the Stanford Office of Institutional Research and Decision Support, as cited in Stanford University, 2017a.

Using the figures from the first four rows in Table 3-11 (undergraduate students, graduate students, post-docs, and faculty) the average annual growth rate is estimated for the academic population from 2018 to 2035 at the same 1.2 percent per year. This is slightly higher than the 1.0 percent historical rate of academic population growth since 1960, presented in the previous chapter.

In forecasting population growth beyond 2035 one could assume it reasonable to extrapolate the 1.2 percent annual rate for the foreseeable future. Doing so indicates that Stanford would reach 47,300 persons by the year 2050 and 85,900 by 2100. While there are examples today of large public universities with total campus populations in this range, only three of the campuses identified as comparable to Stanford have populations over 50,000, and two of those have developable land areas three times the size of Stanford's Academic Campus. The extent to which the Stanford population grows will be affected by a variety of factors, including potential external constraints, as well as Stanford's internal decisions about the size of the student body and faculty on the campus, the evolving nature of the delivery of education and the conduct of research, and other factors. Additionally, university campuses have not historically exhibited a steady rate of development growth over time; rather they go through intense periods of development followed by period of relative slow growth.

Population Forecast Based Relationship to Academic Space

Another reasonable method of estimating future campus population is to consider the relationship between total campus population and academic space. In 2000, the Stanford campus had 3.14 persons per 1,000 sf of academic and academic support space, as reported in the 2018 GUP Application. The anticipated ratio for 2018 is 3.13 persons per 1,000 sf. The 2035 prediction, based on the projections presented in this document and the proposed net new academic and academic support space, is 3.16 persons per 1,000 square feet. This ratio has proven to be consistent since 2000, as shown in **Table 3-12**.

Table 3-12: Stanford University Population Density Comparison over Time

	Fall 2000	Fall 2018 (Projected)	Fall 2035 (Projected)
Standard Total Population	25,821	32,051	39,560
Permitted academic square footage	8,220,391	10,255,391	12,530,391
Approximate density	3.14 persons per 1,000 sf	3.13 persons per 1,000 sf	3.16 persons per 1,000 sf

Source: Stanford University Land Use and Environmental Planning Office (Stanford 2017a, p. 5.11).

Using the average ratio from 2000 to 2035 of 3.14 persons per 1000 sf of academic space, hypothetical population estimates can then be based on the square footage of academic development expected in the future. Using the 3.14 ratio and assuming that the percentage of overall development at Stanford dedicated to academic use remains close to the historical average of 65%, Stanford's future populations after 2035 could grow to the numbers shown in **Table 3-13**.

Table 3-13: Campus Population Forecasts based on Growth of Academic Space

FAR	Cumulative SF	Academic SF (65%)	Campus Population
0.46 (2035)	20,400,000	12,530,391	39,560
0.5	22,200,000	14,400,000	45,216
0.75	33,300,000	21,600,000	67,824
1.0	44,400,000	28,900,000	90,746

Notes: Campus population estimates are based on the historical ratio of 3.14 persons per sf of academic space expected from 1990 to the 2035 planning horizon of the 2018 GUP.

Under this approach, with a campus buildout to a FAR of 1.0 (approximately 44 million total sf, or 28.9 million sf of academic space), the total population would be 90,746. It is important to recognize, however, that the future ratio of population to academic space could vary from historical ratios if more students are interacting with the university remotely, or if technological advancements and changes to the future techniques of higher education alter considerably the correlation between students and academic square footage. Possible future changes to educational facilities, and the delivery of higher education is further considered in Chapter 5, Planning for the Distant Future.

Population Forecast using a Comparative Analysis with Other Universities

A third method for forecasting Stanford's future campus population capacity considers the relationship of academic population (students plus faculty) to total development at comparable universities. **Table 3-14** summarizes the data from the Ayres Saint Gross study for the 16 benchmarked campuses that can be considered most highly residential (provide at least 0.5 housing units per 1000 sf) and lists them from highest to lowest in terms of academic population. Table 3-14 indicates that Stanford's academic population density in 2010 was second lowest across comparable universities at 1.56 persons per 1000 sf, and much lower than the mean value of 2.7. If the 2035 academic population forecast for 2035 (26,743) with full buildout of the 2018 GUP (Table 3-1) is used for Stanford, the result is an even lower 1.38.[9]

[9] 28,136 students (including non-matriculating) and faculty divided by 20,400 (thousands of sf of development.)

Table 3-14: Academic Population Densities at Universities Comparable to Stanford

University	Data Year	Students	Faculty	Academic Population	Student Housing Units	Buildings gsf	FAR	Student housing units per 1000 sf	Academic Population per 1000 sf
Yale	2000	10,807	3,196	14,003	6,400	12,100,000	0.33	0.53	1.16
Stanford	2010	18,498	1,910	20,408	10,864	13,100,000	0.31	0.83	1.56
Georgia Tech	2000	14,075	681	14,756	6,500	8,778,298	0.56	0.74	1.68
Syracuse	1999	15,366	1,002	16,368	7,339	8,410,000	0.2	0.87	1.95
Carnegie Mellon University	1998	7,557	778	8,335	3,611	4,121,863	0.92	0.88	2.02
Georgetown University	2004	12,800	1,100	13,900	5,064	6,500,886	1.43	0.78	2.14
UC San Diego	2010	29,110	2,320	31,430	10,500	13,522,840	0.27	0.78	2.32
Boston University	2002	22,202	2,377	24,579	9,662	10,042,877	1.75	0.96	2.45
Boston College	2001	11,481	641	12,122	6,500	4,942,049	0.98	1.32	2.45
Washington University	1999	10,649	1,167	11,816	3,000	3,968,468	0.5	0.76	2.98
UC Santa Cruz	2001	11,863	434	12,297	5,427	4,000,000	0.18	1.36	3.07
University of Colorado, at Boulder	2010	30,659	3,594	34,253	7,805	10,437,951	0.23	0.75	3.28
UC Berkeley	1999	30,011	1,309	31,320	6,175	8,591,167	1.11	0.72	3.65
Texas A&M	2001	44,026	2,123	46,149	11,082	12,153,842	0.09	0.91	3.8
Columbia University	2004	23,422	3,145	26,567	10,800	6,699,181	2.61	1.61	3.97
San Diego State University	2003	31,355	2,302	33,657	3,600	6,600,000	0.51	0.55	5.10
								Mean academic population per 1000 sf:	2.72

Source: Carnegie Classification of Institutions of Higher Education, 2017; and Ayres Saint Gross, 2018.

Looking at the data there is not an obvious correlation between academic population density and FAR. However, it is apparent that regardless of FAR, most of the comparable universities have a higher academic population density than does Stanford, and all of the campuses with academic populations larger than Stanford's exhibit densities of at least 2.3.

As shown in **Table 3-15**, if Stanford adds development beyond 2035 while maintaining its relatively low projected academic population ratio of 1.38 persons per 1000 sf, it would increase its academic population from 28,136 forecasted in 2035 under the 2018 GUP to 30,636 with a 0.5 FAR, 45,954 with a 0.75 FAR, and 61,272 with a 1.0 FAR.

Table 3-15: Academic Population Forecasts based on Development Growth

	0.46 FAR	0.5 FAR	0.75 FAR	1.0 FAR
Cumulative development (sf)	20,400,000	22,200,000	33,300,000	44.400,000
Academic Population at 1.38 persons per 1000 sf	28,136	30,636	45,954	61,272
Academic Population at 2 persons per 1000 sf	40,800	44,400	66,600	88,800
Academic Population at 3 persons per 1000 sf	61,200	66,600	99,900	133,200

It is reasonable to assume that as Stanford grows, it could increase population density along with development density, more in line with similar universities. Table 3-14 also shows what accommodating higher academic population densities up to 3 persons per 1000 sf would mean for the Stanford campus. However, with any of these scenarios, there remains the question of how many students does Stanford want to accommodate on its campus in the future? At a FAR of 0.75 and 1.0 the total populations rise to very high numbers that are likely well beyond what the university would choose to accommodate on campus, even at the current density of 1.38 persons per 1000 sf. Higher population densities at these FARs result in totals that far exceed the academic population of any comparable university.

Student Faculty Relationship

Although Stanford's ratio between campus population and academic space has remained relatively stable, as described above, its ratio of faculty to students has decreased significantly since 1960, as shown in **Table 3-16**. From 1960 through 2016, Stanford has steadily reduced its faculty-student ratio from 7.61 faculty members per 1,000 students in 1960 to 4.6 in 2016.

Table 3-16: Stanford University Ratio of Faculty to Students over Time

Year	Undergraduate Students	Graduate Students	Academic Council Faculty	Faculty per 1,000 students
1960	5,648	4,208	619	7.61
1970	6,221	5,217	1,029	6.56
1980	6,630	6,236	1,230	5.83
1990	6,555	6,886	1,340	5.58
2000	6,548	7,700	1,368	5.26
2010	6,887	8,779	1,468	4.79
2016	7,032	9,304	1,659	4.59

Note: Academic Council Faculty = tenure-line faculty, non-tenure-line faculty, and senior fellows at specified policy centers and institutes

Source: Stanford, 2018

Regional Population Comparisons

The Association of Bay Area Governments (ABAG) is the regional planning agency for the nine Bay Area counties and forecasts the region's demographic and economic trends. The regional forecast is an important component of Plan Bay Area, the region's first integrated land use and transportation plan, which was adopted by ABAG and the Metropolitan Transportation Commission (MTC) in 2013. The effort grew out of the California Sustainable Communities and Climate Protection Act of 2008 (Senate Bill [SB] 375), which required all metropolitan regions in California complete a Sustainable Communities Strategy (SCS) as part of a Regional Transportation Plan. MTC and ABAG are jointly responsible in the Bay Area for developing and adopting a SCS that integrates transportation, land use, and housing to meet greenhouse gas (GHG) reduction targets set by the California Air Resources Board. In July 2017, MTC and ABAG adopted an update to the plan, Plan Bay Area 2040, which is a limited and focused update of the 2013 plan. Using the employment, household, and population figures through 2035 and 2040 provided in these reports, Stanford's growth can be compared with the anticipated growth in neighboring communities.

Table 3-17 presents a summary of the Plan Bay Area's forecasts for regional growth in population, households and employment from 2015 to 2040, showing 25 percent, 26 percent, and 18 percent, respectively.

Table 3-17: Population, Households, and Employment – Bay Area, 2015 and 2040 (millions)

Demographic	2015	2040	2015-2040 Increase	Percent Increase
Population	7.6	9.5	1.9	25%
Households	2.7	3.4	0.7	26%
Employment	4.0	4.7	0.7	18%

Source: ABAG/MTC, 2017a

Table 3-18 presents population for the local and regional jurisdictions in the vicinity of Stanford for 2010 and 2035. Stanford's resident population numbers (students, staff and faculty who live on campus) are included for comparison. Over the 25-year period represented, Stanford's resident population is expected to grow faster than any of the neighboring cities and faster than San Mateo and Santa Clara counties. Stanford's forecasted residential population increase by 2035 (52 percent) is roughly double that of the Bay Area (25 percent), as shown Table 3-17. These results indicate that the Stanford campus is adding housing faster than are surrounding communities and the Bay Area as a whole.

Table 3-18: Population of Local and Regional Jurisdictions – 2010 and 2035

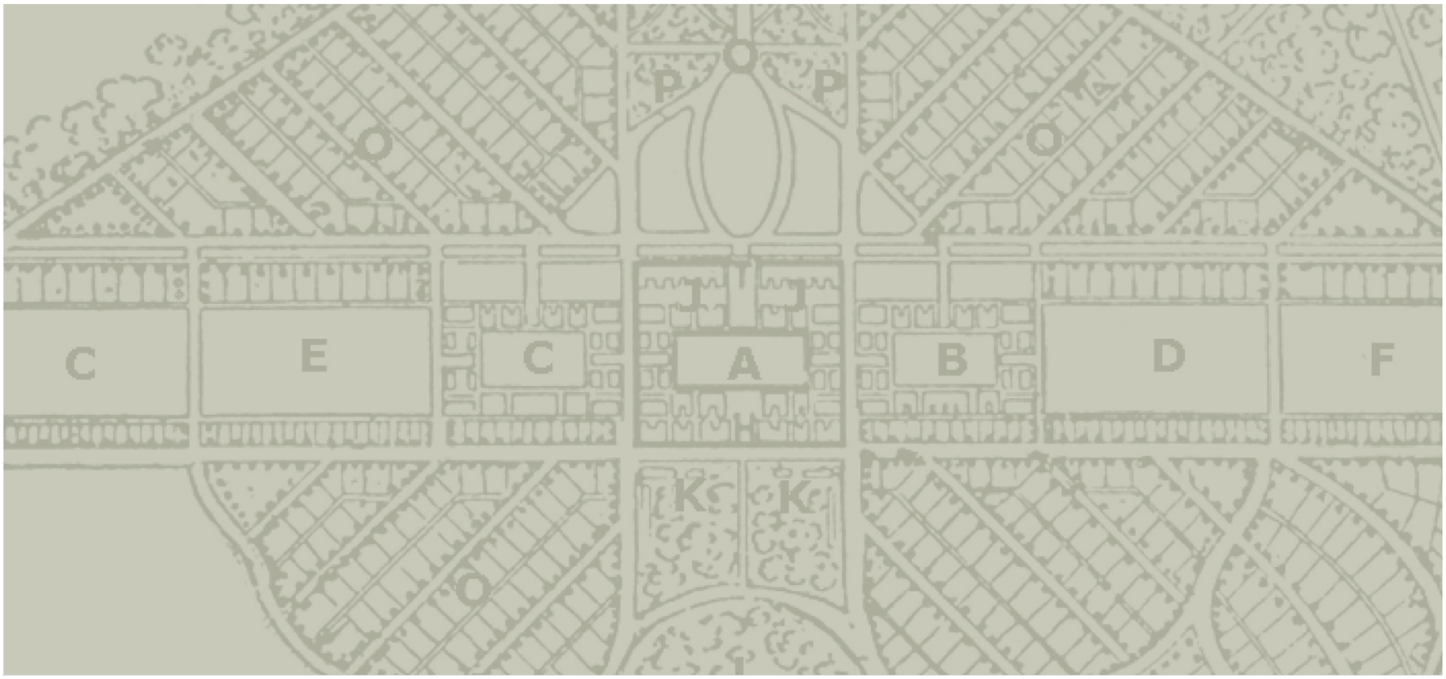
Jurisdiction	2010	2035	Percent Increase
Stanford University – resident population	14,200	21,664	52%
City of Palo Alto	64,403	80,800	25%
City of Menlo Park	32,026	36,800	15%
Town of Woodside	5,287	5,600	6%
Town of Los Altos Hills	7,922	8,500	7%
Santa Clara County (Unincorporated)	89,960	100,200	11%
Santa Clara County (Total)	1,781,642	2,303,500	29%
San Mateo County (Total)	718,451	869,300	21%

Note: Stanford resident population assumes one resident for each undergrad student housing unit, 1.2 residents per graduate student housing unit, and 2.5 residents per faculty unit, based on data provided for 2018 in Table 5.12-10 in the Draft EIR for the 2018 GUP Application.

Sources: Stanford 2010 resident population estimate based on housing units reported in Draft EIR for 2000 (Table 2-5) plus the 1,358 additional units added through August 2010 as reported in the GUP Annual Report No. 10. Santa Clara County, 2011; Stanford 2035 resident population as reported in Draft EIR Table 5.12-10; City population data from ABAG, 2013b.

Conclusions

Under any method presented above, it is likely that the population of the campus will continue to grow to levels that are substantially higher than under current conditions. As with any city or local planning area, those higher population levels will increase demand for housing and public services. Higher populations will also increase the need for travel and mobility, and for local services. More people on campus will increase the need for efficiency and conservation. The manner in which the Stanford population grows will be affected by Stanford's internal decisions about the size of the student body and faculty on the campus, the evolving nature of the delivery of education and the conduct of research, and other factors. These issues are discussed further in Chapters 4 and 5 of this SDS Supplement.



4. Constraints Analysis

There are potential constraints to future development of the Stanford campus related to housing, transportation, public services, natural resources, and supporting infrastructure. These constraints, or regulations imposed because of these constraints, could present limits on the theoretical development capacity described in Chapter 3.

This chapter assesses the degree to which future growth on the Stanford campus could be limited based on past trends and future scenarios for each resource, and the known and potential limits to future growth. These may include physical constraints, such as the known limit in available potable water supply due to Stanford's current contract with the San Francisco Public Utilities Commission and may also include policy and regulatory constraints, such as California's ambitious targets for greenhouse gas reduction. Stanford's ability to manage future constraints will be affected by the rate and intensity of future development, and may depend on availability of new technologies, legal and regulatory developments, societal trends, and further expansion of its sustainability programs.

4.1 Energy

Potential Constraints

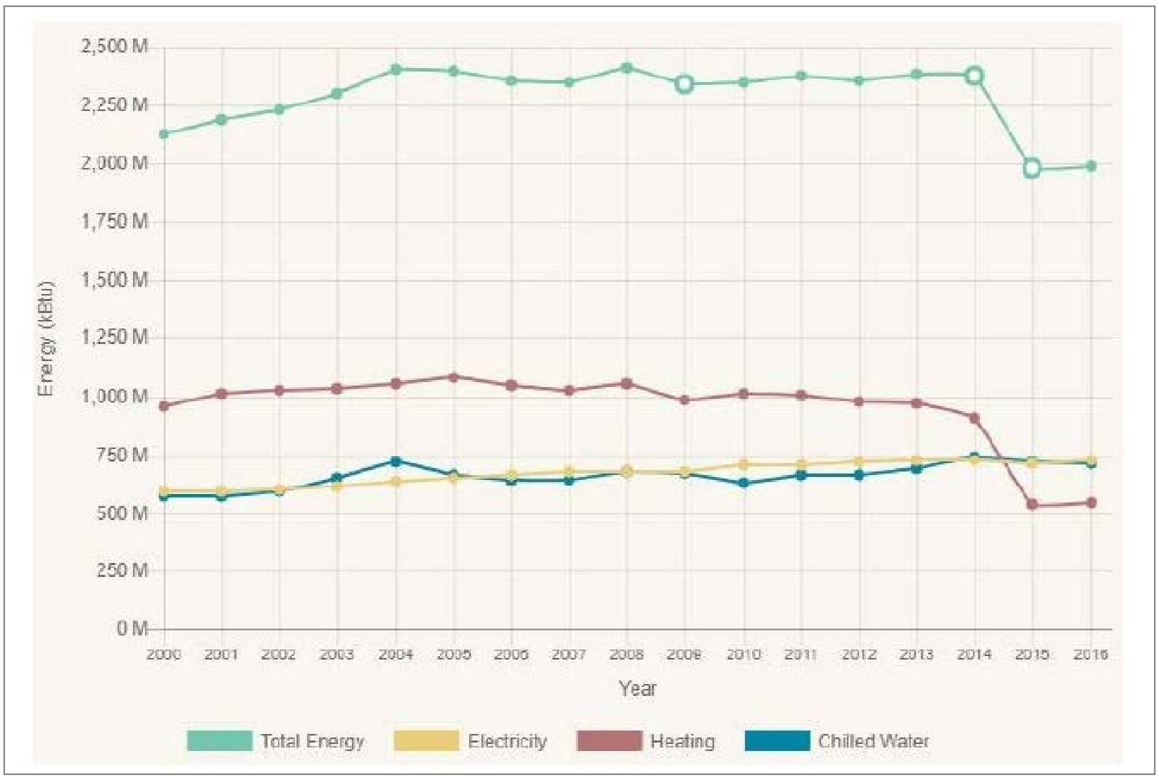
The primary potential development constraint related to energy is the availability of adequate supply of electricity, natural gas, and vehicle fuels to meet future demands related to campus construction and operations. California's GHG and energy policies and regulations represent a pathway to energy decarbonization, including more renewables in the energy supply, and a shift to transportation powered by clean energy. The State's renewables portfolio standard (RPS) is expected to continue ratcheting up the minimum required percentage of renewables in the electricity supply, while demand will be influenced by increasingly stringent statewide energy efficiency standards for both buildings and vehicles. Vehicle energy demand may also be affected by state policies and regulations requiring fewer vehicle miles traveled (VMT) per capita, and by changing behavior around transportation due to emerging technologies and societal trends.

Trends and Forecasts

Campus Energy Systems

As shown in **Figure 4-1** from the Stanford Sustainability White Paper (Stanford, 2018e), the university has reduced its total campus energy consumption (electricity, hot water/steam, and chilled water) by 6 percent over the past 17 years, from approximately 2.15 million British Thermal Units (Btu) in 2000 to approximately 2.0 million Btu in 2016, even with a growth of 2.5 million usable square feet during this time. While consumption of electricity and chilled water energy has slowly increased over this period, a significant reduction in heating demand occurred after 2014, when the Stanford Energy System Innovations (SESI) project overhauled the campus heating and cooling system with new Central Energy Facility (CEF) and heat-recovery process that is 70 percent more efficient than the prior cogeneration process used by Stanford. The result has been an overall improvement in building-level and district-level energy efficiency.

Figure 4-1: Stanford Energy Consumption



Notes:

kBtu = thousands British Thermal Units

Meaning of green circles on Total Energy line:

2009: Introduction of energy saving building retrofits along with new construction standards

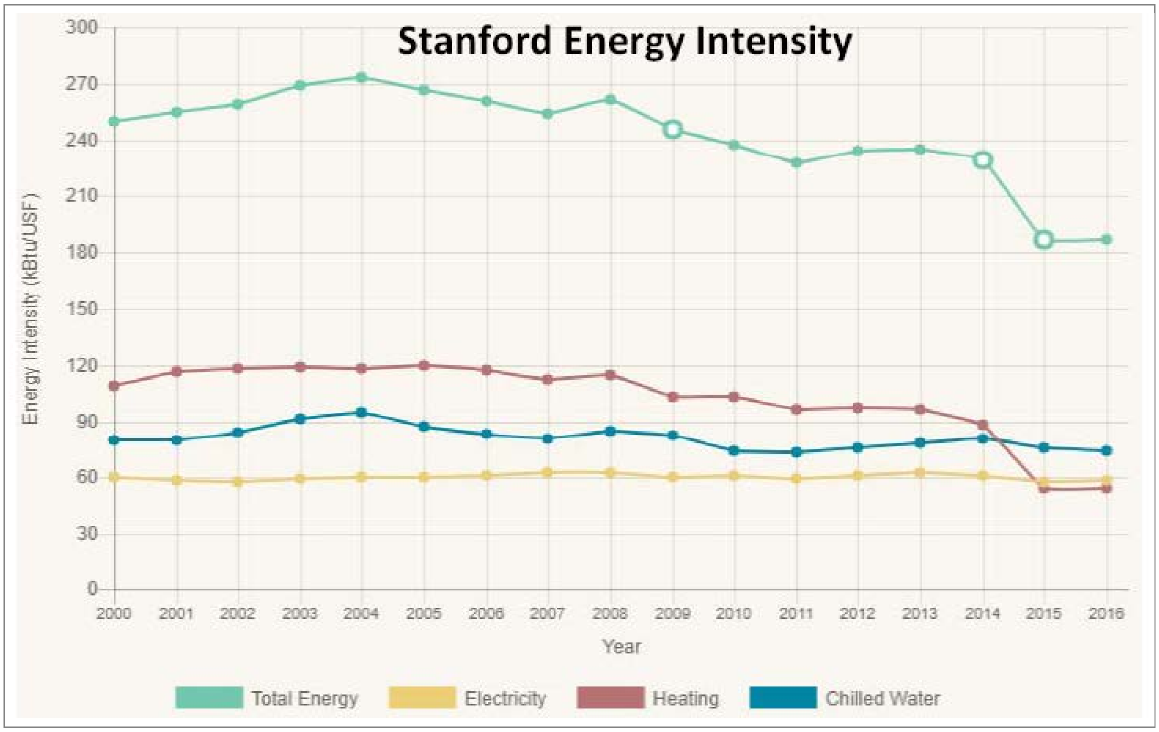
2014: Transition to SESI begins

2015: Transition to SESI completed

Source: Stanford, 2018e, and 2018f.

Figure 4-2 shows how Stanford has reduced its energy intensity by approximately 25 percent over the past 16 years, from 250,000 Btu per usable square feet (Btu/USF) in 2000 to 190,000 Btu/USF in 2016. As with total energy consumption, greater efficiencies in heating energy have driven the downward trend in energy intensity, with electricity and chilled water energy per USF remaining relatively flat over this period.

Figure 4-2: Stanford Energy Intensity



Notes: kBtu/USF = thousands British Thermal Units per usable square foot.
Green circles on Total Energy line refer to:
2009: Introduction of energy saving building retrofits along with new construction standards
2014: Transition to SESI begins
2015: Transition to SESI completed

Source: Stanford University, 2018e, and 2018f.

Energy Analysis of the 2018 GUP

The Energy Technical Report in the proposed 2018 GUP Draft EIR (see Appendix ENE) estimated campus energy consumption for the 2018 environmental baseline condition and for full implementation of the proposed 2018 GUP in 2035. In addition to electricity use and natural gas combustion associated with buildings and the campus heating and cooling system, the DEIR analysis accounts for energy use by mobile sources, emergency generators, construction and other miscellaneous sources. **Table 4-1** presents these values along with the net change in energy demand as compared to a 2018 baseline. Appendix ENE in the DEIR provides additional details on the derivation of these estimates.

As can be seen from Table 4-1, additional development and growth through 2035 under the proposed 2018 General Use Permit would result in an overall increase in energy demand, driven by an increase in demand for electricity and natural gas. Table 4-1 also shows that demand for gasoline and diesel would decrease by 2035 as compared to the 2018 baseline; this is due to implementation of Stanford's electric vehicle initiatives; as well as from reasonable assumptions about increasing fuel efficiency of vehicles based on established State and federal regulatory standards.

Table 4-1: Net Change in Energy Consumption Under the 2018 General Use Permit

Energy Sector	Energy Demand in 2018 Baseline (MMBtu)	Total Energy Demand in 2035 with Buildout of the 2018 General Use Permit (MMBtu)	Net Change in Energy Demand (MMBtu)
Electricity	1,095,088	1,355,768	+260,680
Natural Gas	577,799	718,441	+140,642
Mobile Gasoline Consumption	673,769	528,237	-145,531
Mobile Diesel Consumption	63,490	22,687	-40,803
Stationary Fuel Consumption	5,042	6,157	+1,115
Construction Activities	5,240	5,240	0
Total	**2,420,428**	**2,636,531**	**+216,103**

Note: MMBtu = million British Thermal Units
Source: Table adapted from Table 5.5-2 in the DEIR

The key findings in the proposed 2018 GUP Draft EIR related to energy demand include the following:

- Stanford's overall energy demand (including all sectors shown in Table 4-1) in 2035 with buildout of the proposed 2018 GUP would increase approximately nine percent over the 2018 baseline.
- Total energy demand per capita would decrease from 2018 to 2035, indicative of an overall improvement in energy efficiency compared to existing conditions.
- The increase in electrical demand by 2035 would not have a substantial effect on the local or regional electrical supplies or require additional capacity to be constructed. The CEF's enhanced capabilities for thermal energy storage, along with Stanford's procurement of new sources of renewable energy, would reduce the demand for grid resources, particularly during peak times when energy demand is the highest.
- Although there would be an increase in natural gas consumption in 2035 compared to the 2018 baseline, usage would be less than half of what it was in 2014 prior to implementation of Stanford's SESI, and represents less than 0.05 percent of the projected statewide annual consumption. The United States produces 20 trillion cubic feet per year of natural gas and had 340 trillion cubic feet of proven reserves in 2014 (USIA, 2016c). Stanford's natural gas consumption is not substantial in comparison to the national natural gas reserves and comprises only 0.003 percent of annual national natural gas production. Given the ample natural gas supplies available, the Draft EIR concluded that the proposed 2018 GUP would not have a significant impact on regional natural gas supply or require additional capacity to be constructed.
- Implementation of the proposed 2018 GUP would result in a reduction of gasoline and diesel demand compared to the 2018 baseline and would not adversely affect the local or regional supply of these fuels, or require additional capacity to be constructed.

Regarding development through 2035 under the proposed 2018 GUP, no energy-related constraints were identified in the Draft EIR.

Future Energy Scenarios

Table 4-2 shows how Stanford's building energy consumption would increase under the three FAR scenarios of 0.5, 0.75 and 1.0, by extrapolating from the energy intensity per square foot expected for 2035. At an FAR of 0.5, campus buildings would consume 2,848,360 MMBtu per year, a 9 percent increase over 2035 building energy consumption. Growing to an FAR of 1.0 would more than double the 2035 annual building energy demand.

Table 4-2: Stanford Building Energy Consumption Forecasts for Future Density Scenarios

FAR	Buildings sq ft	Total MMBtu	MMBtu/sf
0.32	14,397,232	1,546,841	0.107
0.34	15,238,461	1,677,929	0.110
0.46	20,393,461	2,080,367	0.102
0.5	22,200,000	2,264,655	0.102
0.75	33,300,000	3,396,982	0.102
1.0	44,400,000	4,529,309	0.102

Note: 2035 average building energy intensity carried forward.
Source: Building energy data from Table 4-1

As explained in Chapter 3, under Stanford's historical (i.e., moderate) growth rate of 200,000 sf per year it would take until 2044 for the campus to reach an FAR of 0.5, until 2100 to reach an FAR of 0.75, and until 2155 to reach an FAR of 1.0.

The post-2035 forecasts for building energy consumption shown in Table 4-2, based on current efficiencies and energy use patterns, should be considered very conservative. The campus' historical gains in building energy efficiency are reasonably expected to continue due to increasingly stringent energy standards and greenhouse gas regulations, new technologies in renewables and energy efficiency, and Stanford's sustainability programs. These factors are discussed in more detail in the following sections.

Policy and Regulatory Factors

Vehicle efficiency standards

Current state and federal regulations require improvements in vehicle fuel efficiency. These regulations include California's Pavley standards and Advanced Clean Cars program, the National Highway Traffic Safety Administration Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles, and Corporate Average Fuel Economy (CAFE) standards.

Building energy efficiency

California has long been a leader in energy efficiency. Due to the state's efficiency programs, per capita energy use has remained flat since the 1970s, while in the rest of the US energy use has increased by about 33 percent (CPUC, 2018). In 2008, the California Public Utilities Commission adopted California's first Long-Term Energy Efficiency Strategic Plan, presenting an integrated framework of goals and strategies for saving energy across all sectors and placing energy efficiency as the highest priority resource in meeting California's energy needs. In order to guide market transformation in a number of key sectors, this Plan embraces four ambitious goals with respect to building energy:

- All new residential construction in California will be zero net energy (ZNE) by 2020.
- All new commercial construction in California will be ZNE by 2030
- 50 percent of commercial buildings will be retrofitted to ZNE by 2030
- 50 percent of new major renovations of state buildings will be ZNE by 2025, and 100 percent by 2025

One of the largest factors in reducing California's energy consumption is its progressive building codes (Title 24). Approximately every three years, the State issues a new set of rules and regulations that are designed to reduce energy usage in new construction and current building stock. The California Energy Commission's (CEC) Building Energy Efficiency Standards (Title 24, Part 6), require new residential and non-residential buildings to meet increasingly stringent efficiency standards and require renewable electricity generation for new residences. The most recent update occurred in 2016, which went into effect January 1, 2017. The next code update (2019) is expected to focus on integrating solar PV and other renewables with energy storage, taking Title 24 another step closer toward the state's zero net energy (ZNE) goals as spelled out in the California Energy Efficiency Strategic Plan (CEC, 2011), calling for all new residential construction to be ZNE by 2020 and all new commercial construction to be ZNE by 2030.

In 2009, the California legislature passed Assembly Bill 758, which requires California to develop a comprehensive program to achieve greater energy efficiency in the State's existing buildings. Implementation is divided into three phases. In the first phase, an action plan was drafted that created a ten-year roadmap of strategies encompassing all energy efficiency approaches. Phase two will focus on voluntary implementation of strategies outlined in the plan to push market development and scaling of technologies. The last phase will develop and institute Mandatory Approaches that will move energy efficiency practices into the mainstream.

Senate Bill 350, known as the Clean Energy and Pollution Reduction Act of 2015, was enacted on October 7, 2015 and provides a new set of statewide objectives in clean energy, clean air, and pollution reduction by 2030. These include increasing the required procurement of electricity from renewable sources from 33 percent to 50 percent, and doubling the energy efficiency of existing buildings through energy efficiency and conservation.

Assembly Bill 802, passed in 2015, directed the CEC to create a statewide building energy use benchmarking and public disclosure program for buildings larger than 50,000 square feet. The program requires building owners to report building characteristic information and energy use data to the Commission by June 1 annually, beginning in 2018 for buildings with no residential utility accounts, and in 2019 for buildings with 17 or more residential utility accounts. Assembly Bill 802 also requires that energy utilities provide building-level energy use data to building owners, owners' agents, and operators upon request for buildings with no residential utility accounts and for buildings with five or more utility accounts.

Renewable energy

The State's Renewables Portfolio Standard (RPS) was launched in 2002 with the passing of Senate Bill 1078 requiring retail sellers of electricity, including investor-owned utilities and community choice aggregators, to obtain at least 20 percent of their supply from renewable sources by 2017. SB 107 changed the target date to 2010, and in November 2008, then-Governor Schwarzenegger signed Executive Order S-14-08, which expands the state's RPS to 33 percent renewable power by 2020. In April 2011, Governor Brown signed SB 2X, which legislated the prior Executive Order S-14-08 renewable standard. As noted above, SB 350 further increased the RPS goals to 50 percent renewables by 2030. This regulatory momentum toward zero carbon electricity is expected to continue. In 2017, California Senate leader Kevin de León proposed Senate Bill 584 calling for 100 percent renewable electricity by 2045, while Governor Brown has expressed support for achieving that goal even earlier.[1]

Stanford Energy Programs

Stanford has made significant strides in recent years procuring new sources of renewable energy and improving the efficiency of its buildings and of its overall management of campus energy systems.

The following discussion summarizes Stanford's energy programs as reported in Stanford's Sustainability White Paper (Stanford, 2018e).

Efficiency in New Buildings

Constructing high-performance new buildings to minimize the impacts of growth on campus energy systems and GHG emissions is a key strategy in Stanford's plan for sustainable growth. Stanford's internal Guidelines for Sustainable Buildings, originally published in 2002 and updated in 2008, in combination with Stanford's internal Guidelines for Life Cycle Cost Analysis and the Project Delivery Process Manual, provide the framework for minimizing energy demand in new construction and major renovation projects on campus.

Stanford's Guidelines for Sustainable Buildings, which adapt the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) system and the US government's Labs21 guidelines to the university setting, include aggressive energy and water goals: 30 percent less energy than code (ASHRAE 90.1-2004 / CA Title 24) and 25 percent less potable water than comparable buildings. In 2015, Stanford replaced the 30 percent-beyond-code energy efficiency goal with a new, more comprehensive method for designing energy efficient buildings: whole-building energy performance targets derived specifically for each new building (Stanford, 2018i). The targets are set by comparing the new building to the energy consumption of peer buildings at other California universities, the energy consumption of similar buildings on campus, and its own best possible energy performance. This new method allows Stanford to continually improve the energy performance of its buildings by incorporating lessons learned into each new building.

These targeted strategies to address energy demand in buildings have the energy use index (EUI) for new buildings coming online. As shown in **Figure 4-3** and **Figure 4-4** from the Stanford's Sustainability White Paper (Stanford, 2018e), the EIR (Btu/sq ft/year) for both office/classroom buildings and for more energy intensive lab buildings has been reduced to about half of what it was in the late 1980s.

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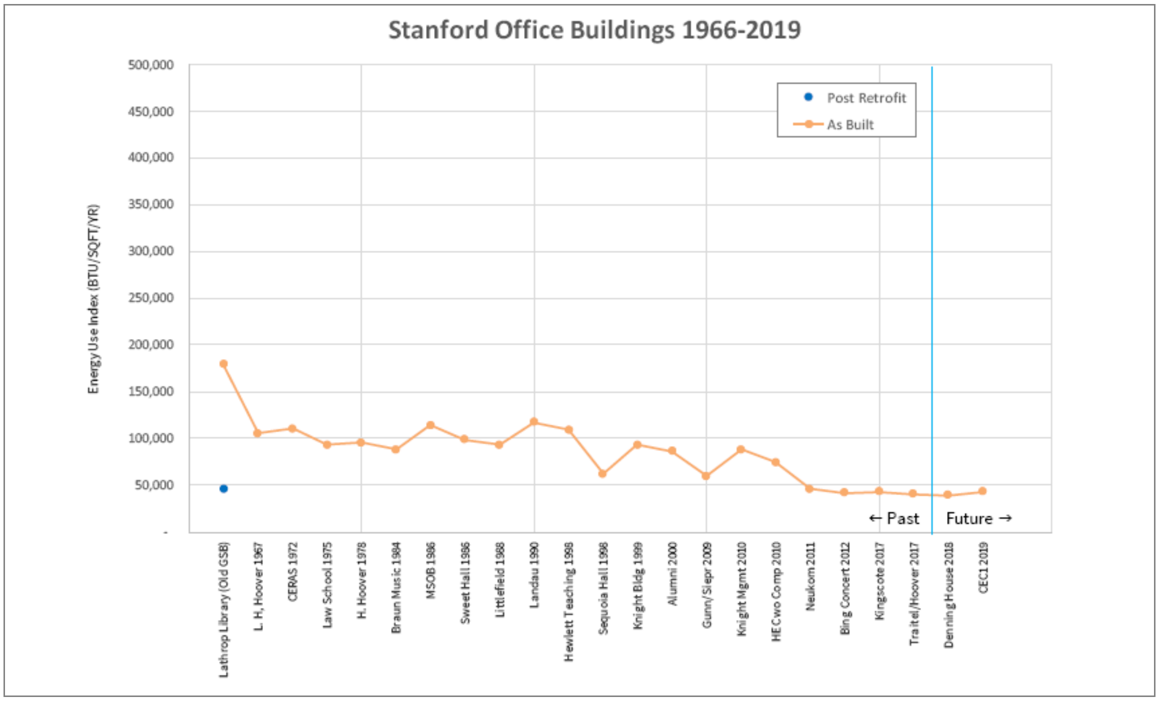
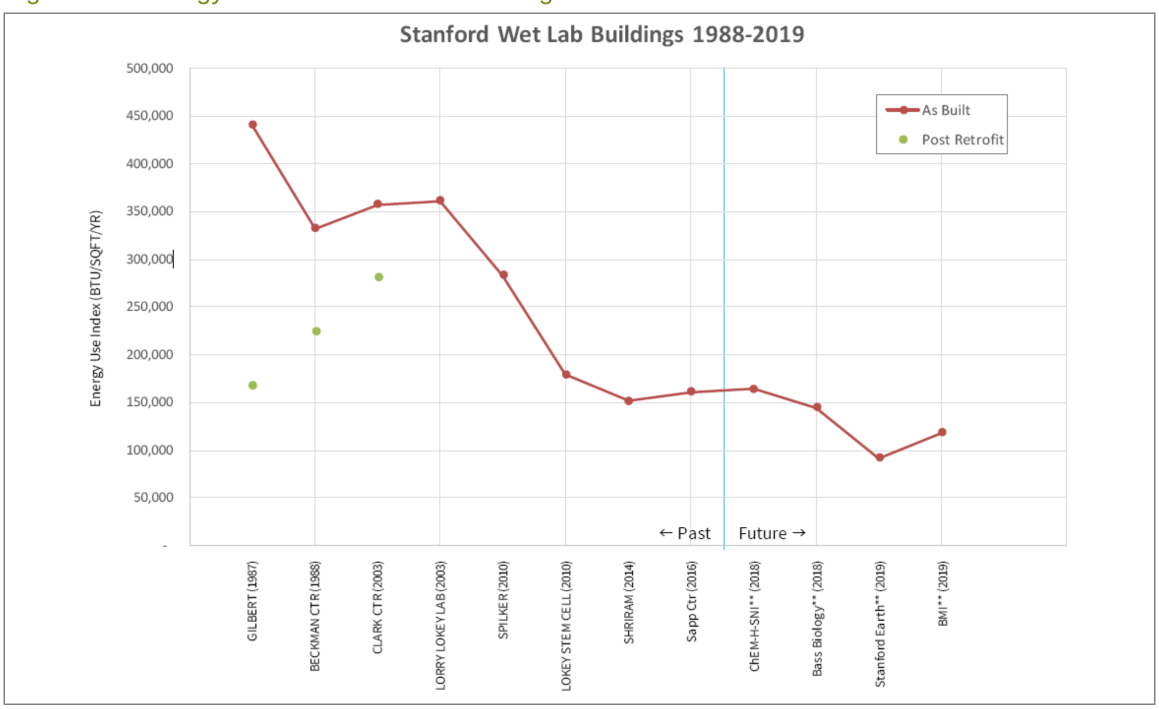
[1] Can California Achieve 100% Renewable Electricity by 2040? Jerry Brown Thinks So. Fix the Grid, December 15, 2017. Article available at: https://www.fixthegridcalifornia.org/can-california-achieve-100-renewable-electricity-2040-jerry-brown-thinks/.

Figure 4-3: Energy Use Index for New Buildings



Source: Stanford, 2018e

Figure 4-4: Energy Use Index for New Buildings



Source: Stanford, 2018e

Additional observations regarding Stanford's energy management that are relevant to the constraints analysis include (Stanford, 2018e):

- Stanford's new benchmark-based, whole-building energy performance approach provides a framework for planning for zero-net energy and staying ahead of the state's energy efficiency requirements for new and existing buildings.
- Stanford produces enough solar electricity on-site and at the Stanford Solar Generating Station to account for over half of campus electricity use.
- Stanford already exceeds the RPS requirement of 50 percent by 2030 through long-term (25 year) Power Purchase Agreements that include provisions entitling the university to purchase those generating facilities when the PPA term ends.
- The university has Direct Access, which allows it to directly assure capacity of electricity supply for the long term.
- Stanford's building energy metering and efficiency programs are already implementing strategies outlined in Assembly Bill's 758 action plan.
- Stanford's WBERP and ERP programs align with state objectives for reducing energy consumption in existing buildings.
- The local electrical grid has adequate capacity to carry the university's forecast electrical load from markets to the campus. The university has maintained constant communication with the Pacific Gas & Electric Company (PG&E) about its long-term forecast peak demand electrical loads and PG&E has plans to assure adequate transmission capacity is available to serve those loads continuously through the long term. The university has reduced its peak electrical load below peak loads that occurred when the previous gas cogeneration energy system operated on the Stanford campus, and Stanford forecasts that it will continue under-running its long-term peak electrical demand forecast on the local transmission system.

Conservation in Existing Buildings

Since the 1980s, Stanford has employed building-level energy metering of all its facilities to understand how and where energy is used and facilitate strong energy efficiency programs. While the university has pursued aggressive energy conservation for many years, the growing market of energy efficiency technologies enables continued investment in existing buildings to maximize energy savings for the university.

Stanford's **Whole Building Energy Retrofit Program (WBERP)** seeks to reduce energy consumption in Stanford's most energy-intensive existing buildings. The $30 million capital program, which began in 2004, includes retrofits to the university's top 27 most energy-intensive buildings, representing 60 percent of total campus energy use. On average, buildings that have participated in the WBERP program have seen 24 percent reductions in energy usage per building, with some individual buildings realizing savings of up to 50 percent.

In addition to the WBERP, **Stanford's Energy Retrofit Program (ERP)** has provided more than $15 million since 1993 for projects throughout the campus to improve energy efficiency and reduce utility demand. Over 500 ERP projects, including equipment upgrades, LED lighting replacements, and HVAC retro-commissioning have been completed for cumulative annual savings of 39 million kilowatt-hours of electricity, 360,000 ton-hours of chilled water, and 11 million MBtu of hot water/steam. Any campus department that is a customer of Stanford Utilities can apply for ERP rebates for projects that save electricity or thermal energy.

These two programs address all components of an existing building's energy load from heating, air conditioning and ventilation, to lighting and plug loads. These two programs have resulted in improvements that cumulatively are saving over 230 million kBtu in energy consumption annually, approximately 10 percent of Stanford's total reduction in energy intensity between 2000 and 2016.

Greener Energy Supply

From 1987 through 2014, Stanford relied on a natural gas-fired combined heat and power plant for virtually all its energy demand. Although efficient, its fossil fuel-based source caused the plant to produce 90 percent of Stanford's GHG emissions and consume 25 percent of the campus potable water supply. Stanford's new Central Energy Facility (CEF) came online in 2015 as part of the Stanford Energy System Innovations (SESI) project. SESI is the university's energy supply program designed to meet the campus energy needs through 2050 while allowing for flexibility in energy procurement and significantly reducing GHG emissions. SESI transformed the university energy supply from fossil fuel-based combined heat and power to a more efficient electric heat recovery system powered by renewable energy. The GHG implications of SESI are discussed in detail under *Greenhouse Gas Emissions*.

More than half of Stanford's annual electricity consumption is fueled by a 67 megawatt (MW) solar plant off-campus, funded by Stanford through a power purchase agreement with SunPower. The plant, located in southern California, uses state-of-the-art photovoltaic technology with single-axis tracking to generate enough electricity to power approximately 20,000 homes. Another 2 percent of Stanford's electricity consumption is powered by 4.9 MW of on-campus photovoltaic solar panels, spread across 16 sites. The last 13 percent of Stanford's renewable portfolio can be attributed to California's Renewable Portfolio Standard in the state's electricity grid.

The efficiencies gained from the new CEF, which also required a transition from steam to hot water for cooling, along with Stanford's commitment to procure much of its electricity from solar, have already reduced the university's overall GHG emissions by 64 percent from peak levels.

The new CEF includes three large water tanks for thermal energy storage and a high voltage substation that receives electricity from the grid. A key feature of the CEF is an innovative heat recovery system that takes advantage of Stanford's overlap in heating and cooling needs. Heat recovery extracts excess heat from chilled water used for cooling and recycles it to meet concurrent heating needs. Stanford's many varied pursuits, from research to olympic-level athletic facilities, result in a 70 percent real-time overlap of heating and cooling demands on campus. The new heat recovery system collects waste heat from buildings via a chilled water loop and captures it at the CEF for reuse, eliminating the need for cooling towers to discharge the heat. Instead, the heat recovery chillers efficiently move the waste heat collected from the chilled water loop to a new hot water loop that then distributes heat to buildings. The project also included updates to the mechanical systems of 155 buildings to receive hot water instead of steam for heating and hot water services, and installation of more than 20 miles of hot water piping to distribute it around campus.

The new Central Energy Facility includes a Central Energy Plant Optimization Model (CEPOM), a patented technology developed by Stanford that creates a forward-looking hourly plan for optimal operation of the CEF. The energy modeling and dispatch system uses over 1,220 variables including building occupancy, ambient conditions, time of year, projected energy prices, weather forecast, current system conditions, etc. to develop 15-minute dispatches that show the optimal way to run the plant.

Transportation Programs

Stanford's efforts related to reducing demand for transportation energy are primarily focused on its goal of No Net New Commute Trips (NNNCT) and its Transportation Demand Management (TDM) program that has decreased the drive-alone rate of Stanford commuting employees from 72 percent in 2002 to 50 percent in 2018 (Stanford, 2018e). The NNNCT goal and TDM programs are described in more detail in Section 4.7 on Transportation.

In support of alternatively fueled vehicles, Stanford recently added 54 new electric vehicle-charging stations with the opening of Roble Field Garage and now has 80 ports on campus and on Porter Drive. The Marguerite shuttle fleet includes 5 diesel-electric hybrid buses and 23 all-electric buses (Stanford University, 2018e). The 2018 General Use Permit application commits to providing electric vehicles for 100 percent of the Marguerite buses and 70 percent of the Land, Buildings, and Real Estate and Bonair fleet vehicles by 2035.

Conclusions

Energy does not appear to pose a long-term constraint to Stanford's growth. The University is a leader amongst institutions of higher learning in sourcing renewable energy and reducing energy demand associated with its operations. Stanford continues to reduce energy demand from existing buildings while making strides in maximizing the efficiency of its campus energy supply with SESI and the new CEF. Stanford's sustainability targets for new buildings along with its approach to designing energy efficient buildings using whole-building energy performance metrics places the university in a strong position to develop future zero net energy buildings that comply with evolving state building standards. In general, the university has been an early adopter of new technologies, helping develop the energy efficiency market in California.

On the supply side, Stanford already sources electricity that exceeds the 2030 RPS target of 50 percent renewables, and has a long-term agreement in place to ensure that remains the case beyond 2030. Meanwhile, the percent of renewables in grid-supplied electricity is expected to rise significantly due to the state's RPS and other factors, including favorable market prices for renewables as carbon pricing begins to affect fossil-based energy in California due to Cap and Trade and other regulations. Further, community choice energy (CCE) programs like Silicon Valley Clean Energy, which in 2017 began offering Santa Clara County businesses and residents greener electricity at lower rates than PG&E, are making it easier and more affordable to purchase 100 percent renewable power.

In summary, energy does not appear to represent a constraint to future development of Stanford's campus. If Stanford continues to grow at its historical rate after 2035, it is reasonable to assume that its energy needs will be met through a combination of new technologies and efficiencies, more stringent efficiency standards, and ongoing implementation of campus energy programs.

4.2 Greenhouse Gas Emissions

Potential Constraints

The primary development constraints related to greenhouse gas (GHG) emissions include California's legislated statewide targets for 2020 and 2030 established by AB 32 and SB 32, respectively. In 2017, the state adopted a revised Climate Change Scoping Plan for achieving the AB 32 and SB 32 targets, encompassing policies and regulations designed to reduce emissions from vehicles, electricity production, stationary combustion, landfills, and refrigeration systems. The cornerstone of the Scoping Plan is the state's Cap and Trade system that places an economy-wide "cap" on major sources of GHG emissions, including refineries, power plants, industrial facilities and transportation fuels. Additional regulations encompassed by the Scoping Plan include, but are not limited to, fuel efficiency standards for vehicles; a renewable portfolio standard for electricity, building energy efficiency standards, and limits on short-lived climate pollutants (SLCPs) such as methane and hydrofluorocarbons.

Trends and Forecasts

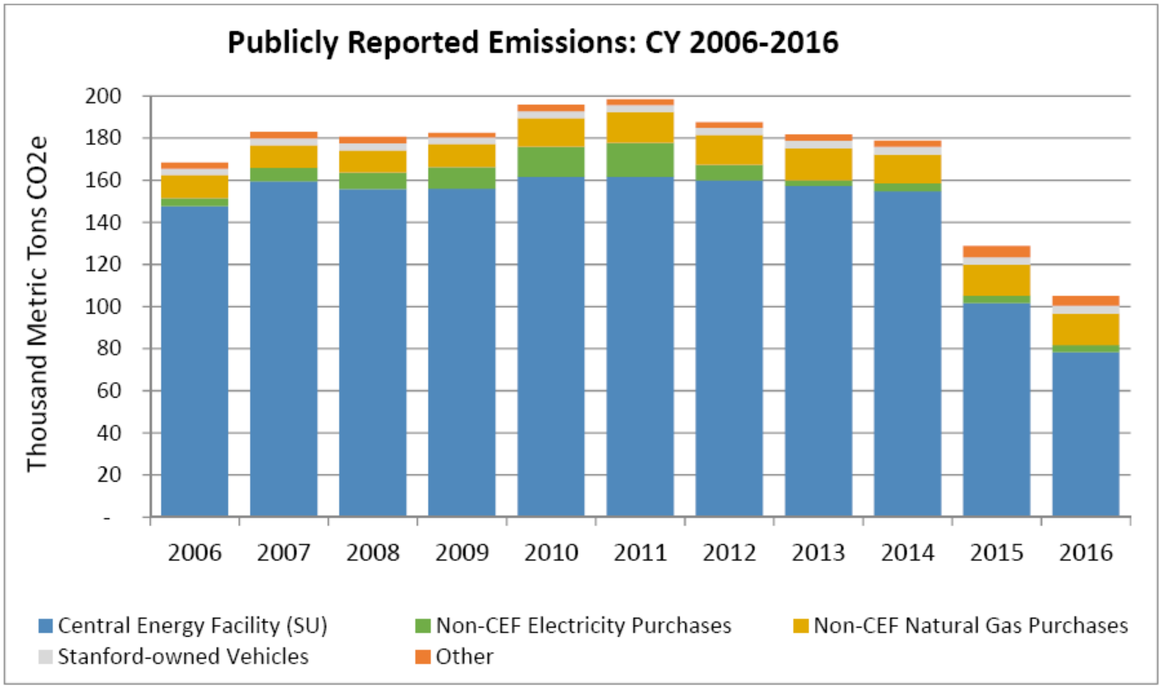
Campus GHG Emissions

Stanford University has been publicly reporting its GHG emissions since 2006 to The Climate Registry (TCR). In accordance with TCR's reporting protocol, Stanford's inventory includes all GHG emissions for facilities in North America for which it has direct operational control, which encompasses Scope 1 and Scope 2 emissions[2] associated with Stanford's building energy consumption, fleet fuel usage, and process and fugitive emissions.

Figure 4-5 shows the university's publicly reported and third-party verified emissions as reported to The Climate Registry (TCR), from 2006 through 2016. The dramatic reduction in emissions from 2014-2016 is primarily due to SESI and the CEF coming online in 2015, greatly increasing the efficiency of the campus heating and cooling systems, as described in the previous section on Energy. Stanford's publicly reported emissions in 2016 were 47 percent below peak 2011 emissions, and are expected to be 64 percent below that peak in 2017, mostly due to the new CEF (Stanford, 2009).

2 Scope 1 emissions are direct emissions from sources over which Stanford has direct operational control, such as the CEF and its fleet vehicles; Scope 2 emissions are indirect emission associated with purchased electricity, steam, and/or hot water.

Figure 4-5: Stanford's Publicly Reported GHG Emissions



Source: Sustainability White Paper (Stanford, 2018e)

GHG Analysis of the Proposed 2018 General Use Permit [3]

The Draft EIR for the proposed 2018 GUP found that development under the proposed 2018 GUP would result in approximately 125,412 MTCO2e of GHG emissions per year in 2035, essentially matching the estimated 2018 baseline of 125,672 MTCO2e per year, despite a net 34 percent growth in development (building square footage) expected over that time.[4] As shown **in Table 4-3** (adapted from Table 5.7-2 in the Draft EIR), 2035 emissions would come primarily from transportation, imported electricity, and natural gas, with each sector contributing 29 percent, 30 percent, and 34 percent, respectively. Smaller contributions are expected from solid waste (4 percent), water transport and treatment (1 percent), emergency generators (<1 percent), and other miscellaneous smaller sources such as construction equipment (<1 percent).

The Draft EIR found that while the proposed 2018 General Use Permit would result in additional development and a larger population, emissions would remain relatively constant between 2018 and 2035 due to more efficient use of electricity, a higher percentage of the electricity being supplied by renewable sources, and the use of more energy efficient vehicles with a higher portion of them powered by clean electricity. Furthermore, the Draft EIR's estimate of 2035 emissions was conservatively developed using 2030 emission factors, in assuming that renewable energy percentages and vehicles efficiencies will remain constant after 2030.

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3 Stanford's *Sustainability Year in Review* (sustainable.stanford.edu/resources) also publicly reports both the official emissions reported to TCR and some additional Scope 3 emissions. These reported emissions can vary from the emissions reported in Stanford's 2018 General Use Permit application, which was prepared following California Environmental Quality Act (CEQA) guidelines and norms. The CEQA inventory includes several sources of GHG emissions that are not normally included in TCR reporting, such as emissions from commute vehicles. On the other hand, TCR reporting includes emissions generated by activities that are not related to the 2018 General Use Permit, and therefore are not included in the CEQA inventory.

4 For campus development, the Draft EIR uses 15,238,461 sf for the 2018 baseline and 20,393,461 for the 2035 GUP buildout.

Table 4-3: Total GHG Emissions in 2035 with Buildout of the 2018 General Use Permit

GHG Sector	GHG Emissions (metric tons CO2e per year)
Electricity – 29 percent	
PG&E Commercial	27
PG&E Searsville/Olmstead	37
New Faculty/Staff Housing	279
Direct Access	454
Imported to Campus and CEF	35,628
Non-Stanford Commercial	419
Subtotal	**36,844**
Natural Gas – 30 percent	
PG&E Residential	4,281
PG&E Commercial	20,559
PG&E Searsville/Olmstead	71
New Faculty/Staff Housing	347
Hot Water Generators	7,104
Replacement Process Steam Plant	5,770
Subtotal	**38,131**
Mobile Sources – 34 percent	
Worker Trips	15,524
Resident Trips	14,222
Campus Vehicles On-road	1,170
Campus Vehicles Off-road	235
Other Trips	11,767
Subtotal	**42,919**
Emergency Generators - <1 percent	
Subtotal	**444**
Solid Waste – 4 percent	
Subtotal	**5,286**
Water Transport and Treatment – 1 percent	
Domestic Water Use	320
Wastewater Treatment	121
Direct Wastewater Emissions	633
Subtotal	**1,074**
Miscellaneous Sources - <1 percent	
On-Campus Research and Fire Suppression	294
Construction Equipment	420
Subtotal	**714**
Total GHG Emissions 2035 with Buildout of the proposed 2018 General Use Permit	**125,412**

Notes:

Adapted from Table 5.7-2 in the Draft EIR for the proposed 2018 GUP.

The service population, comprised 49,428 workers, 19,353 residents and 17,116 workers who are residents, as derived from population estimates the SB 743 VMT Analysis prepared by Stanford in support of its 2018 General Use Permit (Appendix VMT).

Source: County of Santa Clara, 2018.

Future GHG Emissions Scenarios

The Draft EIR found GHG emissions under the proposed 2018 GUP would be below the significance thresholds that relate to consistency with state GHG reduction goals for year 2030 and, to the extent feasible, year 2050. With full development under the proposed 2018 GUP, GHG emissions would be below the per capita threshold representing a GHG reduction trajectory in line with the state's longest-term reduction goal for 2050. Thus, the proposed Project would not generate GHG emissions, either directly or indirectly, that would make a cumulatively considerable contribution to a significant impact on global climate change.

Looking past 2035, more stringent standards and regulations, new energy technologies, and market-driven innovations driven by regulatory limits should continue to reduce Stanford's emissions. California's climate stabilization goal of reducing statewide emissions 80 percent below 1990 by 2050 is consistent with several international agreements on emissions limits, including the Paris Agreement[5] signed by 175 national governments, which aims to keep the global temperature rise this century below 2 degrees Celsius, and the Under2 Coalition signed by Governor Brown and over 200 states, provinces, regions and cities, as well as national governments.[6] Driven by these commitments, one can expect that the ongoing policy and regulatory efforts to reduce emissions at the state, national, and international levels will continue and likely intensify.

Clearly, achieving reductions of this magnitude required by the Paris Agreement is an enormous challenge faced not just by Stanford, but for the State, the nation, and the world at large. GHG emissions are a global problem, but actions are needed at all levels. Continued developments in government policy, technology, markets, and Stanford's own sustainability programs will play important roles, as further described in the following sections.

Policy and Regulatory Factors

California's Climate Change Scoping Plan, most recently updated in December 2017, provides a framework of action for achieving the State's 2030 GHG target of 40 percent reduction in GHG emissions relative to 1990 levels (SB 32). The 2017 Scoping Plan Update identifies key sectors of the implementation strategy, which includes improvements in low carbon energy, industry, transportation sustainability, natural and working lands, waste management, and water. The key strategy of the 2017 Scoping Plan Update is an expansion of the Cap-and-Trade program designed to meet the 2030 GHG emissions goal and ensure achievement of the 2050 limit set forth by Executive Order No. S-3-05 (80 percent below the statewide 1990 level by the year 2050) (CARB, 2017a).

The 2017 Scoping Plan Update incorporates the full range of legislative actions and state-developed plans that have relevance to the SB 32 target year 2030. These include:

- Extending the low carbon fuel standard (LCFS) beyond 2020 and increasing it to 18 percent by 2030 (up from 10 percent in the 2014 Scoping Plan);
- SB 350, which increases the RPS to 50 percent and requires a doubling of energy efficiency for existing buildings by 2030 (described in the Energy section);

5 https://unfccc.int/process/the-paris-agreement/the-paris-agreement
6 http://under2mou.org/

- Title 24 energy efficiency standards for new buildings (described in the Energy section);
- The State Advanced Clean Cars initiative and Pavley Vehicle Standards (which until recently have been aligned with the federal CAFE vehicle standards);
- California's 2016 Mobile Source Strategy targets for more zero emission vehicles (ZEVs) and much cleaner trucks and transit;
- California's 2016 Sustainable Freight Action Plan to improve freight efficiency and transition to zero emission freight handling technologies;
- SB 1383, which requires a 50 percent reduction in anthropogenic black carbon and a 40 percent reduction in hydrofluorocarbon and methane emissions below 2013 levels by 2030; and
- Assembly Bill 398, which extends the state Cap-and-Trade Program through 2030.

The 2017 Scoping Plan Update also encourages development in higher-density, walkable and bikeable communities with access to transit. With California's expected population growth, densification will need to achieve future GHG targets.

A core component of the State's climate stabilization strategy, as described in the 2017 Scoping Plan Update, is widespread electrification of buildings, appliances, and transportation in conjunction with decarbonization of the electricity sector (CARB, 2017a). In support of that goal, the State RPS has driven rapid growth of renewable energy installations in California in recent years. The California Energy Commission (CEC) estimates that about 30 percent of 2017 retail electricity sales in the state were served by renewable energy generated by wind, solar, geothermal, biomass, and small hydroelectric, up from 29 percent in 2016 (CEC, 2017).

As described in the 2017 Scoping Plan Update, achieving the California's long term GHG targets will not be possible without significant electrification of the vehicle fleet. Although there is a lack of leadership at the federal level regarding vehicle fuel efficiency standards, the State is expected to continue its efforts to decarbonize the transportation sector. California's 2016 Mobile Source Strategy, listed above, calls for 4.2 million zero-emission and plug-in hybrid light-duty vehicles on the road by 2030. In January 2018, signed Executive Order B-48-18 committing the state to a goal of 5 million zero-emission vehicles on the road by 2030.[7]

The Bay Area Air Quality Management District's 2017 Clean Air Plan, adopted in 2017, envisions a nearly carbon-free transportation sector by 2050, with about 90 percent of motor vehicles emitting zero GHGs and a large share of trips taken by walking, bicycling, transit, or ride-share modes. New technologies and services will reduce the need for personal vehicle ownership, while car-sharing services, transportation network companies, and autonomous electric-powered vehicles will greatly reduce emissions of air pollutants and GHGs from transportation (BAAQMD, 2017).

Stanford GHG Reduction Measures

The Stanford Energy and Climate Action Plan, originally released in 2009 and updated in 2013 and again in 2015, outlines the university's greenhouse gas (GHG) reduction measures through high-efficiency standards for new buildings, efficiency improvements for existing buildings, and

[7] https://www.gov.ca.gov/2018/01/26/governor-brown-takes-action-to-increase-zero-emission-vehicles-fund-new-climate-investments/

the Stanford Energy System Innovations (SESI) project. A majority of Stanford's emissions reductions is due to both the building-level and district-level (SESI) energy efficiency measures described in the section above.

As described in the section on Energy, SESI has also enabled Stanford to incorporate 65 percent renewable electricity into its portfolio, which has been a factor in reducing GHG emissions associated with campus operations. By the end of 2016, SESI reduced Stanford's GHG emissions by 47 percent from peak emissions in 2011, and 64 percent by the end of 2017 (the 2017 emissions inventory is not yet certified for public release).

Stanford's commitment to low carbon transportation is exemplified by its commitment to electrify the Marguerite fleet and increase the electric share of other campus fleet vehicles by 2035,[8] complemented by installation of EV charging stations and campus programs that encourage and allow for use of pedestrian, bicycle and public transit travel modes rather than single-passenger driving. Stanford is also expanding research and development of novel transportation and electricity demand strategies; and implementing campus programs that encourage and allow for use of pedestrian, bicycle and public transit travel modes rather than single-passenger driving.

Conclusions

In the future, regulatory, market, and technology driven changes are likely to result in increased energy efficiency and cleaner electricity supplies that would further reduce Stanford's energy use and GHG emissions. As described in the constraints analysis for energy, California has made great strides in improving building energy efficiency since the 1970s. With increasingly stringent Title 24 standards for new buildings and new efficiency targets for existing buildings (SB 350), the state's trend in efficiency improvement is expected to continue.

Other expected developments include an increase in the state's RPS; a tightening of Cap and Trade Program requirements; more stringent vehicle efficiency standards; more cost-effective renewable power generation; improvements to energy storage and to the state transmission grids to accommodate renewable power generation and distribution; and regulatory changes to the state power market that could make it easier to implement thermal and electricity storage or advanced energy management programs such as Stanford's.

The SDS and the 2018 GUP application seek to achieve higher-density, walkable and bikeable development within the AGB, with access to transit and transportation management programs. Densification typically lowers GHG emissions on a per capita basis. As Stanford continues to construct new campus buildings, it essentially implements the efficient, compact infill development sought in the Scoping Plan. In concert with the university's concerted efforts at reducing emissions from its buildings and transportation systems, this type of growth on the Stanford campus is unlikely to impede progress toward the State's climate goals, and thus GHG emissions will likely not become a constraint to future growth of the campus.

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8 The 2018 General Use Permit application commits Stanford to providing electric vehicles for 100 percent of the Marguerite buses and 70 percent of the Land, Buildings, and Real Estate and Bonair fleet vehicles by 2035.

4.3 Water

Potential Constraints

Barring a contract renegotiation and/or securing new sources of future water supply, water supply represents a known potential constraint to Stanford's future growth. Additional constraints related to water may include future environmental conditions affecting the surface water supply and groundwater supply such as severe drought, or conversely, the ability of the university to continue increasing its water use efficiency.

Trends and Forecasts

Stanford's water infrastructure is made up of a network of supplies, storage and distribution facilities for domestic (potable), and non-potable sources. As described in the 2018 GUP EIR, Stanford receives its water supply from three sources:

1. water purchased wholesale from the San Francisco Public Utilities Commission (SFPUC);[9]
2. local surface water supplies; and
3. groundwater.

Specific components of the water service system include wells, reservoirs, pump stations, and creek diversion facilities, in addition to pipe networks. These water systems are managed by Stanford's Water Resources and Civil Infrastructure Group (WRCI Group) within the Department of Sustainability and Energy Management (SEM).

As with its neighboring communities and Santa Clara County, Stanford currently faces a finite limit of available potable water. Each of its three sources of water present limitations during both normal rainfall years and during drought conditions. For example, under Stanford's current contract with SFPUC the university is allocated 3.03 million gallons per day (mgd) through 2035. However, the SFPUC advises wholesale customers to anticipate that their supply will be reduced during dry years to as low as 83 percent of normal for a single dry year and up to 72 percent over a multiple dry year period. These conditions are represented in **Table 4-4**, which shows Stanford's existing water supply as anticipated through 2035.

Table 4-4: Summary of Projected Water Supply in Normal and Dry Years

	Water Year Type				
	Normal Year	Single Dry Year	Multiple Dry Years		
Water Use Category			1	2	3
Potable Supply (SFPUC)	3.03	2.51	2.51	2.18	2.18
Surface Water Supply	1.12	0.94	0.94	0.06	0.06
Groundwater Supply	1.52	1.52	1.52	1.52	1.52
Total Supply	**5.67**	**4.97**	**4.97**	**3.76**	**3.76**

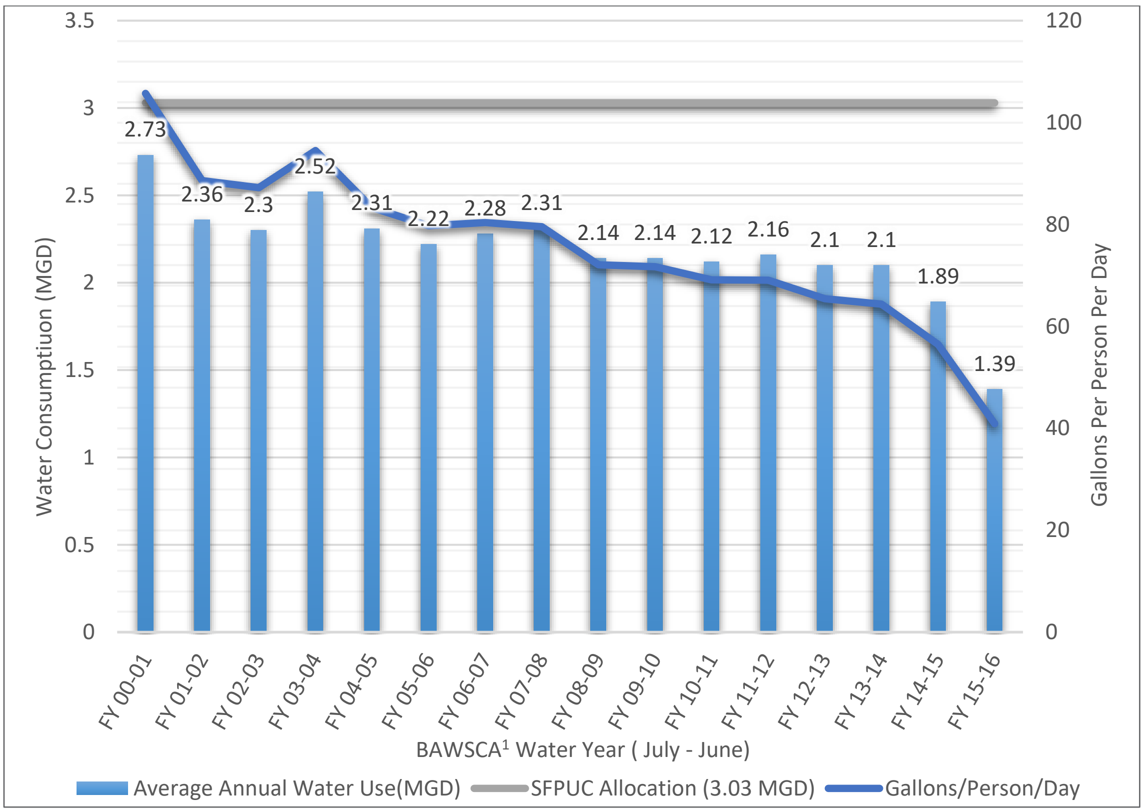
Note: Numbers are rounded.
Source: Schaaf & Wheeler, 2017 as cited in Santa Clara County, 2017 (Appendix WSA)

9 The SFPUC owns and operates the regional Hetch-Hetchy water system that is supplied by water from the Sierra Nevada Mountains and from local watersheds, serving 27 Bay Area cities and agencies.

Campus Water Demand

Historic water consumption at Stanford is a direct result of the campus population, developed area, landscaped area, and water-use efficiency. **Figure 4-6** below presents potable domestic water use by Stanford from 2001 to 2016, in total million gallons per day (mgd) and gallons per person per day.[10] This figure demonstrates that even though the campus size and population have grown since 2000, annual average consumption decreased from approximately 2.7 mgd in 2001 to 2.1 mgd by fiscal year 2012-2013. This significant reduction was largely due to Stanford's rigorous Water Conservation Program despite substantial campus growth of more than 3 million square feet. In fiscal years 2014-2015 and 2015-2016, Stanford further reduced its SFPUC water use to less than 2.0 mgd by implementing the Stanford Energy Systems Innovations (SESI) Project and additional mandatory conservation measures called for during the recent 5-year drought. The graph also shows that average water consumption has decreased from over 100 gallons per person per day to below 50 gallons per person per day, demonstrating a per-capita efficiency as well.[11]

Figure 4-6: Potable Domestic Water Use by Stanford from 2001 to 2016



Notes:

[1] Bay Area Water Supply and Conservation Agency (BAWSCA)

In addition, note FY 15-16 values are particularly low due to drought-required cutbacks to water use.

Source: County of Santa Clara, 2017 (Appendix WSA), and Population from Stanford, 2017c, (Waste Diversion Rates 1998- 2016 Table).

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[10] Annual population is estimated based on solid waste data provided by Stanford (Stanford, 2017c, Waste Diversion Rates 1998- 2016 Table).

[11] Per the WSA, water demand is generated at varying rates according to land use (i.e., faculty housing demands more water than student housing per unit). The dark blue line representing per capita water consumption relies on annual campus population data that was used in the Draft EIR for analysis of solid waste generation (Stanford 2017c).

In addition to potable uses, Stanford is also reliant on water for irrigation. Landscape irrigation usage, which is historically supplied by non-potable water, fluctuates from year to year. However, over time this usage remains relatively constant under the 2000 GUP, and despite substantial campus growth, irrigation usage in 2015 was approximately the same as in 2000 (1.0 mgd). **Table 4-5** shows a more detailed breakdown of consumption demand during these periods of campus-wide efficiency changes as well as the landscape water demand during years of drought (2015-2016) and normal precipitation (2012-2013).

Table 4-5: Water Demand Snapshot

Water Use Category	2012-2013 (normal)	2015-2016 (drought)
Academic and Childcare	0.66	0.47
Student Housing	0.46	0.42
Faculty/Staff Housing	0.52	0.32
Energy Systems	0.46	0.18 [a]
Total Potable Demand	**2.10**	**1.39**
Landscape (Non-Potable)	**1.23**	**0.81**
Total	**3.33**	**2.20**

Note:
[a] Decrease in water use for Energy Systems is attributable to SESI
Source: County of Santa Clara, 2017 (Appendix WSA)

Water Analysis of the 2018 General Use Permit

Under the proposed 2018 GUP, additional development and growth would increase demand for both potable and non-potable water. Stanford receives its water from the SFPUC, local surface water supplies, and groundwater. As discussed under above, a Water Supply Assessment (WSA) was prepared for the proposed 2018 GUP pursuant to the requirements of the California Water Code enacted in Senate Bill 610 (refer to Draft EIR Appendix WSA). The WSA evaluated if the total projected water supplies, determined to be available for Stanford during normal, single dry, and multiple dry water years during a 20-year projection, would meet the projected water demand associated with buildout in 2035. The WSA forecasted potable water demand using a factor of gallons per day per unit (gal/day/unit) based on historic trends and updated where required due to improved efficiencies. The various categories for calculation and rates calculated area as follows:

- Academic and Childcare require 0.072 gal/day/sf,
- Student Housing requires 40.6 gal/day/be,
- Faculty/staff housing requires 555 gal/day/unit for existing units with an increased efficiency of 225 gal/day/unit for new development, and
- Energy Systems require a constant demand of 0.20 million gallons a day (mgd).

Projected potable water demand was then calculated by considering the factors of campus development in relation to these generation rates. **Table 4-6** below presents existing and forecast campus land use in terms of academic and childcare uses, student housing, and faculty/staff housing.

Table 4-6: Summary of Existing and Projected Development from 2012 to 2035

Water use category	Unit of Measure	Existing development in 2012	Completed development 2012-2015	Projected development 2015-2018	Projected development 2018-2020	Estimated Buildout at 2020	2018 GUP development 2018-2035	Estimated at Buildout Fall 2035
Academic and Childcare	sq. ft.	9,104,902	412,603	769,354	0	10,286,859	2,315,000	12,601,859
Student housing	beds	11,323	559	416	2,020	14,318	2,600	16,918
Faculty/staff housing	dwelling units	937	0	0	0	937	550	1,487

Note: In 2012, there were 937 faculty units for 11,323 student housing units, a ratio of 12.1 student/faculty units, in 2020 this is estimated to increase to 15.3 student/faculty units with the completion of Escondido Village, but by 2035 this is anticipated to drop to 11.4 students/faculty units.

Source: County of Santa Clara, 2017 (Appendix WSA)

Table 4-7 provides a summary of the daily potable water use increases under each category with full buildout of the 2018 GUP, showing that potable water demand for the campus is expected to increase by approximately 0.4 mgd. Added to existing water use, the 2018 GUP increase results in a total potable water demand of 2.44 mgd, which is approximately 0.59 mgd below the current allocation by SFPUC of 3.03 mgd. The WSA also forecasted landscape (non-potable) water demand by assuming an increase of 10 percent over the previously identified peak use of 1.23 mgd, so that by 2035, landscape water demand would be 1.35 mgd.

Table 4-7: 2018 GUP Potable Water Demand Assumptions

Water use category	2018 GUP development 2018-2035	Use factor (gal/day/sf)	Water Use (mgd)
Academic and Childcare	2,315,000 sf	0.072	0.167
Student housing	2,600 beds	40.6	0.106
Faculty/staff housing	550 units	225	0.124
2018 GUP Total			**0.397**

Source: County of Santa Clara, 2017 (Appendix WSA)

The key findings in the Draft EIR and WSA related to water supply and demand include the following:

- Stanford's total water demand upon buildout of the 2018 GUP would be approximately 3.80 mgd, consisting of a potable water demand of 2.44 mgd, and a non-potable water demand of 1.35 mgd;
- Stanford's SFPUC water supply with buildout of the proposed 2018 GUP would be similar to conditions at present, and Stanford would maintain existing water rights for surface water diversion of non-potable water of at least 1.12 mgd, as well as a sustainable groundwater supply of up to 1.52 mgd as a supplemental source of non-potable water;
- Collectively, the total estimated water supply 5.67 mgd would be more than necessary to accommodate the projected water demand of 3.80 mgd with buildout of the 2018 GUP; and

- The WSA also determined that through feasible water conservation measures implemented in the past, such as irrigation demand reduction measures, demand would also be met with adequate water supply under future drought years.

In summary, the 2018 Draft EIR found there would be sufficient water supplies to accommodate the water demand from buildout of the proposed 2018 GUP through existing entitlements and resources under normal, single dry, and multiple dry water years. There were no water supply related constraints identified through the build out year 2035.

Future Water Scenarios

Estimates for Stanford's hypothetical water use beyond 2035 is dependent on many factors, including the increase in demand associated with future development and population increases, the available supply from SFPUC and other sources, future regulatory developments, and environmental factors like climate change that are expected to result in longer and more extreme periods of drought by the end of the 21st Century.

A reasonable approach to considering Stanford's future water use is to assume that total usage would not exceed the current total water supply of 5.67 mgd, including the current potable water allocation of 3.03 mgd guaranteed by SFPUC (refer to Table 4-4).[12] Under a scenario that only considers the 3.03 mgd guaranteed by SFPUC, after buildout of the 2018 GUP there would be approximately 0.59 mgd (3.03 minus 2.44) of additional potable water supply and 1.29 mgd of non-potable supply that could be available to support future growth. Under one-year drought conditions, Stanford's SFPUC allocation of potable water would be 2.51 mgd and the total maximum water supply would be 4.97 mgd. Under the drought conditions scenario, after buildout of the 2018 GUP there would be approximately 0.07 mgd (2.51 minus 2.44) of additional potable water supply and 1.11 mgd of non-potable supply that could be available to support future growth.[13] These scenarios do not include use of groundwater as potable water, or treatment of surface water as potable water. Stanford could utilize both of these sources as potable water in the future.

Using the moderate growth rate assumed for the proposed 2018 GUP along with water supply and consumption rates from the WSA (as shown in Table 4-4 and Figure 4-6) and extrapolating them to future years, the remaining potable water supply under normal conditions (0.59 mgd) is shown to be exhausted by approximately 2060, when the campus square footage would reach approximately 25,400,000 sf and the average FAR would be 0.57.[14] At the same rate of growth, the remaining potable water supply under drought conditions (0.07 mgd) would be exhausted by approximately 2038 if Stanford did not utilize surface water or groundwater, when campus square footage would reach approximately 21,000,000 sf and the average FAR would be 0.47.

However, there is no guarantee that Stanford's allocation of SFPUC water will remain at 3.03 mgd for normal conditions and 2.51 mgd under drought conditions after the current supply

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12 This includes the current 3.03 mgd allocation of potable water from SFPUC, plus existing water rights for surface water diversion of non-potable water of at least 1.12 mgd, and a sustainable groundwater supply of up to 1.52 mgd.

13 This analysis assumes the average annual demand increase would be 0.0234 mgd/year based on potable water demand anticipated under the 2018 GUP (0.397 mgd divided by 17 years of development), and that the proportion of development between academic and student housing uses remains the same as under the 2018 GUP. The 0.59 mgd of remaining potable supply (normal precipitation scenario) would be used up in approximately 25.2 years at a rate of increase of 0.0234 mgd. The 0.07 mgd of remaining supply under drought conditions would be used up in approximately 3 years.

14 The net annual growth rate under the proposed GUP is expected to be approximately 200,000 sf/year. At that rate campus buildings would amount to approximately 25,400,000 sf by 2060.

contract officially expires in 2034,[15] and future growth will not necessarily continue at historical rates, or at the rate represented by the 2018 GUP. In addition, the availability of future potable and non-potable supplies is dependent on precipitation and other factors beyond Stanford's control.

Although it is possible that alternative regional potable water supply solutions could become available over time to support additional Stanford growth in the future, there are long-term challenges to regional and local water supply are expected to continue for the foreseeable future. These include:

- Continued and intensified political and environmental challenges to SFPUC's Hetch-Hetchy (Tuolumne River) water supply diversions could potentially affect allocations of this pristine imported potable water supply to all agencies.
- Increased regional groundwater usage that could result from the high cost and diminished supply of SFPUC water could potentially affect Stanford's groundwater supply availability, particularly if neighbors increase their groundwater pumping.
- More frequent and longer droughts could reduce groundwater recharge and necessitate regulation and potential reductions of surface water diversions from local creeks, diminishing local surface water supplies.

Policy and Regulatory Factors

Growth beyond 2035 could continue to increase water demand at the rates identified in the referenced WSA; however as demonstrated by policy trends over the past ten years, from the California Water Conservation Act (2009) to Executive Order B-37-16 (2016), the region can expect even more aggressive goals for water conservation and related policy and regulatory developments designed to improve management of water resources.

Water Conservation in Landscaping Act of 2006

In September 2009 the State adopted Assembly Bill 1881 (AB 1881), the Water Conservation in Landscaping Act of 2006, which directs local governments to require the use of low-flow plumbing fixtures and the installation of drought-tolerant landscaping in all new development. As of January 2010, all jurisdictions were required to implement this law.

California Water Conservation Act

The Water Conservation Act of 2009 (SBx7-7) requires each urban water supplier to select one of four water conservation targets contained in California Water Code Section 10608.20 with the statewide goal of achieving a 20 percent reduction in urban per-capita water use by 2020.

The Bay Area Water Supply and Conservation Agency

The Bay Area Water Supply and Conservation Agency (BAWSCA) was enabled by AB 2058 and was created in 2003 to represent the interests of 24 cities and water districts, and two private utilities, in Alameda, Santa Clara and San Mateo counties that purchase water on a wholesale basis from the San Francisco Regional Water System. BAWSCA is governed by a 26-member

[15] The 2009 Agreement has a 25-year term (through 2034), however, the SFPUC's 2015 Urban Water Management Plan (UWMP) assumes that the amount that is allocated to wholesalers (including Stanford) under the Agreement will continue through the year 2040 (Santa Clara County, 2017 p 5.16-2).

Board of Directors comprised of respected community leaders representing the 24 cities and water districts that are member agencies of BAWSCA, and two private utilities that also have appointees to the board, Stanford and California Water Service Company.

BAWSCA is the only entity having the authority to directly represent the needs of the cities, water districts and private utilities (wholesale customers) that depend on the regional water system. BAWSCA provides the ability for the customers of the regional system to work with San Francisco on an equal basis to ensure the water system gets fixed, and to collectively and efficiently meet local responsibilities.

BAWSCA is developing the Long-Term Reliable Water Supply Strategy to quantify the water supply reliability needs of the BAWSCA member agencies through 2040, identify the water supply management projects and/or programs (projects) that could be developed to meet those regional water reliability needs, and develop an implementation plan for the Strategy. In February 2015, BAWSCA published the Long-Term Reliable Water Supply Strategy Phase II Final Report. The Phase II Final Report identifies water management actions that provide long-term water supply reliability for the region. For the Phase II Final Report, BAWSCA performed an assessment of the regional water supply reliability needs through the year 2040, evaluated potential water supply reliability projects that could be implemented to meet these needs, and identified actions to achieve increased regional reliability.

Executive Order B-37-16

On May 9, 2016, Governor Brown adopted Executive Order B-37-16, which directed five state agencies – the State Water Resources Control Board, the California Department of Water Resources, the California Energy Commission, the California Public Utilities Commission and the California Department of Food and Agriculture – to take coordinated action to help California achieve four key water conservation objectives over the long-term:

1. Use water more wisely;
2. Eliminate water waste;
3. Strengthen local drought resilience; and
4. Improve agricultural water use efficiency and drought planning.

EO B-37-16 outlines 13 specific tasks, and the five agencies published a detailed report, *Making Water Conservation a California Way of Life: Implementing Executive Order B-37-16 (Final Report, Apr. 2017),* to present the rationale for each task and how it will be implemented to achieve the four aforementioned goals. In implementing these tasks, the Department of Water Resources and State Board have identified and proposed new legislation that could result in additional reduction requirements and new reporting regulations for agencies and urban water users.

Stanford Water Programs

Stanford Water Conservation and Recycled Water

Stanford developed a Water Conservation, Reuse and Recycling Master Plan in 2001, and is currently developing a Sustainable Water Management Plan to guide its long-term water supply development, water conservation, wastewater and storm-water management, and habitat conservation programs. Stanford also implements a Water Efficiency Program to decrease domestic water and improve water efficiency at the campus.

The water conservation program has reduced campus domestic water use by more than 0.6 million gallons per day (annual average) or 20 percent of the university's total allocation under its contract with SFPUC (3.033 million gallons per day annual average), since 2000.

In addition to monitoring and reporting campus compliance with local, state, and federal regulations, the Water Resources Group works with its sustainability and campus operations partners to increase and promote water awareness and conservation across campus. Due to ongoing conservation efforts, campus domestic water use averaged 1.4 million gallons per day (mgd) from July 1, 2016 – June 30, 2017, compared to 2.7 mgd at the start of the water conservation program

- The annual Water Campaign, in partnership with the Office of Sustainability, focuses on educating the community on Stanford's water systems, stewardship efforts, and encouraging conservation regardless of drought conditions. The 2016-2017 campaign debuted the new Water Resources website and a short video introduction to Stanford's water systems.
- Water Resources staff collaborate with Grounds Services and the Land Use and Environmental Planning's Conservation Program for Stanford's annual Earth Day service project at the Arizona Garden and in the Foothills. Volunteers weed and remove invasive plants to help restore the historic cacti garden and salamander habitat in the foothills.
- Water Resources staff partners with campus facilities groups to operate a 24-hour water waste and leak hotline. Anyone observing leaking taps, toilets, or showers, misaligned irrigation, broken irrigation sprinklers (water shooting into the air), or excessive irrigation runoff (flowing in gutters), is encouraged to dial (650) 723-2281 for immediate attention.

Improved Metering

Stanford has also made progress in modernizing its water metering and data collection infrastructure and digitizing water use data management processes. Most of the water services are now converted to new meters that precisely measure water use, particularly at the low flow rates that have resulted from the installation of more efficient water fixtures and equipment. The water use data are transmitted via radio signal at frequent intervals. These enhancements result in water use being monitored much more frequently than the monthly water meter reading process, enabling excessive uses to be identified and addressed much sooner, reducing overall wasteful water use (Stanford, 2018e).

Water Reuse

In addition, many buildings on campus are equipped to use recycled water for toilet flushing with the use of "dual plumbing" using "purple pipe;" examples of existing dual plumbed buildings include the Science and Engineering Quad, School of Medicine, and the Knight Management Center complex. While Stanford's recycled water system is currently fed by domestic water, as new sources of recycled water emerge, Stanford anticipates that the dual plumbed buildings will be among the first to implement recycled water use (Stanford, 2017e; and County of Santa Clara, 2017).

Conclusions

Based on current rates of growth and water consumption, and the assumption that Stanford's existing potable water supply will continue to be available into the future, water could become a very real constraint to campus development, particularly under drought conditions. The constraint could happen by 2060 if Stanford's allocation of SFPUC water under normal conditions (currently 3.03 mgd) remains in place once the current contract with SFPUC expires in 2034, or as soon as 2038 if SFPUC reduces the allocation to 2.52 mgd due to drought conditions. These constraints under both normal and drought conditions could be managed by increasing conservation efforts to sufficiently reduce per-capita water use, or by exploiting other supplies available to Stanford, including surface water and groundwater sources, to replace what is lost from the SFPUC supply.

Future developments in technology, conservation practices, and water policies can also be expected to affect regional water use and the ability to manage supply constraints. As shown in Figure 4-6, while Stanford has continued to grow since 2001, its per capita water consumption rate has decreased substantially. Future water efficiency improvements will likely manifest in higher efficiency fixtures, and exploration of various alternative water sources that are being considered through sustainable water management planning. Future technology could also make water recycling and recovery a much more feasible and cost-effective. Such technologies are currently being tested at Stanford under the William and Cloy Codiga Resource Recovery Center, whose mission is to "accelerate commercial development of new wastewater technologies by testing at a scale large enough to demonstrate a process's effectiveness and stimulate investment for full-scale implementation" (Stanford, 2014).

In summary, the analysis indicates that water supply could become a constraint to Stanford's growth before 2060 if the Stanford campus continues to grow beyond 2035 at the pace anticipated by the proposed 2018 GUP, particularly if longer and more severe droughts become the "new normal" due to climate change or other factors. It is equally plausible that water supply will not become a constraint by that date if campus growth slows, conservation increases, or new supplies are developed through use of alternative water supplies and/or new contractual agreements with water wholesalers. It is worth reiterating that under the current consumption rates provided in the WSA (as shown in Figure 4-6), the currently available supply of potable water represents a constraint under drought conditions when the campus square footage reaches approximately 21,000,000 and the average FAR is 0.47; the currently available supply of potable water represents a constraint under normal conditions when the campus square footage reaches approximately 25,400,000 sf and the average FAR is 0.57.

4.4 Wastewater

Potential Constraints

Possible wastewater constraints that Stanford could experience as it grows are related to existing contracted service capacity provided by the City of Palo Alto-owned and -operated Harold L. May Regional Wastewater Quality Control Plant (RWQCP), and the capacity of the wastewater sewerage system that serves the Stanford campus.

Trends and Forecasts

Wastewater generated by Stanford University is collected in its sanitary sewer system and then conveyed off-site through City of Palo Alto sewer lines to the RWQCP, where it is treated. The Palo Alto Public Works Department is responsible for operation of the RWQCP.

Stanford has separate sanitary sewer and stormwater systems, and therefore, any increases in sanitary sewer flow during wet weather days are minimal, and are related to infiltration and inflow, and not conveyed storm drainage flows (County of Santa Clara, 2017 p. 5.16-5). Thus, for the purpose of this constraint analysis, wet weather flows are generally not considered as a significant contributing factor to available services.

As of 2017, approximately 220,000 people live in the RWQCP service area (this includes the populations of the six partner agencies: Palo Alto, Stanford, Mountain View, East Palo Alto Sanitary District, Los Altos, and Los Altos Hills). About 60 percent of the wastewater generated in this service area comes from residences, 10 percent from industries, and 30 percent from commercial businesses and institutions. The Long Range Facilities Plan Final Report published by Palo Alto projects demand for the treatment plant through 2062 (City of Palo Alto, 2012). The RWQCP is designed to have an average dry weather flow (ADWF) capacity of 39 mgd and an average wet weather flow capacity of 80 mgd (City of Palo Alto, 2016). Stanford's allocation is 2.11 mgd of the RWQCP's wastewater treatment capacity (ADWF).

The RWQCP treated 21 mgd of effluent from all the partner agencies before the drought (2012-2013), and just under 18 mgd in the July 2015-June 2016 plant fiscal year (City of Palo Alto, 2016; Stanford, 2017h). As of 2017, the City of Palo Alto indicated the RWQCP capacity was sufficient for current dry and wet weather loads and for future load projections (City of Palo Alto, 2016).

Campus Wastewater Generation

Stanford wastewater demand is generated in direct relationship with its water supply. Between 2000 and 2014, prior to the construction of the new Central Energy Facility, wastewater discharge was about 55 percent of domestic water use – with the difference primarily being loss of water through cooling towers at the cogeneration facility and through irrigation. In 2015, after the cooling tower water loss was drastically reduced, the campus wastewater discharge was also reduced (Stanford, 2018e). The current wastewater generation anticipated at buildout of the 2000 GUP is 1.3 mgd, while the projected water demand in 2020 is about 2.0, demonstrating that about 65 percent of consumed potable water now ends up in the wastewater system.

Wastewater Analysis of the 2018 GUP

At buildout of the proposed 2018 GUP, the Draft EIR estimated a net increase in wastewater generation of approximately 0.4 mgd, plus another 0.2 mgd from the remaining development under the 2000 GUP. Overall, the Draft EIR found that Stanford's average discharge would increase 0.6 mgd, from 1.1 mgd in 2017 to 1.7 mgd by 2035.

Stanford's sanitary sewers discharge to a 21-inch City main that runs parallel to El Camino Real, with a 4,370 gallon per minute (gpm) capacity. The Draft EIR found that an increase in Stanford wastewater generation of 0.6 mgd would be equivalent to an average increase in daily flow of approximately 417 gpm.

The key findings in the Draft EIR related to wastewater include the following:

- Stanford is currently allocated 2.11 mgd of wastewater treatment capacity at the RWQCP owned and operated by the City of Palo Alto. The anticipated increase in wastewater flow to 1.7 mgd is within Stanford's allocated treatment capacity.
- There are no capacity deficiency issues for any of the City of Palo Alto collection mains that carry wastewater flows from the Stanford campus to the RWQCP (City of Palo, Alto, 2017); the increase of 417 gpm at full buildout of the 2018 GUP would result in a total dry-weather peak flow estimated at approximately 2,117 gpm, which is well below the 4,370 gpm capacity of the City sewer main.

Given these factors, sewer flows from the campus would not represent a constraint on growth through 2035.

Future Wastewater Scenarios

As described above, Stanford wastewater demand is generated in direct relationship with its water supply. In 2015, after the cooling tower water loss was drastically reduced, the campus wastewater discharge was about 69 percent of the decreased domestic water usage (Stanford, 2018 – Sustainability- p. 28). The current wastewater generation anticipated at buildout of the 2000 GUP is 1.3 mgd, while the projected water demand in 2020 is about 2.0, demonstrating that only about 65 percent of consumed potable water is ends up in the wastewater system. Given that the recent rate of wastewater discharge has ranged between 65 and 69 percent, a reasonable but conservative estimate for current wastewater generation can be assumed to be 69 percent of potable water use.

Consistent with the analysis discussed under Section 4.3 Water, above, a reasonable starting point to considering constraints to campus wastewater generation is to assume that Stanford's current allocation of RWQCP treatment capacity (2.11 mgd) cannot be exceeded. The Draft EIR and WSA found that buildout of the 2018 GUP would result in an increase of approximately 0.40 mgd over pre-2018 GUP water demand, equivalent to an average annual increase of 0.023 mgd over the 17-year planning horizon of the 2018 GUP. Assuming wastewater is generated at the rate of 69 percent rate of potable water use (as explained above), the corresponding average annual increase in wastewater discharge would be 0.016 mgd.[16]

The remaining treatment capacity at the RWQCP is approximately 0.41 mgd (2.11 minus 1.7). Using the same growth and development assumptions used in the previous analysis for water use, the remaining wastewater treatment capacity would be consumed by around 2060[17] when the campus square footage would reach approximately 25,400,000 sf and the average FAR would be 0.57.[18]

The capacity of the sewer systems servicing Stanford and the City of Palo Alto must also be considered. On-campus flows are navigated through a system that includes 43 miles of pipe, owned by Stanford and managed by its WRCI Group; future increases in capacity would be addressed by Stanford through this group. From the campus, wastewater is conveyed into the

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16 0.40 mgd of increased water x 69 percent discharge / 17 years = approximately 0.016 mgd increased discharge per year.

17 0.41 mgd/0.016 mgd/year= approximately 25.6 years, which added to 2035 is approximately 2060.

18 The net annual growth rate under the proposed GUP is expected to be approximately 200,000 sf/year. At that rate campus buildings would amount to approximately 25,400,000 sf by 2060.

City sewer main, which at a capacity of 6.29 mgd, far exceeds Stanford's current RWQCP allocated volume of 2.11 mgd. The remaining conveyance capacity of the City sewer main is unknown, but it is likely that the university would face a RWQCP treatment capacity constraint (by adding 0.41 mgd of wastewater flow) before it would face a conveyance constraint.

Policy and Regulatory Factors

There are no specific policies that result in a finite capacity restriction to wastewater. The following policy regulates the quality of wastewater treatment under the Clean Water Act, which ensures treatment plants have capacity to address service area wastewater.

National Pollutant Discharge Elimination System (NPDES)

The NPDES permit requires the City of Palo Alto, as the RWQCP operator, evaluate its local limits, such as those established by the other entities contributing to the RWQCP, to ensure compliance with updated effluent limits. The RWQCP is required to monitor the permitted discharges into the collection system in order to evaluate compliance with the RWQCP's permit conditions.

Operation of the Palo Alto RWQCP and its wastewater collection system is regulated by Waste Discharge Requirements (WDRs; NPDES No. CA0037834), found in Regional Water Quality Control Board (RWQCB) Order No. R2-2014-0024, effective August 1, 2014, and expiring July 31, 2019. The effluent from the RWQCP also is subject to two other NPDES permits: 1) the WDRs for mercury and polychlorinated biphenyls (PCBs) from municipal and industrial wastewater discharges to San Francisco Bay (NPDES No. CA0038849); and 2) waste discharge requirements for nutrients from municipal wastewater discharges to San Francisco Bay (NPDES No. CA0038873). The three NPDES permits enable Palo Alto to discharge treated wastewater into San Francisco Bay and Matadero Creek (City of Palo Alto, 2016).

Conclusions

Under existing conditions, there is remaining capacity for wastewater sewerage and treatment that can accommodate growth of the Stanford campus until around 2060 under current growth rates and wastewater generation rates. Stanford's increase in wastewater discharge would be a small portion of the expected increase resulting from regional growth, and would be addressed in capacity expansion planning for the RWQCP. It is highly likely that any future constraints could be addressed through increased financial commitments by Stanford to increase their allotted capacity at the RWQCP or to upgrade sewerage capacity.

From a cumulative impact perspective, considering the anticipated regional population growth forecasts for the six RWQCP partners (including Stanford and the City of Palo Alto) provided by Plan Bay Area, it also not likely that the RWQCP would experience a capacity constraint before Stanford reaches its allocation of 2.11 mgd. Palo Alto's Long Range Facilities Plan projects waste treatment demand through 2062 and identifies priority projects to ensure adequate service capacity of the RWQCP (City of Palo Alto, 2012). At such a time when the plant would require additional capacity itself, a larger development process would take place to ensure it meets its entire service area needs.

In summary, the analysis indicates that Stanford's current wastewater treatment capacity could become a constraint to growth by 2061 if the Stanford campus continues to grow beyond 2035 at the pace anticipated by the proposed 2018 GUP. However, treatment capacity and conveyance capacity can be expanded with capital projects to enlarge the RWQCP and sewers that serve the university. Thus, while there are costs associated with growth, and potential constraints associated with getting permits and funding for expansion of the systems, there are no physical constraints to speak of. It is worth reiterating that under the wastewater generation rates assumed in this analysis, the existing capacity for wastewater treatment represents a constraint by approximately 2060 when the campus square footage would reach approximately 25,400,000 sf and the average FAR is 0.57. Also – if longer and more severe droughts become the "new normal" due to climate change or other factors, decreased wastewater volumes can be expected due to less water use, thus extending the available treatment capacity.

4.5 Solid Waste

Potential Constraints

Potential constraints related to solid waste include the capacity of available landfills to accommodate Stanford's waste, policies and regulations that are requiring higher diversion rates and less solid waste going to landfills, and the available markets for diverted and recyclable materials.

Trends and Forecasts

Solid waste generated by Stanford is managed exclusively by Peninsula Sanitary Service, Inc. (PSSI), which has contracted with Stanford for over 50 years to provide recycling, composting, and solid waste management services. In 2017, PSSI delivers solid waste from Stanford to generally three facilities: the Newby Island Sanitary Landfill, the Zanker Road Class III Landfill, and Sims Metal Management (PSSI, 2017 as cited in Santa Clara County, 2017 p. 5.16-6). These facilities are described as follows in the 2018 GUP Application EIR:

- The 342-acre Newby Island Sanitary Landfill is the primary facility used, with a capacity of 57.5 million cubic yards. As of October 2014, this landfill had a remaining capacity of 21.2 million cubic yards, with an anticipated cease operation date of January 2041 (CalRecycle, 2017b).

- PSSI generally delivers construction and demolition-related waste generated at Stanford to the 70-acre Zanker Road Class III Landfill in San Jose, California. As of 2012, the Zanker Road Landfill had a total remaining capacity of 700,000 cubic yards in two units that collectively process construction and demolition waste, green materials, and industrial waste, with an expected closure date of 2029. Overall the facility has maximum throughput of 2,600 tons per day (landfill tonnage is limited to 300 tons per day, compost at 400 tons per day, with the remaining amount permitted recyclables) (CalRecycle, 2012). As of 2017, the facility recorded throughput at 1,500 tons per day (CalRecycle, 2017c).

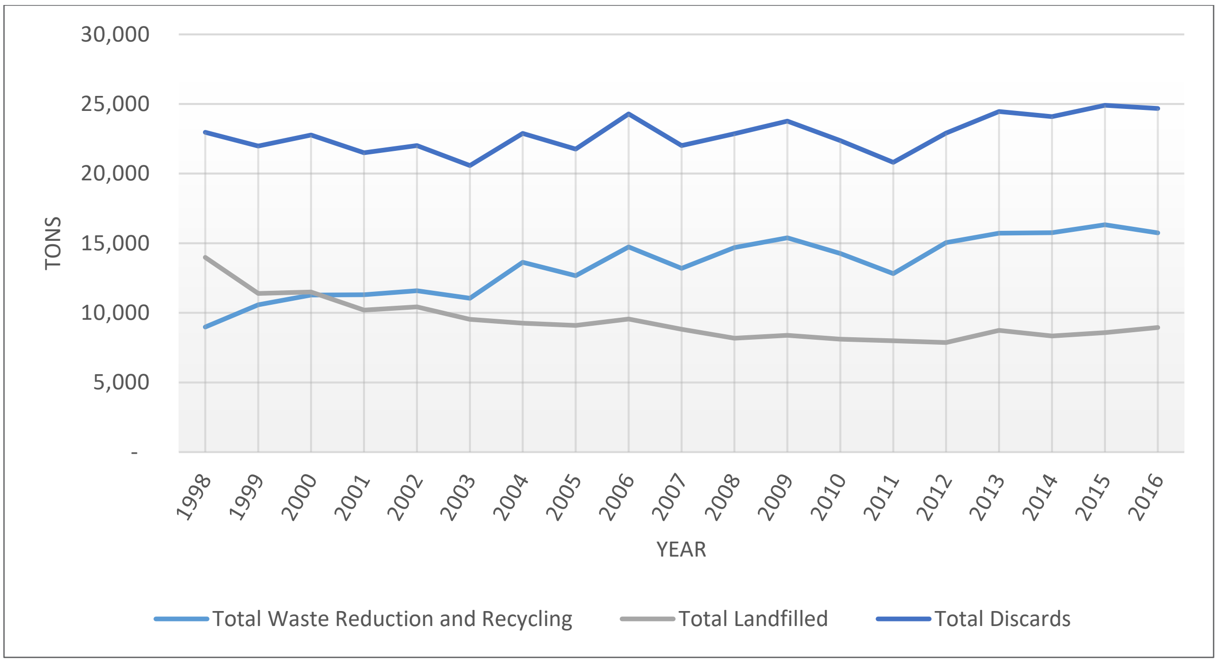
- PSSI generally delivers recyclable metal collected at the Project site to Sims Metal Management in Redwood City. Sims is a scrap metal yard, which purchases and processes ferrous scrap metal with an onsite shredder and logistics to support off-site shipment (Sims, 2017).

Part of PSSI's service to Stanford is to manage the contracts for disposal facilities to ensure adequate disposal. Therefore, while the identified landfills each have expected life expectancies and closure dates based on capacity limits and maximum daily throughput, Stanford through their contracting with PSSI would identify alternate landfills once presently used facilities met their capacities.

Campus Solid Waste Generation

Over the last 30 years, the Stanford's Waste Reduction, Reuse, Recycling and Composting program has been expanded and improved in response to demands from the campus community, recycling markets and new legislation. Stanford has increased its landfill diversion rate from 39 percent in 1998 to 64 percent in 2016 (refer to **Figure 4-7**). In 2016 Stanford generated a total of 24,685 tons of solid waste, of which 8,945 tons were sorted as landfilled waste and 15,740 tons were diverted through recycling and reduction.[19] In FY 2015-16 this represents a total discard generation rate of 0.74 tons per person per year. This included landfill waste at a generation rate of 0.27 tons per person per year and recycled waste at a generation rate of 0.47 tons per person per year (Stanford, 2017c). The solid waste total includes the majority of all demolition and construction waste, which in 2016, accounted for nearly 4,100 tons or approximately 16 percent of total waste (Stanford, 2017c).

Figure 4-7: Tons of Waste Generated Per Year



Source: Stanford, 2017c

Solid Waste Analysis of the 2018 GUP

The Draft EIR estimated that the proposed 2018 GUP would generate an estimated 2,235 tons of construction related waste per year that would be disposed at a landfill. The Draft EIR also found that at buildout of the 2018 GUP, Stanford would be generating a net increase of approximately 6,381 tons of discards per year, consisting of 4,053 tons of recyclables and 2,328 tons going to landfill.[20] In combination with the existing waste generation, total generation

[19] Based on an estimated Stanford on-campus and affiliated commuter population.
[20] These numbers include both operational discards and construction and demolition (C&D) debris.

with buildout of the 2018 GUP would be approximately 31,066 tons of discards per year, consisting of 19,793 tons of recyclables and 11,273 tons of landfill waste.

The key findings in the Draft EIR related to solid waste include the following:

- While construction and operation waste from the campus would be delivered to the Zanker Road Landfill, which has an expected closure date of 2029, other existing landfills are available, such as Newby Island, that would remain operational could be utilized and would have more than adequate capacity to accommodate Stanford solid waste needs.
- Based on the existing disposal rates and continued waste diversion by residents and employees of Stanford, the university would continue to be in compliance with CALGreen and AB 939.
- Given the above, operation of the project would not exceed available permitted landfill capacity and would comply with federal, state, and local statutes and regulations related to solid waste diversion; the impact would be less than significant.

Given these factors, solid waste from the campus would not represent a constraint on growth through 2035.

Future Solid Waste Management

California continues to set aggressive goals in the area of waste reduction, recycling, and composting, with a goal of achieving a 75 percent recycling rate by 2020, requiring all businesses to collect and recycle their organic waste in phases from 2016 to 2019 (AB 341 2011). At Stanford, there is general and growing interest in achieving higher recycling and diversion rates on campus, and planning is underway to increase the current 64 percent diversion rate to 75 percent to meet and exceed the California goal. The university assumes that waste consumption per capita will continue to decrease over time, driven by both state laws and campus sustainability programs (see Stanford Waste Reduction Actions, below).

However, there are challenges to overcome. The current market for recyclables is down. The U.S. exports approximately one-third of its paper and plastic recyclables to China, which uses it as a source material in manufacturing. However, in the summer of 2016, China announced that it would no longer accept foreign waste that doesn't meet a very low contamination threshold (less than or equal to 0.5 percent). The ban went into effect on January 1, 2018. Most waste haulers, including Stanford's, will struggle to meet this stringent threshold. In the near term, the ban is causing recyclables to be stockpiled and possibly landfilled if new markets cannot be found. Solutions to these problems may lie in greater emphasis on waste reduction, rather than recycling. For example, one promising system is the Ozzi machine (agreenozzie.com), which replaces disposable to-go containers with reusable ones. This system charges customers a fee for a reusable container at the point of sale, which they then receive back when returning the container to a collection machine (Stanford, 2018e).

The market for recyclables and material reuse may also improve as a result of regulatory and technological advances in closed-loop manufacturing, where post-consumer waste is collected, recycled and used to make new products. In addition to expanding markets for recycling, closed loop manufacturing generally has the benefit of reducing lifecycle energy consumption, reducing transportation and goods movement, and reducing packaging.

Policy and Regulatory Factors

The following California policies and laws will assist Stanford and the rest of the state in handling waste sustainably.

CALGreen Building Code

The California Code of Regulations (CCR) Title 24, Part 11, or the California Green Building Standards Code (CALGreen), reduces solid waste impacts by requiring that at least 50 percent of the weight of non-hazardous job site debris generated by new construction be recycled, reused, or otherwise diverted from landfill disposal. CalGreen requires submission of plans and verifiable post-project documentation to demonstrate compliance.

Assembly Bill 939 and Senate Bill 1016

The California Integrated Waste Management Act of 1989, or Assembly Bill 939 (AB 939), established the Integrated Waste Management Board, required the implementation of integrated waste management plans, and mandated that local jurisdictions divert at least 50 percent of all solid waste generated (from 1990 levels), beginning January 1, 2000, and divert at least 75 percent by 2010. Projects that would have an adverse effect on waste diversion goals are required to include waste diversion mitigation measures to assist in reducing these impacts to less-than-significant levels. With the passage of Senate Bill 1016 (SB 1016, the Per Capita Disposal Measurement System) in 2006, only per capita disposal rates are measured to determine if a jurisdiction's efforts are meeting the intent of AB 939.

Public Resources Code Section 41780

The California State Legislature set the policy goal for the state that not less than 75 percent of solid waste generated be source reduced, recycled or composted by the year 2020. Furthermore, a 50 percent diversion rate will be enforced for local jurisdictions.

Assembly Bill 341

In an effort to reduce greenhouse gas emissions from disposing of recyclables in landfills, AB 341 requires local jurisdictions to implement commercial solid waste recycling programs. Businesses that generate four cubic yards or more of solid waste per week or multifamily dwellings of five units or more must arrange for recycling services. In order to comply with AB 341, jurisdictions' commercial recycling programs must include education, outreach and monitoring of commercial waste generators and report on the process to CalRecycle. Jurisdictions may enact mandatory commercial recycling ordinances to outline how the goals of AB 341 will be reached. For businesses to comply with AB 341, they must arrange for recyclables collection through self-haul, subscribing to franchised haulers for collection, or subscribing to a recycling service that may include mixed waste processing that yields diversion results comparable source separation.

Assembly Bill 1826 – Commercial Organics Collection

In order to further reduce greenhouse gas emissions from disposing of organics materials in landfills, AB 1826 requires businesses to recycle their organic waste beginning on April 1, 2016, depending on the amount of solid waste they generate per week. Similar to AB 341, jurisdictions are required to implement an organic waste recycling program that includes the education, outreach and monitoring of businesses that must comply. Organic waste refers to food waste, green waste, landscaping and pruning waste, nonhazardous wood waste, and food-soiled paper that is mixed with food waste. Stanford receives organics collection services from its waste hauler, PSSI.

AB 1045 – Inter-agency Compost Workshop

The bill requires CalRecycle, the Air Resources Board, and the State Water Board to work together to develop policies that aid in diverting organic waste from landfills. This includes reducing 5 million metric tons of GHG emissions per year through the application of compost in agriculture and landscaping, which increases soil carbon sequestration, prevents erosion, and reduces the need for synthetic fertilizers. This bill will increase the demand for compost, potentially making it more cost effective for generators of organic waste, like Stanford, to send their waste to a composting facility (currently the compost tipping fee is approximately equivalent to the landfill tipping fee).

SB 1383 – Short-lived Climate Pollutants

To address methane emissions resulting from organic waste in landfills, the bill sets targets to achieve a 50 percent reduction in the level of the statewide disposal of organic waste from the 2014 level by 2020 and a 75 percent reduction by 2025.

AB 976

AB 976 requires that counties plan for 15 years of organics facility capacity similar to what they do for landfill capacity. Traditional composting facilities require large areas of land, which is a scarce resource for the Bay Area. More compact organics processing facilities, similar to the Sustainable Alternative Feed Enterprise (SAFE), located in Santa Clara County (forktofeed.com), may provide viable solutions. In only 5,000 square feet of land, the facility processes 99 tons of food scraps per day into nutrient-rich, non-ruminant animal feed. In addition to being space efficient, the end-product is higher up on the waste hierarchy than compost for soil. Stanford currently sends food scraps from its dining halls to SAFE.

Stanford Waste Reduction and Diversion Actions

In 1998, the first year that Stanford began comprehensively tracking waste metrics, the university diverted 39 percent of its waste from landfill. Since then, in partnership with PSSI, Stanford has implemented a number of programs to increase its landfill diversion rate to 64 percent in 2016. To better understand its sources of waste and areas for improvement, Stanford conducted waste audits from 2016-2017 to identify materials going to the landfill that can either be recycled or composted. The university is currently expanding its compost programs, revamping Campus Cleanup so departments properly dispose of unwanted items, and imposing stricter guidelines on environmental preferable purchasing (Stanford, 2018e).

Stanford's waste diversion programs include:

- The Deskside Paper Recycling and Mini–Trash Can Program has expanded into 96 buildings, with 8,224 total sets of bins and Zero Waste Guidelines delivered. This program continues to be extended into existing and new academic buildings, becoming the campus standard. Stanford currently collects building-level waste data for 230 of its buildings using the Recycle IQ software tool.

- Stackable multi-recyclers were installed in 2017 for 3,200 students (about 50 percent of undergraduates). This system allows residents to sort their landfill and recyclables in their rooms instead of at the waste corral, reducing contamination and landfill waste.
- Departments have funded 96 compost collection points through the Customer-Funded Compostables Collection Program, launched in July 2015. The Voluntary Compost Program increased participation to over 150 volunteers collecting food and other compostable materials from common spaces to bring to collection bins.
- In 2017 alone, over 700 people were trained on best waste sorting, recycling, and composting practices through waste reduction classes, café staff trainings, and custodial trainings. Other outreach efforts included ten campus tabling events and eight tours of the Stanford Recycling Center.
- PSSI and the Office of Sustainability regularly host Sustainability Game Day Challenges in partnership with the Department of Athletics, Physical Education, and Recreation. Game Days result in an 8 to 24 percent increase in waste diversion rates, thanks to increased composting infrastructure, food donation programs, student participation, and fan outreach and engagement.
- Housing: When building multi-story housing buildings, to meet goals of increased housing densities, building designs can encourage proper sorting of waste by the building residents. Stanford's new graduate student housing currently under construction, will include multiple chutes for residents to sort their waste.

The Draft EIR for the 2018 GUP based future waste generation and diversion rates on 2016 rates, and found there would be no constraints to solid waste through 2035, even without accounting for additional diversion that will be required by the laws outlined above. These laws, in combination with Stanford's waste diversion programs, should result in lower volumes of waste per capita going to landfill by 2035 and beyond.

In addition, where the Draft EIR found that there would be no constraints through the 2035 buildout of the 2018 GUP in terms of landfill capacity, despite the expected closure of its primary landfill (Zanker Road Landfill) in 2029. It also found that beyond 2035 additional landfill space would be identified or developed should the subsequently used landfill reach capacity.

Given these factors, there is no expected date when landfill capacity would represent a constraint on campus growth.

Conclusions

It appears that Stanford could continue developing its campus for the foreseeable future without landfill capacity becoming a constraint. Policies and regulatory constraints at the state and regional level, combined with Stanford's waste diversion programs, are designed to increase diversion of solid waste from landfill, and extend the remaining capacity of existing landfills. There are challenges to overcome in terms of finding markets and developing manufacturing process that can accommodate the expanding volume of recycled materials, but it can be expected that future innovation, regulation and market forces will combine to prevent land use capacity from being a real constraint to the long-term future growth of the Stanford campus.

4.6 Housing

Potential Constraints

The primary development constraints related to housing include regional housing shortages and a lack of housing affordable to the Stanford population. As Stanford grows, demand for both on-campus and off-campus housing will grow. The lack of housing will be a high priority planning issue for the university and surrounding communities for the foreseeable future.

The Housing Linkage policy in the Community Plan stipulates that "*increases in academic space may be granted only on condition that a specified amount and type of housing supply has been or will be constructed concurrently*" (County of Santa Clara, 2000a). This policy allows for both on-campus and off-campus housing to be considered as meeting the requirement.

Stanford prioritizes on-campus housing for a high percentage of its students and a good portion of its faculty because housing them in close proximity fosters collaboration and learning. In fact, of the universities benchmarked, Stanford is near the top in terms of the percentage of students living in university housing (US News & World Report, 2018). Stanford also provides some off-campus housing for students, staff, and other affiliates, in nearby cities.

As it develops, Stanford can hypothetically dedicate enough new square footage to on-campus housing to accommodate the growth in its academic population (students plus faculty). There are, however many students and faculty who, by circumstance or necessity, choose to live off-campus in housing that is not owned by or affiliated with the University (i.e., market-based). Those members of Stanford's population are at the mercy of local housing markets in terms of housing availability and affordability.

Although Stanford provides more employee housing than other Bay Area employers, the university depends upon regional housing availability to attract and retain high-quality staff and other workers. If regional housing shortages continue to worsen over the long term, Stanford like all Bay Area employers may be constrained in its ability to grow its workforce (Stanford, 2018b).

Trends and Forecasts

On Campus Housing

After completing the new facilities authorized by the 2000 GUP, Stanford will provide a total of 14,300 beds for students and over 900 single-family and condominium housing units for its faculty on campus lands in unincorporated Santa Clara County. Stanford currently houses approximately 93 percent of all its undergraduates on its campus, and over half of its graduate students. After completion of the recently approved Escondido Village Graduate Residences (approximately 2,020 net new graduate student beds), Stanford will have sufficient on-campus space to house over 70 percent of its graduate students (Stanford, 2018b).

As discussed in Section 2.3, growth in on-campus student housing development has been relatively steady over time, with the highest rates of growth occurring between 1960-1965 and 1996-2000. In particular, the anticipated addition of the Escondido Village Graduate Residences in 2020 will contribute to a significant increase in Stanford's historical growth rate for on-campus housing (Stanford, 2018b).

As proposed, the 2018 GUP would allow approximately 3,150 net new housing units/beds, of which up to 550 units would be available for faculty, staff, postdoctoral scholars, and medical residents. Of the approximately 2,600 net new student housing units/beds that would be developed under the 2018 GUP, it is anticipated that 1,700 would be for undergraduates and 900 would be for graduate students (County of Santa Clara, 2018).

On-campus rents are relatively affordable in comparison to the surrounding community. For example, according to the 2017-2018 Undergraduate Residence Rates, a student would pay an average of $9,193 plus a boarding charge averaging between $6,019-6,518 to be housed during the academic year, which equates to approximately $1,550 per month. (Stanford R&DE, 2018a). Graduate rental rates range between $795-2,010 per month for single graduates, $1,482-2,815 for couples without children housing, and $2,160-2,610 for students with children (Stanford R&DE, 2018b). In comparison, the average rent for Palo Alto is approximately $3,050 and $3,481 for Menlo Park (RENT*Café*, 2018a, 2018b).

Off Campus Housing

Today, Stanford provides over 1,000 off-campus housing units for its faculty, staff and students in nearby cities (Stanford, 2018b). Stanford began facilitating construction of housing outside of the academic campus in the 1950s with 123 single-family units in the Stanford Hills and Stanford Creek subdivisions in Menlo Park, followed by the construction of 759 units at the Oak Creek Apartments in 1969. Additional off campus housing units were constructed in 1987 with the construction of 108 apartments near the Stanford Hospital. Since 2000, Stanford has developed housing on Stanford lands in the City of Palo Alto, including 628 faculty and staff units at the Stanford West Apartments and 388 independent living senior housing units at the Vi at Palo Alto. Also, 70 below-market housing units were recently completed on El Camino Real in Palo Alto (Mayfield Place), and 112 condominiums and 68 single-family residences are under construction on California Avenue in Palo Alto (University Terrace). In Los Altos, Stanford recently purchased the newly constructed 167-unit Colonnade Apartments (Santa Clara County, 2018). In addition, the City of Menlo Park recently approved Stanford's application to build 215 rental units at 500 El Camino Real that Stanford plans to make available to faculty and staff (Stanford, 2018b).

For students, faculty and staff who live off campus but are not accommodated by Stanford housing, the high rents in neighboring Palo Alto and Menlo Park mean they must look further out to find affordable housing. Rental prices average $2,520 in East Palo Alto (3 miles away from campus), $2,332 in Fremont (12 miles away), $2,080 in Livermore (28 miles away) (RENT*Café*, 2018c, 2018d, 2018e). Stanford workers have even moved as far away as Stockton (60 miles away) to find affordable housing (KQED News, 2015), where rental prices average $1,071 (RENT*Café*, 2018f).

Housing affordability has become a major concern in California, as rising housing prices have outpaced incomes. In 2016, the national median home price of $209,325 (Zillow, 2018) was approximately 3.9 times the national median income of $55,322 (US Census, 2016).[21] As a

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[21] 2016 data for home price and income is considered in this evaluation as this is the most consistent currently-available information. The 2017 ACS 1-year and 5-year estimates are not expected to be released until later in 2018, this is posted online at American Community Survey, 2017 Data Release New and Notable at: https://www.census.gov/programs-surveys/acs/news/data-releases/2017/release.html.

comparison, in 2016 the California median-priced single family home was approximately $502,178 (CAR, 2018), or approximately 7.9 times the California median household income of $63,783 (US Census, 2016). Specifically, in Santa Clara County, a median-priced single family home in 2016 was approximately $1,015,000 (CAR, 2018), approximately 10 times the median household income of $101,173 (US Census, 2016). Home prices have continued to rise in some areas, including Santa Clara County where the median single family home price was $1,454,500 in March 2018 (CAR, 2018).

The local jurisdictions neighboring the University have had an even wider gap. In Palo Alto in 2016, a median-priced single family home was approximately $2,528,000 (Zillow, 2018) in 2016, approximately 18.8 times the median household income of $137,043 (US Census, 2016). In Menlo Park, a median-priced single family home was approximately $1,974,000 (Zillow, 2018) in 2016, approximately 15.7 times the median household income of $126,045 (US Census, 2016).

Both Menlo Park and Palo Alto have recently completed General Plan Updates that include policies and action items to increase housing supply. Menlo Park's updated Land Use Element provides for the development of up to 4,500 residential units in the Bayfront area targeted for high-density, mixed-use development (City of Menlo Park, 2016). Menlo Park's increase in households that would result from buildout of the General Plan represent a 40 percent increase for households (53 percent compared to 13 percent) above what was projected in the regional growth forecasts (City of Menlo Park, 2014). This projected surplus of housing may ease the housing shortage in Menlo Park, but could also result in an influx of residents from other nearby communities that are not developing sufficient housing.

Palo Alto's adopted Comprehensive Plan 2030 is anticipated to result in growth of between 3,545 and 6,000 housing units over the life of the plan, a rate of housing increase exceeding the city's long-term average. Other policies commit the City of Palo Alto to identifying publicly-owned land for affordable housing development, collaborating with Palo Alto Unified School District to explore opportunities to build housing affordable to school district employees, and working with community members to identify and remove barriers to infill development of affordable housing (City of Palo Alto, 2017b). Palo Alto's General Plan growth scenarios are at or below regional growth forecasts for households; however, the increased housing growth is projected to allow the City to meet its regional allotment of housing need (City of Palo Alto, 2016, 2017a). Without increases in households over regional projections, housing availability and affordability would not be expected to significantly improve in Palo Alto.

Housing Analysis of the 2018 GUP

The Draft EIR for the proposed 2018 GUP found that development under the proposed 2018 GUP would result in growth of the Stanford-affiliated population that could not be entirely accommodated by on-campus housing, thereby increasing the demand for off-campus housing by up to 2,425 units by 2035, which would be distributed among nearby jurisdictions in the Bay Area (County of Santa Clara, 2018).

Within Santa Clara County, the largest increase in off campus households under the 2018 GUP is anticipated in Palo Alto (approximately 367 new households), followed by San Jose (279 new households), Mountain View (244 new households), and Sunnyvale (152 new households). In San Mateo County, the largest distribution of off campus households would occur in Menlo Park (153 new households) and Redwood City (133 new households). The remaining 1,097 households would be distributed among other jurisdictions in these and other counties in the Bay Area (County of Santa Clara, 2018).

In order to help address off-site housing demand generated by the Project, as part of the 2018 GUP, Stanford proposes to continue its contributions to the County-administered Stanford Affordable Housing Fund, as was required under 2000 GUP Condition F.6. Under Condition F.6, for each 11,763 square feet of academic development built pursuant to the GUP, Stanford would be required to either provide one affordable housing unit on the Stanford campus, or make a cash payment in-lieu of providing the housing unit. Under the 2000 GUP, in-lieu cash payments have been required to fund affordable housing projects within a 6-mile radius of the boundary of the Stanford campus. Under the 2018 GUP, Stanford proposes a modification to that requirement where in-lieu payments would support development of affordable housing within one-half mile of a major transit stop or a high-quality transit corridor, as defined by SB 375. (County of Santa Clara, 2018).

Future Housing Scenarios

Potential strategies for easing California's housing crisis include identifying "housing hot spots" where large numbers of housing units could be built with attractive returns, providing incentives for local governments to approve already planned-for housing, accelerating land-use approvals and construction permitting timelines, cutting the cost and risk of producing housing, and ensuring that low-income and vulnerable individuals who are priced out of the market have access to housing (McKinsey Global Institute, 2016).

On the regional level, the Association of Bay Area Governments (ABAG) has addressed housing supply by adopting Plan Bay Area 2040. Plan Bay Area 2040 includes the following actions to increase the region's housing supply: (1) developing a plan to generate regional revenues to support the production and preservation of affordable housing; (2) implementing recently-adopted housing loan and direct investment programs; (3) evaluating policies to connect transportation funding to housing production and performance; (4) strengthening the technical assistance provided to local governments for establishing and implementing housing policies; (5) collecting, analyzing, and disseminating data related to housing and improving the accessibility of information; and (6) supporting state legislative and funding solutions to reduce costs and barriers to housing development, and to otherwise increase the supply of both market-rate and affordable housing.

Plan Bay Area 2040 acknowledges the Bay Area's housing affordability and neighborhood stability crisis that is due to a lack of housing, whether market-rate or affordable, given the growing number of residents and jobs. Plan Bay Area 2040 presents a development pattern to build enough housing within the region to accommodate the household growth. The Plan Bay Area identified key Priority Development Areas (PDA) or places identified by Bay Area communities as areas for investment, new homes and job growth. Plan Bay Area 2040 focuses growth and development in nearly 200 PDAs. These existing neighborhoods are served by public transit and have been identified as appropriate for additional, compact development (ABAG/MTC, 2017a). Stanford is located in close proximity to the California Avenue PDA in Palo Alto, and the El Camino Real Corridor and Downtown PDA in Menlo Park (ABAG, 2018). The California Avenue PDA projects to add 330 households by 2040, and the El Camino Real Corridor and Downtown PDA in Menlo Park projects to add 690 households by 2040 (ABAG/MTC, 2017a).

Plan Bay Area 2040 recommends pursuing more ambitious funding, legislative and policy solutions at the state, regional and local levels as well as strengthening and expanding existing regional housing initiatives. The MTC and ABAG are helping to coordinate the Committee to House the Bay Area (CASA), a multi-sector set of partners whose goal is to identify and agree upon significant regional solutions that address the region's chronic housing challenges in the Bay Area. Through stakeholder engagement, research and interviews, CASA is developing a comprehensive regional approach to the housing crisis, focusing on increasing housing supply, improving housing affordability, and strengthening preservation and anti-displacement measures. Objectives include a suite of legislative, financial, policy and regulatory recommendations, with partners agreeing on a path forward and working together on implementation. A final report is expected by the end of 2018 (ABAG/MTC, 2017a).

Stanford depends upon regional housing availability to attract and retain high-quality staff and other workers. Regional housing shortages, should they persist, theoretically could make it more difficult for Stanford to attract and retain faculty and staff over the long term. It is plausible that Stanford could use some of its lands outside the academic campus lands to build faculty and staff housing if the region continues to experience long term housing shortages, or such shortages increase.

Policy and Regulatory Factors

The State, the San Francisco Bay Area, and local governments near Stanford are actively developing and implementing solutions aimed at encouraging housing production. To date, no existing or proposed regulations require an academic institution like Stanford, or any other employer, to build housing for its employees. Rather, the regulations target regional housing supply and focus on creation of incentives for private housing developers to build housing and for cities and counties to plan for and approve housing (Stanford, 2018b).

State Housing Actions

In 2017, the State Legislature enacted a comprehensive package of 15 bills designed to increase housing supply. The approved legislation takes various approaches to increasing the State's supply of housing, especially at affordable levels. Some bills involve streamlining and expedition of the entitlement process for housing. For example, Senate Bill 35 provides, under specified circumstances, a ministerial approval process for multifamily residential developments that include affordable housing. Other bills intend to raise funds through fees and a proposed bond measure for affordable housing construction and related activities. Several other enacted bills strengthen and reinforce existing laws that require localities to plan for housing development and prohibit cities and counties from disapproving proposed housing projects under most circumstances.

So far in 2018, over 20 new bills have been proposed in the State Legislature to address housing supply. While the bills span many areas relevant to housing production, they focus primarily on entitlement streamlining, planning for housing, accessory dwelling units, the State Density Bonus Law, and residential parking requirements (Stanford, 2018b).

Assembly Bill 2853

Assembly Bill 2853 (AB 2853), enacted in 1980, requires all governments to discuss their regional "fair share allocation" of regional housing need by income group in their Housing Elements. In the nine-County San Francisco Bay Area, ABAG is the council of governments authorized under California law to identify existing and future housing needs for the region. The Regional Housing Needs Allocation (RHNA), identifies housing needs in each ABAG jurisdiction and allocates a fair share of that need to every community. ABAG's determination of the local share of regional housing takes into consideration factors including market demand for housing, employment opportunities, availability of suitable sites and public facilities based on local plans, commuting patterns as they relate to the differences between job creation and labor supply, type and tenure of housing and housing needs of farmworkers.

The Regional Housing Need Plan for 2014 to 2022 was adopted by ABAG on July 18, 2013. The total need identified for Santa Clara County was 58,836 housing units, of which only 277 units were allocated for unincorporated areas of the County. San Mateo County's total need is 16,418 housing units. The allocation of 277 units is a substantial decrease compared to the 1,090 units allocated for the 2007-2014 period and reflects Plan Bay Area's emphasis on concentrating housing opportunities within incorporated Priority Development Areas (Santa Clara County, 2018).

Under the 2018 GUP, Stanford anticipates that the 900 net new graduate student units/beds would equate to approximately 450 affordable housing units that would be credited by the County towards its RHNA (County of Santa Clara, 2018). The Santa Clara County's current RHNA is 58,836 additional units by 2022, including 277 units in the portion of unincorporated Santa Clara County that includes the University, and 1,988 units in neighboring Palo Alto (ABAG, 2013).

Santa Clara County General Plan

The Santa Clara County General Plan Housing Element Update 2015-2022 was adopted by the County in June, 2014. Strategy #1 of the Housing Element entails planning for a balanced housing supply, which is supported by *Implementation Measure HG(i), or* maintaining and updating when necessary the Stanford University General Use Permit conditions which link creation of academic space with creation of housing units.

The Housing Element of the Santa Clara County General Plan recognizes that Stanford constructed 816 affordable units under the 2000 GUP, including 298 graduate student housing units recognized as affordable to very-low-income individuals and 518 graduate student housing units affordable to low-income individuals. The County credited all of these units toward its RHNA (County of Santa Clara, 2018)

Conclusions

The land use capacity analysis herein indicates there is space for more on-campus housing within the AGB. Irrespective of on-campus housing, however, Stanford also depends upon the availability of housing in the region to attract and retain high-quality faculty and staff. Stanford has contributed approximately $25.7 million to fund additional affordable housing in the surrounding communities. As of 2017, approximately $13.3 million had been disbursed to five projects totaling 319 units. By completion of the 2000 GUP it will have contributed more than $39 million to this fund (Stanford, 2017a).

Should regional housing shortages persist or worsen, Stanford could see adverse effects on its ability to grow over the long term. Regional housing shortages are unlikely to negatively affect Stanford's ability to continue to attract a diverse and highly qualified student body, as Stanford provides a large amount of on-campus housing for its students, and likely would continue doing so in the future (Stanford, 2018b). However, facilitation of off campus housing availability and affordable housing options for faculty, staff, and other affiliates remains a challenge for the future.

4.7 Transportation

Potential Constraints

The primary development constraints related to transportation include the capacity of the local circulation networks and transportation systems to accommodate traffic during commute hours and special events, and the capacity of the regional transportation infrastructure to support those who commute from distant jurisdictions. If local and regional transportation and transit infrastructure improvements are not realized, traffic and transit congestion could act as a constraint to future growth of the Stanford campus.

Primary regional automobile access to the Stanford campus is provided by US Route 101 (US 101), Interstate 280 (I-280), and El Camino Real (State Route [SR] 82). Major local roadways include Junipero Serra Boulevard/Foothill Expressway, University Avenue/Palm Drive, Embarcadero Road/Galvez Street, Sand Hill Road, and Page Mill Road/Oregon Expressway.

Alternative modes of transportation are also available in proximity to the Stanford campus. Bicycle facilities on- and off-campus include a combination of Class I, II, and III bikeways. There are many transit providers that offer service near Stanford. The Palo Alto Transit Center, located in close proximity to the campus, is a point of convergence for Caltrain and several bus lines operated by VTA, San Mateo County Transit (SamTrans), Alameda-Contra Costa Transit District (AC Transit), and Stanford Marguerite Shuttle. There are free shuttles operated by Stanford (the Marguerite), the City of Palo Alto, and the City of Menlo Park that offer service to Stanford and neighboring cities (County of Santa Clara, 2017).

Caltrain's daily ridership more than doubled in the last 10 years, from approximately 30,000 in 2006 to a record 62,400 in 2016. The 10 highest demand trains operated by Caltrain now have ridership exceeding 100 percent of seated capacity (ABAG/MTC, 2017a). Other transit operators are not experiencing such high volumes. VTA has instituted a Transit Ridership Improvement Program as an agency-wide effort to increase ridership on VTA and improve VTA's operating revenue (VTA, 2018). SamTrans has experienced variable fixed-route bus ridership over the past five years with a total ridership increase of 1.9 percent from 2012-2016 (SamTran, 2018). Between 2007 and 2012, AC Transit ridership and service levels dropped to their lowest levels in the past decade. The decrease was directly attributed to the economic recession, which forced AC Transit to reduce service by nearly 15 percent in 2010. Despite a degradation in the service network from the 2010 service cuts, ridership increased by nearly 5 percent from 2012 to 2014. The ridership growth is evident on Transbay routes where AC Transit has received recent complaints of overcrowding (AC Transit, 2018).

In addition to local transit, an extensive public transit network of rail, buses, and ferries serves the greater San Francisco Bay Area. The impacts of the recent economic boom and widening housing crisis, and the resulting disconnect between where people live and work, has contributed to record levels of freeway congestion and unprecedented crowding on transit systems like Caltrain, Bay Area Rapid Transit (BART), and San Francisco's Municipal Railway

(Muni). Average commute time in the Bay Area is at an all-time high, as are time spent commuting and miles traveled in highway congestion (ABAG/MTC, 2017).

Trends and Forecasts

Campus Transportation Patterns

While Stanford houses approximately 93 percent of all its undergraduates on its campus, and over half of its graduate students (Stanford, 2018b), the University does contribute to traffic congestion in the area surrounding campus largely due to commuting students, faculty, visitors, and other staff, and also due to off campus trips by campus residents. There is commute auto use in communities located within 10 miles of the campus, and relatively high commute bicycle use in communities located within 5 miles of the campus. However, there are also clear and consistent patterns in the commute travel mode based on the availability of, and proximity to, alternative modes such as Caltrain (East San Francisco and then along the Peninsula) and the Dumbarton Express bus service (Newark and Fremont) (County of Santa Clara, 2017).

Of Stanford commuters in 2015, approximately 43.3 percent drove alone, 23.1 percent used rail, 19.9 percent biked, 8.0 percent carpooled, 2.9 percent used a local bus routes, and 2.8 percent used an express bus route. Due to the 2018 GUP expanded TDM program, the campus commuter drive alone rate is expected to decrease to 36.5 percent, and the commuter rail rate is conservatively projected to increase to 29.9 percent in 2035, if the increase in alternative mode trips was accommodated on Caltrain. The bicycle, carpool, local and express bus commute rates are projected to remain unchanged from their 2015 rates (County of Santa Clara, 2017).

Campus Transportation Program

The 2000 Stanford Community Plan establishes a standard for the Stanford campus of “No Net New Commute Trips” (specifically applied to vehicle trips in the peak hour and peak direction) compared to measured baseline conditions (from 2001). To date, Stanford has achieved this standard each year through a combination of onsite trip reduction programs and offsite programs that have removed trips from the roads nearest to the campus (County of Santa Clara, 2017).

Stanford’s Transportation Demand Management (TDM) program has decreased the drive-alone rate of Stanford’s commuting employees from 72 percent in 2002 to 50 percent in 2017. When students who commute to campus are accounted for, the combined employee and student drive-alone rate has fallen from 67 percent in 2002 to 43 percent in 2017. Thus, as Stanford has been increasing facilities and expanding campus population, the number of vehicles traveling to the campus has remained within the baseline established in 2001 (Stanford, 2018).

Stanford’s TDM program uses combinations of rewards and penalties to reduce its drive-alone rate. For example, the Commute Club rewards those that do not drive alone to campus with free transit passes and other benefits, while the cost of parking penalizes those who drive. In addition, Stanford offers free transit passes for employees, free first-last mile Marguerite Shuttles that connect to public transit, and a ride and car share program (Stanford, 2018). Stanford’s Commute Club has grown from 3,600 members in 2002 to more than 9,000 in 2017, and ridership on the Marguerite shuttle has risen to 3.2 million annually (Stanford, 2017).

Charging for parking provides an important disincentive for driving to campus, making sustainable commute options more attractive. Stanford requires that people driving to campus, including visitors, campus residents, and commuters, pay for parking. In addition, Stanford restricts freshmen from bringing cars to campus. By restricting cars in the freshman year, students can take advantage of alternative transportation options available to them. In subsequent years, their need for a car will not be as likely (Stanford, 2017).

Stanford has also been supporting public transit systems, as opposed to running an exclusive commuter bus system, thereby aiding and enhancing service for the broader community. Stanford has worked with public transit agencies to supplement public transit routes, such as the Dumbarton Express, with additional Stanford-funded services such as the U Line and the AE-F Line (Stanford, 2018e).

Stanford is also a bicycle-friendly campus with high numbers of students and others using bikes to get around. In addition to supporting its on-campus bicyclists, Stanford promotes commuter cycling as a TDM strategy. Secure bicycle parking and clothes lockers are offered to make it easy to commute by bicycle. Other resources available for both commuters and intra-campus bicyclists include bike maintenance facilities, safety classes and discounted equipment (Stanford, 2017).

Stanford's Parking & Transportation Services offers a variety of educational and other programs to provide education and information designed to encourage use of alternative transportation modes including transportation information and bike resources for new undergraduates, commute planning assistance, an informational website, and online transit pass sales (Stanford, 2017).

Stanford's residential and commuter parking demand has been decreasing on a per capita and per square foot basis due to implementation of Stanford's TDM programs and nationwide trends of reduced vehicle ownership by the student population. From 2004 to 2015, commuting graduate students have reduced their drive-alone mode share from approximately 60 percent to approximately 40 percent. Stanford residential parking permit sales have also declined for both graduate and undergraduate students. The number of commuter parking permits purchased has declined on a per square foot basis from 2003 to 2015, remaining relatively flat since 2009 as campus square footage has increased. (Stanford, 2017).

Transportation Analysis of the 2018 GUP

The Draft EIR for the proposed 2018 GUP found that development under the proposed 2018 GUP could increase local traffic volumes by generating approximately 751 additional inbound vehicle trips in the AM peak hour and approximately 779 additional vehicle outbound trips in the PM peak hour if Stanford did not expand its TDM program. Mitigation measures were identified in the Draft EIR that would reduce the transportation impacts of additional development and population growth either by continuing the current program of "no net new commute trips", or by funding improvements for adversely affected intersections, proportionate to Stanford's impact on those intersections.

The EIR found that mitigation would substantially reduce traffic congestion impacts to intersections and area freeway segments and off-ramps; however, adverse impacts related to increases of traffic volumes at nearby intersections and on area freeways were considered significant and unavoidable because it is uncertain whether it would be feasible to improve some of the affected roadways if the No Net New Commute Trips standard is not achieved, if there are not sufficient additional funds to complete the intersection impacts, or if there are not sufficient off-campus projects available to reduce peak hour traffic. Many of the intersections adversely affected are located in other jurisdictions that govern and operate independently of Stanford, and any improvements would be subject to available funding, right-of-way considerations, and their own environmental review.

The Draft EIR found that between 2018 and 2035, total vehicle miles traveled (VMT) at Stanford would increase slightly but VMT per capita (students plus staff) would decrease,[22] due in part to adding 550 faculty/staff housing units on the campus. Since these units would be in the core area of the campus, Stanford workers living in this housing would choose to use alternative modes of travel including bicycling, walking, or riding the Marguerite.

With buildout of the 2018 GUP, the daily VMT per capita for those living on campus is expected to increase because the ratio of graduate student housing to undergraduate student housing would change and because additional faculty/staff housing would be added. Prior to the EV Graduate Residences project, Stanford housed approximately 55 percent of its graduate students on the campus. With the EV Graduate Residences, Stanford will house more than 70 percent of its graduate students on campus. Graduate students have a higher daily VMT per capita than undergraduate students. Some spouses of graduate students are assumed to generate home-based work trips off-campus and both the graduate students and spouses generate more home-based-other trips than undergraduate students. Further, by Fall 2035, Stanford is proposing to add up to 550 new housing units occupied by faculty/staff. These new faculty and staff would generate additional home-based trips at a per capita rate that is higher than the addition of student housing units. While faculty and staff living in campus housing would likely commute by alternative modes, spouses and other family members may drive to their workplaces and all residents may drive to non-work-related destinations.

Despite the increases in total VMT associated expected with development under the 2018 GUP, Stanford's per capita VMT for is expected to remain well below the regional average for both workers and residents.[23] **Table 4-8**, based on information presented in the 2018 GUP Draft EIR, compares Stanford's average VMT per capita for its residents (students, faculty and staff housed on campus) and "workers" (students, faculty, staff, and contractors who visit from off-site) in 2018 and 2035 in comparison with regional averages. Worker VMT accounts for trips that start at home and end at work, or start at work and end at home. Resident VMT includes all trips that originate at the home, including trips related to work, shopping, recreation, or school.

Table 4-8: Stanford's 2018 and 2035 VMT per Capita Compared to Regional Average

Traveler	Stanford Fall 2018 VMT per Capita	Stanford Fall 2035 VMT per Capita	Regional Average VMT per Capita
Workers	4.64	4.53	16.18
Residents	9.27	10.75	17.33

Source: County of Santa Clara, 2017

22 See Tables 5.15-39 and 5.15-40 in the DEIR.

23 Regional average VMT is derived from the VTA transportation model, which is a trip-based model developed and validated for the estimation of trips made for home-based work, home-based non-work and non-home based trips, and establishes the Bay Area and Santa Clara County average daily VMT per worker and per capita at an aggregate level.

The primary reasons that Stanford's Worker VMT generation is so low compared to the regional average include the university's TDM program and the provision of on-campus housing for faculty and students, which reduces worker VMT since living on campus eliminates home-based work vehicle trips. Similarly, the primary reason that Stanford's Resident VMT generation per capita is so low compared to the regional average is that Stanford campus residents can commute to work or class without using personal vehicles (County of Santa Clara, 2017).

Additionally, due to the expanded TDM program under the proposed 2018 GUP, the campus commuter drive alone rate is expected to decrease to 36.5 percent from 43.3 percent in 2015, and the commuter rail rate could conservatively increase to 29.9 percent in 2035 from 23.1 percent in 2015. For purposes of performing a transit capacity analysis, the bicycle, carpool, local and express bus commute rates were assumed to remain unchanged from their 2015 rates (19.9 percent, 8.0 percent, 2.9 percent, and 2.8 percent, respectively) (County of Santa Clara, 2017). Along with the expected increase in the Stanford commuter rail rate, Caltrain capacity is expected to increase with electrification and other modernizations allowing for an additional peak hour train trip and, even more significantly, an expansion from five-car to eight-car trains. These improvements would provide enough capacity at the peak load points affected by Stanford to meet demand (County of Santa Clara, 2017).

Future Transportation Scenarios

Plan Bay Area is the regional blueprint for short-term and long-term transportation investments in the nine-county San Francisco Bay Area, jointly developed and adopted by the Association of Bay Area Governments (ABAG) and the Metropolitan Transportation Commission (MTC). The plan was adopted in 2013 and updated in 2017 as *Plan Bay Area 2040,* charting the course for transportation investment and land use priorities for the next 25 years. It identifies key Priority Development Areas (PDA) or places identified by Bay Area communities as areas for investment, new homes and job growth, and Transit Priority Areas (TPA) or areas within one-half mile of an existing or planned major transit stop such as a rail transit station, a ferry terminal served by transit, or the intersection of two or more major bus routes.

Through the Plan Bay Area 2040 effort, MTC worked with local jurisdictions, transit operators and the California Department of Transportation (Caltrans) to develop cost estimates for operating and maintaining the Bay Area's transit system, local street and road network, the state highway system, and local and regional bridges. MTC also worked with partner agencies to determine funding needs for projects that would expand capacity and increase system efficiency beyond operating and maintaining the existing system. Plan Bay Area 2040 also directs almost two-thirds of future funding to investments in public transit, mostly to ensure that transit operators can sustain existing service levels through 2040.

The Plan Bay Area 2040 also identifies key transportation strategies, and investments to focus growth in PDA and TPA areas. Stanford is located within a TPA area, and is located in close proximity to the California Avenue PDA in Palo Alto, and the El Camino Real Corridor and Downtown PDA in Menlo Park (ABAG, 2018). Thus, the areas surrounding Stanford have been identified by the Plan Bay Area as appropriate for additional, compact development.

As Stanford's population grows, there will be an increase in demand for transit services and alternatives. Over the long-term the regional transit infrastructure needs to keep pace or transit capacity in combination with road congestion could limit growth and development.

In the next 5 to 10 years the region will see major infrastructure and transit investments in the regional network, such as Caltrain electrification, US 101 Managed Lanes, and extending BART to the Silicon Valley (ABAG/MTC, 2017a). Regional investments from recently implemented or pending taxes such as the State Gas Tax (SB1), Regional Measures 3 (bridge toll), and county transportation ballot measures are making it clear that the public is willing to invest in mobility infrastructure (Stanford, 2018).

Caltrain is working to improve efficiency, increase capacity, and serve the influx of daily riders over the past 10 years. The 2015 Caltrain Strategic Plan outlines planning through 2024 for a Caltrain/High-Speed Rail (HSR) blended system on the Peninsula and the Caltrain Modernization Program. The Caltrain Modernization Program includes electrification and other projects that will upgrade the performance, efficiency, capacity, safety and reliability of Caltrain's service. Electrification provides the foundation that future CalMod improvements are based on, including full conversion to an electric fleet, platform and station improvements, the extension of service to Downtown San Francisco, and other projects that allow Caltrain to grow and evolve with the Bay Area. The Caltrain/HSR blended system in the San Francisco to San Jose corridor will support modernized Caltrain service and high-speed rail service primarily on shared tracks substantially within the existing Caltrain corridor (Caltrain, 2014).

Meanwhile, transportation technology is rapidly changing. Autonomous vehicles (AVs) are poised to change the transportation landscape in the near future. AVs could allow for improved crash avoidance, increased highway speeds due to improved safety, increased road capacity, and reduced traffic congestion (University of Michigan, 2017). Current road infrastructure may need to be updated for AVs to function optimally. Street lighting may need to be changed to optimize for radar vision instead of human sight. State and local governments may need to invest in radically changing roadways, including networking streetlights and installing sensors at intersections and elsewhere (Council of State Governments, 2017). Many cities and states, including California, are taking action to form policies and land use principles (University of Michigan, 2017).

Additional Policy and Regulatory Factors

Senate Bill 743

In 2013 the State enacted SB 743, which started a process intended to fundamentally change transportation impact analysis for purposes of CEQA. These changes include elimination of auto delay, level of service (LOS), and other similar measures of vehicular capacity or traffic congestion as a basis for determining significant impacts for transit priority areas and infill opportunity zones. SB 743 reflects a Legislative policy to balance the needs of congestion management with statewide goals related to infill development, promotion of public health through active transportation, and reduction of greenhouse gas emissions.

Stanford Community Plan

The Stanford Community Plan (December 2000) is a component of the Santa Clara County General Plan. The Stanford Community Plan provides the County General Plan policies for Stanford's academic campus. The Circulation chapter of the plan provides a description of the transportation network and services on the campus, and defines strategies, policies, and implementation steps related to transportation.

As described above, the Stanford Community Plan establishes a goal to achieve "No Net New Commute Trips", which Stanford has been able to achieve since 2002. This means that as Stanford has grown, the number of vehicles entering or leaving the campus during the commute period has not increased.

Valley Transportation Plan 2040

The Santa Clara County Valley Transportation Authority (VTA) is responsible for countywide transportation planning, including congestion management, design and construction of specific highways, pedestrian, and bicycle improvement projects, as well as promotion of transit oriented development. The VTA's current long-range transportation plan is the draft *Valley Transportation Plan (VTP) 2040,* adopted in October 2014. The three objectives of the plan are:

- To facilitate the creation and support of an integrated multimodal transportation system that serves all socio-economic groups efficiently and sustainably;
- To pursue, develop, and implement advances in technology, management practices, and policies; and
- To be the region's foremost advocate for transportation projects, programs, and funding.

The plan highlights the projects and programs that will be pursued in partnership with member agencies in the next 25 years. Some of the types of projects being pursued are complete streets, express lanes, bus rapid transit, and bicycle/pedestrian improvements.

Santa Clara County 2015 Congestion Management Plan

VTA also functions as the County's congestion management agency, and maintains and implements the Congestion Management Program (CMP). The current document, the *2015 Congestion Management Plan*, was adopted in October 2015. This document includes updates to previous standards and practices, including an emphasis on multimodal analysis and the renaming of the Deficiency Plan Element to the Multimodal Improvement Plan Element to reflect the need to shift travelers from autos.

Santa Clara Countywide Bicycle Plan

In 2008, VTA completed the *Santa Clara Countywide Bicycle Plan* (SCCBP), which provides a foundation for maintaining and enhancing the countywide bicycle network. The County is in the process of updating this document to incorporate the advances in bicycle infrastructure design and cultural shift toward bicycling. The vision of the SCCBP is to establish, protect, and enhance bicycling as a viable transportation mode and to assure that bicycling is a practical and safe mode of travel, by itself and in combination with other modes.

San Mateo County Congestion Management Program

City/County Association of Governments of San Mateo County (C/CAG) functions as San Mateo's County's congestion management agency, and as such, maintains, implements and periodically updates the County's Congestion Management Program (CMP). The first CMP for San Mateo County was adopted by C/CAG in 1991 and was last updated in 2015, with monitoring reports provided every two years. The overall goal is to help C/CAG promote countywide solutions to transportation problems based upon cooperation and mutual support.

San Mateo County Comprehensive Bicycle and Pedestrian Plan

C/CAG and the San Mateo County Transportation Authority (SMCTA) developed the 2011 San Mateo County Comprehensive Bicycle and Pedestrian Plan (CBPP) to address the planning, design, funding, and implementation of bicycle and pedestrian projects of countywide significance. The CBPP identifies five specific bikeway and pedestrian network projects, which includes over/undercrossing, arterial crossing and interchange improvement projects, near the Stanford campus and in the City of Menlo Park.

Conclusions

The Bay Area is faced with worsening traffic congestion and growing needs for transportation infrastructure improvements. Transit improvements are being implemented with varying success across regional transit agencies, and will continue to be planned for in the future, but ridership is generally not keeping pace with regional growth. Technological innovations are rapidly occurring that have the potential to increase roadway capacity and relieve traffic congestion; coordinated regional planning efforts are already underway in recognition of the rapid development of autonomous vehicles (AVs) and the corresponding need for additional infrastructure and new legislative policies.

While regional transportation improvements remain a concern, Stanford has achieved significant reductions in drive-alone trips on campus with its TDM program and the “No Net New Commute Trips” goal. Additionally, Stanford’s VMT is low compared to the regional average due to its TDM program and the provision of on-campus housing for faculty and students.

Stanford may be more resilient to regional transportation infrastructure constraints than many employers. Stanford has collected extensive data about the transportation needs of its workforce over many years, and has used the data to develop a wide range of transportation options. Stanford is continuing to add state-of-the-art transportation programs, while also exploring remote work locations and technological innovations that can enable employees to reduce the number of days they must travel to the campus (Stanford, 2018).

4.8 Public Services

Potential Constraints

Students, faculty, and staff at Stanford, as well as their families, are served by both on- and off-campus public services, including fire protection and emergency medical services, police protection, schools and libraries. Potential constraints to these services primarily relate to their service capacity in direct relationship to demand from their service population. Fire, police, and schools services operate on publicly approved annual budgets and performance metrics set by their annual reports.

Due to the infill nature of residential development within county and city limits, and by future growth within the AGB, there are no *hard-line* constraints related to public services, such as a fundamental lack of service from being located in a remote or inaccessible region, thus constraints are essentially related to the supply of services, which can be alleviated through increased staffing, new facilities, and modified annual budgets.

Trends and Forecasts

Each public service operates within its own metric of service capacity and annual service budget; therefore, these services are addressed individually with respect to their trends and forecasts. Overall, the Draft EIR for the proposed 2018 GUP identified no constraints related to public services. The following discussion of fire, police and schools provides a high-level consideration of current demand and future needs, recognizing that there is not a resource constraint related to these services. Additional detail for each of these subtopics may be found in Section 5.13 of the Draft EIR.

Fire Protection and Emergency Services

Palo Alto Fire Department (PAFD)

The Palo Alto Fire Department (PAFD) provides fire protection and suppression, and emergency medical service (EMS), for all areas within the jurisdictional boundaries of Palo Alto in addition to some of the unincorporated land surrounding the city limits, including Stanford University. EMS is the primary service the PAFD provides to Palo Alto and Stanford. The PAFD is the only fire department in the County that provides ambulance and transport services. All responding fire engine and ambulances to emergency calls include paramedics (City of Palo Alto, 2017a).

In addition to its primary service area, the City of Palo Alto maintains mutual aid and automatic aid agreements with the City of Menlo Park, the California Department of Forestry and Fire Protection (CAL FIRE), the Santa Clara County Central County Fire Department (CCFD), the City of Mountain View, and the Woodside Fire Protection District in San Mateo County (Local Agency Formation Commission (LAFCO) of Santa Clara County, 2010).[24]

In 1976, the City of Palo Alto and Stanford signed an agreement for the PAFD to provide EMS, fire protection and rescue services for the university. This agreement is set to terminate in 2026. The agreement specifies that the PAFD occupy and operate Stanford Fire Station (Station 6), located at 711 Serra Street in the northeastern portion of the Academic Growth Boundary within the Project site. The agreement, and subsequent amendments, also establish that Stanford's fair share be reimbursed to the City of Palo Alto for fire protection services.[25] The City of Palo Alto assesses fire protection needs through its annual budget, and as part of this process, the City identifies Stanford's share and Stanford pays its annual allotment.

California Master Mutual Aid Agreement

The California Master Mutual Aid Agreement is a framework agreement between the State of California and local governments for aid and assistance by the interchange of services, facilities, and equipment, including but not limited to fire, police, medical and health, communication, and transportation services and facilities to cope with the problems of emergency rescue, relief, evacuation, rehabilitation, and reconstruction.

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[24] Mutual aid and automatic aid agreements call for the department with crews closest to the incident to respond to the call, and to provide assistance before, during, and after an emergency event in order to facilitate the rapid mobilization of personnel, equipment, and supplies.

[25] Until 2013, the agreement also provided coverage through a fire station at the SLAC National Accelerator Laboratory in unincorporated San Mateo County, however, that station has since been closed and fire protection service for that land is now provided under a contract with the Menlo Park Fire Protection District.

Fire Protection and Emergency Services Trends and Forecasts under the 2000 and 2018 GUP

As under the 2000 GUP, during operation under the proposed 2018 GUP, Stanford would pay the City of Palo Alto a fair share contribution annually for PAFD fire protection services and for communication and emergency dispatch services from the PAPD.

Future growth by Stanford would require continued service by local emergency and fire suppression services, which would warrant future agreements to extend or modify the existing funding structure with the PAFD.

Police Protection Services

Stanford Department of Public Safety (DPS)

Police protection for Stanford is provided by the DPS under the authority of the County of Santa Clara Sheriff's Department. The Stanford DPS provides a variety of services, including law enforcement, crime prevention, emergency response, and traffic and parking control. A Memorandum of Understanding (MOU) regarding police services between the County of Santa Clara and Stanford provides for sworn Stanford Deputy Sheriffs to have full law enforcement powers to make arrests and enforce State laws and county ordinances. The MOU does not contain an expiration date (Stanford and County of Santa Clara, 2007; Stanford University, 2016).

The Stanford DPS primary administrative functions are currently housed in the Fire and Police facility on the Stanford campus. When Stanford DPS has temporary needs for additional police support (e.g., large events) it contracts with private security companies that provide additional off-duty officers. The Stanford DPS uses a variety of factors, including call volumes and population, to determine the adequacy of its staffing levels (Stanford University, 2017).

Santa Clara County Sheriff's Office

The Santa Clara County Sheriff's Office provides police protection services to all unincorporated areas of Santa Clara County, including Stanford (in conjunction with Stanford DPS) as discussed above, as well as the City of Saratoga, Town of Los Altos Hills, and the community of Moffett Field.

City of Palo Alto Police Department (PAPD)

The PAPD provides police protection service to the City of Palo Alto, including Stanford-owned lands adjacent to Stanford within the Palo Alto city limits (e.g., Stanford Shopping Center and Medical Center). The PAPD operates a Communications Center that handles dispatching for the PAPD, PAFD, the City of Palo Alto Utilities and Public Works departments, and for the Stanford DPS. Stanford pays the City of Palo Alto a fair share contribution annually for the communication and dispatch services it receives from the PAPD.

Police Protection Services Trends and Forecasts under the 2000 and 2018 GUP

Under the 2000 GUP, as referenced above, Stanford pays the City of Palo Alto a fair share contribution annually for the communication and dispatch services it receives from the PAPD. This arrangement is expected to continue under the proposed 2018 GUP. Future communication and emergency dispatch services received from the PAPD would be similarly compensated by a fair share contribution for the services provided. Additionally the DPS, as managed by Stanford, would continue to operate under a MOU, modified as needed to serve the university.

Public Schools – Palo Alto Unified School District (PAUSD)

The PAUSD service area covers the Palo Alto, portions of the town of Los Altos and Portola Valley, and Stanford. PAUSD operates 13 elementary schools (grades K-5), three middle schools (grades 6-8), and two high schools (grades 9-12). The nearest PAUSD elementary and high schools to Stanford are Escondido Elementary School, Lucille M. Nixon Elementary School, (both located on the Stanford campus, though outside the AGB), and Palo Alto High School. In addition, the PAUSD currently operates a pre-school, a Young Fives program, a self-supporting Adult School, the Hospital School at Stanford's Lucile Packard Children's Hospital, and Summer School.

During the 2016/17 school year, PAUSD elementary schools had 5,214 students in attendance and a capacity of approximately 5,521 students, PAUSD middle schools had 3,094 students in attendance and a capacity of approximately 2,950 students, and PAUSD high schools had 3,848 students in attendance and a capacity of approximately 4,500 students (California Department of Education [DOE], 2017; and PAUSD, 2017).

Leroy F. Greene School Facilities Act of 1998 - Senate Bill 50 (SB 50)

The California Legislature passed SB 50 in 1998, which authorized school districts to impose fees on developers of new residential, commercial, and industrial construction to offset impacts of increased school capacities. SB 50 was codified in California Government Code sections 65995.5 through 65997.

Pursuant to Government Code sections 65995.5 through 65995.7, school districts may collect fees to offset the costs associated with increasing school capacity as a result of development. Three levels of development fees may be levied upon new construction. Level 1 fees are the maximum amount of fees that can be imposed on new development as set by the State Allocation Board. In general, Level 2 and Level 3 fees apply to new residential construction only. Both Level 2 and Level 3 funds only may be levied if the school districts have conducted and adopted a school facility needs analysis. Specifically, Government Code 65997 establishes a State preemption of school mitigation. Under the terms of this statute, payment of school development fees is considered, for the purposes of CEQA, to mitigate in full any impacts to school facilities associated with a development project. Government Code 65997(b) restricts the ability of local agencies to deny project approvals on the basis that public school facilities (e.g., classrooms and auditoriums) are inadequate.

The PAUSD collects school impact fees on new residential and commercial development within the PAUSD's boundaries, including that developed by Stanford. Prior to issuance of a building permit for a development at Stanford, the County requires that Stanford submits the appropriate school impact fees to PAUSD, and that PAUSD has confirmed receipt of payment.

Public Schools Trends and Forecasts under the 2000 and 2018 GUP

Under the 2000 GUP, Stanford constructed far fewer family housing units than were anticipated in the 2000 GUP EIR, resulting in less than 10 percent of the increase in school-age children that was anticipated in the report. In accordance with 2000 GUP Condition P.7, as of June 2016, Stanford paid approximately 1.2 million dollars in school impact fees to the PAUSD. Stanford will continue to pay the fee for the remaining development authorized under the 2000 GUP including the 2,020 net additional graduate student beds under construction, accruing an additional

1.3 million dollars for the PAUSD. As identified in the 2000 GUP EIR, the fees paid by Stanford provided adequate support to the PAUSD to avoid potential constraints to schools.

The 2018 GUP similarly found that the school impact fees for new residential and commercial development that would be developed by Stanford under the proposed 2018 GUP would be adequate to serve school demands.

Future Public Service Scenarios

Increased development by Stanford would result in increased population and more buildings that would generate higher frequency calls for service from local fire and police facilities, and generate a higher student population attending nearby public schools.

New development would adhere to regulations for emergency accessibility and fire and safety design features, minimizing the additional fire and police service demands needed. Through continued on-campus safety measures and police staffing and through updates to service contract negotiations with local law enforcement, dispatching and police services could presumably be adequately met. Should it be determined in the future that there is a significantly higher need for police support, new staff could be hired, equipment purchased and facilities constructed. This argument also applies to fire protection. While an increase in Stanford's population and buildings may result in a higher frequency of emergency calls and need for dispatch, that increase in level of service could be offset through updates to service contracts with the fire department.

With regards to local schools, Stanford's growth of faculty and graduate housing units will generate a higher demand for classroom space in local schools. Children living in these units could be served at existing schools or by new facilities that the local school district determines is needed through its normal planning processes.

Conclusions

Ultimately, each of these public services is subject to annual review and forecasting to measure the success of current operations and identify gaps in service. Future growth by Stanford would require a public review process that would feed into each of these public service provider's own models for projected growth and service demand. Therefore, public services is an example of a malleable constraint that is subject to change and growth itself based on service capacity ratios, response times and class size. Long term provision of these services will most likely be provided through additional funding and/or improvements to service efficiency to meet demand. Therefore, public services do not represent a likely constraint to future growth.

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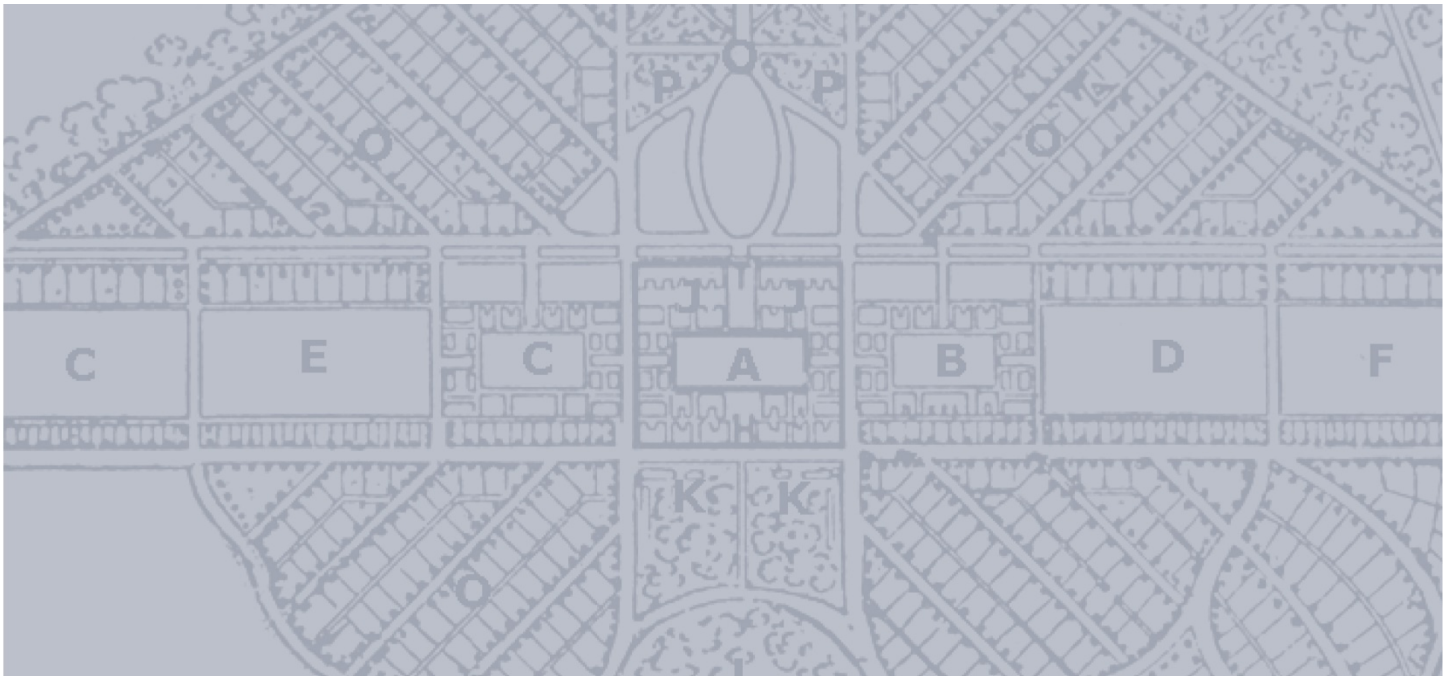


5. Envisioning the Distant Future

Land use and infrastructure planning in California is typically undertaken for time horizons that strike a balance between the need to take a long-term view and the inaccuracies inherent in long-term forecasting. Whether it is local government general plans, sustainable community strategies, capital improvement plans, water management plans, and the like, typically they are prepared for a planning horizon of approximately 20 years, and they are typically updated every decade or thereabouts. Plans focused on the coming one or two decades can be undertaken with a general understanding of the technology and societal norms that will be present over the planning period.

The General Use Permit that the County uses to regulate development in the unincorporated Santa Clara County portion of the Stanford campus was reconsidered and approved in 1989 and 2000. A new General Use Permit is currently under consideration; if approved, the proposed 2018 GUP is anticipated to regulate development on the campus through 2035. These periodic GUPs occur on a frequency that is comparable to the planning processes undertaken by local governments.

The time horizon of development on the Stanford campus considered in this document is 50 to 100 or more years, well beyond the planning horizon for typical long-range plans. Consideration of the very long-term future means through the lens of the current environment is invariably uncertain and speculative.

This chapter provides discussion of trends and dynamic change that could affect the degree to which constraints may influence long-term growth at the Stanford campus.

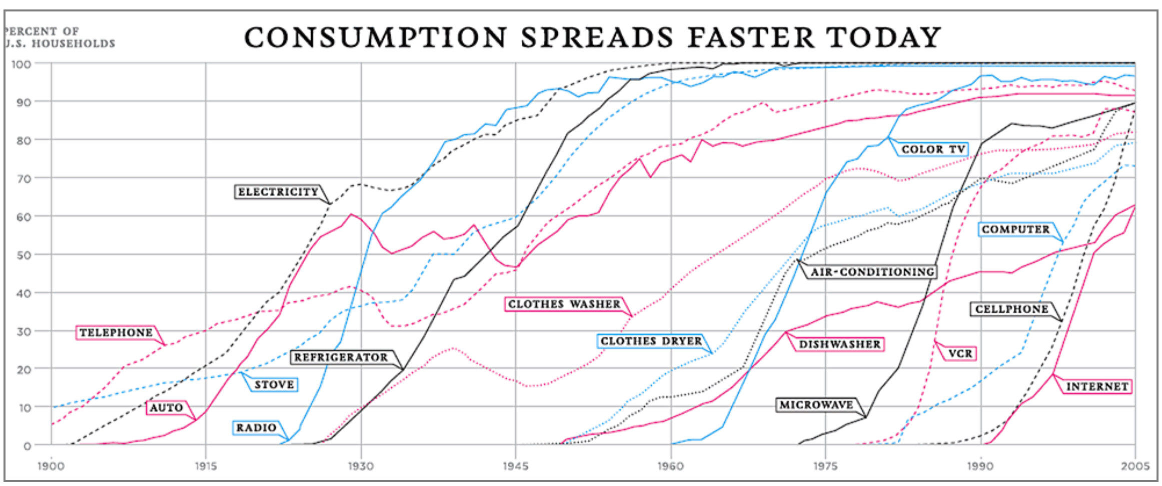
5.1 The Past as Future

In order to understand the nature of change in the future, it is worth consideration of the magnitude of change in the past. A century ago one could scarcely imagine daily life in 2018. In 1918, the country was embroiled in World War I. Movies were silent and television had not been invented. Electric consumer products were unknown and computers were a distant fantasy. Social Security did not exist, nor did contraception or credit cards. The concepts of space travel, the internet, or even smart phones would have been the realm of science fiction.

Rapid technological developments are changing our daily lives in ways that no one could have predicted in 1918, and the pace of change is accelerating dramatically. The chart shown in **Figure 5-1** below, created by Nicholas Felton of the New York Times, shows just how much faster changing technologies are being adopted in our modern era than they were a century ago. From the telephone to the refrigerator to color television to the internet – over the past century the uptake of new inventions by US households has taken less and less time. It took decades for the telephone to reach 50% of households, starting before 1900. It took five years or less for cellphones to accomplish the same penetration in 1990. As recently as 1994, fewer than 10 percent had a cell phone or access to the internet, in a matter of 15 years the internet was available in over 60% of U.S. households, and nearly 90% of households had a cellphone.

This increase in the pace of change and technological evolution means that our ability to predict the future is increasingly challenged.

Figure 5-1: The Pace of Technological Change since 1900



Source: Felton, 2008

5.2 California's Foreseeable Planning Horizon

Along with technological change has come population growth. California had 3.4 million people in 1920; today it has nearly 40 million. California continues to grow, albeit at a lower rate over the last decade then in prior decades. According to the Public Policy Institute of California (PPIC), future projections suggest this pattern will continue, with almost all of the state's population growth expected to come from natural increase rather than migration (PPIC, 2018). California's population is projected to be 50 million or more by the middle of this century and as many as 92 million by 2100 (Landis, 2003).

While California's population growth has moderated in recent years, much of the growth over the next 40 years is expected to occur in the inland parts of the state as opposed to the more urbanized coastal areas, but the San Francisco Bay Area is still projected to grow more quickly than the state overall. Santa Clara County alone is expected to add approximately 1 million people from 2010 to 2060, and potentially another 1 million by 2100 (CDF, 2017b; Landis, 2003).

Despite uncertainties, there are efforts to match long-term growth predictions with long-term plans. For example, California is planning to achieve deep reductions in GHG emissions by 2050, despite increases in population. In 2015, the Governor's Office of Policy and Research (OPR) released and adopted the first update to its Environmental Goals and Policy Report (EGPR) since 1978, offering a forward-looking strategy for continued prosperity in new era of carbon limits. The 2015 EGPR update, entitled *A Strategy for California @ 50 Million*, describes how land use planning will need to accommodate a growing and aging population, while enabling the state to continue to grow economically and thrive in the face of a changing climate. *California @ 50 Million* proposes development goals that are compatible with the State's long-term climate change goals, to substantially reduce land consumption for new development, reduce vehicle miles traveled, accelerate the transformation of the State's energy and transportation to low-carbon, and prioritize the conservation of high quality agricultural land (OPR, 2015).

5.3 The Future of Education

California's economy, as with other parts of the national and international economies, increasingly demands highly educated workers. For decades, employment growth has been strongest for workers with college degrees, driven by changes across and within industries. For example, California's relatively rapid growth in the health care and information technology sectors is increasing demand for qualified workers, who generally need college degrees. Also, within most sectors, more jobs are requiring degrees than ever before (PPIC, 2018).

The continuing demand for a highly skilled workforce ensures that education will continue to play a crucial role in helping California and the U.S. remain economically competitive. As such, Stanford believes its research and residential education programs will continue to thrive for many years beyond the 2035 planning horizon of the proposed 2018 GUP, affected as they may be by societal, technological, and environmental dynamics. Much of the literature predicts learning environments will change profoundly over the course of the 21st Century as on-line delivery proliferates and a broader range of professional credentials and accredited certificates competes with the traditional 4-year degree. This could conceivably reduce the need for traditional brick-and-mortar universities significantly (Stanford 2018a).

Like many institutions of higher learning, Stanford is experiencing a move away from specialized departments and towards interdisciplinary programs that thrive on a concentration of academic life where close proximity and density can foster collaboration and creativity. Indeed, much of Stanford's recent physical growth is in response to the need to house new collaborations and multi-disciplinary research. The proliferation of distance learning technologies and the explosion of digital content is changing how professors and students interact, and changing the nature and functional requirements of libraries and research centers. With virtual experiences and online learning becoming more prevalent, some facilities like the traditional lecture hall may go the way of the Model-T, but Stanford believes there will always be a demand for a dynamic campus that supports social interaction and shared experience, including plazas, performance spaces, and athletic spaces and pavilions.

5.4 Future Opportunities and Constraints

Looking out 50 to 100 years or more, it is reasonable to expect that continued social and technological innovation will shape much of the urban infrastructure that affects and is affected by the growth of the Stanford campus. The constraints identified herein, most notably the lack of affordable and proximate housing; increased levels of congestion; availability of water supply and other public utilities; and concerns about climate change, influence the evolution of our urban landscapes. All of these elements can and will be altered due to evolving technologies and social norms.

It is noted in Chapter 4 that the lack of affordable and proximate housing could become a constraint to growth at the Stanford campus, as well as other major employers and the overall economic growth of the region. Projecting to the long-term future, it is unlikely that the basic requirements for housing will change materially. Over millennia human homes have met the essential requirements of a place for sleeping, congregation, food preparation, and sanitation. Observations of housing in increasingly expensive and dense urban areas suggest that future housing units will be smaller and more densely sited.

Looking to the very long-term, futurists have speculated that urban development, including homes, will become more self-contained with such features as on-site treatment and disposal of human wastes. As early as 2020, it is expected that California's Title 24 energy standard will be amended to require residential uses to be net zero consumers of energy. Futurists have speculated that in the future, it is possible that homes will be almost fully independent of the energy grid, designed to produce, store, and reuse their own energy, using "microbial fuel cell stacks" and more efficient solar panels to generate electricity, and power-banks like the Tesla Powerwall to store it for future use (Jaquith, 2017).

The ability to develop housing without creating community-scale burdens on infrastructure could materially improve the ability to develop housing in a more affordable manner and at locations of need. To the extent that such technological advances in urban development occur as described above, the availability of housing could be materially increased, while many of the infrastructure constraints that limit or burden housing development could be overcome.

It is likely that technology will evolve over the long term in the transportation industry to an even greater degree than in the housing industry. Technologies such as Hyperloop and mag-lev trains have the potential to materially alter the inter-city transportation system. Local and regional transportation will almost certainly be altered through the introduction of autonomous vehicles, already being tested in California, which have the potential to increase the transportation capacity of the road and highway systems. The size of automobiles may decrease. Smaller vehicles, envisioned by some in the future to become individual transportation pods, will further increase the carrying capacity of the road and highway system.

The transportation system is one of the largest contributors to air pollution, including greenhouse gas emissions. Transformation of the today's fossil-fuel based transportation system to one that is almost, if not entirely, based on renewable, clean energy sources is foreseeable in the middle to later part of this century. Such a transformation will have the potential to reduce the adverse environmental effects of transportation and mobility.

The evolution of our transportation system has the potential to have correlative benefits to the development potential of urban areas. Some speculate that large-scale introduction of autonomous vehicles will have the potential to change the urban landscape. Reduced need for automobile storage (residential garages, parking lots and structures), will free up land in urban areas to accommodate housing, parks and other uses that have social benefits, and such reductions will eliminate costs that drive up the price of housing.

Over the very long-term, it is reasonable to expect transformative changes in buildings, transportation infrastructure and energy supply as fossil fuel vehicles become obsolete and renewable energy sources become an increasing and perhaps exclusive source for utility-scale energy. Increases in water efficiency and expansion of wastewater reuse can also be expected. Further changes in communication technology and the delivery of education may alter the travel patterns and even the nature of the campus community. Such changes would likely extend the carrying capacity of existing levels of resources, potentially alter the rates of development and population growth on the campus, and push further out the point at which resource limitations physically constrain the campus' ability to add square footage and increase student, faculty, and staff/worker population.

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