Forge

@A&M-Central Texas Appendix

December 2022

Perkins&Will

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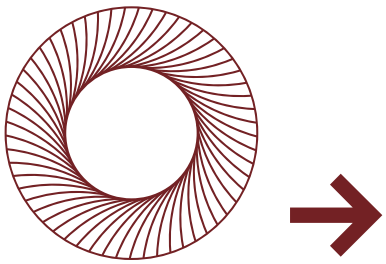


1. Existing Conditions

The first step for starting the planning process of the Forge was reviewing the existing conditions of the site and region it's located in. Within this chapter the various existing systems assessed and conditions which led the decision making throughout design process are introduced. The main systems studied for this site include, built fabric and physical conditions of the place, mobility systems, and ecological conditions of the area.

Built Fabric

Google Earth Image,
Date Captured: 1/2018

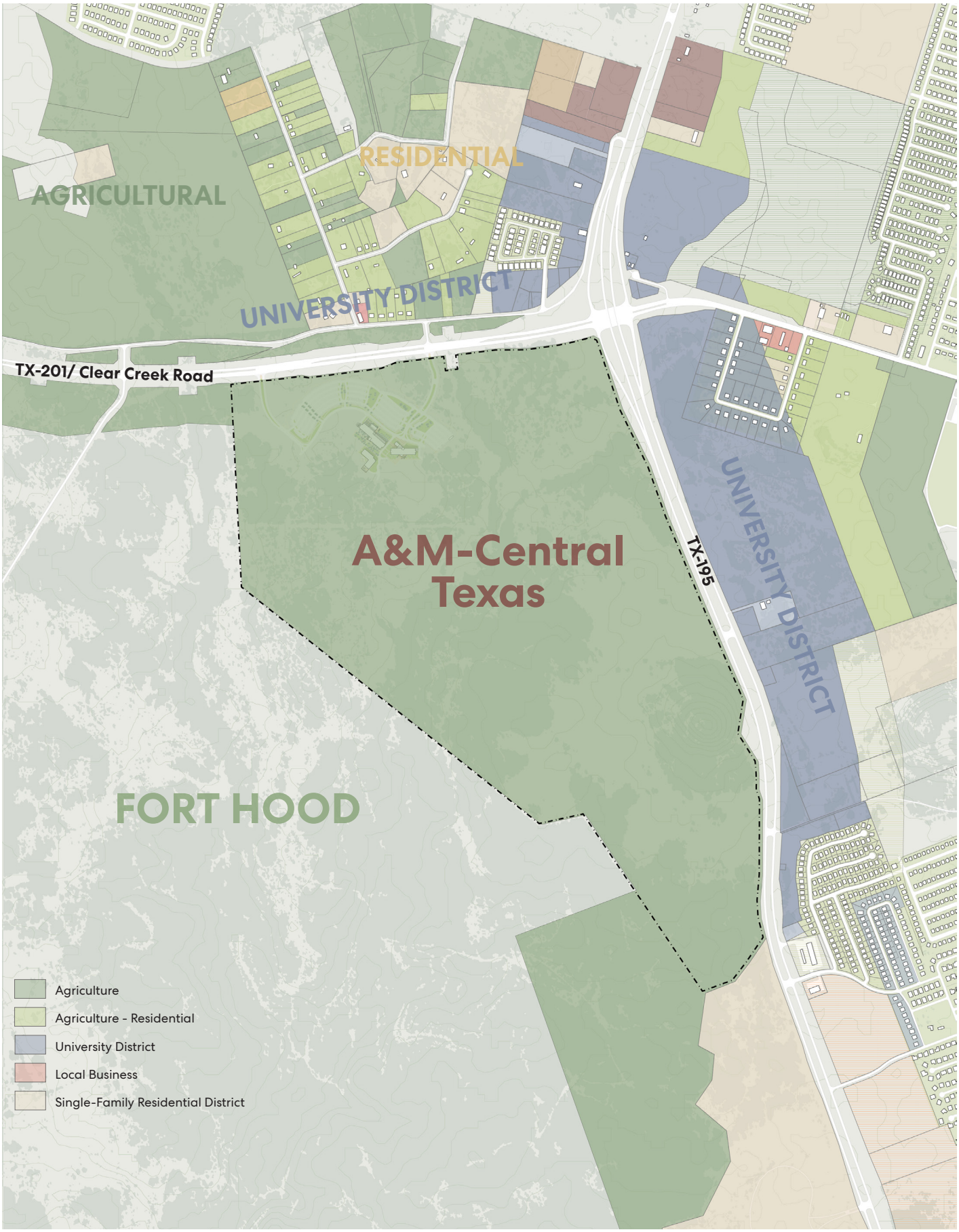
Drone Survey Image,
Date Captured: 9/2018

The A&M-Central Texas campus is located in a low-density area at the southwestern edge of Killeen. The surrounding development has a rural character with the prevalent zoning designation being agricultural, agricultural single-family residential, and single-family residential. Across the road at the intersection of the highways neighboring the university campus, there is a "University District" zoning designation which allows for uses supportive of the academic institution with medium-density development (up to 4 stories).

Most of the neighboring land is comprised of large parcels with an average area of 4.2 acres within a half mile capture area of the campus, while the median area of parcels within the capture area is 0.2 acres. This demonstrates the emergence of subdivided properties within the neighboring land, however further breakdown of land will be required in order to create a well-connected community surrounding the campus.

The existing developed area is located on the northwestern portion of the site, with parking being provided on the northern fringe and development of the campus core south of the campus loop road (Leadership Place). This approach to the site layout allows for a pedestrian-only core and park once strategy as the campus develops further. Currently there are three buildings on campus all of which are housing a mix of activities with no single building being dedicated to a single function.

The first building of the campus, Founder's Hall, is primarily dedicated to classroom space and academic offices but also has some small areas for student life/services and retail. Founder's Hall also houses the university's first industry partner, Centex Technologies. The second building built on-site, Warrior Hall, houses the library in addition to academic spaces and administrative functions. Trideum, the university's second industry partner, has a space on the third floor. The third building of the campus is Heritage Hall, which is home to the existing recreational spaces. Finally, the university is underway with the design of a central plant , police, and service building that will be located near the intersection of entrance two and Leadership Place.


AGRICULTURAL
RESIDENTIAL
UNIVERSITY DISTRICT
TX-201/ Clear Creek Road
A&M-Central Texas
TX-195
UNIVERSITY DISTRICT
FORT HOOD
Agriculture
Agriculture - Residential
University District
Local Business
Single-Family Residential District

Mobility

Site Access

The regional access to the site is provided by TX-195 highway and TX-201 road. There is a signaled access point on TX-201 just off the intersection of the two roads and an additional right in, right out connection further down the road provides a second access point.

Driving is the main/only mean of access to the site, therefore parking has become an important feature in the planning of the campus. Currently parking utilization is very low at proximately 13-17% on weekdays which leaves a large surplus of parking out of the existing 1,500 spaces available for future development.

External Connections:

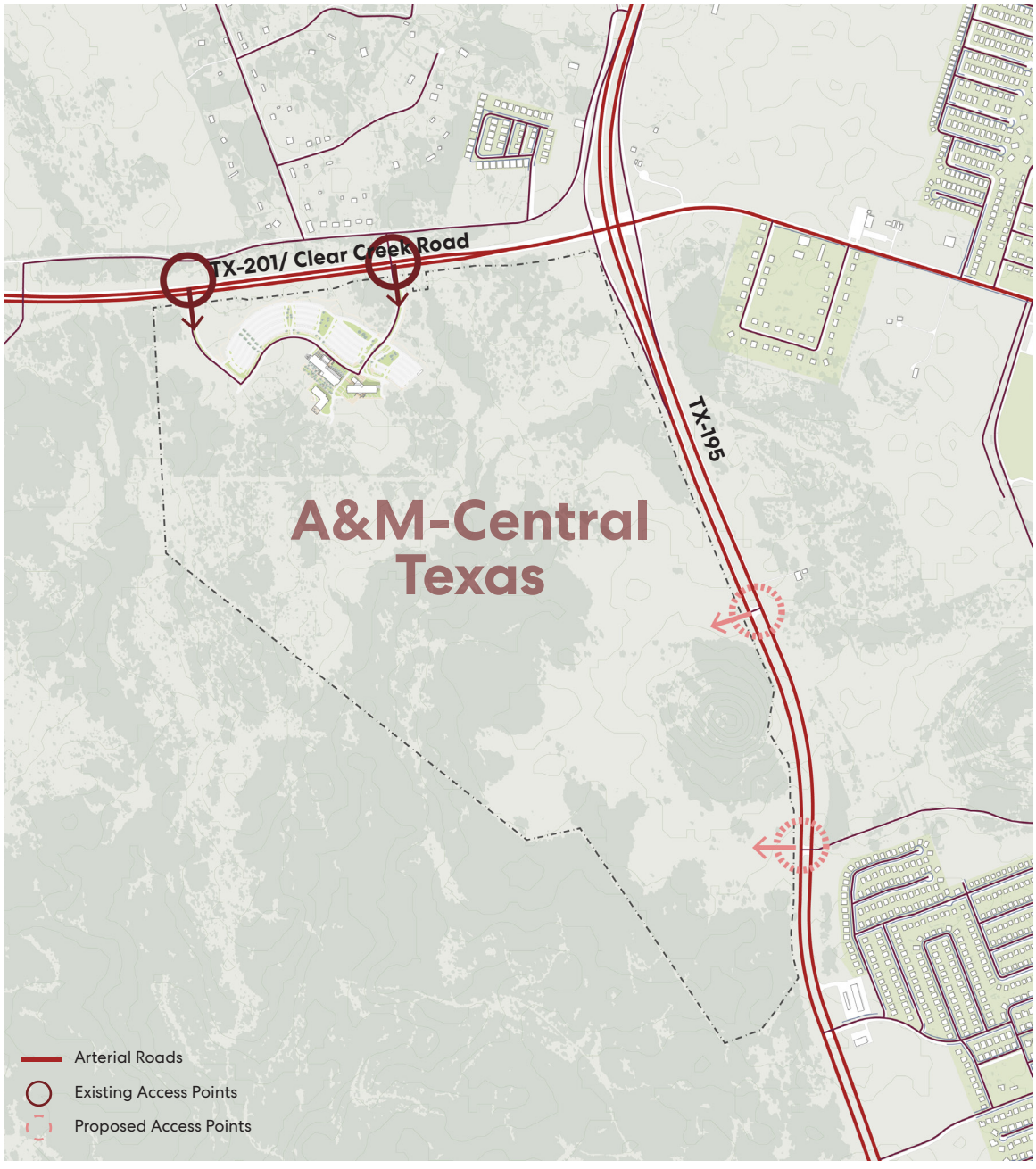
- Pedestrian network near A&M-Central Texas campus is poor/nonexistent
- No bicycle connections

Internal Network:

- Strong network of pedestrian paths with ample shade and landscaping
- Wide paths are suitable for shared bicycle and pedestrian use

Other services:

- No fixed-route transit service to, or in vicinity of, A&M-Central Texas
- Hill County Transit District (HCTD) operates TheHop transit system
- 10 routes with hourly headways in the Killeen, Copperas Cove, and Temple area
- 1 flex-route in Killeen
- Paratransit and rural demand-response



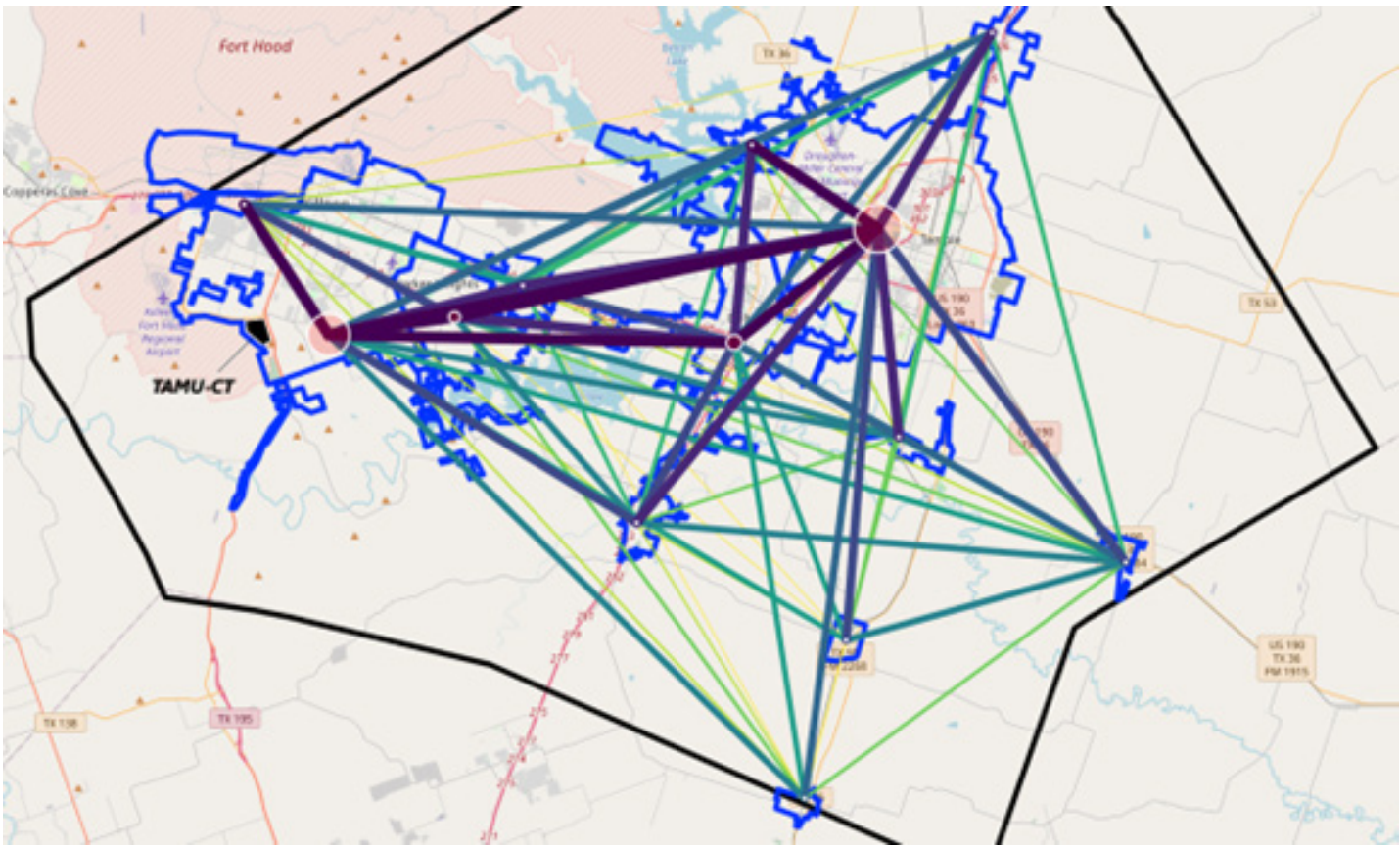
Vehicular Access

Access network and points available to the existing campus

Regional Travel Patterns

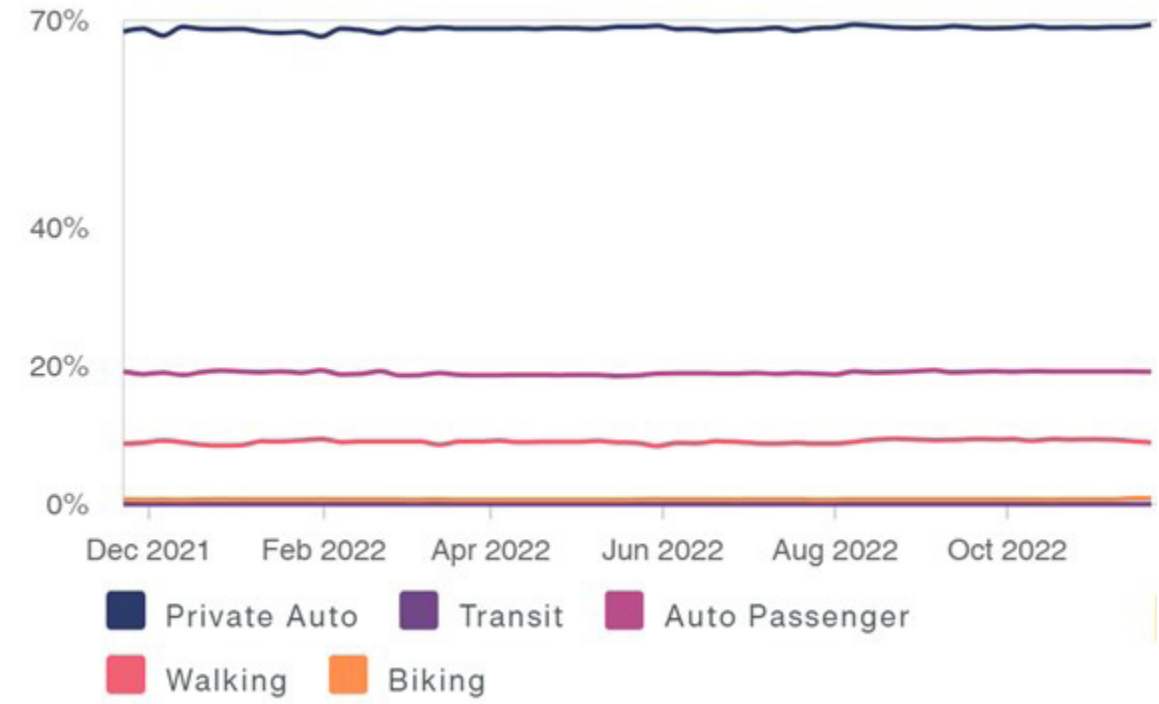
Commute trips within the region is polycentric, with Fort Hood, Temple, and Killeen all serving as key nodes of trip origins and destinations. As dispersed economic, social, and residential nodes, they generate a large share of the region's commute trips and have longer trip distances. In addition, trips are made beyond the immediate area, with travel to and from areas to the south, such as Georgetown, Round Rock, or Austin.

Most trips in the region, both commute and non-commute, are either drive-alone or multi-passenger personal vehicle trips, with limited bicycle and transit use. Estimates show that about 9% of all trips in the area are walking trips.



Regional Daily Work Trip Origin-Destination Travel Flows

Source: *US Census LEHD, 2019*



Killeen-Temple Average Weekday Mode Split (11/22/21-11/21/22)

Source: *Replica*

Transit, Biking, and Walking

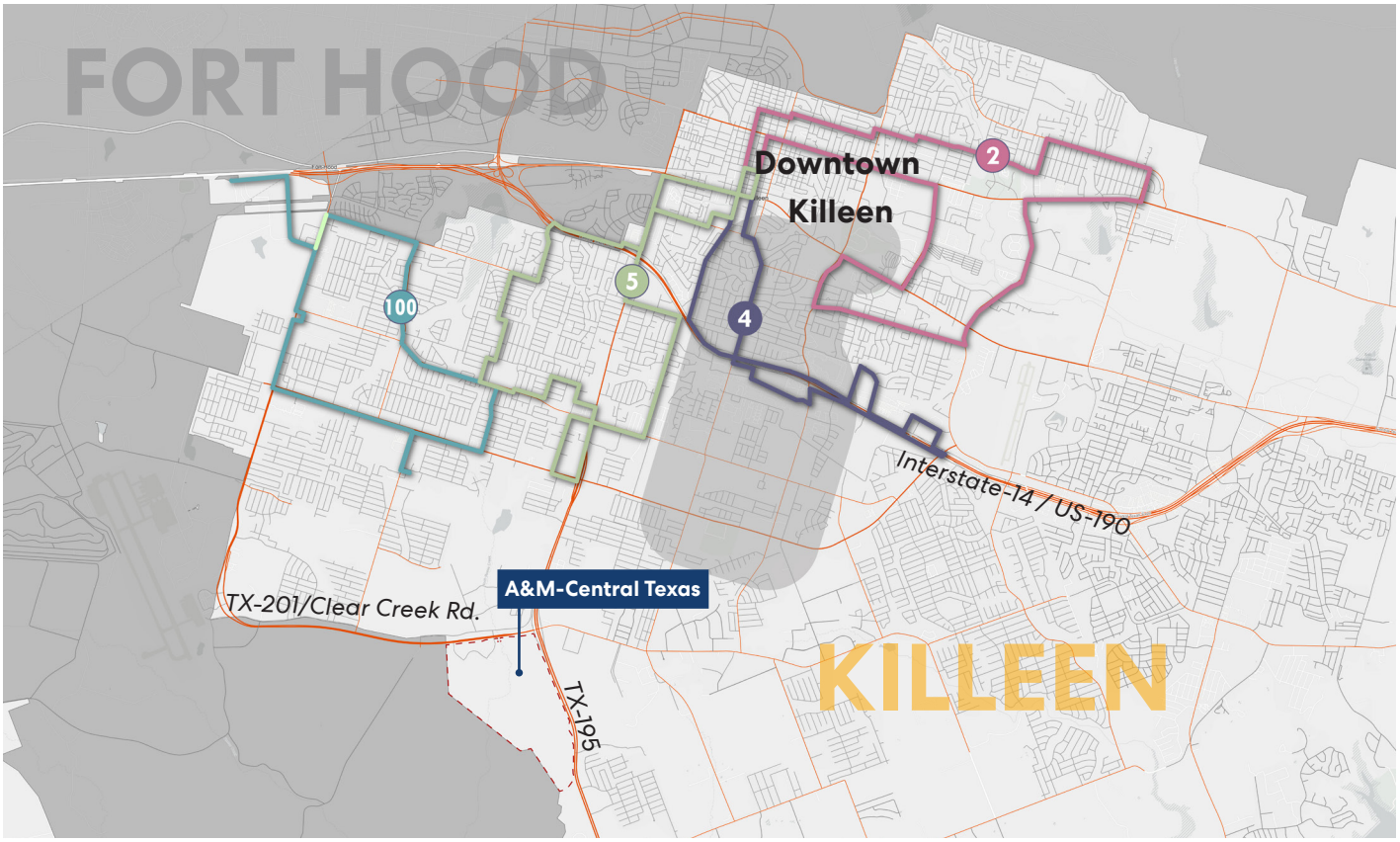
Transit service in Killeen, Copperas Cove, and Temple is operated by Hill County Transit District (HCTD) and is branded as "The HOP." Today, none of The HOP's 10 bus routes or the flex-route service area serve the A&M-Central Texas campus. Existing HCTD bus services closest to campus are shown in the HOP service map.

As the campus grows and new land uses are added, there may be opportunities to create a direct transit or shuttle connection between A&M-Central Texas to Fort Hood or other destinations in the Killeen/Temple area. Such a service would make it possible to shift some daily travel from driving alone, which can help minimize future vehicular traffic volumes and parking demand.

Bicycle and pedestrian connections to A&M-Central Texas are limited, with few sidewalks and no bike facilities in the campus vicinity (sidewalk network map). However, the bicycle and pedestrian networks on campus are strong with ample shade, landscaping, and wide paths that make biking and walking pleasant and safe (existing facilities images). These facilities support an existing and future "park-once" campus.

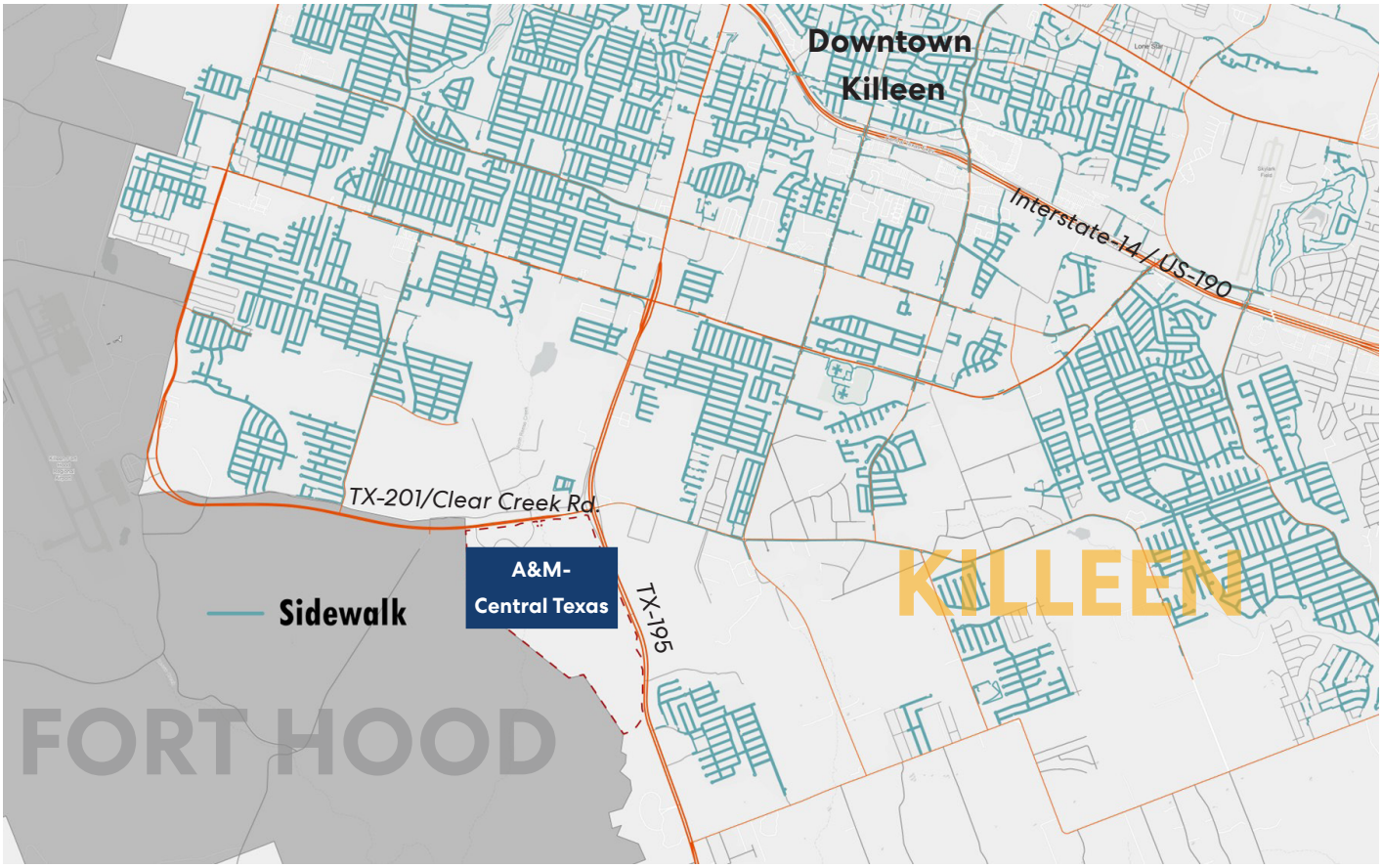
The HOP Bus System

The HOP system utilizes 40-foot buses with 2-space bike racks, as well as cutaway shuttles.



The HOP Services near A&M-Central Texas Campus

The HOP provides fixed-route and flex transit service for the region. None of them currently directly serve the campus but there was a route connecting campus and Central Texas College in the past.



Sidewalk Network in the A&M-Central Texas Vicinity

The local street network offers limited direct access to campus and streets connecting to the campus do not have existing sidewalks.

Existing Pedestrian and Bicycle Facilities within Campus

The campus has a strong network of sidewalks and internal pedestrian walkways. These facilities support a walkable, park-once campus.

Roadways and Traffic

The A&M-Central Texas campus is bordered by two highways, TX-201 and TX-195, with access to campus via two entrances on TX-201. The east entrance is signalized and has a double left pocket in the westbound direction coming from TX-195. The west entrance is rarely used and is often closed to vehicles.

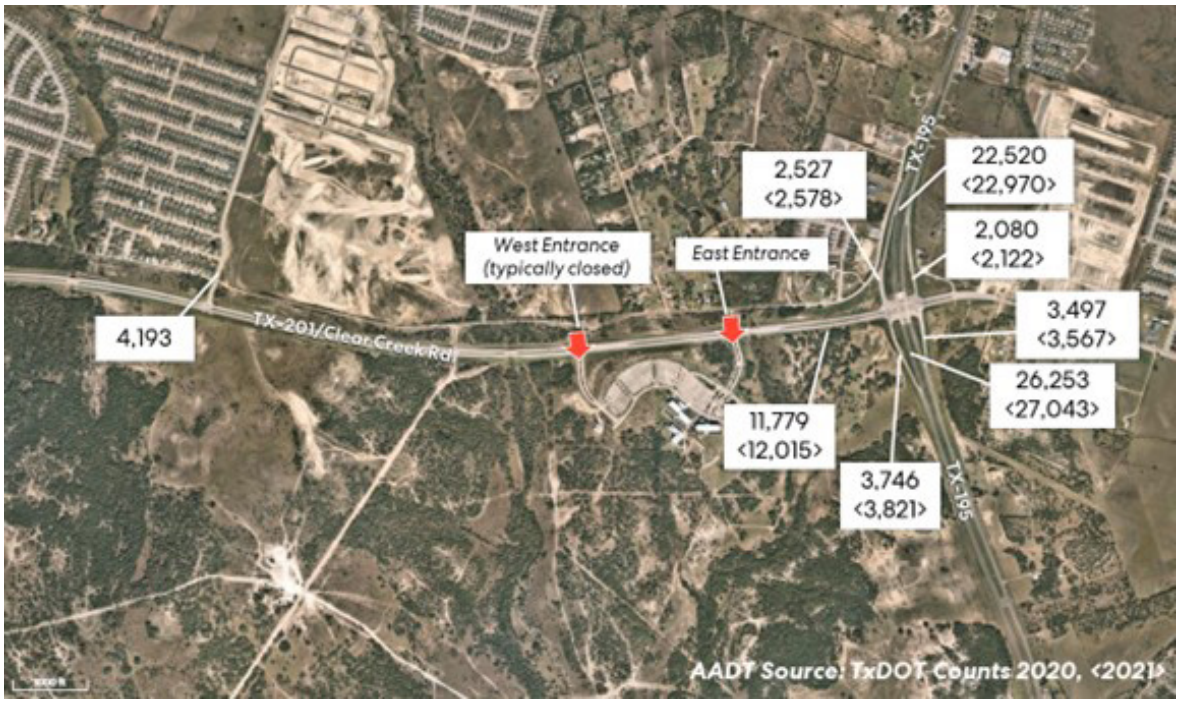
TxDOT recently completed construction of a new interchange at the intersection of TX-201 and TX-195, which replaced a signalized intersection. The interchange helped to minimize vehicle delay and conflicts, while increasing vehicle capacity. The interchange, however, has minimal to no facilities for pedestrians or bicyclists.

Current traffic volumes on TX-201 and TX-195 are relatively low. Average Annual Daily Traffic (AADT) for TX-201 just west of TX-195 was about 11,800 in 2020 and 12,000 in 2021, well below the capacity of the roadway. The current volumes indicate that there is available existing roadway capacity to support all future campus growth. Safety on TX-195 and TX-201 was identified as a growing concern by campus and city stakeholders. Since 2016, crashes on roadways near A&M-Central Texas campus have become more frequent and more severe (Figure 9). The average number of injuries or deaths per crash has increased by 30%. During this period, speeding was the most common contributing factor in crashes on TX-201 and TX-195 near the A&M-Central Texas campus.

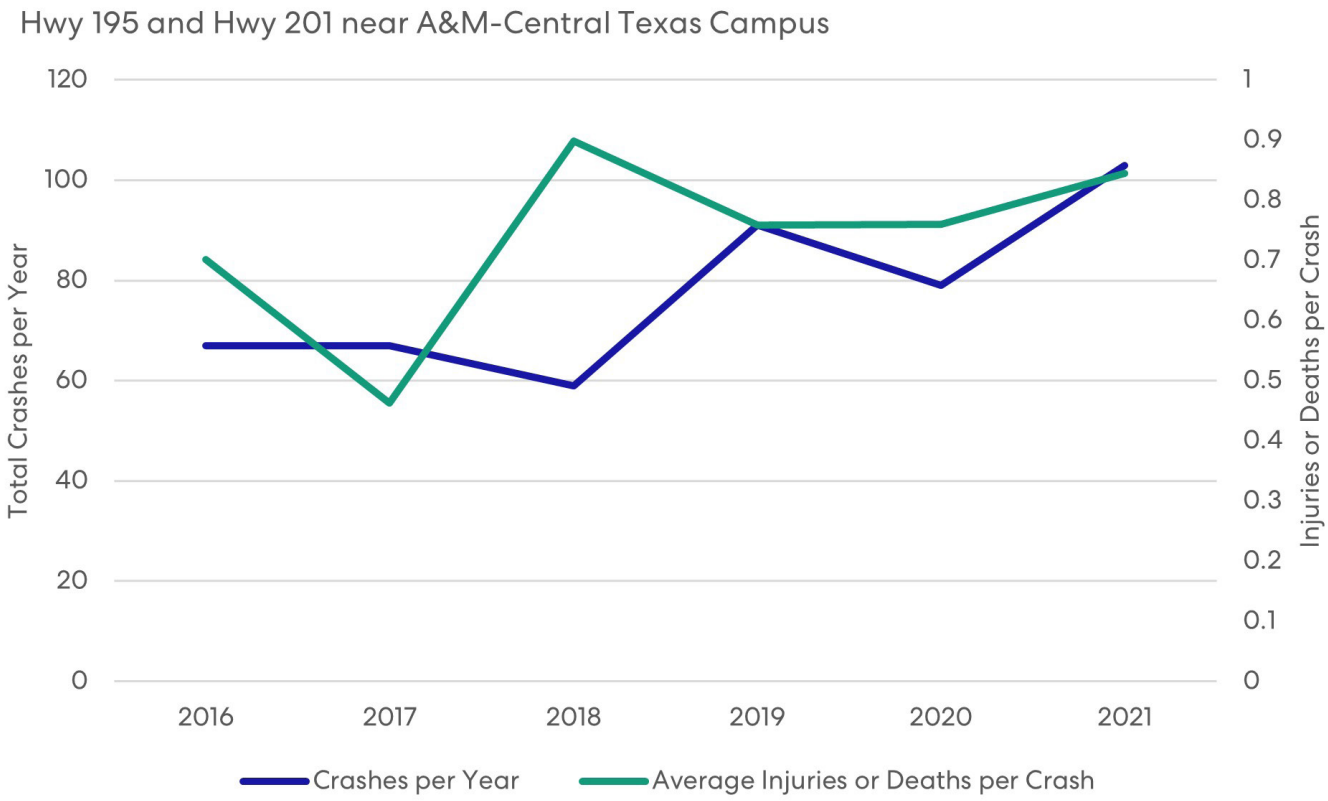
As the campus and the region grows, new opportunities to connect A&M-Central Texas campus to the east across TX-195 may arise. Given the traffic safety trends on that roadway and the increased tendency for vehicle crashes at intersections, any such connection should be designed to minimize vehicle conflicts, protect bicyclists and pedestrians, and balance the potential needs and benefits of new access points against the potential impacts to roadway safety.

TX-201 eastern entrance to campus

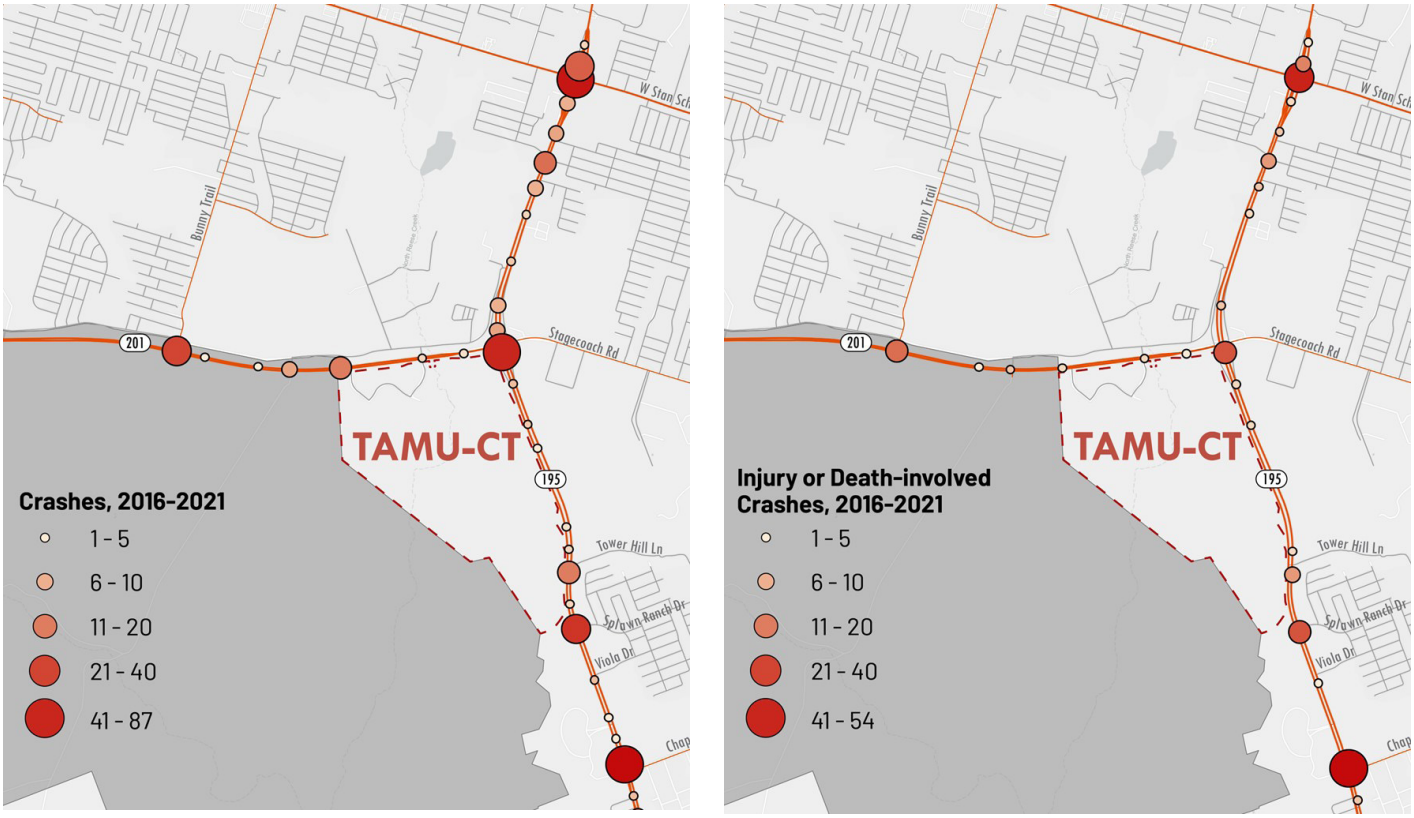
TX-201 is very wide with high vehicle speeds. The primary eastern entrance has incomplete sidewalks, a narrow crosswalk on only one leg of the intersection, no pedestrian-scale lighting, and no pedestrian refuge.



Average Annual Daily Traffic (AADT), 2020 and 2021



Crash Frequency and Severity near A&M-Central Texas Campus, 2016-2021



Total Crashes (Left) and Severe Crashes (Right) on TX-195 and TX-201, 2016-2021

Source: *TxDOT Crash Data*

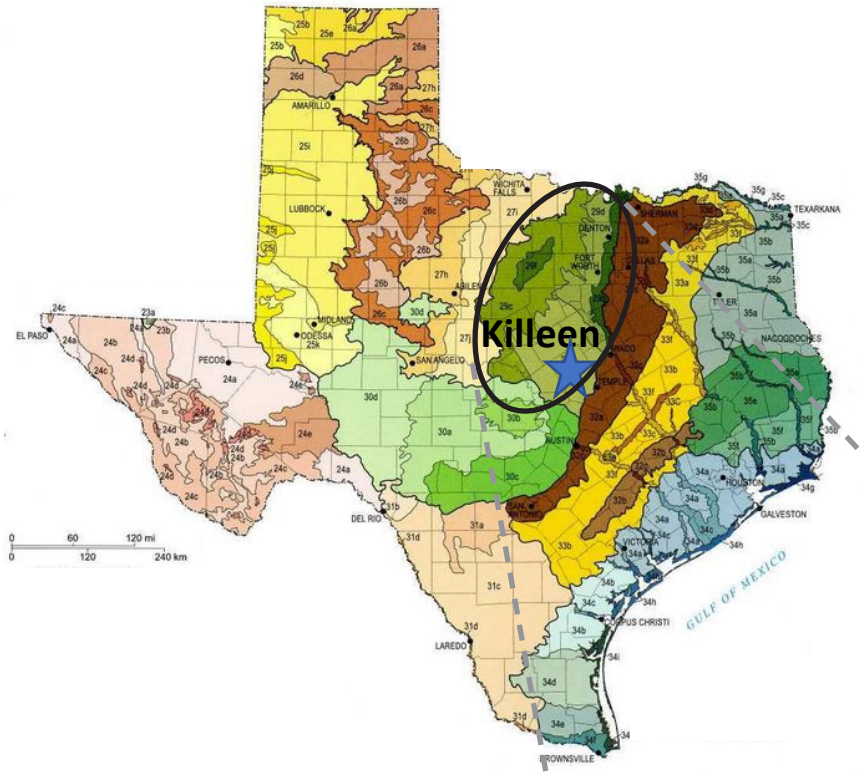
Ecological Systems

The surrounding ecosystems and dynamics of a natural space set the context for ecological opportunities and constraints. For example, the presence or absence of water, a particular species, and local climate define the working materials and the limitations of a planning process. Stewarding a space with a long-term focus on water, soil, plants, and wildlife is needed for sustained resilience for natural and human communities alike. The ecological planning approach for A&M-Central Texas uses this multiscale analysis, in space and time, to understand and identify site-specific features within a landscape context, which in turn is nested within a regional and even continent-level perspective.

The rich natural history of Central Texas strongly influences the character of A&M-Central Texas and guides this Ecological and Master Planning effort. Located in the continental transition from eastern forests to western grasslands (the Cross Timbers, circled in green), this overlap of habitat types supports exceptional landscape and biological diversity. While much of Central Texas has been converted to agricultural use, A&M-Central Texas retains the region's original character.

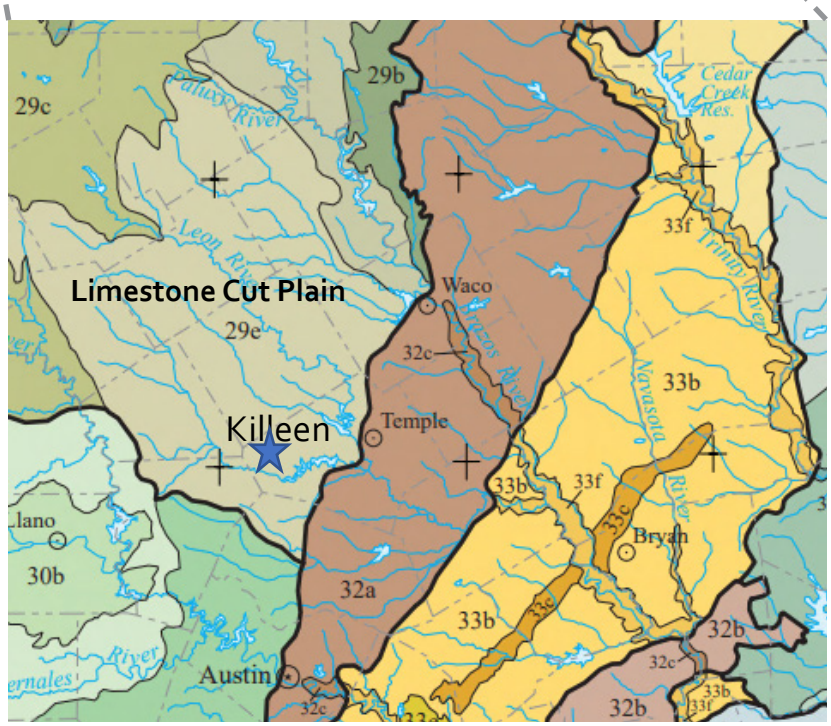
The Limestone Cut Plain heritage landscape (map detail on right) supported a mosaic of evergreen and deciduous-oak woodland, oak savanna, and Blackland Prairie. Despite similarities between the Limestone Cut Plain and the Edwards Plateau (to the south and west of the Cross Timbers, left) the Limestone Cut Plain has somewhat higher precipitation and its vegetative signature is more localized, with grasslands reminiscent of eastern tallgrass and woodlands more open than in the Balcones Canyonlands ecoregion to the south.

Also distinguishing the Limestone Cut Plain from the Edwards Plateau is a geology that, while also Lower Cretaceous limestone, is mostly older formations of Glen Rose and Walnut Clay. Glen Rose erodes more easily and differently among its layers of limestone, chert, and marl. The higher precipitation in the Limestone Cut Plain also manifests in more significant erosion and dissolved limestone layers.



Multiscale Ecological Context

In Northcentral Texas, the Lampasas Cut Plain vegetative sub-region lies south and southwest of the East and West Cross Timbers and Fort Worth Prairie, extending to the upper reaches of the Edwards Plateau. Counties found in the sub-region include parts of Somervell, Erath, Hamilton, Comanche, Brown, Mills, Bosque, Hill, and McLennan counties. Most of this region is underlain by various limestone formations.



Ecoregion

Killeen is in the Cross Timbers Level III Ecoregion (circled above) and the Limestone Cut Plain Level IV Ecoregion (labeled 29e, right). USGS 2004.

Historic Ecology

The broad lowlands of the Limestone Cut Plain historically supported grasslands growing in Walnut Clay soils. BiZson grazed species such as big and little bluestems, sideoats grama, yellow Indiangrass, and tall dropseed, and sideoats grama.

In addition to species endemic to the Edwards Plateau, oak savanna grew among the mesas and grasslands often dominated mesa caps. Woodlands were comprised of plateau live oak, cedar elm, Texas ash, big tooth maple, and bur oak. White shin oak, sumac, and Ashe juniper were found on dry, rocky slopes.

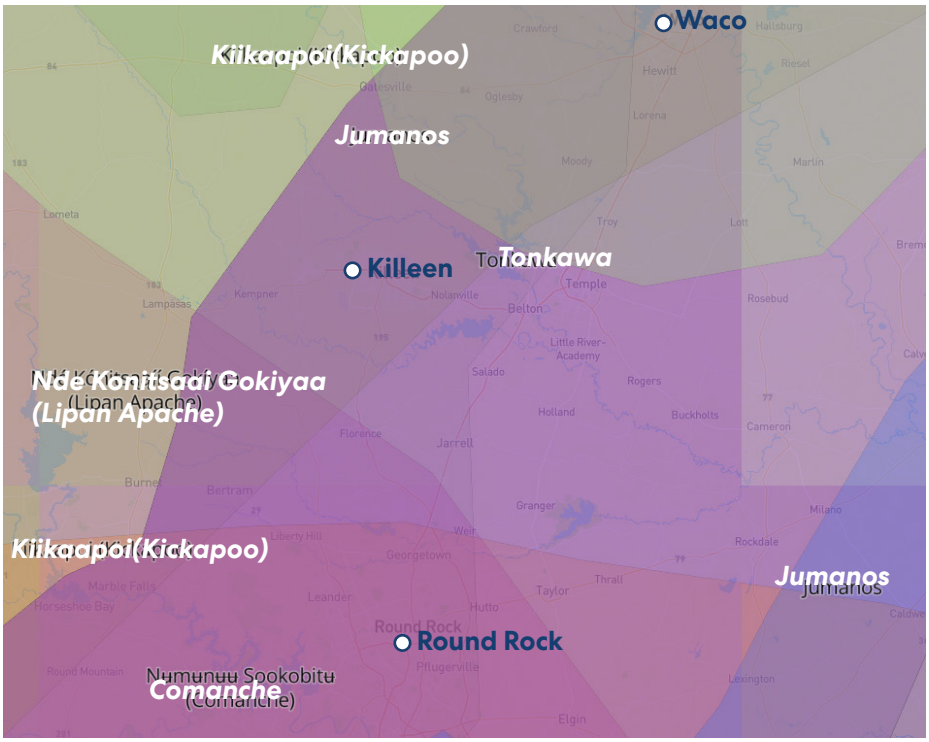
Aerial view of Bell County

Date Unknown; (https://texashistory.unt.edu/ark:/67531/metapth12963/ accessed 11 Nov 2022), University of North Texas Libraries, The Portal to Texas History, https://texashistory.unt.edu; Killeen City Library System.

Land Acknowledgement and Socio-Ecological Historic Context

We, the Race and Ethnic Studies Institute, acknowledge that Texas A&M University (College Station) is situated on the land of multiple Native nations, past and present. These original homelands are the territory of Indigenous peoples who were largely dispossessed and removed. We specifically acknowledge the traditional stewardship of this land by the Tonkawa, Tawakoni, Hueco, Sana, Wichita, and Coahuiltecan peoples. We pledge to support and advocate for the histories, cultures, languages, and territorial rights of historic Indigenous peoples of Texas and those of the Indigenous peoples who live here now. This statement affirms continuous Indigenous presence and rights, acknowledges the ongoing effects of settler colonization, and supports Indigenous struggles for political, legal, and cultural sovereignty.

Several indigenous groups used the natural resources in and around Killeen before European settlement. Tribes included the Kiikaapoi, Jumanos, Tonkawa, and Sookobitu (Comanche). Reliant on bison and other bounty of the Great Plains, these earliest managers used prescribed burns to stimulate grass growth in the spring. Even before these tribes were known to use the area, humans may have inhabited the area as early as 6000 BC.

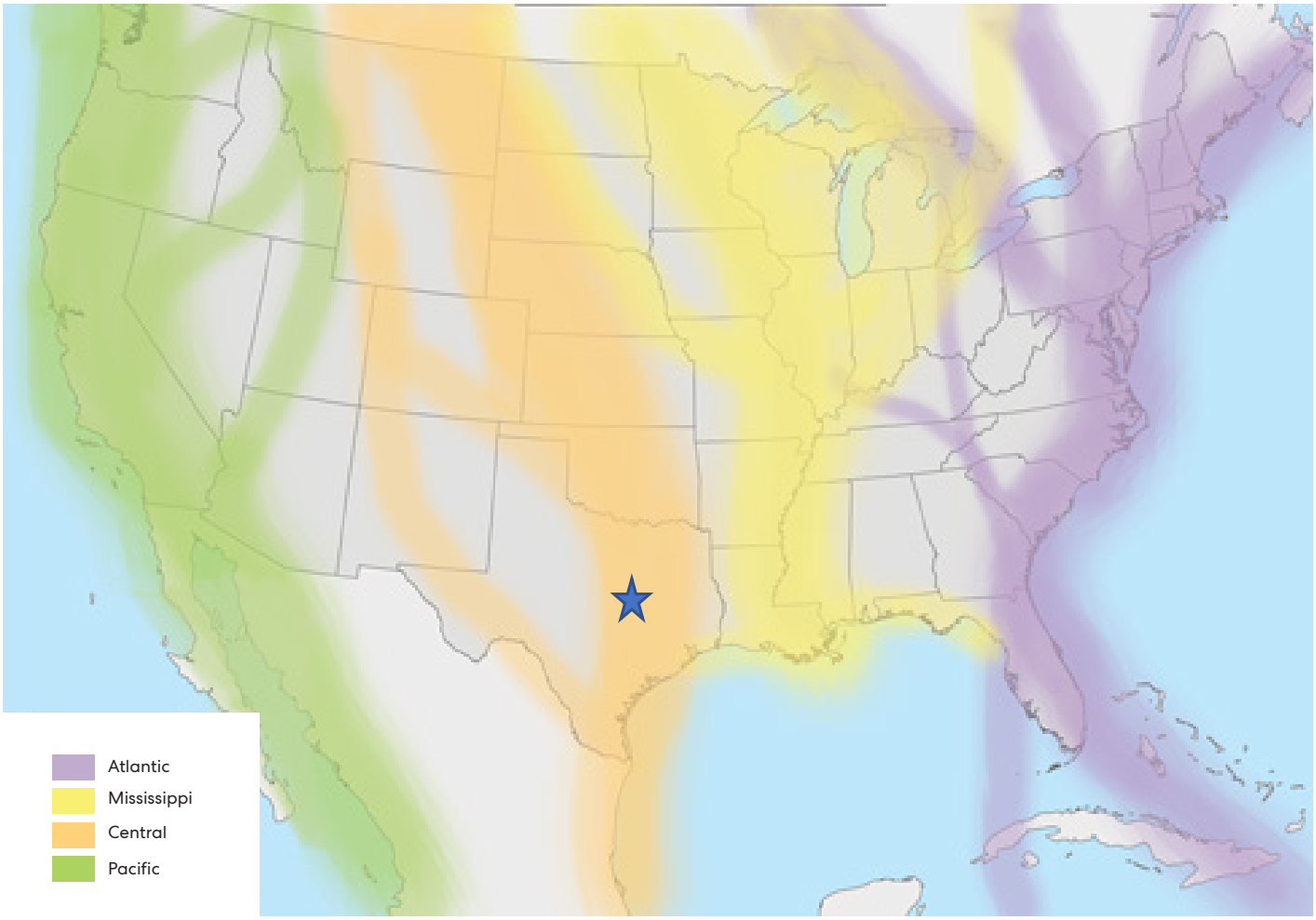


Overlapping tribal territories around present-day Killeen, TX. Figure from Native Land Digital, **https:**//native-land.ca/

Role of Killeen in Continental Biodiversity

A&M-Central Texas is directly in the Central flyway for birds flying from the arctic to the tropics. Priority upland birds for regional conservation that occur in Bell County include

- Golden-cheeked warbler (endangered)
- Black-capped vireo (of concern)
- Townsend's Solitaire (rare)
- Vermilion flycatcher
- Bald eagle
- Scissor-tailed flycatcher
- Bobolink
- Painted bunting
- Western kingbird

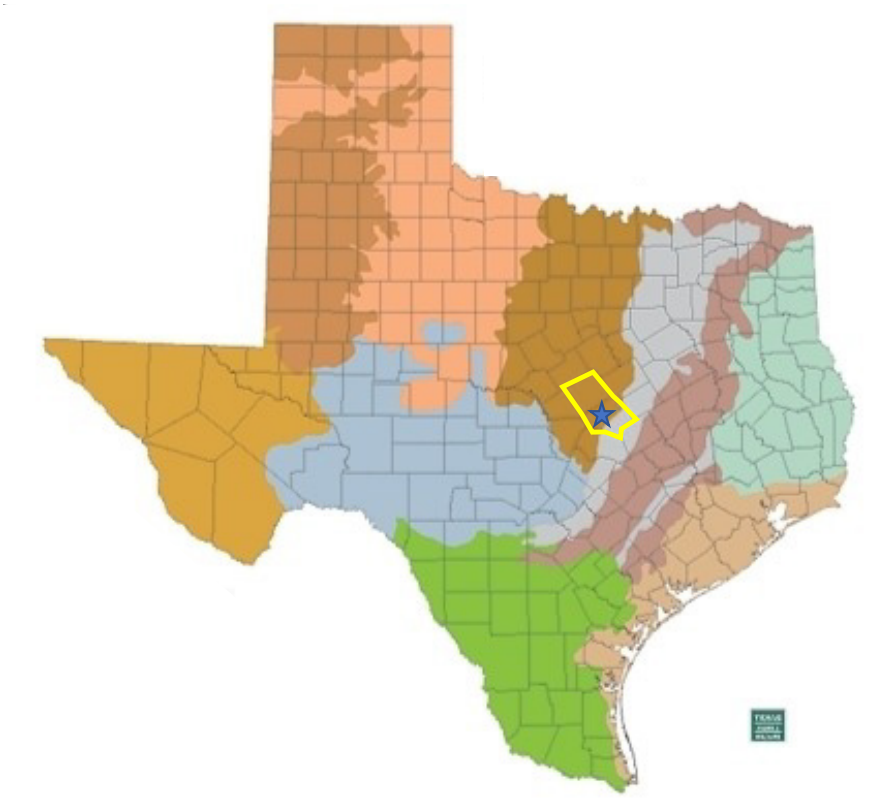


Regional Imperiled Species

Bell and Coryell Counties (yellow outline) are developing a Regional Habitat Conservation Plan for

- Golden-cheeked warbler (Endangered, ESA),
- Monarch butterfly (Endangered, IUCN),
- Salado salamander (Threatened, ESA),
- Karst invertebrates (Endangered, ESA),
- Freshwater mussels (candidates, ESA), and
- Other species to be determined.

Anticipated to be finished in 2024, the HCP will provide for the protection of these wildlife and their habitat needs. With its position on the western side of Bell County and broad expanse of open space, A&M-Central Texas is positioned to be a significant support for this conservation effort.

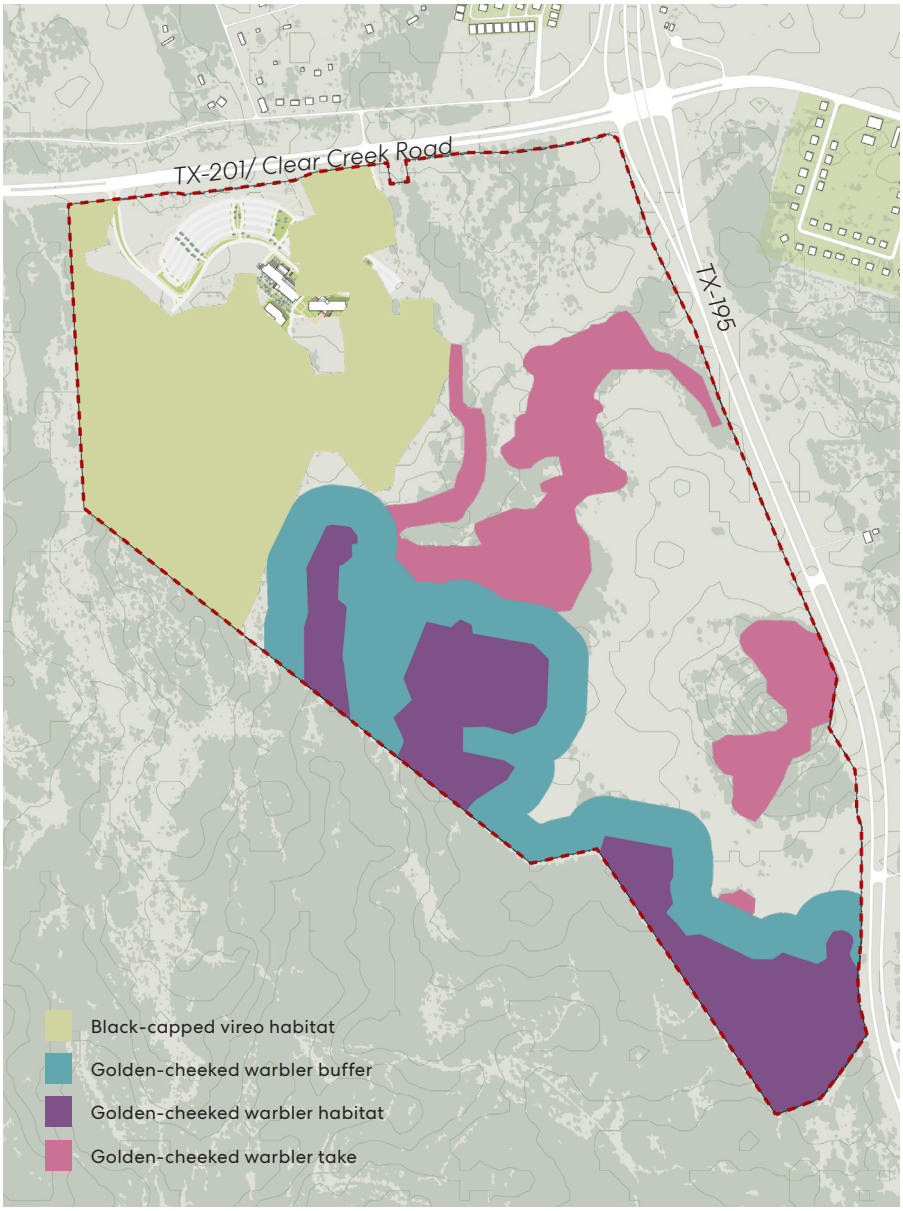


Sensitive Wildlife

In order from the top; black-capped vireo, monarch, Salado salamander, and golden-cheeked warbler

Cross-Boundary Habitat

Habitat for the endangered golden-cheeked warbler and black-capped vireo occurs on both sides of the A&M-Central Texas boundary (although the black-capped vireo has been de-listed it is still treated as a sensitive species and is monitored closely). While both land use types present different stressors, careful ecological planning will protect and enhance bird habitat while educating university and recreational users. Although areas of "take" have been designated by the Fish and Wildlife Service, impacts to these areas will be minimal.



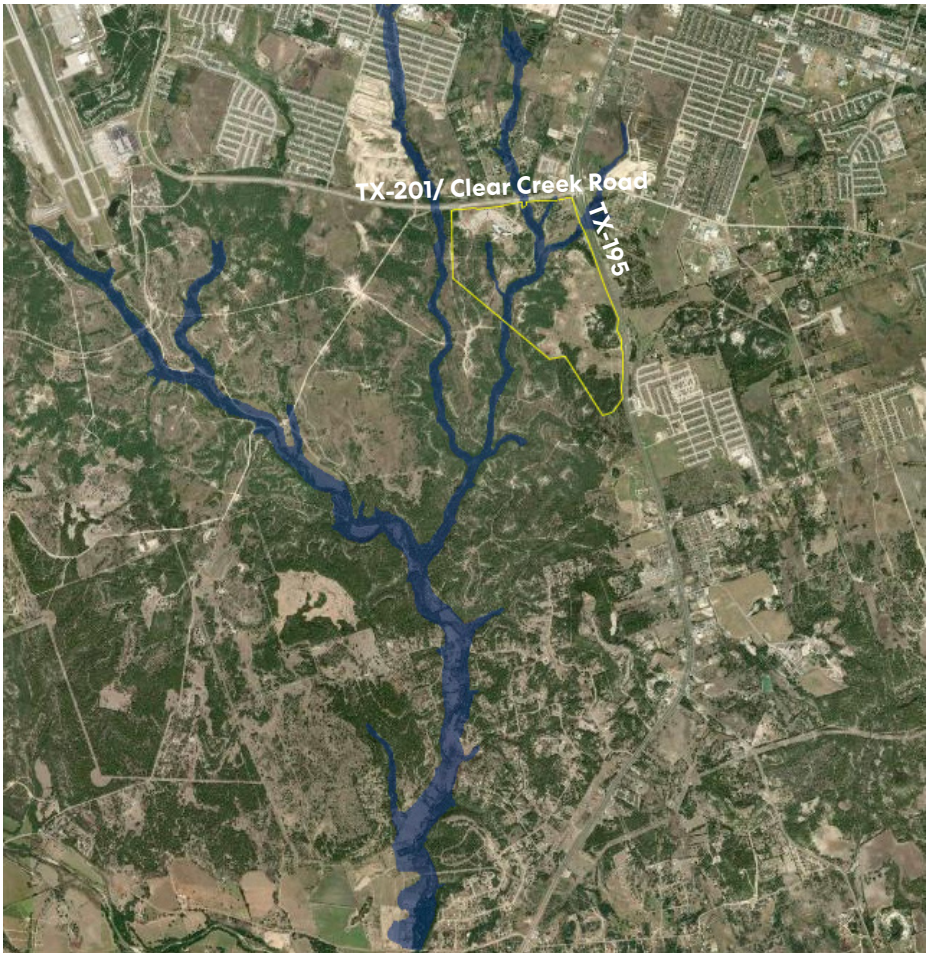
Watershed Connections, Resilience, and Climate change

Killeen is situated on Lower Cretaceous limestone over the Edwards Aquifer. Discharge from the aquifer occurs at intermittent springs throughout the region.

North Reese Creek flows through A&M-Central Texas. Downstream of the site it converges with Reese Creek, which in turn joins the Lampasas and ultimately the Brazos River. Protection of headwaters such as Reese and North Reese Creeks is essential to protect water basin resilience and the uncommon habitat it provides in this arid region.

These important watershed relationships are emphasized by resilience mapping, where higher resilience is captured by higher landscape diversity and connectivity. The Lampasas River, into which Reese Creek drains, is clearly significant for regional resilience (blue arrows), while both water and topographic features such as Bald Knob are important for local resilience at the campus.

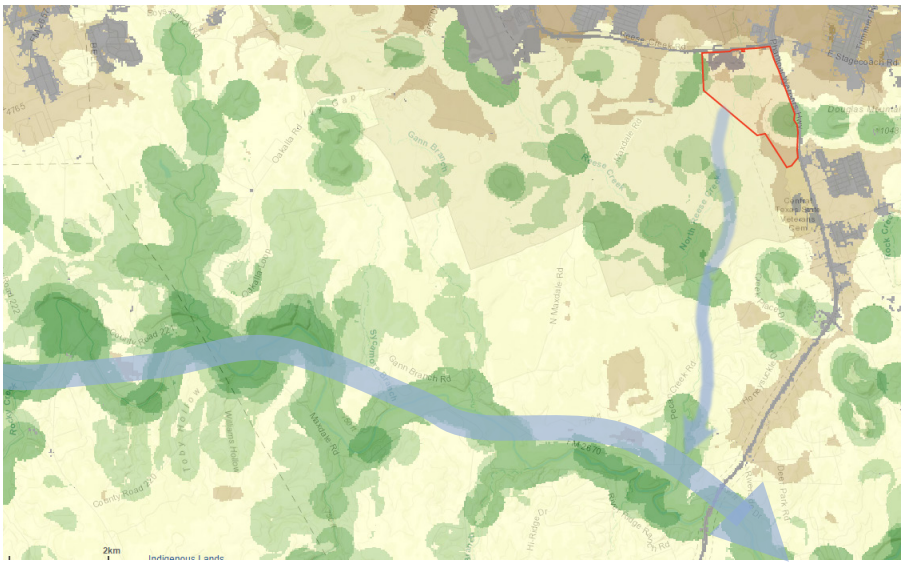
Regional Watershed

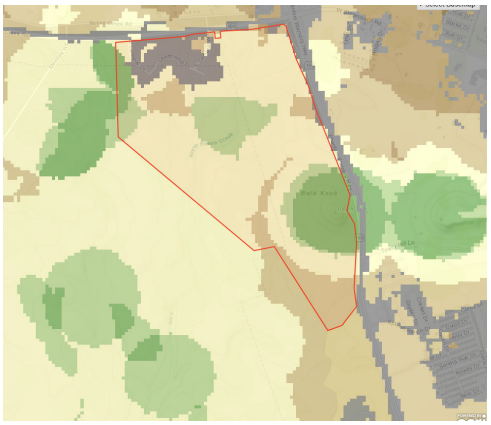


Water Resilience

Resiliency mapping

Regional below, site scale to the right



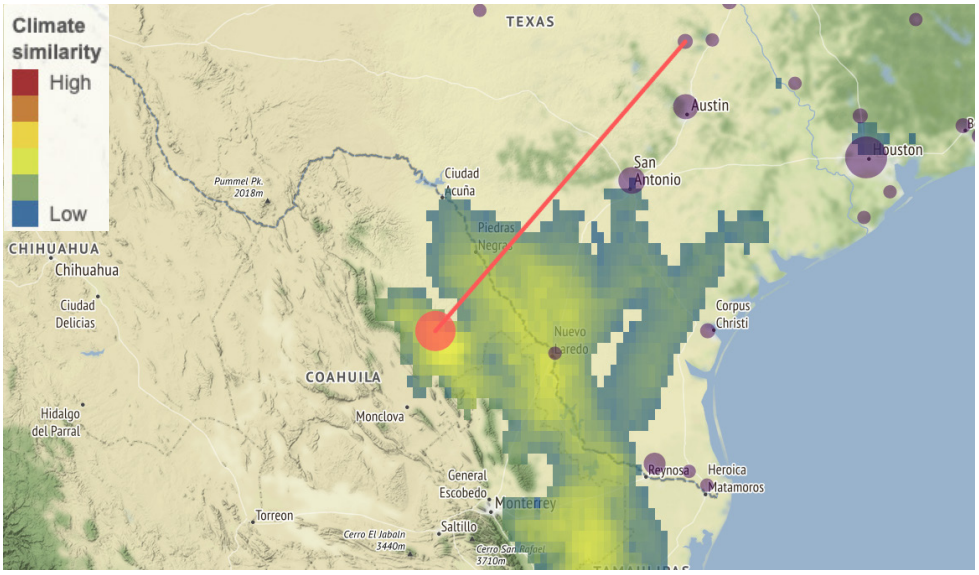


Most Resilient
More Resilient
Slightly More Resilient
Average or Medium Resilience
Slightly Less Resilient
Less Resilient
Least Resilient
Developed

Analog Climates and Resilience

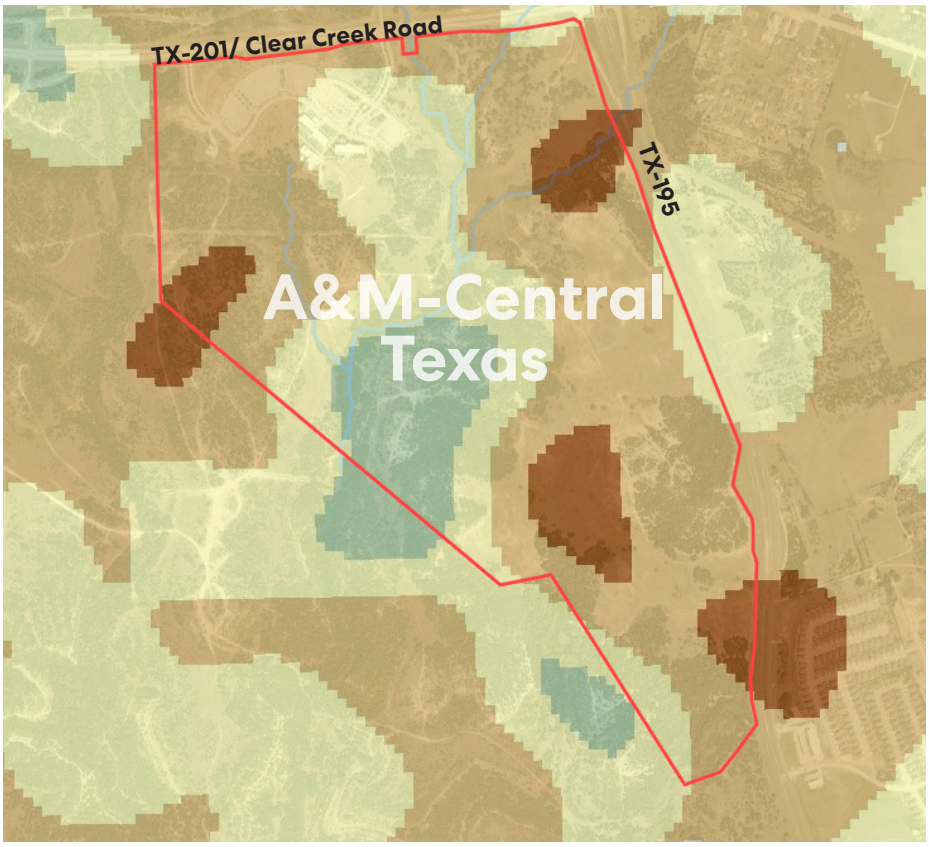
With unchanged greenhouse gas emissions, Killeen's climate in 2080 will be most similar to today's climate near Sabinas, Mexico. Typical summers in Sabinas are 7.8°F (4.3°C) warmer and 25.3% drier than Killeen. Resilience planning including the protection of connected and high-value areas, such as floodplains and their drainages, will be important for local- and large-scale biodiversity conservation.

Map source: *https://fitzlab.shinyapps.io/cityapp/*



Wildfire Risk

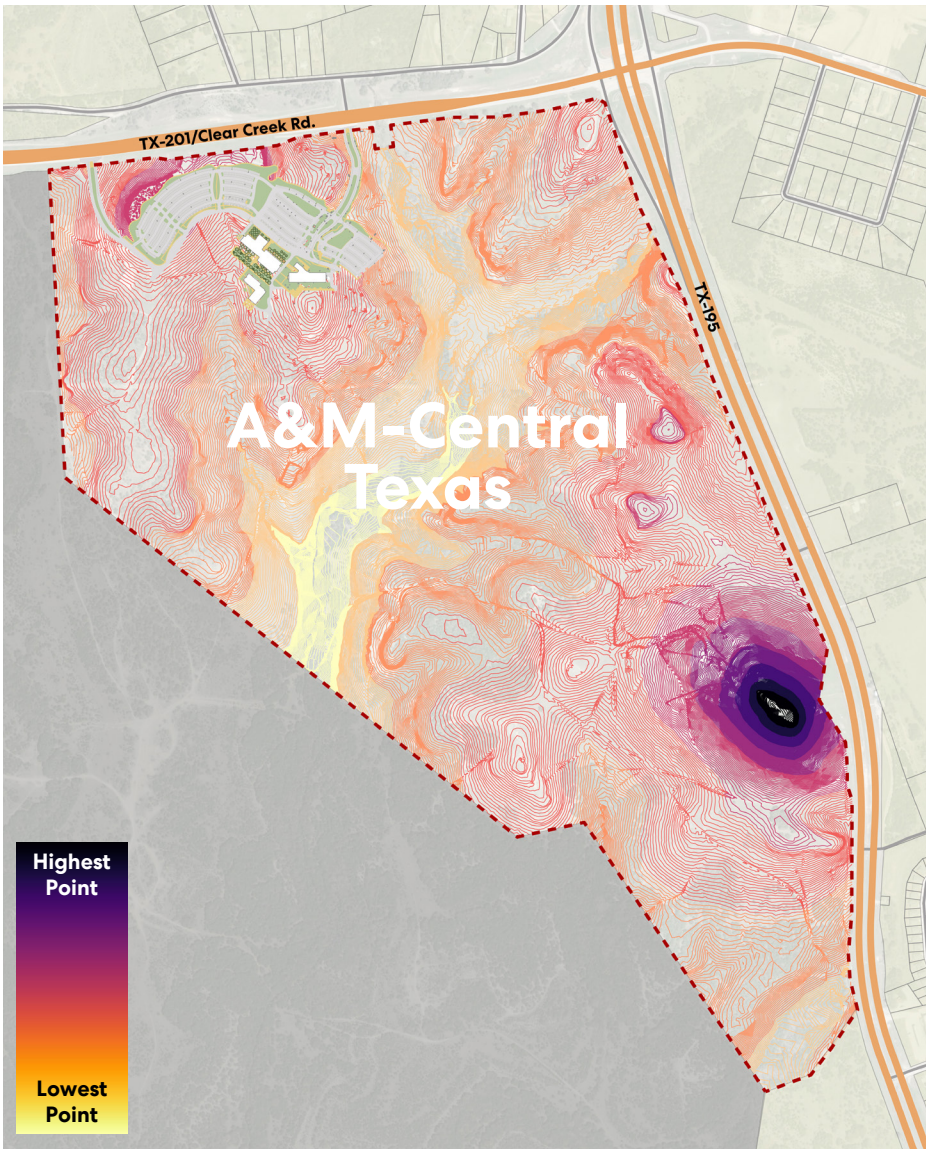
The potential for moderate to high wildfire intensity ranges from very low to very high at A&M-Central Texas. Four feet is considered the height limit for manual fire control, so this map (FLEP4, based on 2014 USFS vegetation and fuels data) indicates the current likelihood of a fire to be beyond the ability of field crews to manage. Lowest probabilities coincide with creeks and their floodplains, while the highest probabilities are associated with dense forest.



Topography

The topography of A&M-Central Texas ranges from 835 ft. where North Reese Creek drains on the southwest boundary to 1,075 ft. at Bald Knob on the eastern boundary (photo below). The second-highest point on campus is in its northwest corner, providing a magnificent viewscape across the central portion of the campus and the North Reese Creek.

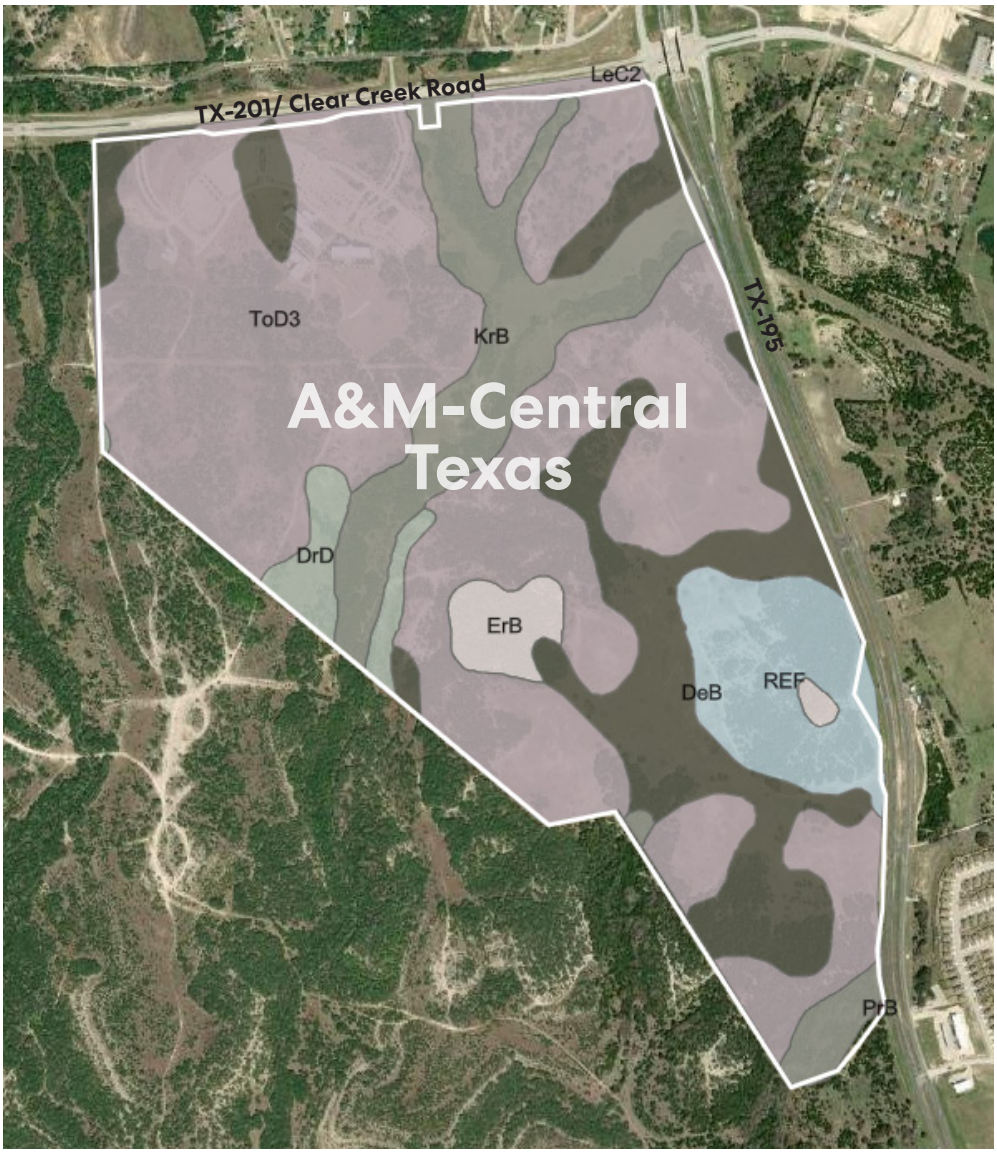
Bald Knob
A unique landmark as the highest point on site.



1-foot contours
Unique changes of elevation througout site with the existing development sitting on a high ridge around a water channel.

Soils

The soils at A&M-Central Texas are derived from Lower Cretaceous limestone and all are relatively shallow. Variation is closely tied to landform, as Bald Knob and the North Reese Creek floodplain exhibit singular soil types for the project area. Bald Knob soils are dry, rocky, and easily eroded. The Krum series along North Reese Creek is alluvial and contains finer clays.



Soil Categories

- Denton Silt Clay, 1 to 3 % slopes
- Doss-Real Complex, 1 to 8% slopes
- Eckrant-Rock Outcrop Complex, 1to% slopes, extremely stony
- Krum Silty Clay, Cool, 1 to 3% slopes
- Leadvale Silt Loam, 3 to 8% slopes, eroded
- Purves Silty Clay, 1 to 4% slopes
- Real-Rock Outcrop Complex, 12 to 40% slopes
- Topsey Clay Loam, 3 to 8% slopes, severely eroded

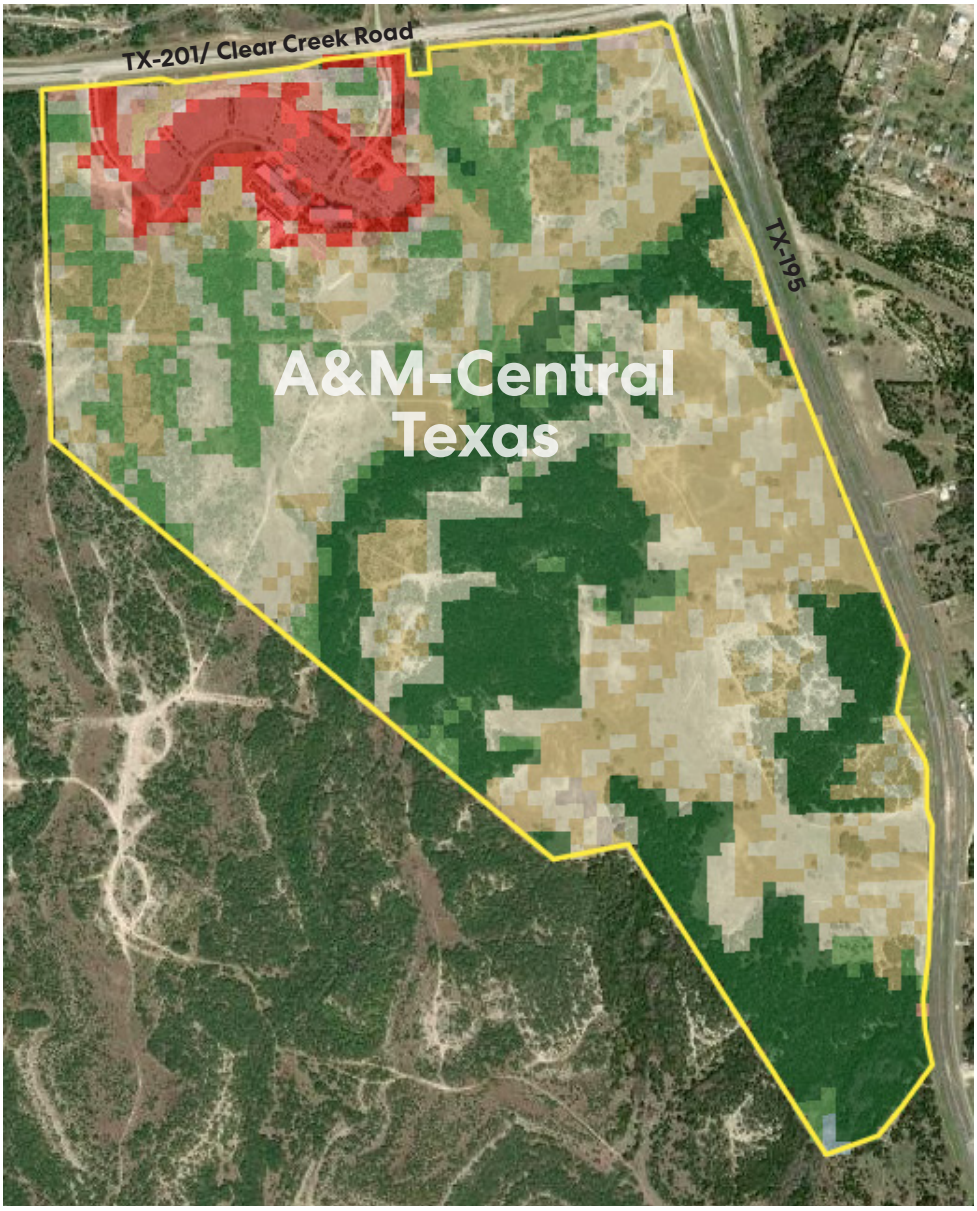
Site Observations

A&M-Central Texas is a classic natural landscape mosaic of several community types. The photo at left was taken from the south side of Knob Hill, showing four habitat types. The grove of live oaks in the middle of the landscape is shown from the ground in the photo below.

Post-settlement grazing has replaced the historic grass community with silver bluestem, Texas wintergrass, and purple threeawn. Typical of other areas with limestone geology, fire suppression and grazing have allowed the expansion of Ashe juniper, which does offer nesting habitat for the endangered golden-cheeked warbler.

Primary Land Cover Types
In order from the top; Deciduous forest; Evergreen forest along N. Reese Creek; Deciduous forest along N. Reese Creek; and Herbaceous (foreground), shrub/scrub (background).

Site Characteristics
Observations from a site visit on February 2022


TX-201/ Clear Creek Road
TX-195
A&M-Central Texas
Barren Land
Developed, High Intensity
Developed, Medium Intensity
Developed, Low Intensity
Developed, Open Space
Everygreen Forest
Deciduous Forest
Herbaceous
Shrub/ Scrub
Woody Wetlands

Land Cover

Resiliency & Climate Analysis

Killeen, TX.

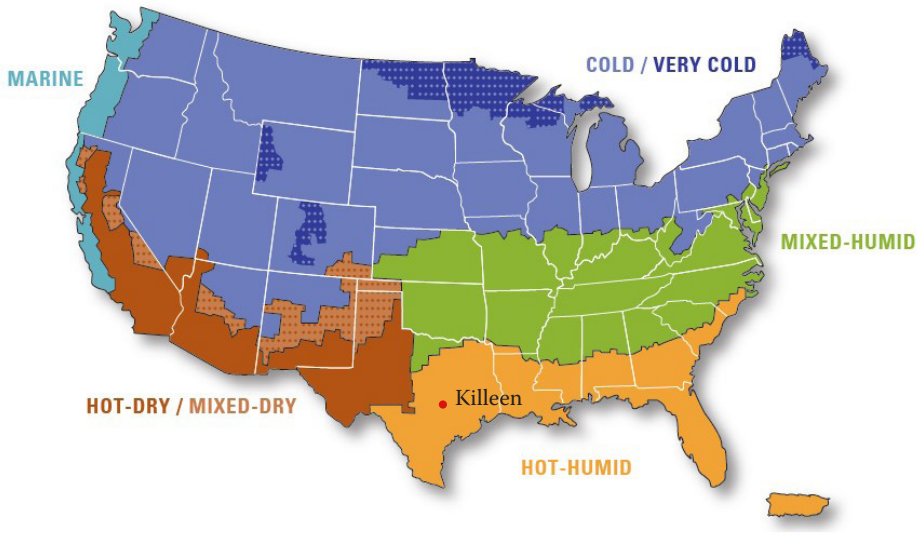
Killeen's climate is Hot-Humid (2A). A hot-humid climate is generally defined as a region that receives more than 20 in. of annual precipitation and where one or both of the following occur:

A 67°F or higher wet bulb temperature for 3,000 or more hours during the warmest 6 consecutive months of the year; or

A 73°F or higher wet bulb temperature for 1,500 or more hours during the warmest 6 consecutive months of the year.

How can Passive Strategies help?

Designing with passive strategies is about understanding the constraints and creating design responses that do not require active mechanical systems. Examples include using ambient energy sources to cool, heat, shade, or ventilate a building space. The challenge with designing for passive strategies is that they must be incorporated in the early stages of the process if they are to be effective. Architects who understand the passive impacts of climate will be better able to deliver cost-effective, energy-efficient, buildings.

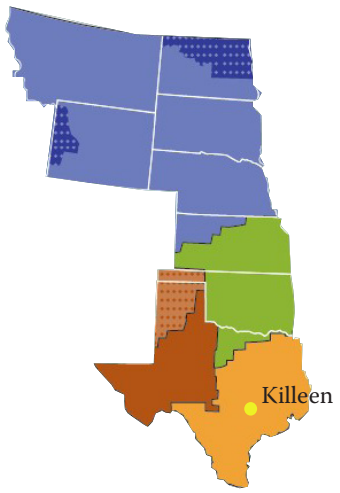


U.S. Climate Zones

The climate region definitions are based on heating degree days, average temperatures, and precipitation.

Great Plains

Rising temperatures are leading to increased demand for water and energy. In parts of the region, this will constrain development, stress natural resources, and increase competition for water.



Potential Shocks

Social: *Crime/Violence, Civil Unrest, Terrorism, Infrastructure Failure, Disease Outbreak, Fuel Supply Disruption, Blackout, and Population Pressure*

Economic: *Market Failures, Cyber Attack, Business Closure, and Housing Shortages*

Environmental: *Tornados, Intense Thunderstorms, Extreme Rainfall, Extreme Cold Weather, Hail, Ice Storms, Winter Storms, Heavy Snow, Drought, Wildfires, and Strong Winds*

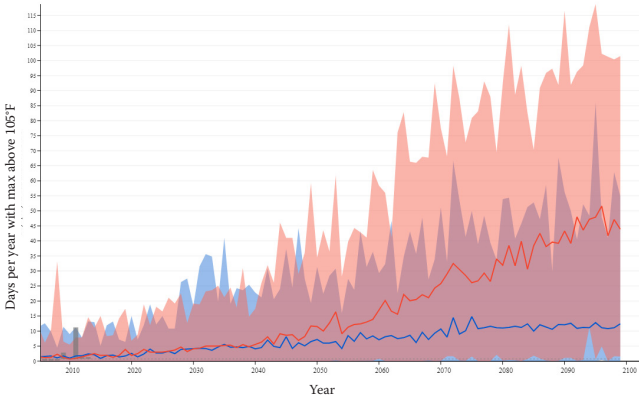
Potential Stressors

Social: *Homelessness, Disease, and Perceived non-inclusivity*

Economic: *Debt, Unemployment, and Recession*

Environmental: *Pollution (air and water), Flooding, and Ecosystem Disruption*

Projected Change in Extreme Heat



Source: *GlobalChange.org, the National Climate Assessment*

Measurable Climate Impacts

	Year		
	Current	*2070*	*2100*
Max Above 95 Deg	80	129	148
Max Above 100 Deg	28	81	102
Max Above 105 Deg	3	29	45
Increase in Cooling Days	3400	4300	5200
Min Below 32 Deg	0.3	0.2	0.1
Increase in Heating Days	1400	1000	800

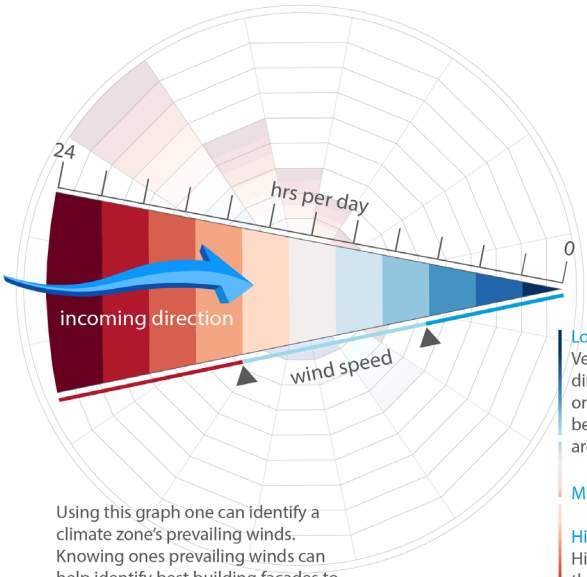
	% Change Since 1958	*30 yr Increase Potential*
Extreme Rain Increase	16%	25%

	Index Value	*Potential Risk?*
Earthquake Index	0	No
Volcano Index	0	No
Tornado Index	215	Yes
Avalanche	0	No
Dust Storm	1	No
High Surf	3	No
Thunderstorm Winds	1,032	Yes
Blizzard	0	No
Flood	488	Yes
Hurricane	0	No
Tropical Storm	3	No
Cold	9	No
Hail	1,258	Yes
Ice Storm	11	Maybe
Wildfire	7	Maybe
Dense Fog	0	No
Heat	100	Yes
Winter Storm	22	Yes
Drought	93	Yes
Heavy Snow	13	Maybe
Strong Wind	21	Maybe
Winter Weather	19	Maybe

Sources: *U.S. Climate Resilience Tool Climate Explorer; National Climate Assessment; USA.com*

Wind Rose Diagrams

The diagrams show the wind direction and intensity coming to the site. The number of hours are reflected by the size of the rose, and the intensity is expressed in colors as shown in the legend.



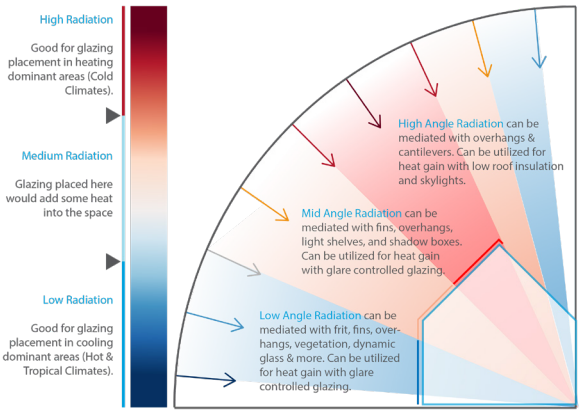
Using this graph one can identify a climate zone's prevailing winds. Knowing ones prevailing winds can help identify best building facades to use for passive ventilation strategies such as operable window placement.

Low Wind Speeds
Ventilation placed along the directions of 'low wind speeds' or 'winds of minor reach' will not be effective in cooling dominant areas (Hot/ Tropical Climates)

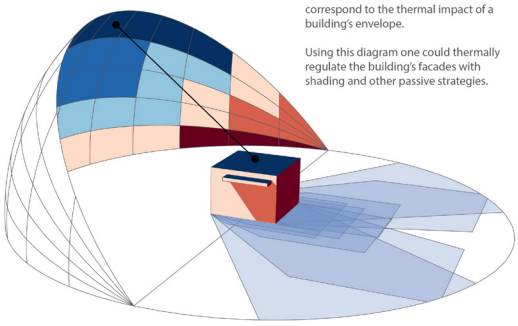
Mild Wind Speeds

High Wind Speeds
High wind with the furthest reach is the prevailing wind for that climate area. This is the best area/ direction for ventilation strategy.

Understanding the Wind Diagram

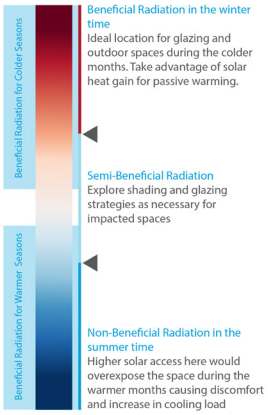


This diagram shows a radiation map projected onto a dome which is used to determine the best placement for glazing and possible radiation mediation strategies. Use the color, angle, and direction of radiation to identify what strategy you can use to optimize thermal comfort and ideal placement.



Panels of the solar radiation dome correspond to the thermal impact of a building's envelope.

Using this diagram one could thermally regulate the building's facades with shading and other passive strategies.



Beneficial Radiation in the winter time
Ideal location for glazing and outdoor spaces during the colder months. Take advantage of solar heat gain for passive warming.

Semi-Beneficial Radiation
Explore shading and glazing strategies as necessary for impacted spaces

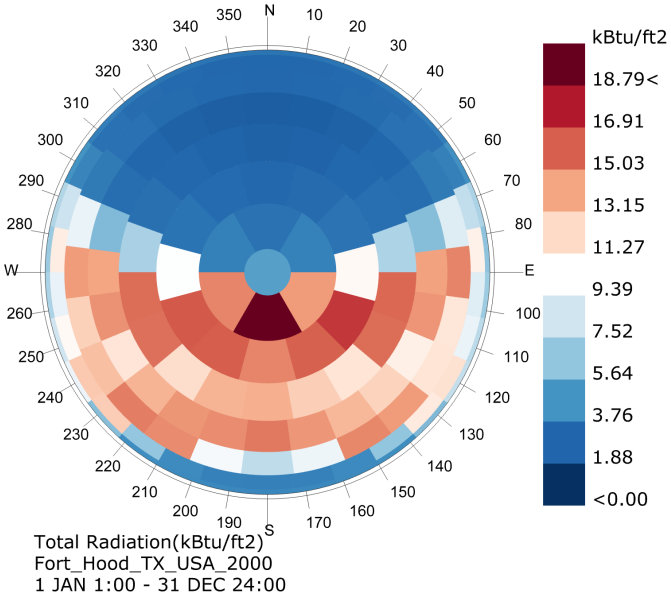
Non-Beneficial Radiation in the summer time
Higher solar access here would overexpose the space during the warmer months causing discomfort and increase in cooling load

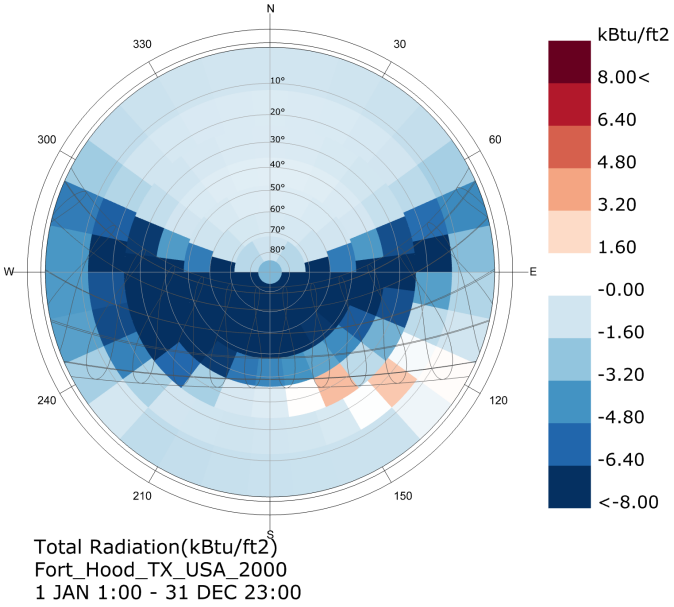
Understanding Total Radiation

By identifying where the maximum direct sunlight (kBTU/ft2) is incident, users can reference the diagram on the right to pick a strategy. Windows and openings are best placed in areas with low radiation (in a cooling load dominated climate i.e. Hot and Tropical climates) and orientations with high radiation protected by overhangs and cantilevers. For solar heat gain, skylights and areas with low roof insulation should be placed in the high radiation zone (in a heating load dominated climate i.e. Cold climates). Openings in the medium radiation zone will allow some heat gain, which can be mediated with fins, overhangs, light shelves, shadow boxes, etc.

Understanding Radiation Benefit

The Radiation Benefit diagram has a similar representation to the Radiation by Sky Segment above, but a different focus on the conclusions that should be drawn. This diagram differentiates "good radiation" from "bad radiation" based on the season. The orange/red zones show the helpful wintertime sun and darker blue regions show the harmful summertime sun. In another word, you may want to block the blue radiation in summer since it leads to overheating of spaces while take advantage of red radiation which provides beneficial solar heat gain in colder times of the year. This climate diagram is helpful when it comes to evaluating building massing and shading strategies.





Radiation by Sky Segment

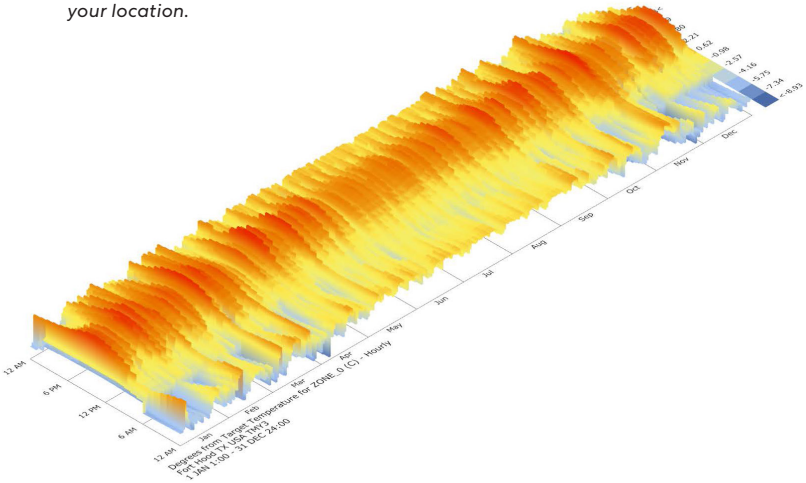
This graph maps the radiation onto a sky dome to show the intensity of the direction and intensity of solar radiation on a yearly basis around the cardinal points for Killeen.

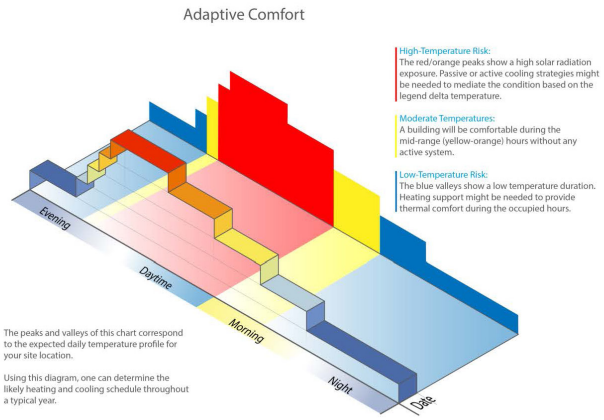
Radiation Benefit

This graph maps the radiation onto a sky dome to show the intensity of "good" radiation vs. "bad" radiation based on the season.

Adaptive Comfort

Adaptive Comfort chart showing the time of day and time of year with the greatest human comfort for your location.

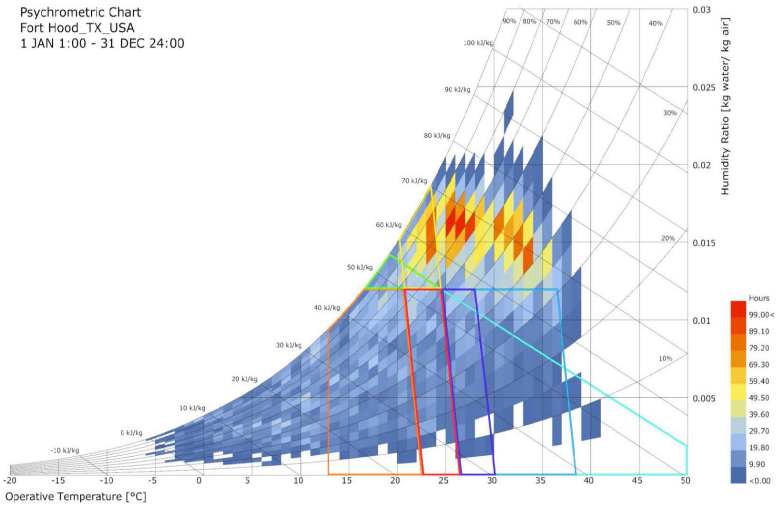




A standard for thermal comfort in naturally ventilated buildings included in ASHRAE Standard 55. In free-running buildings, the internal air temperature can be calculated successfully by taking into account several factors such as the interaction of the inhabitants with their surroundings including when they change their clothes, opening/closing windows, the use of low-energy fans, drinking water, and drawing shades. The adaptive comfort chart showcases the expected daily comfort profile for the project location. Using this diagram, users can determine the likely heating, cooling and de/humidification schedule throughout a typical year.

Using the graph, one can determine the number of hours per year a specific physical and thermodynamic condition occurs. Each opaque block (blue to yellow to red) represents the number of hours where a specific condition occurs. Overlaid polygons are used to identify strategies that add to the annual percentage of hours an occupant would be comfortable. A higher percentage is better, i.e. more hours where no mechanical support is necessary. Users can refer to the polygon glossary below to understand which strategy would be most useful to improve comfort.

Psychrometric Chart



5.92 % COMFORT - NO PASSIVE STRATEGIES

Impact of Design Strategies

% of additional comfort - higher is better

4.90 % EVAPORATIVE COOLING

3.84 % THERMAL MASS + NIGHT VENTILATION

3.90 % OCCUPANT USE OF FANS

19.02 % INTERNAL HEAT GAIN

2.99 % DESICCANT DEHUMIDIFICATION

9.50 % DEHUMIDIFICATION

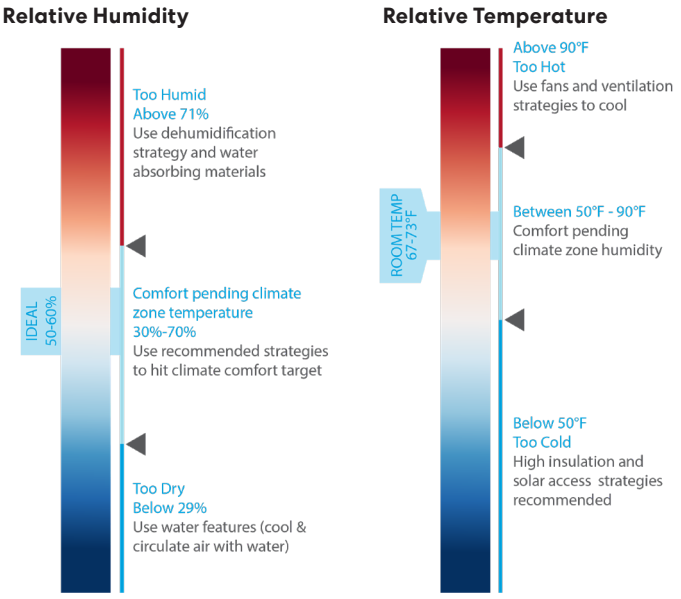
This chart shows the relationship between dry bulb, humidity ratio, and enthalpy. The polygons overlaid on the chart represent different strategies to increase comfort. Based on ASHRAE 55-2013 under standard conditions.

Understanding Relative Temperature & Humidity

Relative Temperature, *also known as dry-bulb temperature (DBT), is the temperature of air measured by a thermometer freely exposed to air but shielded from radiation and moisture.*

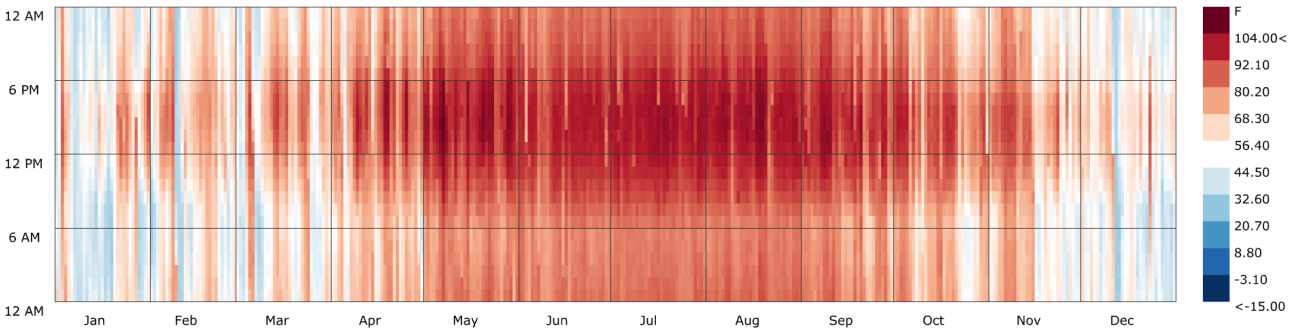
Relative Humidity (RH) *is the amount of moisture in the air relative to what the air can 'hold' at that temperature.*

Both relative humidity and dry bulb temperature are used to predict the thermal comfort of occupants during critical time intervals. In certain climate zones, they may determine most of a project's Energy Use Intensity (EUI).

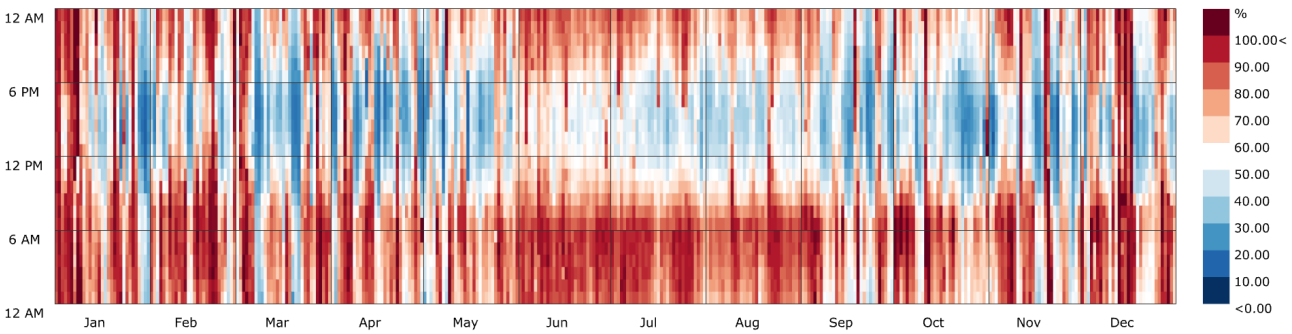


Relative Temperature & Humidity

This graph shows the outdoor comfort in Killeen using the yearly range of temperatures and humidities.



Dry Bulb Temperature (F) - Hourly
Fort Hood_TX_USA
1 JAN 1:00 - 31 DEC 24:00



Relative Humidity (%) - Hourly
Fort Hood_TX_USA
1 JAN 1:00 - 31 DEC 24:00

Suitability Analysis

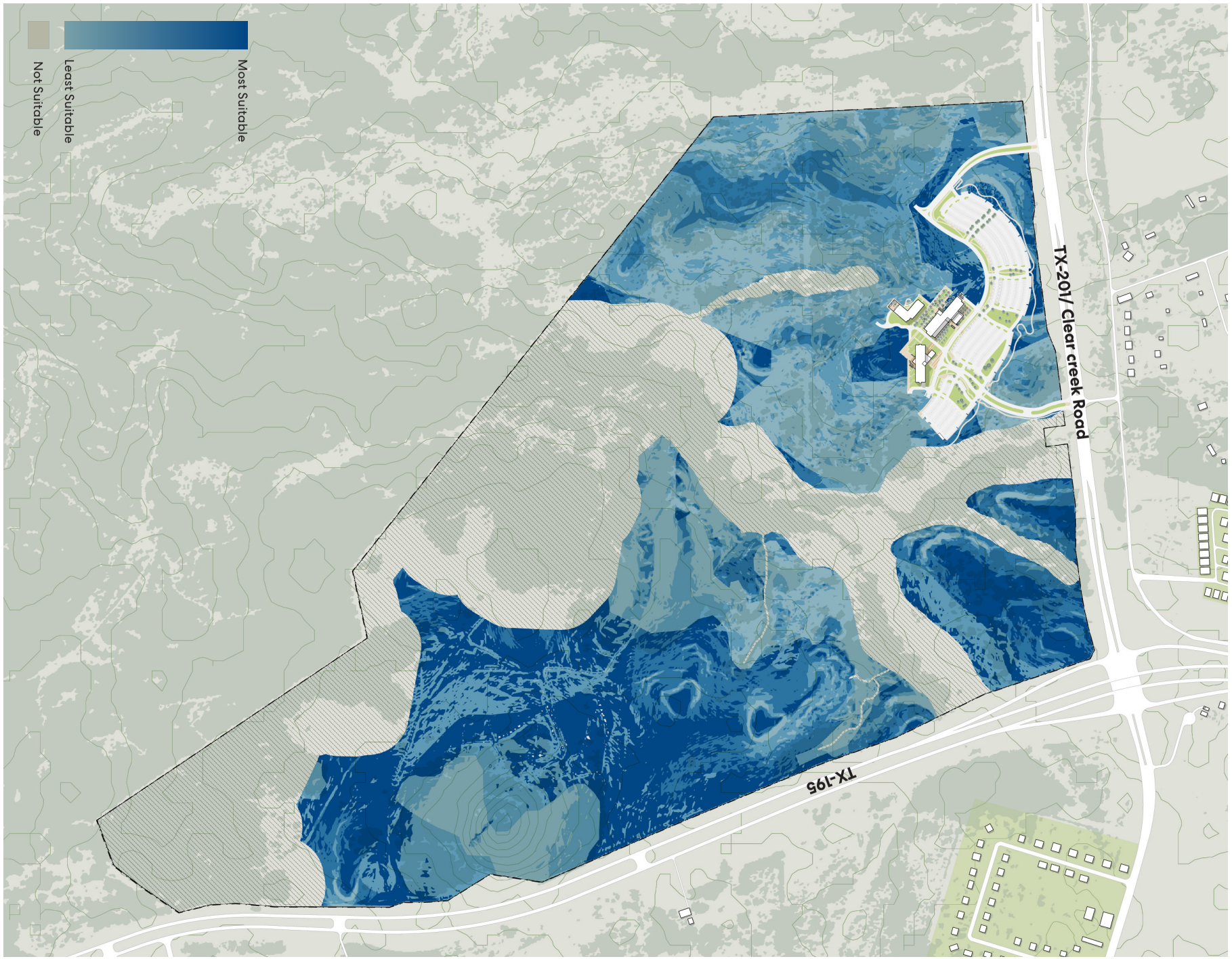
In order to guide the most thoughtful approach to future development on the campus property, the team explored and identified the most sensitive natural areas to protect and the best opportunities to enhance. Zones of potential development were identified away from the most sensitive ecosystems and analyzed further for how development can promote long-term resilience of natural areas integrated with and supportive of the campus community.

Ecological suitability analysis is a GIS-based modeling technique that uses the most influential geospatial data for an area to produce a base map identifying a range of ecologically valuable and/or sensitive natural resource areas. This information is then used for design and resilience and management planning.

The criteria used for the A&M-Central Texas suitability analysis were golden-cheeked warbler habitat and buffer, occurrence of floodplain, land cover type, slope, and soil depth and erodibility. Warbler habitat and floodplain are binary in that their occurrence in any location automatically defines it as sensitive and high-functioning. Other than warbler habitat and floodplain, slope was weighted highest for the ecological suitability analysis due to its relationship to distinct landforms.

Outside of the warbler habitat and floodplains, the base map indicated areas ranging on a scale from high ecological function and conservation priority (lighter shades) to low function and more appropriate for Low-Impact Development (LID; darker shades).

Although the black-capped vireo is no longer listed as endangered and its habitat was not included as a criterion in the Ecological Suitability Analysis, it remains a species of concern and presents a high-value conservation opportunity for A&M-Central Texas. Other considerations for design will be pragmatic and related to existing campus structures, infrastructure, and site access.


Not Suitable
Least Suitable
Most Suitable
TX-201/ Clear creek Road
TX-195

Suitability Attributes

An ecological suitability analysis combines mapped site features at different weights to create a geospatial model of conservation opportunities. Within this suitability model, attributes were categorized into subtracting factors which designate the covered areas as conservation zones and weighted attributes which get calculated to identify the most suitable areas on site. Details of the analysis factors are included in the following table.

Factor	Data Source	Analysis Attribute	Value Categories 0 = not suitable	Calculation
Drainage Contributing Area • **Stream centerline** • **25-ft buffers** • **floodplain** • **Soil type**	Stream centerline & floodplain from 2010 Pacheco-Koch Drainage study Soil types from NRCS	Subtract	Drainage Contributing Area = 0	At any point along drainage, soil type KrB or floodplain boundary, whichever is further from stream centerline + 25 ft
Soil K factor (erodibility)	NRCS	Weighted	≥0.28 = 0 0.16-0.27 = 1 ≤0.15 = 2	
Soil Prime Farmland	NRCS	Weighted	Yes = 0	
Soil depth	NRCS	Weighted	based on soil/veg relationships	
Slope	Master Plan Survey	Weighted	>10% = 0 5-10% = 1 0-5% = 2	Percent slope
Sensitive bird habitat	2004 Biological Opinion	Subtract + Weighted	GCW habitat or buffer = 0 GCW take = 1 BCV take = 1	
Vegetation type	Will need existing conditions from field observations	Weighted	Deciduous Oak/ Evergreen Motte & Woodland = 0 Oak / Hardwood Motte and Woodland =0-1?(1) Savanna Grassland =0-1?(0) Ashe Juniper/ Live Oak Shrubland = 1-2(1) Live Oak Slope Shrubland = 0-1?(0) Ashe Juniper Motte and Woodland = 1 Ashe Juniper Slope Forest = 2 Live Oak Motte and Woodland = 2 Oak / Ashe Juniper Slope Forest = 2 Native Invasive: Mesquite Shrubland = 2-3?(3, shin oak 2) Barren = 3	

Suitability Analysis Factors

Detailed calculations methodology for the suitability model.

2. Benchmarks & Studies

Research Park Case Studies

Best Practices

Market Analysis

As systems of knowledge economy are driven by many physical and programmatic attributes, studying how these attributes play into other areas can help decision makers throughout the planning process and implementation stages. Throughout collaboration with Forge stakeholders multiple locations were selected to be studied as how they are physically built out and programmatically managed. Along with the real estate market conditions analysis of the Greater Killeen area, these studies helped the decision making process from a design and planning standpoint for Forge.

Research Park Case Studies

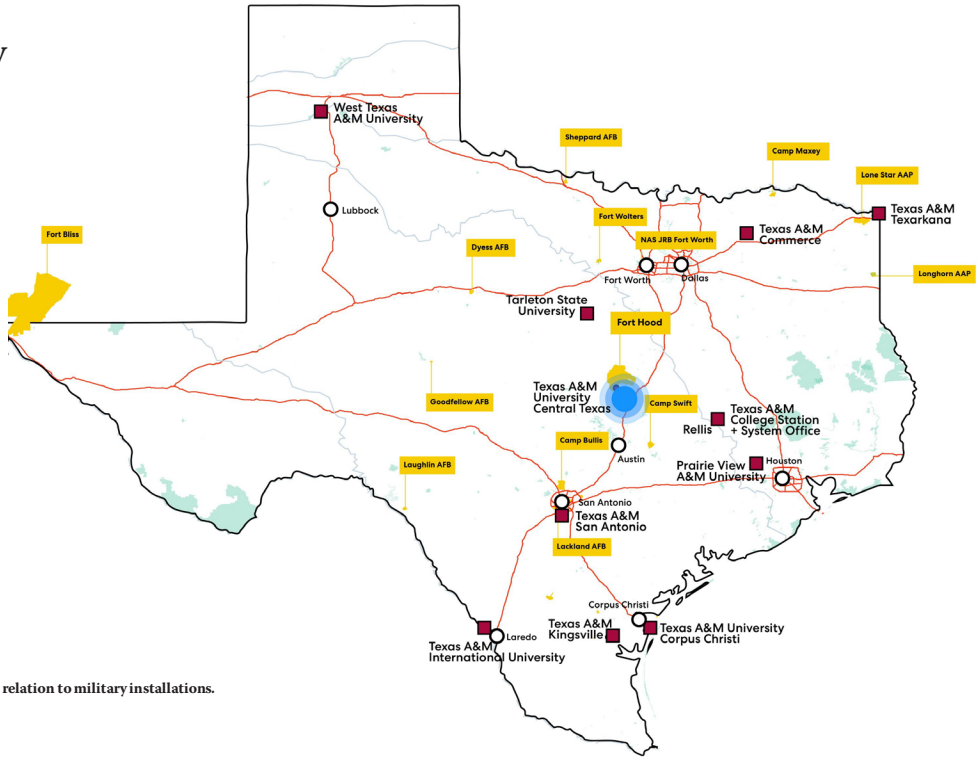
US-based precedent projects similar in scope and size featuring technology and defense-oriented land uses were identified as cases to be reviewed. These cases provide an understanding of how prevailing models were conducive to the transformation of those locations. The case studies also consider the impact of the precedent sites on their surrounding communities and land uses.

Texas A&M University Central Texas

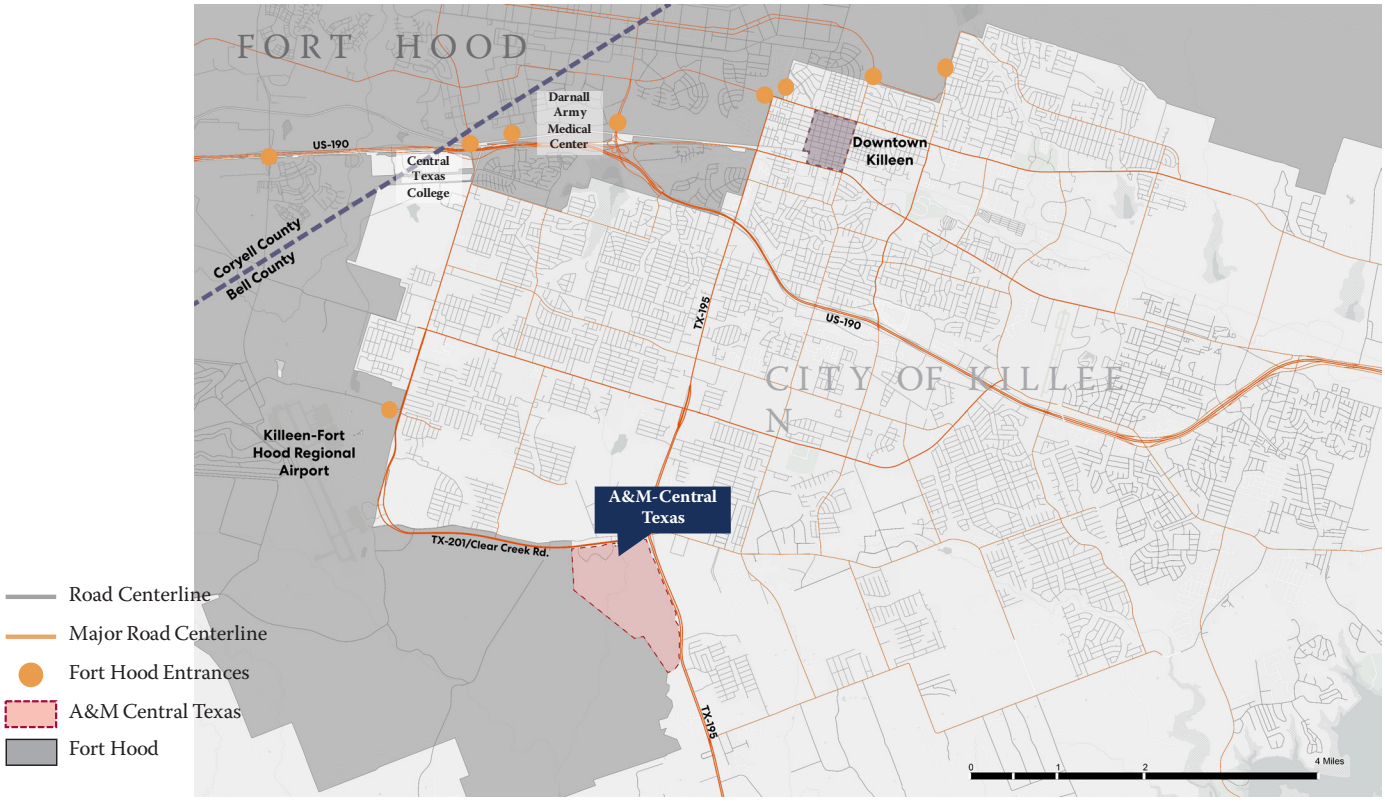
Innovation District Convergence Analysis

March 22, 2022

Texas A&M University



Texas A&M University system campuses in relation to military installations.



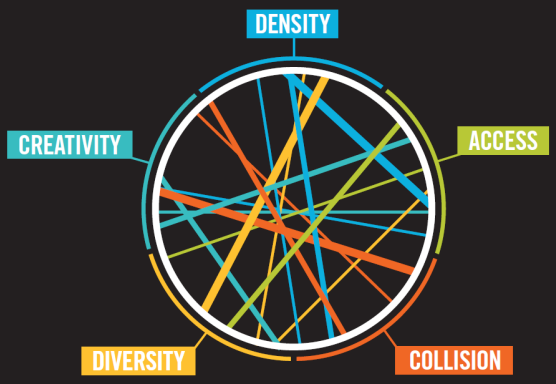
Why are we doing this

1. Apply transferable key takeaways from national precedents to establish A&M Central Texas as a center of innovation and exchange.

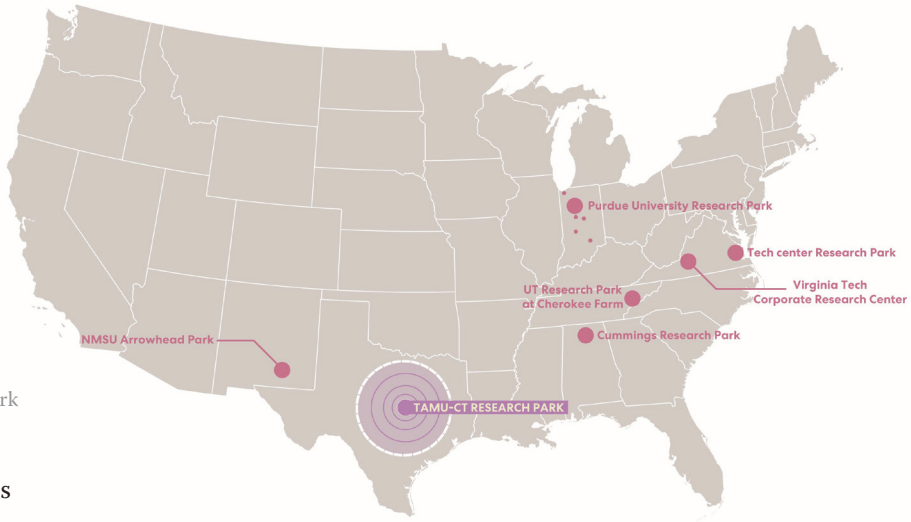
2. Implement a calibrated approach toward economic development anchors and entrepreneurship efforts to support a thriving innovation ecosystem.

3. Forge better economic, social, and physical connections between the innovation district, Fort Hood, the larger University system, and the surrounding community.

4. Create a denser, more active, and better-connected, mixed-use environment in and around the innovation district.



Case Studies



1. Virginia Tech
   - Tech Center Research Park
   - Virginia Tech Corporate Research Park
2. Cummings Research Park
3. Purdue University Research Parks
4. University of Tennessee Cherokee Farms
5. New Mexico State University Arrowhead Park

How Case Studies Were Selected

Some key factors:

1. Federal Presence
2. University Presence
3. Metropolitan Scale / Proximity
4. Stage of Development

After selection, the case studies were assessed across a scale of other benchmarks.

Long List

#	Name	City/State	Urban Geography	Proximity to Major Metros	Scale (small vs. large towns/ metros)	Population trends	Creation Date	Significant Federal Presence	University Presence	Size (of Research	Campus Size (R1, R2, etc.)	Student Population
0	TAMU-CT	Killeen, Tx										
1	Tech Center Research Park	Newport News, VA	Suburban	1 hour from Richmond, 3.5 hours to Washington D.C., 4 hours to Blacksburg, VA	Small metro	Newport News had fastest rate of growth between 1950s and 1990s, growth rate has slowed over last 20 years	Building One opened in 2018, Building Two is currently under development	Yes, adjacent to Jefferson Lab (DOE National Accelerator Facility) and nearby NASA Langley Research Center	Yes, partnership between Virginia Tech Corporate Research Center, V.M. Jordan Development Co., S.J. Collins Enterprises, Venutre Realty, and City of Newport News. VT's Newport News Center is located in Building One and offers professional development and	900,000 s.f.	R1	37,000 across all campuses
2	Cummings Research Park	Huntsville, AL	Suburban	2 hours from Chattanooga, Birmingham	Small metro	Fast growing population (+19.4% from 2010-2020)	1962	Yes, CRP is built adjacent to Redstone Arsenal, an important location for the US Army and NASA.	University of Alabama-Huntsville aquired land near where the research park was being planned. The university is now an R2: Doctoral Universities - High research activity with 10,000 students		R2	students total, 10,000 students across 9 colleges in University of Alabama Huntsville with $98M in annual research expenditure. Theres is also Calhoun
3	WestGate@Crane Technology Park	Crane, Indiana	Rural	40 min from Bloomington, 1.5 hours from Indianapolis	Small town	The population of the surrounding area is small and declining.	2006	Yes, Crane is home to Naval Surface Warfare Center Crane Division, the third largest Naval installment by area in the world. Operations include Strategic Missions; Electronic Warfare; and Expeditionary Warfare.	Yes, Crane is home to various, some are subtle programs that have partnered with Indiana University and Purdue University (Purdue occupies a part of one building), but neither has a meaningful physical presence or involvement in the			
4	Innovate ABQ	Albuquerque, NM	Urban	Located in Albuquerque and 1 hour from Santa Fe	Large metro	Metro population of 565k and growing, though growth has slown in the last decade.	2013 project announced, Lobo Plaintorent (first building) opens 2017, completion stated for 2024	Yes, Sandia National Lab (National Nuclear Security Administration research and development laboratory), Air Force Research Laboratories.	Yes, public-private partnership between University of New Mexico, STC.UNM, County of Bernalillo, Navajo Nation	7 acres, 720,000 SF	R1	25,000 across all campuses (22k in ABQ alone)
						Population of 389k,			Yes, University of Central Florida,			

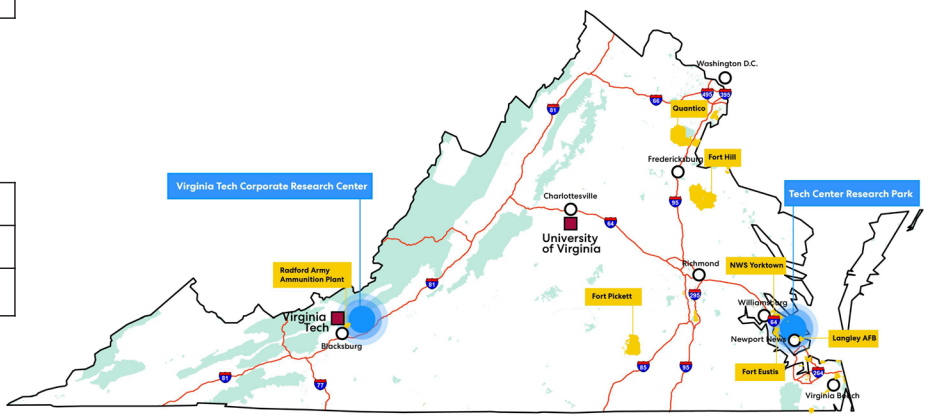
Case Study 1:
Virginia Tech

Tech Center Research Park

City/State	Newport News, Virginia
Urban Geography	Suburban
Proximity to Major Metros	1 hour from Richmond 3.5 hours to Washington D.C. 4 hours to Blacksburg

Virginia Tech Corporate Research Center

City/State	Blacksburg, Virginia
Urban Geography	Suburban
Proximity to Major Metros	45 minutes from Roanoke



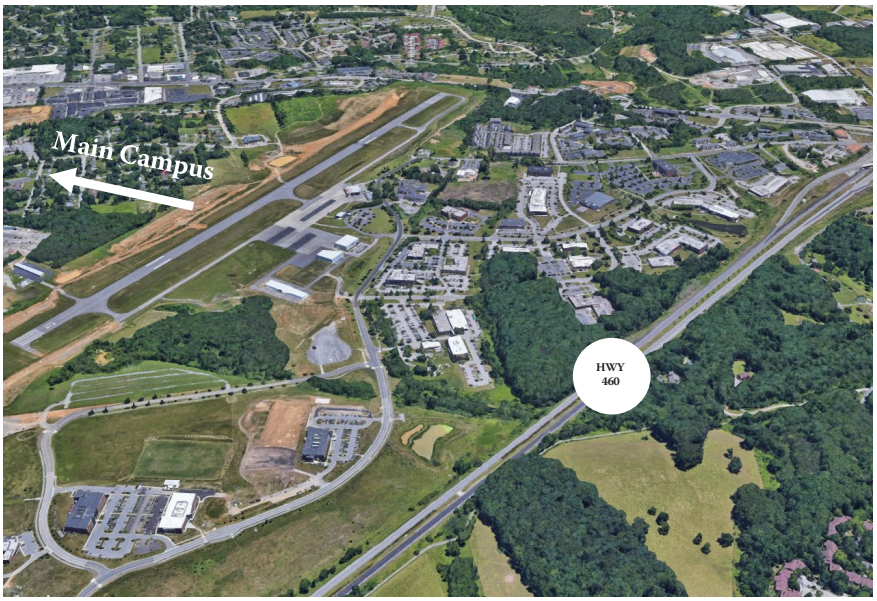
Statewide map of Research Centers in relation to military installations and major universities.

Virginia Tech Corporate Research Center (VTCRC)

Blacksburg, Virginia

At A Glance:

- Established in 1985, VTCRC was created to help enhance the technology transfer of Virginia Tech.
- The 230-acre Research Center is located next to campus and employs over 3,500 people.
- VCTRC is a for-profit wholly owned, private subsidiary of the Virginia Tech Foundation, and is not a state entity.



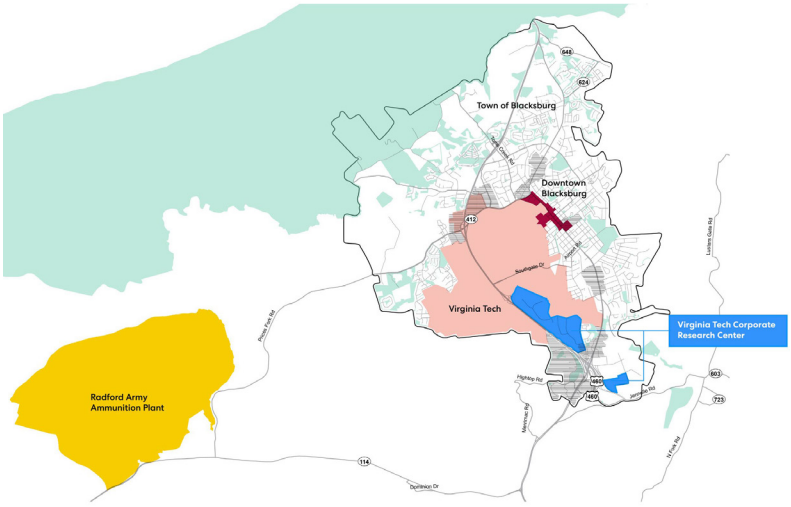
Virginia Tech Corporate Research Center

Blacksburg, Virginia

Location

Blacksburg is home to Virginia Tech with a University population of over 30,000 people.

VTCRC is home to 750 companies in Blacksburg.



Density

Regional Population	Blacksburg-Christiansburg	181,863
City Population	Blacksburg	44,303
Military Population	Radford Army Ammunition Plant	--
University Population	Virginia Tech	30,598

Virginia Tech Corporate Research Center

Blacksburg, Virginia

Access

Connectivity Score (Scored out of 100)	Walk Score	**17**
	Bike Score	**0**
	Transit Score	**29**

Amenities	To nearest urban center	+/- 1.5 miles to Downtown Blacksburg
	To nearest park	+/- 3 miles to Cedar Hill Park
	To nearest grocery	+/- 3 mile to Kroger

Suburban development model

Adjacent residential within district

Proximate to VT main campus

Virginia Tech Corporate Research Center

Blacksburg, Virginia

Collaboration

Industry Anchors

VTCRC is a for profit, wholly-owned, private subsidiary of the Virginia Tech Foundation with 750 companies in the following industries:

- Aerospace and Defense
- Automotive and Transportation
- Biotechnology
- Electronics and Sensors
- Materials
- Software
- University Research

Entrepreneurship

- VTCRC hosts a variety of networking events, co-working office and lab spaces, and connects companies with **KnowledgeWorks**, VTCRC's business building program.
- Opening in 2022, **COgro LABS** provide space with purpose for researchers to discover, test, and advance ideas.
- Types of Memberships: Wet/Dry Includes 6' lab bench, locker, over bench shelving, rolling locking cabinet, lab stool, cold water, and RO water.
- Fume Hood Suite Includes fume hood, 6' lab bench, and lab stool. Available space for 25 memberships.

Tech Center Research Park

Newport News, Virginia

At A Glance:

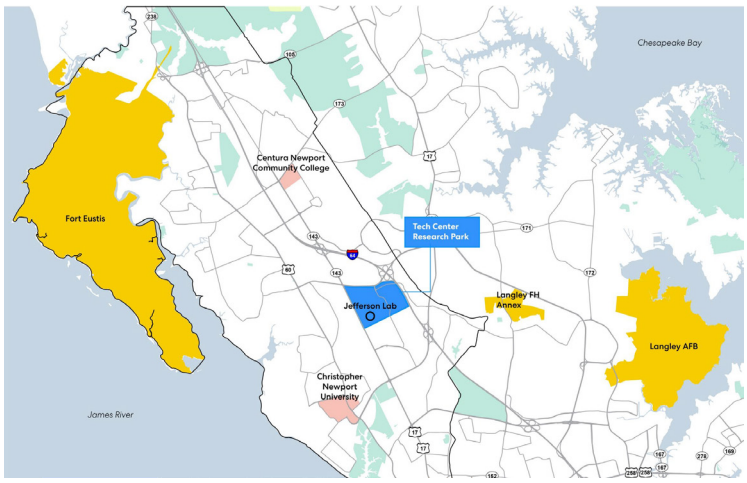
- Building off the success of VTCRC's success in Blacksburg, VTCRC spearheaded a new campus in Newport News, VA in 2014.
- The development is a partnership between a private developer, VTCRC, Jefferson Labs, and the City of Newport News.
- The complete vision for the Tech Center Research Park will cost approximately $450 million.
- The Center is also anchored by the Marketplace at Tech Center which includes many restaurants, shopping, convenience amenities (e.g. banks), and a Whole Foods.

Tech Center Research Park

Newport News, Virginia

Location

Newport News is an important innovation hub in Virginia for the aerospace industry and is home to the Thomas Jefferson National Accelerator Facility, a leader in nuclear research and one the Center's partners.



**Also consider Norfolk Naval Station to the south*

Density

Regional Population	Virginia Beach – Norfolk – Hampton – Newport News	1,799,674
City Population	Newport News	180,000
Military Population	Joint Base Langley-Eustis	50,546 active duty, guard and reserve, and family members and civilians. 12,000 students
University Population	Virginia Tech (main campus located in Blacksburg, VA)	30,598

Tech Center Research Park

Newport News, Virginia

Access

Connectivity Score (Scored out of 100)	Walk Score	**60**
	Bike Score	**54**
	Transit Score	**35**

Amenities	To nearest urban center	+/- 1 mile to City Center at Oyster Park
	To nearest park	+/- 2.2 mile to Deer Park
	To nearest grocery	+/- .5 mile to Whole Foods

Pedestrianization of former road

Adjacent new multifamily residential units

Tech Center Retail

Tech Center Research Park

Newport News, Virginia

The Master Plan

- 850,000 sf of office space across 10 buildings.
- 250,000 sf of retail space
- 285 residential units
- First building completed in 2019 and was over 94% leased at time of completion.
- Second building is slated to be completed in Winter 2023 and is already 60% pre-leased.
- Development phasing is dependent on demand and new buildings will only developed if completed buildings hit at least 50% occupancy.

Proposed Master Plan

Tech Center Research Park

Newport News, Virginia

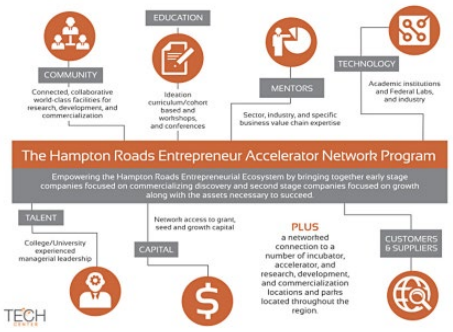
Collaboration

Industry Anchors

Significant Federal Presence	Jefferson Lab (DOE National Accelerator Facility), Fort Eustis and Langley AFB. The Tech Center has also partnered with NASA to bring space-related technologies to market.
University Presence	Virginia Tech's Newport News Center is in Building One. In proximity to Centura Newport Community College and Christopher Newport University.
Innovation Anchors	Canon Virginia, Inc. Gather Newport News – Office Space and Co-working

Entrepreneurship

The Hampton Roads Entrepreneur Accelerator
To fully leverage the innovative companies and government facilities in the area, VTCRC developed the Hampton Roads Entrepreneur Accelerator Network Program to bring together early-stage companies.



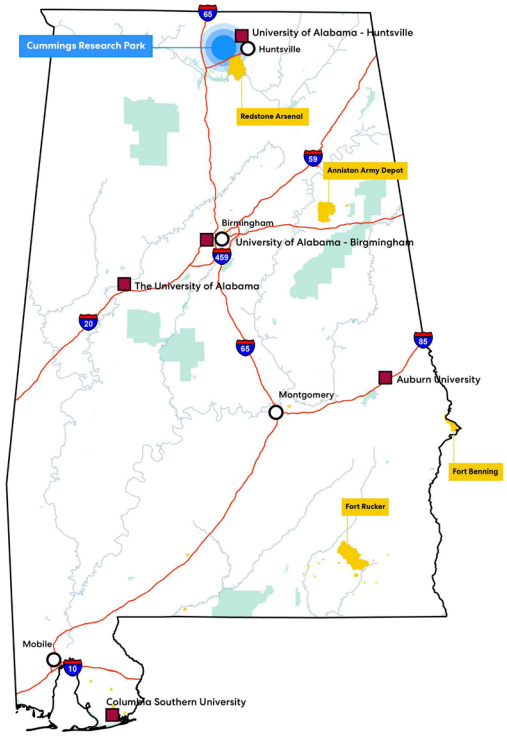
Key Findings:

- The Tech Center provides an interesting benchmark for A&M-CT, as it is still early in the development process but has seen great success with its development to date.
- The park developed rapidly from an idea to a completed building within five years.
- A large part of the Tech Center's success is that VTCRC had an existing strong reputation and was able to work collaboratively with industry partners to develop the park.
- A&M-CT is in a similar position to leverage A&M's brand in Central Texas to drive industry partnerships.

Case Study 2:
Cummings Research Park

Cummings Research Park

City/State	Huntsville, AL
Urban Geography	Suburban
Proximity to Major Metros	2 hours from Chattanooga and Birmingham



Statewide map of Research Centers in relation to military installations.

Cummings Research Park (CRP)

Huntsville, Alabama

At A Glance

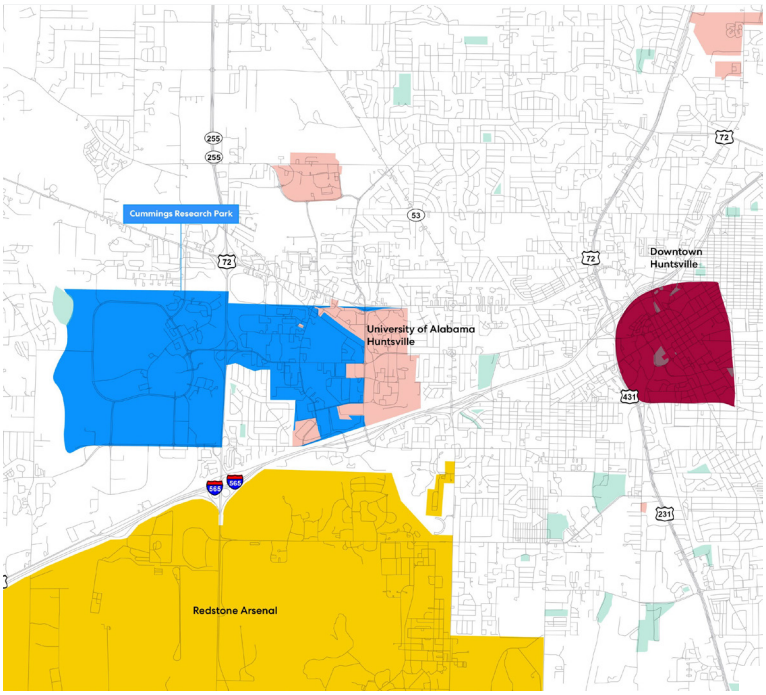
- Established in 1962, Cummings Research Park (CRP) is the nation's second largest research park at over 3,800 acres
- CRP is home to more than 300 companies, 26,000 employees, and a R-1 university enrolling 13,500 students annually.
- The Park has continued to evolve over the last sixty years, and today includes private and public sector companies, academia, retail, hospitality, and multifamily housing.
- From the park's inception, a large share of the companies located on the park worked collaboratively with the federal government on research, development, and support for the operations on Redstone Arsenal.

Cummings Research Park

Huntsville, Alabama

Density

Regional Population	Huntsville Metro	491,723
City Population	Huntsville	215,006
Military Population	Redstone Arsenal	850 active-duty soldiers 37,000 civilian and contract employees
University Population	University of Alabama - Huntsville	13,500
Research Park	Cummings Research Park	300+ companies 26,000+ employees 13,500 students



Cummings Research Park

Huntsville, AL

ACCESS

Connectivity Score (Scored out of 100)		
	Walk Score	2
	Bike Score	34
	Transit Score	17

Amenities		
	To nearest urban center	+/- 5 miles to Downtown Huntsville
	To nearest park	Indian Creek Greenway on site
	To nearest grocery	+/- 1 mile to Trader Joes

Suburban development model

Adjacent residential within district

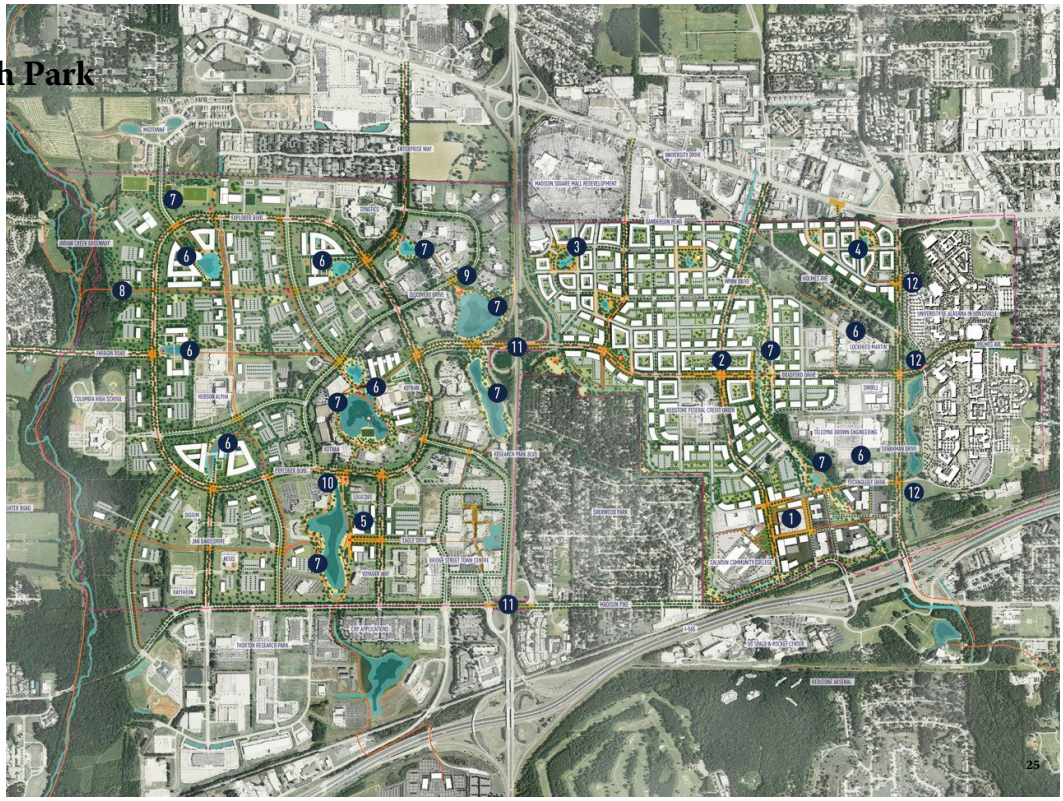
Redstone Arsenal

Cummings Research Park

Huntsville, AL

The Master Plan

1. Maker-Hacker Village
2. Bradford Crossing
3. Madison Square Mall Redevelopment Interface
4. University Corner
5. Waterfront Center
6. Landmark Sites
7. District Parks
8. Indian Creek Greenway Link
9. Discovery Hub
10. Explorer Hub
11. Boulevard Bridge
12. Sparkman Crossing



Cummings Research Park

Huntsville, AL

Collaboration

Industry Anchors

- Anchor tenants in the Park include:
  - Teledyne Brown Engineering
  - University of Alabama Huntsville
  - Lockheed Martin
  - Redstone Federal Credit Union
  - Calhoun Community College
  - ADTRAN
  - Dynetics
  - HudsonAlpha.

Entrepreneurship

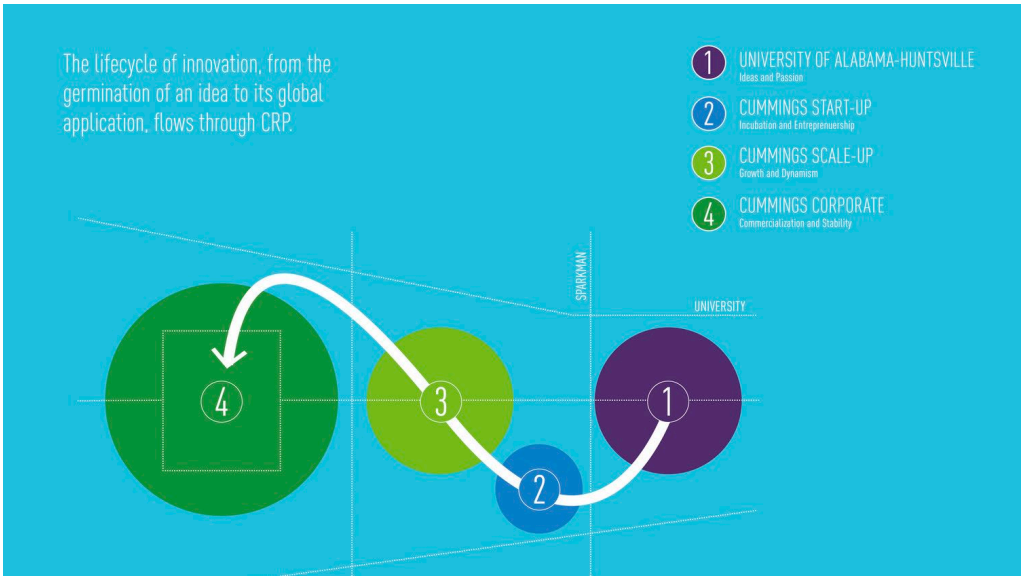
- In the late 1960s, the University of Alabama in Huntsville's (UAH) campus located to CRP. Today, UAH has a 500-acre campus within CRP, and is home to more than 17 high-tech research centers and labs responsible for nearly $131.6 million in annual research expenditures.

- The Park is also home to Calhoun Community College (the only two-year college campus in the nation to be located in a major research park), Columbia High School, and the Alabama School of Cyber Technology and Engineering (ASCTE), a public, residential magnet school who will begin open in August 2022.

Cummings Research Park

Huntsville, AL

The Master Plan



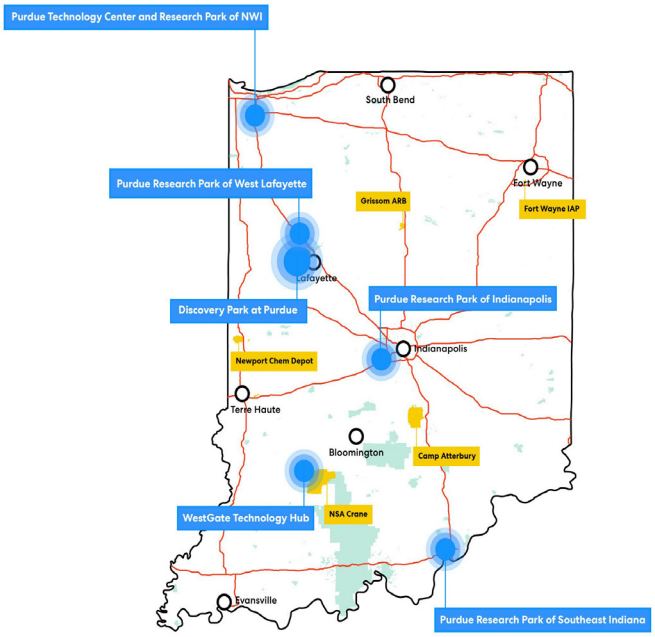
Key Findings:

- **Cummings Research Park was chosen as a benchmark for its ability to create significant, long-lasting partnerships with diverse mix of industry and federal partners.**
- **Unlike the other benchmarks we've explored, CRP was not a university-led development. Formerly Huntsville Research Park, CRP was created by community leaders in Huntsville to provide a collaborative environment for companies supporting research at Redstone Arsenal.**
- **UAH is an integral part of the Park and through collaboration and programming, ensures Huntsville is creating a strong talent pipeline to continue to attract and retain new industry partners.**

Case Study 3:
Purdue University

Purdue University Research Park(s)

Purdue Technology Center and Research Park of NWI	
City/State	Merrillville, IN
Urban Geography	Suburban
Proximity to Major Metros	2 hours from Indianapolis, 45 minutes from Chicago
Discovery Park and Purdue Research park of West Lafayette	
City/State	West Lafayette, IN
Urban Geography	Urban / Suburban
Proximity to Major Metros	1 hour from Indianapolis, 2 minutes from Chicago
Purdue Research Park of Indianapolis	
City/State	Indianapolis, IN
Urban Geography	Urban
Westgate @ Crane	
City/State	Crane, IN
Urban Geography	Rural
Proximity to Major Metros	1 hour and 30 minutes from Indianapolis
Purdue Research Park of Southeast Indiana	
City/State	New Albany, IN
Urban Geography	Suburban
Proximity to Major Metros	1 hour and 47 minutes from Indianapolis



Purdue Discovery Park

West Lafayette, IN

At A Glance:

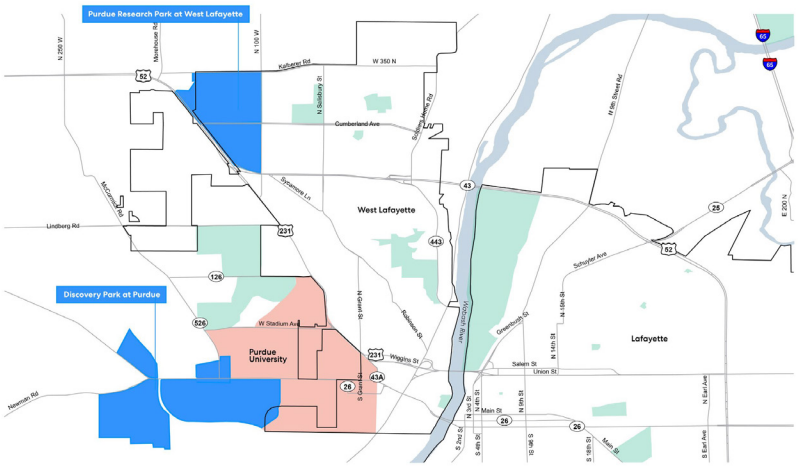
- Located at the western gateway to Purdue University, Discovery Park is a 40-acre district.
- Home to Fortune 100 companies, early-stage startups.
- An emerging walkable community with ample green space, restaurants, residential, and entertainment options.

Purdue Discovery Park

West Lafayette, IN

Density

Regional Population	Lafayette Metro	237,130
City Population	West Lafayette, IN	48,551
Military Population	N/A	N/A
University Population	Virginia Tech (main campus located in Blacksburg, VA)	30,598



Purdue Discovery Park

West Lafayette, IN

The Master Plan

- Master plan consists of approximately 450 acres.
- The full plan will include student housing; non-student residential; hospitality; lab, research and other collaboration spaces; office; discovery and entrepreneurial spaces; retail; public spaces; and aerospace industry-focused research, advanced manufacturing and light industrial space.
- Totaling several million square feet with a total investment in excess of $1 billion, developers will be executing vertical development over the next 15 to 30 years

Proposed Master Plan

WestGate @ Crane

Crane, IN

At A Glance:

- Established in 2005, WestGate @ Crane is home to NSA Crane, the world's third-largest naval installation and a major hub for research and training around national defense.
- Comprised of several nodes within roughly 25 miles of the base, Westgate @ Crane offers a number of locations for defense contractors to locate in the region while still supporting NSA Crane and its two major tenants, NSWC Crane and CAAA.
- As a robust innovation ecosystem has risen from the bucolic landscape, WestGate @ Crane has been transformed into a "miracle in a cornfield."
- The district is home to more than 50 organizations and more than 850 employees including Fortune 500 firms and industry-leaders.

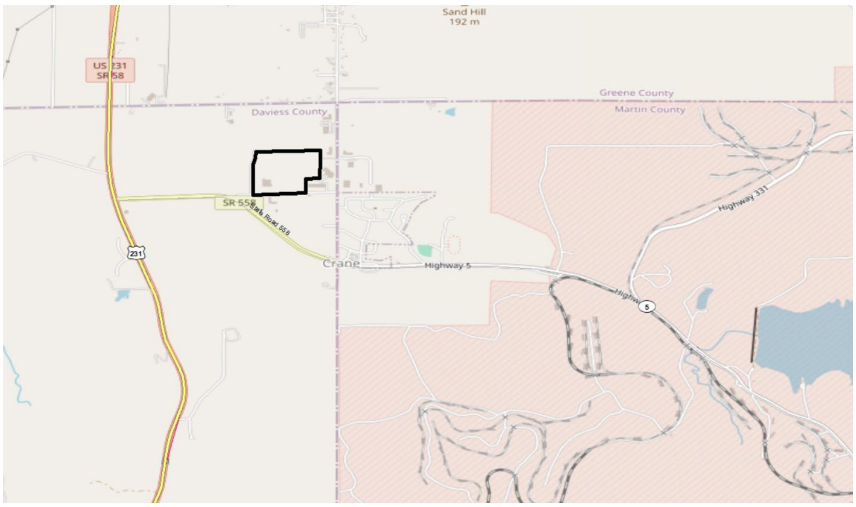
WestGate @ Crane

Crane, IN

Density

Regional Population	Martin County	10,327
City Population	Crane, IN	184
Military Population	NSA Crane	3,300
University Population	N/A	N/A

Significant Federal Presence	Naval Surface Warfare Center Crane Division, the third largest naval installation in the world by geographic area.
University Presence	N/A



WestGate @ Crane

Crane, IN

The Master Plan

- The master plan considers a broad area of more than 750 acres, proposing large-scale, transformational development for the next 10-15 years, while embracing and celebrating the landscape's natural splendor as an attraction and anchor.
- A Park within A Park - the technology park should protect, enhance, and celebrate its natural landscape as its most valuable asset.
- Westgate @ Crane will support the strategic military value of the base with compatible development that protects and expands DOD missions.

WestGate @ Crane

Crane, IN

The Master Plan

- Westgate @ Crane will honor the rural traditions of the Indiana Uplands region with a design that captures the most beloved facets of the area's small towns.

Key Findings:

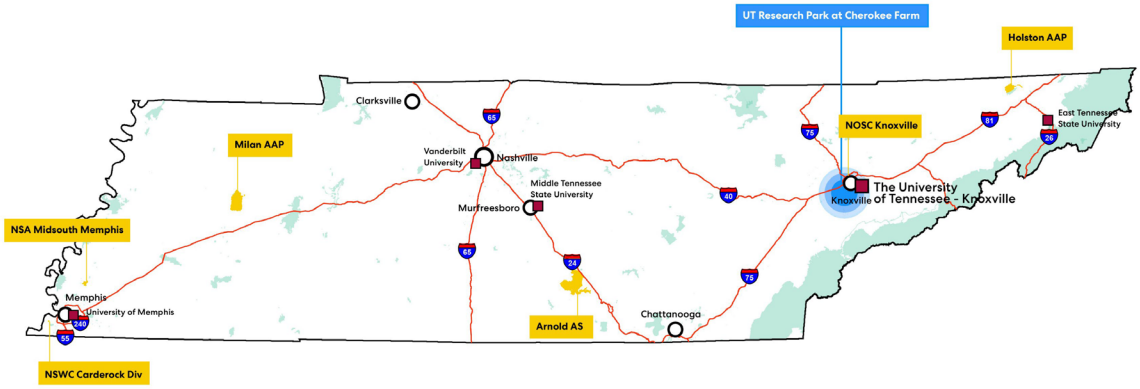
- The Discovery Park has fully embraced a mixed-use innovation community with an emphasis on housing for both students, faculty, and employees paired with aerospace industry-focused research, advanced manufacturing, and light industrial space.
- Westgate @ Crane was chosen as a benchmark as it is primed to become one of the most important defense industry research destinations.
- Westgate @ Crane is not trying to be a typical 'urban center' but rather embraces rural, small - town development but doing it in a 'smart growth way'. The district takes advantage of its varied landscape by developing unique groups of programmatic development to help focus investments during implementation.

Case Study 4:

University of Tennessee Research Park at Cherokee Farm

University of Tennessee Research Park at Cherokee Farm

City/State	Knoxville, TN
Urban Geography	Urban
Proximity to Major Metros	Located in Knoxville



Statewide map of Research Centers in relation to military installations.

University of Tennessee Research Park at Cherokee Farm

Knoxville, TN

At A Glance:

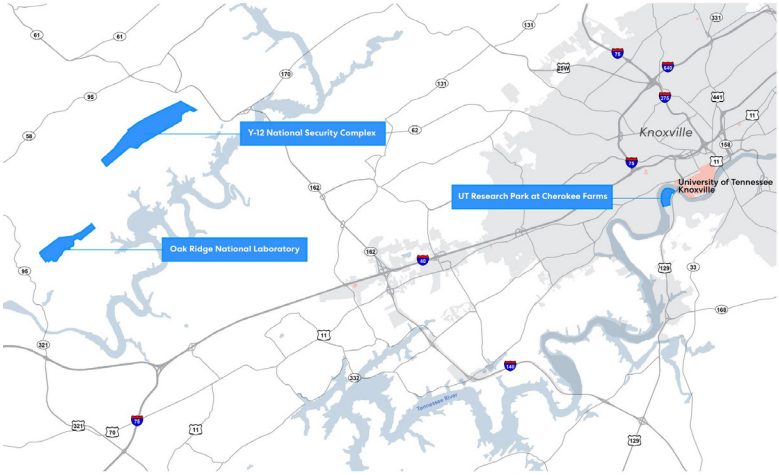
- The University of Tennessee Cherokee Farm is a 200-acre science and technology research campus
- 'Centrally' located in Knoxville, Tennessee, the Cherokee Farm Campus lies immediately southwest of and across the Tennessee River from the University system's flagship campus in downtown Knoxville.
- Directly adjacent to UT Medical Center Campus.
- The Cherokee Farm Campus will serve the entire University of Tennessee and other public and private partners through interdisciplinary research in computational science, biomedical, material and nanoscience, climate and atmospheric, environmental, and energy.

University of Tennessee Research Park at Cherokee Farm

Knoxville, TN

Density

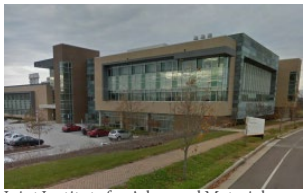
Regional Population	Greater Knoxville	879,773
City Population	Knoxville	186,173
Military Population	Navy Operational Support Center	20 full time support sailors
University Population	University of Tennessee	28,321



University of Tennessee Research Park at Cherokee Farm

Knoxville, TN


Campus development model


Joint Institute for Advanced Materials


UT Medical Center

University of Tennessee Research Park at Cherokee Farm

Knoxville, TN

The Master Plan

- The master plan for the park will include:
    - 1.6 million square feet of development space.
    - 16 building sites
    - $31 million infrastructure investment
    - $130 million five-year research funding
    - $22 million in Materials Science & Advanced Manufacturing Research

University of Tennessee Research Park at Cherokee Farm

Knoxville, TN

Collaboration

Industry Anchors

- Anchor tenants in the Park include:
    - Joint Institute for Advanced Materials (JIAM)
    - The University of Tennessee Medical Center
    - Volkswagen Innovation Hub
    - Civil and Environmental Consultants (CEC)
    - AUBO Robotics
    - C2 Labs
    - Spark Innovation Center
    - American Nanotechnologies Inc.
    - Chem Chip, LLC
    - Eonix
    - Neptune Fluid Flow Systems
    - Sky Nano
    - Qubit Engineering

Partnerships and Entrepreneurship

The University of Tennessee Knoxville
The university has helped Tennessee become a world leader in renewable energy, and the University of Tennessee Research Park at Cherokee Farm is a catalyst to continue to move the university, state and country forward in multiple areas of research, including materials science, high-speed computing, agriculture and biotechnology.
Oak Ridge National Laboratory
Oak Ridge National Laboratory (ORNL), jointly managed by the University of Tennessee and Battelle, provides exceptional researchers with sophisticated equipment and unique facilities to solve some of the nation's most compelling challenges. As the largest U.S. Department of Energy (DOE) open science laboratory, ORNL's mission is to deliver scientific discoveries and technical breakthroughs that accelerate the development and deployment of solutions in clean energy and global security while creating economic opportunities for the nation.

National Science Foundation's I-Corps
Supports technology researchers as they move innovation beyond the lab and into the marketplace.
UT Bredesen Center
Entrepreneurial curriculum provides opportunities for entrepreneurs and startup companies to work with PhD students pursuing interdisciplinary degrees in energy sciences and data science.
Innov865 Alliance
Develops, supports and promotes the Knoxville region's entrepreneurial ecosystem in a collaborative effort to showcase the area as a place for entrepreneurs to start and grow businesses and increase access to capital.

Key Findings:

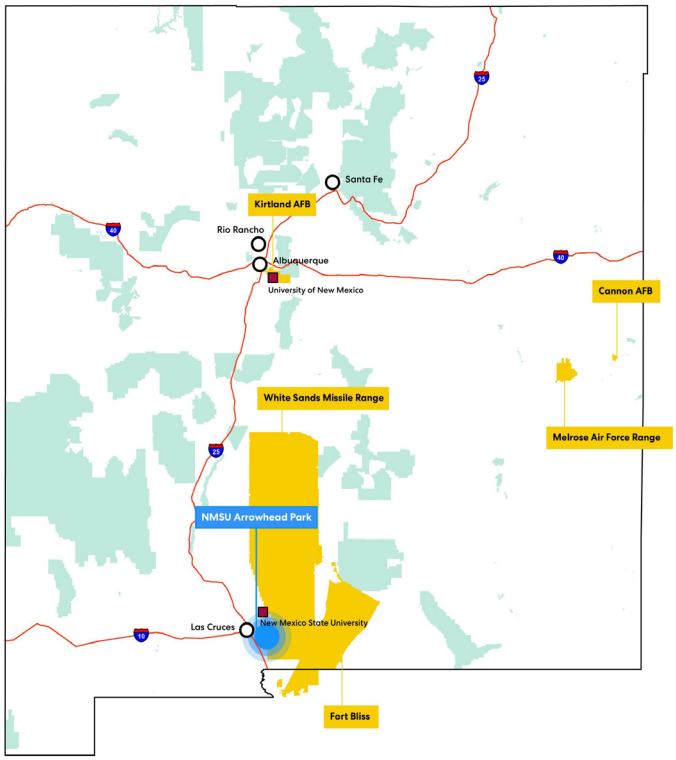
- Major regional research anchors like Oak Ridge National Laboratory are looking for new facilities to be located closer to the main academic campus and downtown core.
- Physical adjacency does not mean good connectivity. Currently, Cherokee Farms only has Alcoa Highway as a direct connection to UT campus and Downtown Knoxville.
- Integrating ecological frameworks and biophilic thinking into the physical planning of research environments brings a myriad of benefits.

Case Study 5:

New Mexico State University Arrowhead Park

NMSU Arrowhead Park

City/State	Las Cruces, NM
Urban Geography	Suburban
Proximity to Major Metros	15 minutes to Downtown Las Cruces; 3 hours to Albuquerque



Statewide map of Research Centers in relation to military installations.

NMSU Arrowhead Park

Las Cruces, NM

At A Glance:

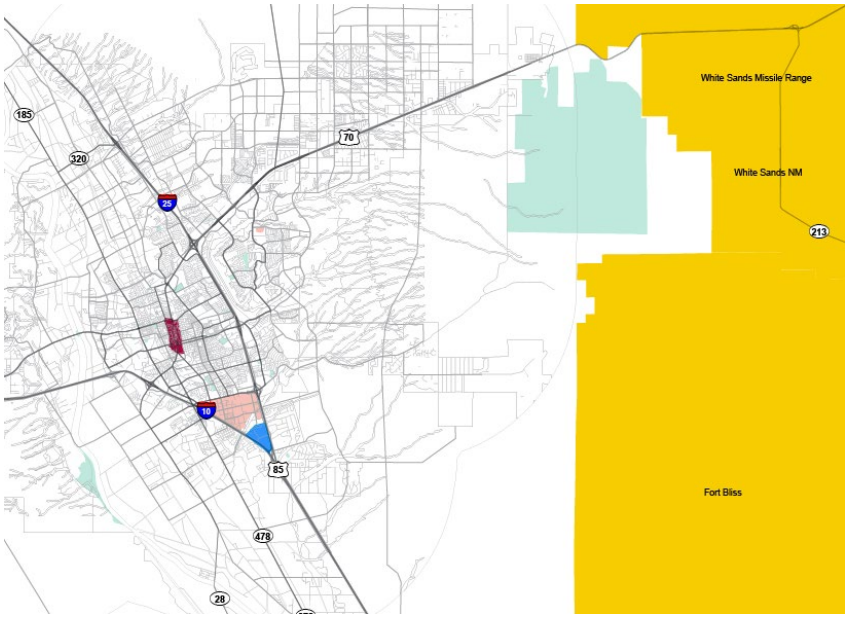
- Arrowhead Park is a new 200-acre master planned research park development in Las Cruces, New Mexico slated to open its first building in early 2022.
- New Mexico State University and the Arrowhead Center worked with both the public and private sectors to bring the park to fruition.
- The driving force behind the Arrowhead Park is the Arrowhead Center, NMSU's accelerator and business park lead. Unlike VTCRC, the Arrowhead Center is fully incorporated into the university.

NMSU Arrowhead Park

Las Cruces, NM

Location

Las Cruces is home to 111,000 people, about an hour north of El Paso, Texas. Las Cruces economy is largely dependent on NMSU and the nearby White Sands Missile Range, a military testing area operated by the US Army.



Density

Regional Population	Las Cruces Metro	213,849
City Population	Las Cruces	102,102
Military Population	Fort Bliss	32,511 total military 39,576 family members 10,063 civilians
University Population	New Mexico State University	25,312

NMSU Arrowhead Park

Las Cruces, NM

Suburban development model

Arrowhead Early College High School

General Dynamics "Spaceplex"

NMSU Arrowhead Park

Las Cruces, NM

The Master Plan

- The master plan for the park will include:
  - 2 million square feet of development, including a town center with retail,
  - The Doña Ana Community College (DACC) Creative Media Technology which will house new state of the art classrooms and lab spaces
  - A 32,000 square foot innovation center which is slated to be completed in early 2022.
- The park, unlike others, is offering land for companies to develop build-to-suit buildings.

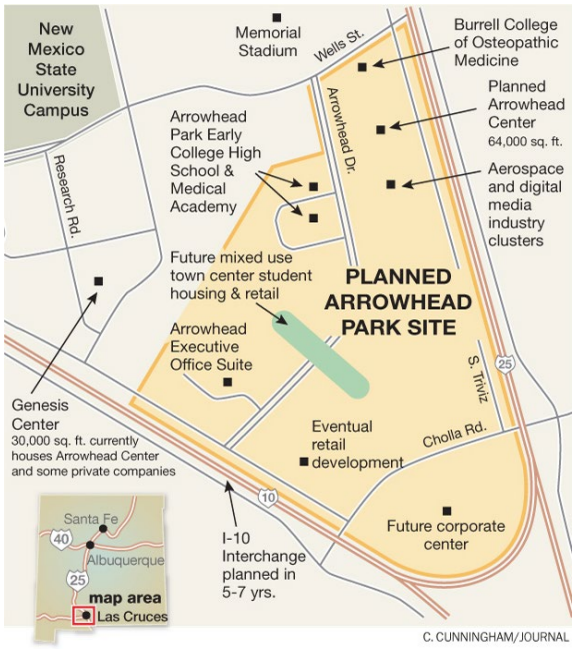
1. Arrowhead Center
2. Burrell College of Osteopathic Medicine
3. BCOM Expansion
4. Arrowhead Park Medical Academy
5. Arrowhead Park Early College High School
6. Medical Campus Expansion
7. Park Street - A Main Street
8. Mini- Campus Area
9. Arroyo Park
10. Film Studio 1
11. Parking Lot Can Transform into Outdoor Studio
12. Film Studio 2
13. Tortugas Arroyo Multi-use Path
14. Arrowhead Drive Multi-Use Path
15. Central Quad North
16. Central Quad South
17. Town Center
18. Apartments or Mini-Campus
19. New Interstate 10 Exit
20. Grocery Store or Big Box Retail
21. Renewable Energy Field
22. General Dynamics Mission Systems
23. Spaceport America Corporate Office
24. US Geological Survey
25. Gateway to Arrowhead Park
26. Aggie Memorial Stadium
27. Presley Askew Field
28. Intramural Fields
29. Tennis Center
30. DACC Creative Campus Media Building
31. NMSU Creative Media Institute Building

New Mexico State University

Las Cruces

Collaboration

- Las Cruces has catalyzed its proximity to the White Sands Missile Range to become home to multiple aerospace companies including Spaceport America, an FAA-licensed spaceport, and Virgin Galactic.
- The park continues to complement its strong industry partnerships by deepening its relationships with surrounding educational anchors including Doña Ana Community College and the Burrell College of Osteopathic Medicine.
- To attract tenants, Arrowhead Park boasts high speed gigabit internet, access to fitness facilities, access to Arrowhead Center business assistance program, and three megawatt solar and battery storage facility that will provide renewable energy to both the NMSU campus and Arrowhead Park.



New Mexico State University

Las Cruces

Collaboration

Arrowhead Center
The Arrowhead Center is working to take advantage of innovation and business opportunities that improve the region's economy. There are 4 paths: - K - University Student Entrepreneurship - Business Creation & Growth - Intellectual Property & Tech Commercialization - Regional Economic Development Collaboratives

Programs:	
American Indian Business Enterprise Center (AIBE)	Native American Business Accelerator that helps support and grow Native Owned Businesses in New Mexico.
Arrowhead Innovation Network (AIN)	An initiative that aims to increase technology commercialization, startup businesses, jobs, and economic growth.
Innoventure	K-12 entrepreneurship education program. Participants learn problem-solving, goal-setting, communication, public speaking, financial literacy, etc.
New Mexico Small Business Accelerator (NMSBA)	Assists for-profit small businesses with technical and/or businesses challenges. In partnership with Los Alamos National Laboratory and Sandia National Laboratories.
New Mexico Clean Energy Resilience and Growth (NM CERG)	Funded in part by the Dept. of Energy, NM CERG is a new effort targeting clean energy tech companies and providing support to succeed.

Programs:	
New Mexico Federal and State Technology (NM Fast)	Partnership program that provides resources, support, and expertise for small businesses to secure SBIR and STTR grants.
Arrowhead Innovation Network (AIN)	An initiative that aims to increase technology commercialization, startup businesses, jobs, and economic growth.
Sprints	Mission is to level the playing field for all high-growth entrepreneurs – particularly those who are underserved – in all places in order to create stronger communities, close the opportunity gap and scale successful businesses.
Studio G	Student Business Accelerator Program
The Hunt Center for Entrepreneurship	Funding to advance work in commercializing discoveries and innovations, encouraging entrepreneurship, launching and developing new businesses, and creating lasting partnerships in Borderplex region.

Key Findings:

- **This is an important benchmark for A&M-Central Texas because Arrowhead Park has successfully leveraged the surrounding aerospace industry to help develop the park.**
- **The park continues to complement its strong industry partnerships by deepening its relationships with surrounding educational anchors including Doña Ana Community College and the Burrell College of Osteopathic Medicine.**
- **Companies that locate in the park are able to take advantage of numerous tax incentives available due to Arrowhead Park's rural location.**
- **The Arrowhead Park is located in an opportunity zone, the Doña Ana County Free Trade Zone Area, and is located in a census tract that qualifies as "rural," so the U.S. Department of Agriculture Rural Development Loan Guarantee program may also be utilized.**

Benchmarks

Site Acreage
Density
Access (Existing)
Access (Proposed)
Collaboration (Targeted Industries)
Collaboration (Regional Anchors)

Lenses

The Convergence Analysis uses the following lenses to measure the ability of a district to fostering innovation.

DENSITY:

Measures concentration of people and activities

ACCESS:

Measures the ability to access serves & amenities

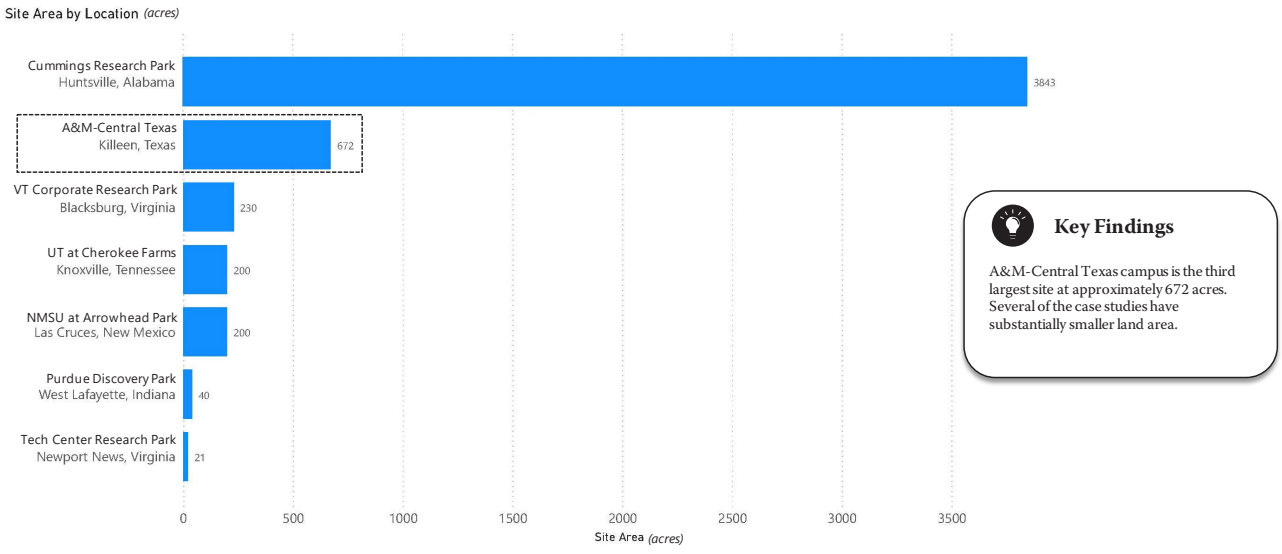
COLLABORATION:

Measures opportunities for interaction

Site Area Benchmarks

	The Site	Case Studies					
	Texas A&M University – Central Texas	**Tech Center Research Park**	**Virginia Tech Corporate Research Park**	**Cummings Research Park**	**Purdue University Research Parks**	**University of Tennessee-Knoxville**	**New Mexico State University Arrowhead Park**
Locations	Killeen, TX	Newport News, VA	Blacksburg, VA	Huntsville, AL	West Lafayette, IN	Knoxville, TN	Las Cruces, NM
Site Area	672 acres	20.6 acres	230+ acres	3,843 acres	40 acres	200 acres	200 acres

Site Area Benchmarks



Key Findings

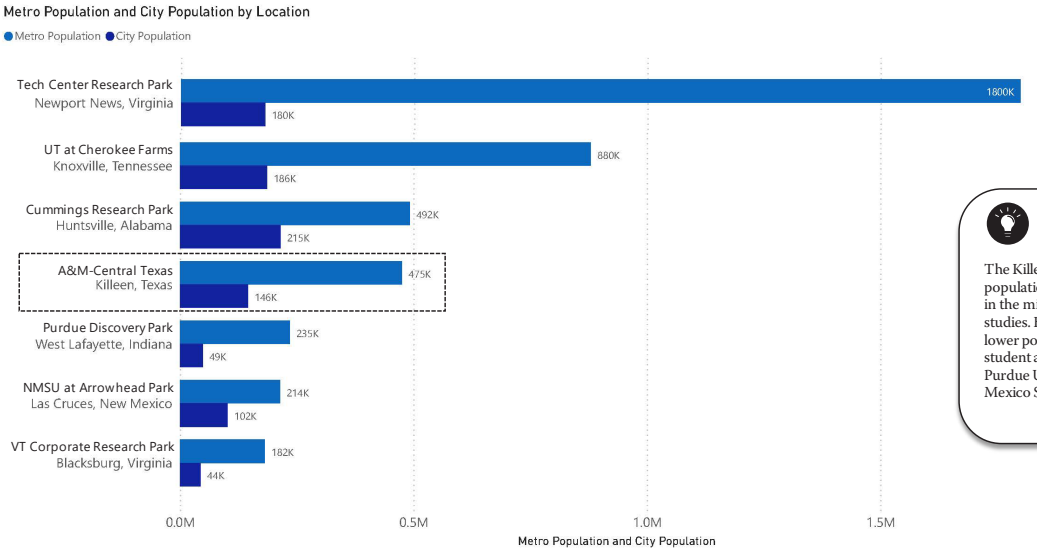
A&M-Central Texas campus is the third largest site at approximately 672 acres. Several of the case studies have substantially smaller land area.

Density Benchmarks

The Site ← → Case Studies

	Texas A&M University – Central Texas	Tech Center Research Park	Virginia Tech Corporate Research Park	Cummings Research Park	Purdue University Research Parks	University of Tennessee - Knoxville	New Mexico State University Arrowhead Park
Metro Population	Killeen-Temple-Fort Hood: 475,367	Virginia Beach –Newport News: 1,799,674	Blacksburg – Christiansburg: 181,863	Huntsville Metro: 491,723	Lafayette Metro: 235,000	Greater Knoxville: 879,773	Las Cruces Metro: 213,849
City Population	Killeen: 145,686	Newport News: 180,000	Blacksburg: 44,303	Huntsville: 215,006	West Lafayette: 48,551	Knoxville: 186,173	Las Cruces: 102,102
Military Population	Fort Hood: 45,414 assigned soldiers (2014) 8,900 civilians (2014)	Langley – Fort Eustis: 50,546 active duty, guard & reserve, family members & civilians 12,000 students	Radford Army Ammunition Plant: Information not available	Redstone Arsenal: 850 active-duty soldiers 37,000 civilian and contract employees	Naval Surface Warfare Center Crane Division: 3,300 employees	Navy Operational Support Center Knoxville: 20 full time support sailors	Fort Bliss: 32,511 total military 39,576 family members 10,063 civilians
University Population	Texas A&M Central Texas: 3,470	Virginia Tech: 30,598	Virginia Tech: 30,598	University of Alabama – Huntsville: 9,636	Purdue University: 41,573	University of Tennessee – Knoxville: 28,321	New Mexico State University: 25,312

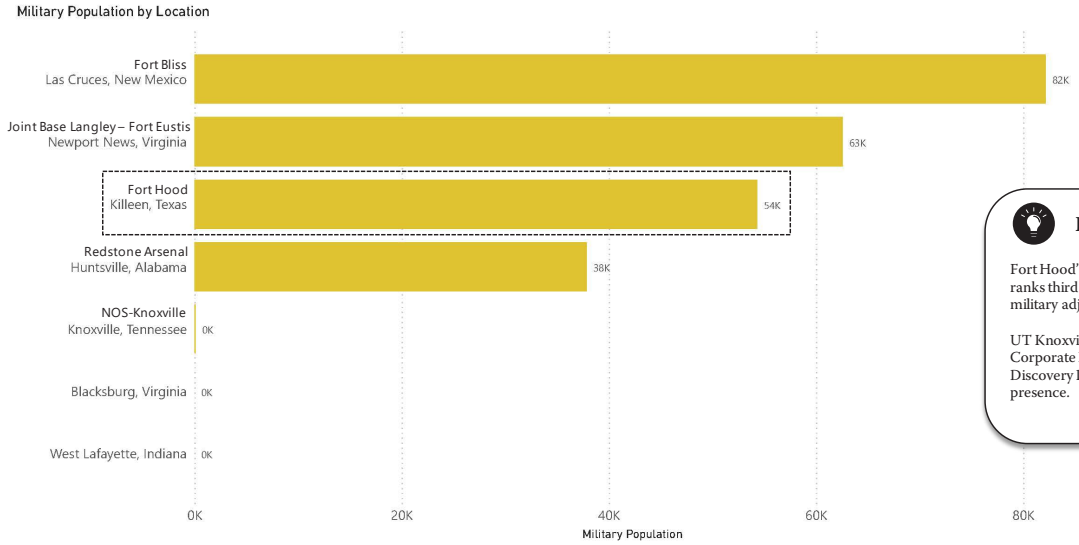
Density Benchmarks



Key Findings

The Killeen-Temple-Fort Hood metro population and Killeen city population are in the middle range among the selected case studies. However, the case studies with lower population are supported by large student and faculty population such as Purdue University, Virginia Tech, and New Mexico State University.

Density Benchmarks



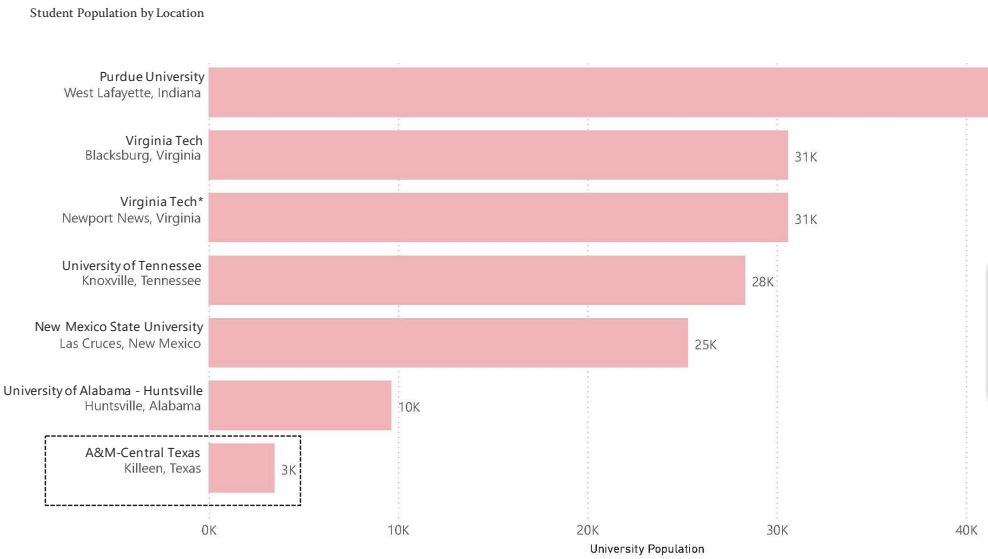
Key Findings

Fort Hood's military and civilian population ranks third among the case studies with military adjacency.

UT Knoxville at Cherokee Farms, VT Corporate Research Park, and Purdue Discovery Park have minimal or no military presence.

* Yuma Proving Ground is not located in Tucson, Arizona

Density Benchmarks



Key Findings

Texas A&M's Central Texas campus currently has the smallest student population compared to innovation district case studies.

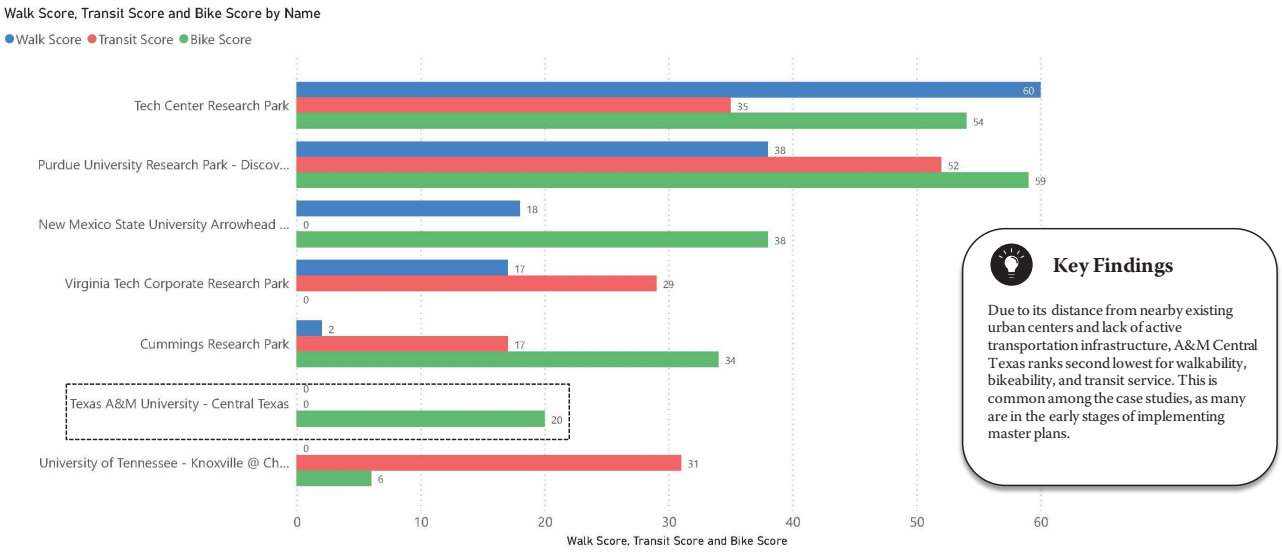
* While Virginia Tech is a major tenant/sponsor of Tech Center Research Park in Newport News, VT's main campus is in Blacksburg.

Access Benchmarks (Existing)

The Site ← → **Case Studies**

	Texas A&M University – Central Texas	Tech Center Research Park	Virginia Tech Corporate Research Park	Cummings Research Park	Purdue University Research Park (Discovery Park)	University of Tennessee-Knoxville	New Mexico State University Arrowhead Park
Walk Score	0	60	17	2	38	0	18
Bike Score	20	54	0	34	59	6	38
Transit Score	0	35	29	17	52	31	0
Distance to Urban Center	+/- 5 miles to Downtown Killeen	+/- 1 mile to City Center at Oyster Point	+/- 1.5 miles to Downtown Blacksburg	+/- 5 miles to Downtown Huntsville	+/- 1.5 miles to Downtown Lafayette	+/- 2 miles to Downtown Knoxville	+/- 4 miles to Downtown Las Cruces
Distance to nearest Park	+/-5 miles (Conder Park)	+/-2.2 miles (Deer Park)	+/- 3 miles to Cedar Hill Park	Indian Creek Greenway on Site	+/- .5 miles to Horticulture Park	Cherokee Farm Park/Greenway on site	+/- .5 miles to Preciado Park NMSU
Distance to nearest Grocery	2.1 miles (H-E-B Curbside & Delivery)	+/- .5 miles to Whole Foods	+/- 3 miles to Kroger	+/- 1 mile to Trader Joes	+/- .8 miles to Am/Pm General Store	+/- 1.2 miles to Publix Super Mark at U. Commons	+/- 1.1 mile to Toucan Market
Distance to Airport	+/- .3 miles to Killeen-Fort Hood Regional Airport	+/- 2.9 miles to Newport News International Airport	+/- .25 mile to Montgomery Executive Airport	+/- 9 miles to Huntsville International Airport	+/- .5 mile to Purdue University Airport	+/- 9 miles to McGhee Tyson Airport	+/- 10 miles to Las Cruces International Airport

Access Benchmarks



Key Findings

Due to its distance from nearby existing urban centers and lack of active transportation infrastructure, A&M Central Texas ranks second lowest for walkability, bikeability, and transit service. This is common among the case studies, as many are in the early stages of implementing master plans.

Key Findings:

Distance to Nearest Urban Center

- All case studies are outside of the 10-minute walkshed to urban centers.

Distance to Nearest Park

- Two case studies (UT-Knoxville, Cherokee Farms and Cummings Research Park) have parks/greenways located within the research park boundaries. These are capital projects implemented as part of adopted master plans.
- Two case studies (Purdue Discovery Park and NMSU Arrowhead Park) have public parks within a 10-minute walkshed.
- A&M CT's nearest public park is 5 miles away. The further distance for any of the case studies.

Distance to Nearest Grocery

- All case studies except for Tech Center Research Park in Newport News are outside of the 10-minute walkshed to nearest grocery.
- While certain case studies are relatively close to groceries, many are separated by barriers such as freeways and waterbodies, requiring a vehicle to access.

Distance to Airports

- All case studies are located within 10 miles of an airport. 3 case studies are less than 1 mile from a regional or international airport.

Access Benchmarks (Proposed)

The Site ← → **Case Studies**

	Texas A&M University–Central Texas	Tech Center Research Park	Virginia Tech Corporate Research Park	Cummings Research Park	Purdue University Research Parks	University of Tennessee-Knoxville	New Mexico State University Arrowhead Park
Plan to Improve Street Network	Yes	Yes	No	Yes	Yes	Yes	Yes
Plan to Improve Parks Network	Yes	Yes	No	Yes	Yes	Yes	Yes
Plan to Improve Mix of Uses	Yes	Yes	No	Yes	Yes	Yes	Yes
Links to Documents	https://www.tamuct.edu/finance-administration/docs/cdp.pdf	http://innovateattechcenterva.com/plans-pricing/	https://www.vtcrc.com/images/uploads/documents/Campus_Map_Rev_5_17_2121.pdf	https://cummingsresearchpark.com/park-of-the-future/	https://www.browninginvestments.com/master-plan-purdue-discovery-park-district/	https://trace.tennessee.edu/cgi/viewcontent.cgi?article=1007&context=utk_campmast	https://architect.nmsu.edu/wp-content/uploads/sites/85/2021/06/Arrowhead-Park-Campus-Plan-September-2020.pdf

Collaboration Benchmarks (Targeted Industries)

Case Studies

	Tech Center Research Park	Virginia Tech Corporate Research Park	Cummings Research Park	Purdue University Research Parks	University of Tennessee-Knoxville	New Mexico State University Arrowhead Park
Number of Companies	-	750	300	325 (across all sites)	13	19
Targeted Industries						
Aerospace	●	●	●	●		●
Cybersecurity / National Security	●	●	●	●	●	
Advanced Manufacturing	●		●	●	●	
Biotech		●	●	●		●
Energy, Environment, Sustainability	●		●		●	●
Nanomaterials	●				●	
Education / Non-Profits / R&D	●	●	●	●	●	●
Healthcare / Medical Tech	●		●	●	●	

Collaboration Benchmarks (Regional Anchors)

The Site — Case Studies

	Texas A&M University – Central Texas	Tech Center Research Park	Virginia Tech Corporate Research Park	Cummings Research Park	Purdue University Research Parks	University of Tennessee-Knoxville	New Mexico State University Arrowhead Park
Regional Innovation Proximity	Fort Hood Operational Test Command Army Futures Command Trideum Centex	Jefferson Lab Canon Virginia, Inc. Virginia Tech Corporate Research Center S.J. Collins Enterprises	Johnson & Johnson Innovation (JLABS)	University of Alabama in Huntsville Redstone Arsenal HudsonAlpha Institute for Biotechnology Calhoun Community College U.S. Space and Rocket Center Jetplex Industrial Park Lowe Industrial Park	State of Indiana Wabash College Kankakee Valley School Corporation Indiana 5G Zone US Ignite	Oak Ridge National Laboratory Y-12 National Security Complex	Spaceport America NASA White Sands Test Facility Holloman Air Force Base Virgin Galactic Headquarters University of Texas at El Paso Fort Bliss El Paso International Airport Sandia National Laboratories Las Alamos National Laboratory

Best Practices

This chapter studies how communities have leveraged their assets to create research parks and/or innovation districts uniquely suited to their goals and aspirations, developing plans that promote university research and academic interests with job creation and residential uses within the sites and the city, creating development standards aligned with both business needs and community goals, and leveraging infrastructure improvements to catalyze and support growth.

Also, best practices in creating effective public/private partnerships and implementation strategies are reviewed within this section.

INTRODUCTION| At its current phase of planning, A&M –Central Texas research park may benefit most from best practices around early-stage research park development.

Image Source: El Paso Herald

THREE KEY THEMES

1| Program: The most successful research parks are established around a programmatic strategy to capitalize on existing or planned research funding and growth.

2| Governance: University-led research parks benefit from governance structures that provide some level of independence and flexibility.

3| Implementation: Clear and well-developed tactics of implementation, such as real estate development planning and partnerships, often lead to successful outcomes.

Program| The most successful research parks are established around a programmatic strategy to capitalize on existing or planned research funding and growth.

Image Source: NCSU

BEST PRACTICES

1| Prioritize defense-oriented industry with civilian applications to bolster the existing relationship with Fort Hood.

2| Build on existing funding opportunities available through federal, state, and local sources.

3| Identify programmatic areas that are growing to attract students, partners, and industry.

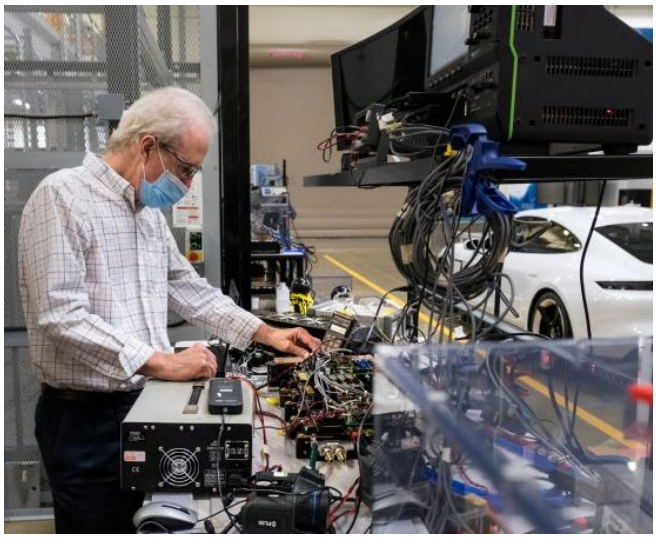
Prioritize Existing Industry| UT-Knoxville and ORNL's partnership with Volkswagen

Prioritize defense-oriented industry with civilian applications to bolster the existing relationship with Fort Hood.

A&M-Central Texas IMPLICATION | A&M-Central Texas should capitalize on the existing defense industry assets and work to develop private sector relationships. A&M-Central Texas should look to the rest of the Texas A&M system for strong private sector partnerships that can be brought to the Central Texas Campus, while also looking to differentiate themselves.

UT-Knoxville and ORNL have built a unique partnership with Volkswagen to capitalize on existing energy talent and research in the region, while also building a new pipeline of talent. Volkswagen was attracted to Cherokee Farm not only because of its location in Tennessee, but also created a cooperative agreement with UT-Knoxville and the Department of Energy to develop a novel composite liftgate. Tennessee is an important location for electric vehicle (EV) manufacturing with over 40% of the nation's EV manufacturing jobs located in Tennessee. Additionally, ORNL has been a leader in energy research since World War II.

One of the other key components in attracting Volkswagen was that Volkswagen has a well-established relationship with the University of Tennessee on the Chattanooga campus. UT-Chattanooga has developed an MBA program for Volkswagen workers that can be partially completed in the Volkswagen manufacturing facility.



Source: Eureka Alert, Volkswagen. Image Source: ORNL

Utilize Existing Funding Opportunities| Centennial Campus at NCSU

Align the vision for the research park with programmatic funding and resource opportunities that are most available in the region.

A&M-Central Texas IMPLICATION | In Killeen, there is large concentration of resources in defense-related industries. Additionally, the broader region has been able to attract significant military research with Army Futures Command partnering with UT-Austin.

North Carolina has historically been a hub for tech research, and NCSU was able to capitalize on this when winning the Next Generation Power Electronics Institute, the Department of Energy's $70M contract matched by $70M in private funding, in 2015. NCSU has been able to continue to build on this momentum with the FREEDM Center, an energy research lab located on Centennial Campus, and PowerAmerica, a member-driven consortium focused on accelerating the adoption of energy efficient silicon carbide and gallium nitride power semiconductor technologies. Both of initiatives not only attracted more funding to Centennial Campus, but also attracted smaller firms and researchers to campus.

Additionally, NCSU's pre-existing relationship with ABB, one of the largest electrical grid infrastructure companies in the world, was leveraged to bring ABB to Centennial Campus as the first industry tenant.

Source: Obama White House, FREEDM NCSU Image Source: Happening Next

Identify Growing Programmatic Areas| NMSU and Healthcare

Identify programmatic areas that are growing to attract students, partners, and industry.

BEST PRACTICE | Beyond the existing industries in Killeen, there are industries such as computer science and healthcare that are growing both nationally and need to be developed locally to support an innovation economy. Identifying these industries, both those existing and those that are needed, and developing programs to nurture them will support a thriving innovation district.

New Mexico State University applied for a $488,000 in funding from the U.S. Economic Development Administration's Regional Innovation Strategies Program Science and Research Park Development Grant to support the growth of the health care industry. Arrowhead Park's successful bid was predicated on the existing moment of the healthcare industry spurred from the creation of the Burrell College of Osteopathic Medicine. This plan has led to development of a healthcare accelerator and additional research.

NMSU has continued to build upon the areas traditional research industry, energy. In 2021, the Arrowhead Center received $1M to encourage the commercialization of high-tech clean energy. This funding is being used to develop a clean energy accelerator.

Source: Las Cruces Sun, The NMSU Arrowhead Center Image Source: The NMSU Arrowhead Center

Governance| University-led research parks benefit from governance structures that provide some level of independence and flexibility.

Image Source: Wikimedia Commons

BEST PRACTICES

1| Establish a governance structure that prioritizes research partnerships and programmatic outcomes rather than institutional process.

2| Create governance processes that allow the research park to move at the speed of business.

3| Integrate Federal agencies into governance thinking to help drive partnerships and programs forward.

Establish Governance Structure| University City

Establish a governance structure that prioritizes research partnerships and programmatic outcomes rather than institutional process.

A&M-Central Texas IMPLICATION | A&M-Central Texas should develop a leadership structure that incorporates the private sector, local officials, military officials, and leadership from Central Texas College.

University City District (UCD) in Philadelphia is one of the Nation's largest and most successful innovation districts. UCD was formed as a collaboration between multiple institutions to form a new entity that has an independent mission and process that leverages university resources to drive partnerships.

Institutional participation has been key. The UCD partnership was created in 1997 through Penn's West Philadelphia Initiatives. Today, the District also includes Drexel University, Penn Presbyterian Hospital, residents, and businesses. The UCD receives its funding from the institutions and businesses.

Source: UCD. Image Source: Brookings Institute

Move At The Speed Of Business| Clemson University International Center for Automotive Research (CU-ICAR)

Develop programs that are best supported by academic institutions, such as workforce development or applicable curriculums, to support businesses while minimizing bureaucratic processes.

A&M-Central Texas IMPLICATION | Work with the Killeen Chamber of Commerce and defense industry partners to develop programs and approval processes that support industry, academic, and military collaboration

CU-ICAR's programs were shaped and developed by industry with strong, industrially supported Research Chairs to focus on industrial needs and shift as appropriate. This model has helped produce research and partnerships that builds a working vehicle every year based upon emerging industrial technologies.

The focus on workforce development to support the automotive industry has been a key draw for private industry, as well as public funding. Clemson University has not only supported the industry by creating an innovation hub, but they have also helped develop curriculums and trainings that build a strong and well-equipped workforce. The ability to provide robust workforce programs is a unique asset that private industry often does not have the bandwidth to provide.

Source: CU-ICAR, EDA Image Source: Jay Capilo

Integrate federal agencies| Centennial Campus at NCSU

Integrate Federal agencies into governance thinking to help drive partnerships and programs forward.

BEST PRACTICE | A&M-Central Texas should coordinate with the military to develop infrastructure that will allow seamless collaboration between the private sector and the military.

Through strategic engagement with the Federal government, NC State University has been able to attract Federal agencies to its Centennial Campus as research partners who attract private industry and support university programs. The National Security Agency, the US Department of Agriculture, and the National Oceanic and Atmosphere Administration all reside at Centennial Campus.

The university has identified mechanisms to incorporate Federal agency requirements, such as sensitive compartmented information facilities ("SCIF's"), create security protocols for sensitive spaces, bolster data infrastructure, and create research partnership mechanisms that accommodate GSA and Army Corp of Engineers financial and legal requirements.

Source: HR&A Image Source: NC State University

IMPLEMENTATION| Clear and well-developed tactics of implementation, such as real estate development planning and partnerships, often lead to successful outcomes.

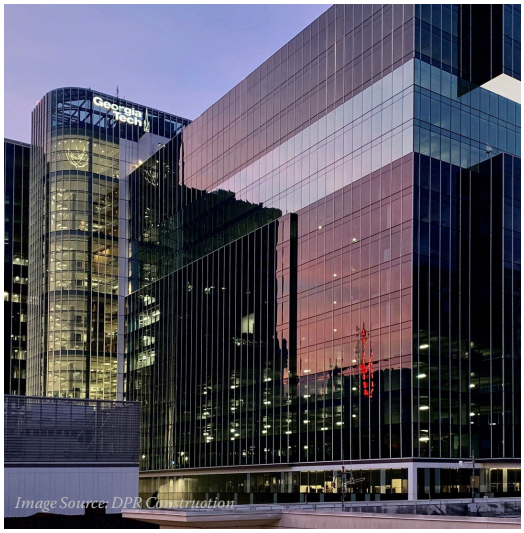


Image Source: DPR Construction

BEST PRACTICES

1| Address deed restrictions and other property constraints that may affect development potential.

2| Invest in catalytic infrastructure to encourage and invite private capital.

3| Explore State and Federal funding and resources for catalytic investment to support existing and key growth industries.

Eliminate Deed Restrictions| Centennial Campus

Address deed restrictions and other property constraints that may affect development potential.

A&M-Central Texas IMPLICATION | A&M-Central Texas should work to eliminate deed restrictions for land that is being ground leased to allow uses that complement innovation.

State and University leaders promoted the enactment of the Centennial Act in North Carolina, which gives special designation to some university real estate to function like private real estate with maximum flexibility and authority. Using this legislation, NC State University has been able to develop nearly 5M SF of space at Centennial Campus in a mix of rental and condominium housing, office and lab buildings, and academic space. The university is now embarking on an ambitious high-density innovation district development at Centennial Campus which will deliver an estimated additional 5M SF of office, lab, residential and retail space.

All private development on Centennial Campus has occurred through ground leases with flexibility to accommodate the risk of development at any given time while also giving the university opportunities for market-rate escalations in ground rent payments. Additionally, the university has taken the lead on all rezoning and entitlements to maximize the development potential of its land and reduce any friction for its development partners.

Source: HR&A; Image Source: NCSU Facilities

Catalytic Investment| Tech Square Georgia Tech

Invest in catalytic infrastructure to encourage and invite private capital.

A&M-Central Texas IMPLICATION | A&M-Central Texas should prioritize developing infrastructure that supports a lively and inviting environment, encouraging future private development.

Tech Square's development was led by Georgia Tech but has heavily integrated industry partners into the planning and development process. Tech Square's location was historically an underutilized area with little investment, but Georgia Tech saw it as an opportunity to create a presence in Midtown Atlanta. The University through the University's foundation, led the initial redevelopment because the area needed a catalytic investment to make industry see the value of Tech Square.

Initial phases of Tech Square's development cost the University $256M to develop, but this investment has led to billions of dollars in private investment in the area. The university invested in not only built environment, but also in unique assets that support research including a $5.3M hive supercomputer to aid researchers. These investments have attracted private companies to move to Tech Square.

Source: AJC Image Source: Tech Square ATL

Explore State and Federal Funding| CU-ICAR, Centennial, Purdue

Explore State and Federal funding and resources for catalytic investment to support existing and key growth industries.

A&M-Central Texas IMPLICATION | A&M-Central Texas should explore grant and funding opportunities through state and federal funding sources that will allow them to further invest in program development that will support the defense and defense-adjacent industries.

Purdue Technology Center of Northwest Indiana: The Center was developed to stimulate the economy of the region with the help of U.S. Rep. Pete Visclosky to secure $6.9M of federal funding and another $1.9M of state funding from the Technology Development Grant Fund, which provides assistance to Certified Technology Parks (CTPs) for capital expenditures and operational expenses incurred by a CTP's redevelopment commission.

CU-ICAR: CU-ICAR has utilized state and federal funding at every step of development. The initial development of CU-ICAR was funded through $40M from the South Carolina Department of Commerce—with funds originating for a BMW tax credit—and a $70M award from a South Carolina Research Bond.

Centennial Campus: Centennial received $160M in bond funding from the State of North Carolina to develop two buildings on campus in 2015.

Source: PRF, Leigh Hopkins, et al, NCSU. Image Source: Northwest Indiana Business Magazine.

Market Analysis

This section includes a high-level real estate overview and derives conclusions on how various programmatic components – military, institutional, research, commercial, mixed use, and housing – can be integrated into the land use and strategic development plan for the Research Park.

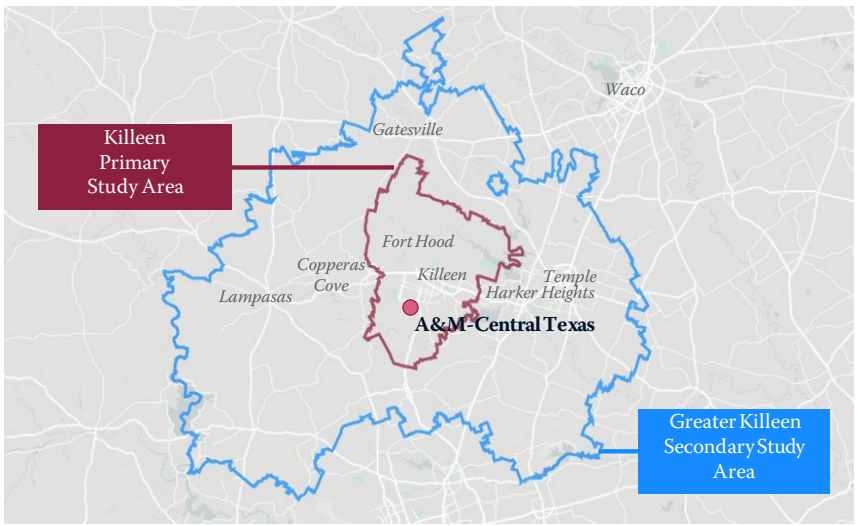
The market is analyzed for potential real estate uses that may be a part of a future development program, including institutional, commercial office, residential, retail, and hospitality to identify appropriate development typologies and delivery models.

Context| Study Area

For this market analysis, HR&A established primary and secondary study areas to differentiate trends and identify needs specific to the City of Killeen and Fort Hood, from the broader regional trends of Greater Killeen.

The Primary Study Area focuses on the City of Killeen and Fort Hood, as any development at A&M-Central Texas will have the most direct and immediate impact to that local economic and real estate market.

The Secondary Study Area captures the Greater Killeen region, including the neighboring jurisdictions of Copperas Cove, Gatesville, Harker Heights, Lampasas, and Temple, which are representative of the regional labor market and retail trade area. The secondary study area intentionally omits the Austin and Waco markets. Though economic and demographic trends of both Austin and Waco impact Greater Killeen, including them in the analysis inflates economic growth and real estate market trends. Where relevant, trends for Austin, Waco and the State of Texas are included for comparison and regional context.



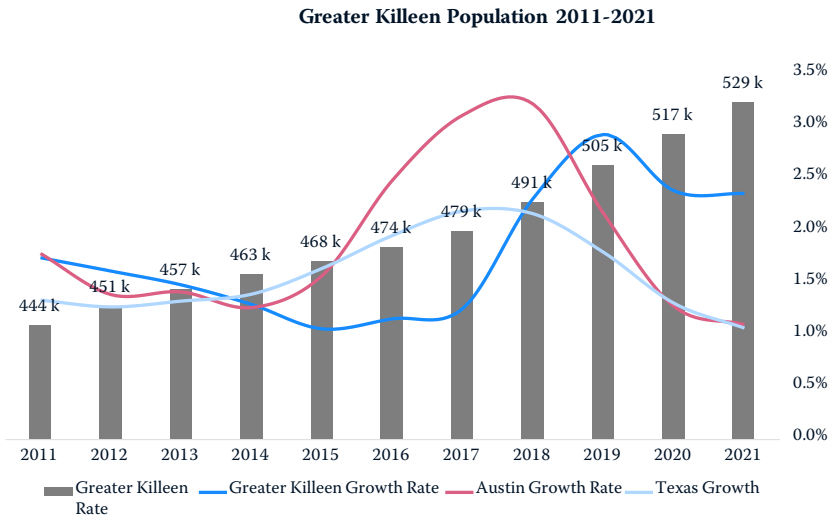
Source: ESRI, 2021

Demographics| Population

Killeen's population growth is accelerating past Texas and Austin's growth, indicating that more people are seeing opportunities to stay in Killeen.

The population of Greater Killeen has grown 2% annually since 2011. This healthy growth rate is reflective of Texas's growth overall and significantly outpaces Waco which grew 11% over the same period. Remarkably, Killeen's growth rate is catching up to Austin which grew 21% since 2011.

This rapid population growth offers Killeen and Texas A&M-Central Texas many opportunities. While throughout the last decade Greater Killeen had consistently strong population growth, since 2017, Greater Killeen's population grew 10% compared to Texas's 6%. Since the onset of COVID, Texas and Austin's population growth slowed slightly, while Killeen's population growth accelerated and continues to exceed pre-pandemic levels. Killeen's population growth mimics that of Austin, underscoring the impact of Austin's market on Central Texas.



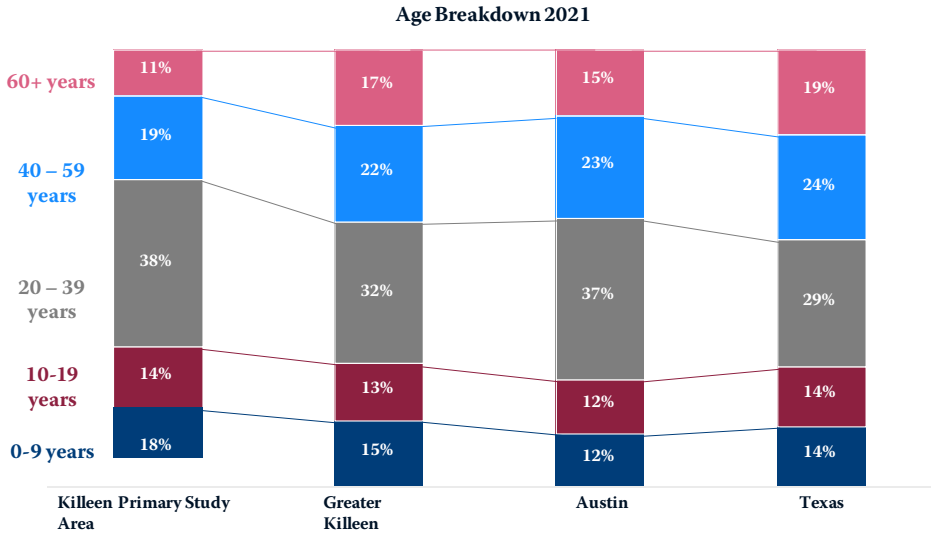
Source: ESRI, 2021.

Demographics| Age

Killeen's younger population base is largely influenced by Fort Hood, with young military families forming in Killeen.

The population of Killeen skews much younger than Texas and Austin. The most noticeable difference about Killeen's population is that 18% of the population is under the age of 10. This is largely due to the prevalence of young families, especially military families.

The share of children 10-19 is a 4% smaller share than children 0-9 indicating that Killeen does not retain families as the children age. This is also mirrored in the 40-59 age group.
There is almost half as many people in Killeen that are between 40-59 as there is from 20-
39. This is likely a result of enlisted soldiers being heavily concentrated in the 20s.
Finally, Killeen's share of people over the age of 60 is 11%, almost half of Texas as a whole.



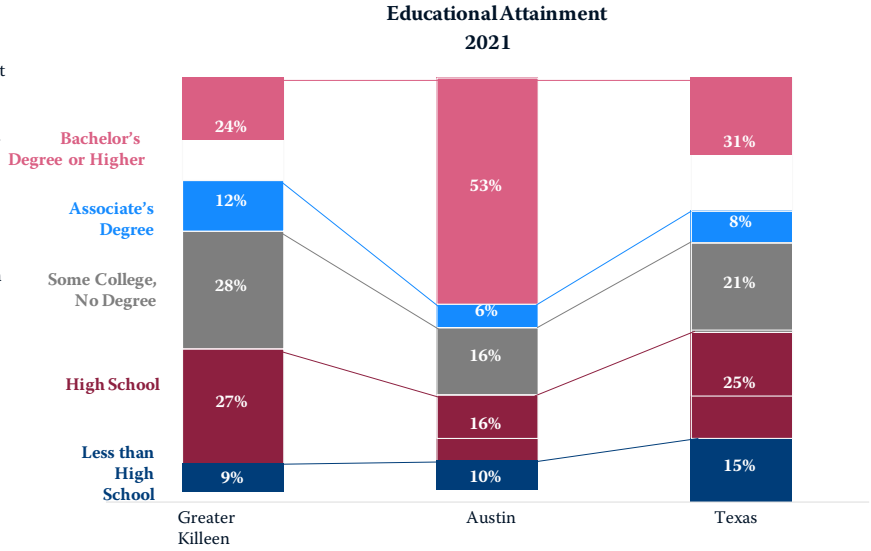
Source: ESRI, 2021.

Demographics| Educational Attainment

Greater Killeen has a much higher rate of associates degrees than Texas as a whole. A&M-Central Texas can continue to partner with the local community college to develop career pathways for students that align with future industry needs.

Killeen's unique demographic makeup and strong community college system contributes to an outsized share of people with associate's degrees. Killeen's current economy is primarily based in the military and blue-collar industries that often require technical certifications or associates degrees, but not bachelor's or advanced degrees. In fact, only 7% of the enlisted soldiers have a Bachelor's degree or higher.

As the supply of high-skilled workers in Greater Killeen grows, tenants at A&M-Central Texas's research park will likely also attract talent from Austin which has a strong educated workforce. As employers adopt more flexible policies around remote work, and more advanced, higher paying opportunities develop around the A&M-Central Texas research park, Greater Killeen is in the position to attract young professionals from Austin drawn to the lower cost of living and quality of life the region offers.



Source: ESRI, 2021; Heart of Texas Defense Alliance.

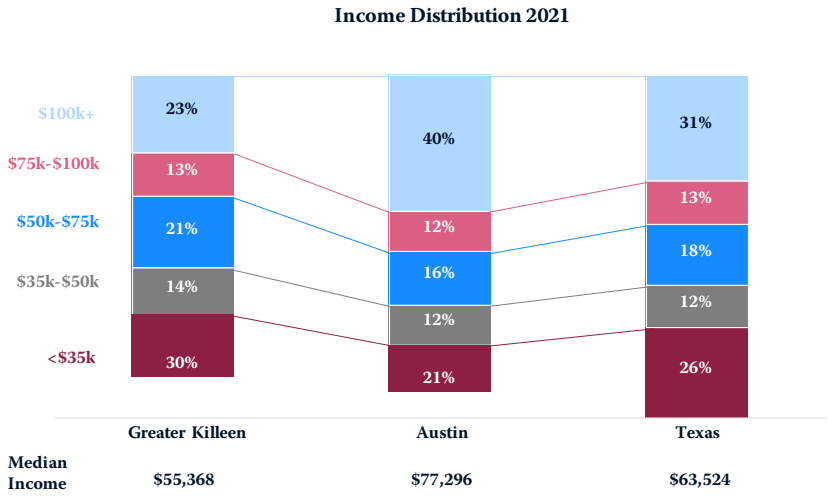
Demographics| Income

Killeen's income distribution reflects its relatively low educational attainment when compared to Austin; A&M-Central Texas may play a pivotal role in increasing the region's income.

Opportunities for higher education through A&M-Central Texas as well as innovation and entrepreneurship opportunities at the research park may help bolster Killeen's income distribution to be more aligned with Austin.

Though Killeen's average median income lags that of Austin and Texas, military families in the region receive subsidies for housing ranging from $939 to $1890 based on tenure and household size, as well as medical and other benefits that are not reported as income in the data shown to the right. Therefore, while reported income is lower than the state average, the additional compensation to military families in the form of benefits and subsidies may boost the overall disposal income available to spend on services and goods.

Source: EMSI, 2021.



Economy| Workforce

The military has become a major driver of research and innovation, and as the largest employment sector in Killeen, could be a key driver of attracting partners to the A&M-Central Texas research park.

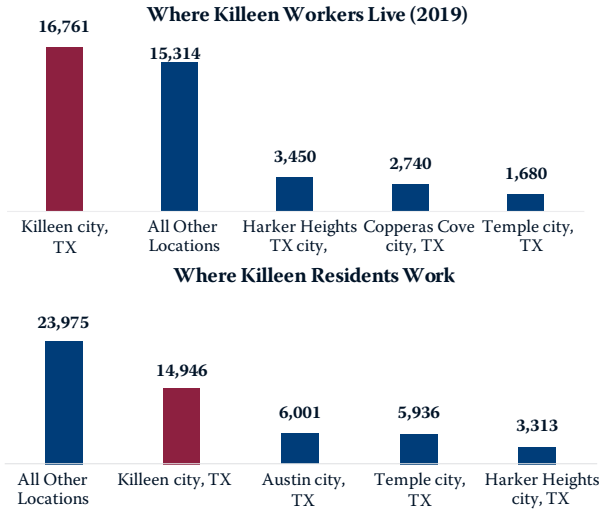
Killeen's current workforce is largely associated with the military: over 35% of the workforce is in the military and an additional 9% are civilians working in the federal government. However, with Fort Hood's focus on mobilization and training of soldiers, research and development opportunities have been limited compared to other installations. In Huntsville, for example, there are over 100 government contracting firms that support defense and aerospace activities, many of which are located in the Cummings Research Park. By contrast, there are currently only two defense contractors with offices in Killeen. However, A&M-Central Texas's recent partnership with Trideum provides a blueprint for future industry partners, actively engaged in product development for civilian and military applications, who value being proximate to students, faculty, and Fort Hood.

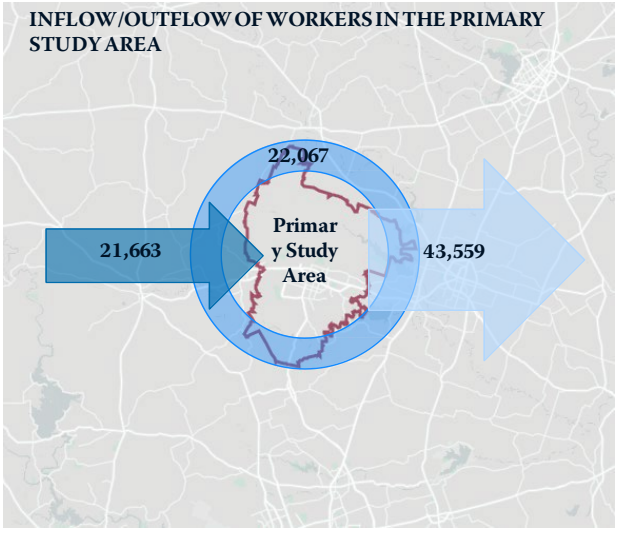
Killeen Workforce 2021

Source: EMSI, 2021.

Economy| Workforce Commuting

Killeen's labor shed is largely locally based, with most workers in the primary study area residing in Greater Killeen. However, two-thirds of Killeen's workforce commutes outside of Killeen for work, with nearly 10% commuting to Austin.





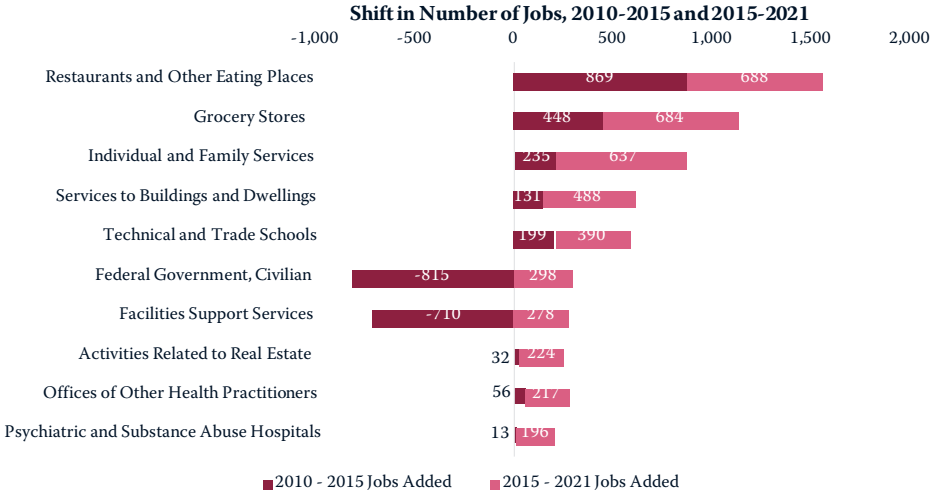
Source: LEHD On The Map, 2019.

Economy| Growth

Despite Fort Hood's current economic dominance, recent growth has mainly occurred in service industries. Stakeholders and industry leaders indicate that the research park should prioritize emerging industries with both military and civilian applications.

In the past decade, there has been a 3% decrease in the number of people employed in military occupations in Killeen and a 5% decrease in overall jobs. In the same time period Killeen has seen robust population growth and housing growth.

A large share of Killeen's job growth came from the opening of a new Walmart Supercenter, which added roughly 500 new jobs in 2015. The largest single growth industry was in restaurants and other eating places which added 1600 new jobs between 2010-2021.



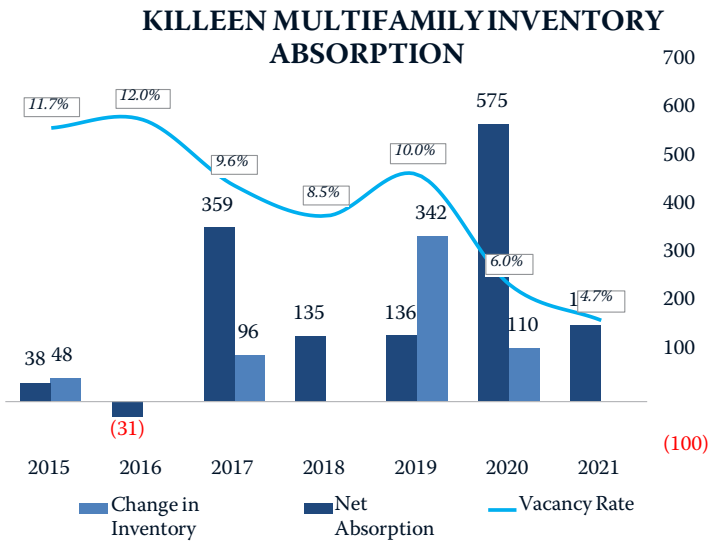
Source: EMSI, 2021.

Residential| Multifamily

The A&M-Central Texas research park ecosystem may be bolstered by multifamily housing; the supply of multifamily housing has become very tight with few new deliveries in recent years.

In the past 10 years, Killeen has seen its population grow by almost 20%, yet the multifamily housing inventory has only grown by 8%. The limited growth in multifamily has contributed to the vacancy rate dropping below 5% in 2021, the lowest rate in the past 20 years. Consequently, new inventory delivered has been readily absorbed.


The Dorel, Built 2013



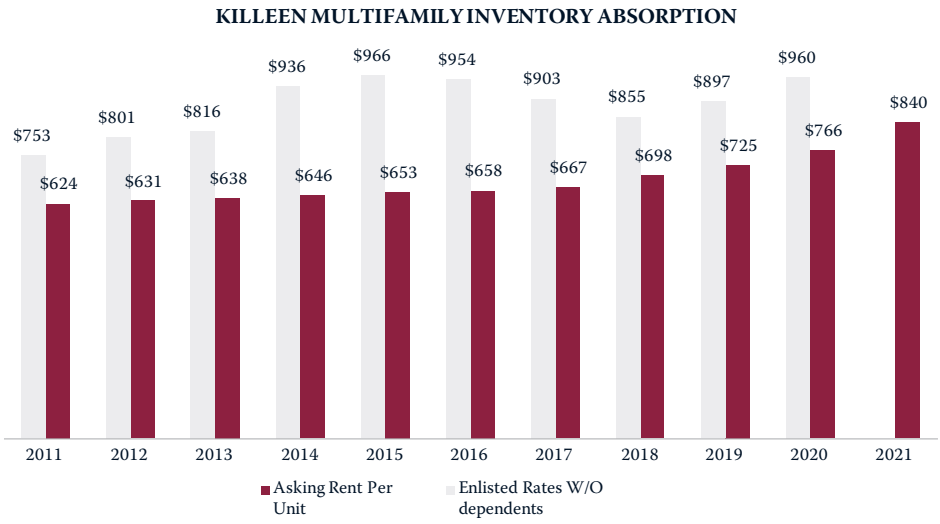
Source: Costar; Apartments.com

Residential| Multifamily

The perception shared by stakeholders in the community is that multifamily rents are bound to the enlisted rate housing stipend; however, multifamily rents have consistently been less than the housing stipend for the lowest ranking enlisted officers.

Multiple stakeholders have suggested that the housing stock in Killeen is relatively low quality due to its age and price point, which stakeholders attributed to the housing stipend offered by the military. However, market data indicates that the asking rent per unit is almost
$100 less than the lowest ranking enlisted officer stipend.

One sentiment from stakeholder conversations reflected in the data is the spike in housing costs in 2021. In 2021, the asking rent per unit in Killeen rose $74, or 10%.



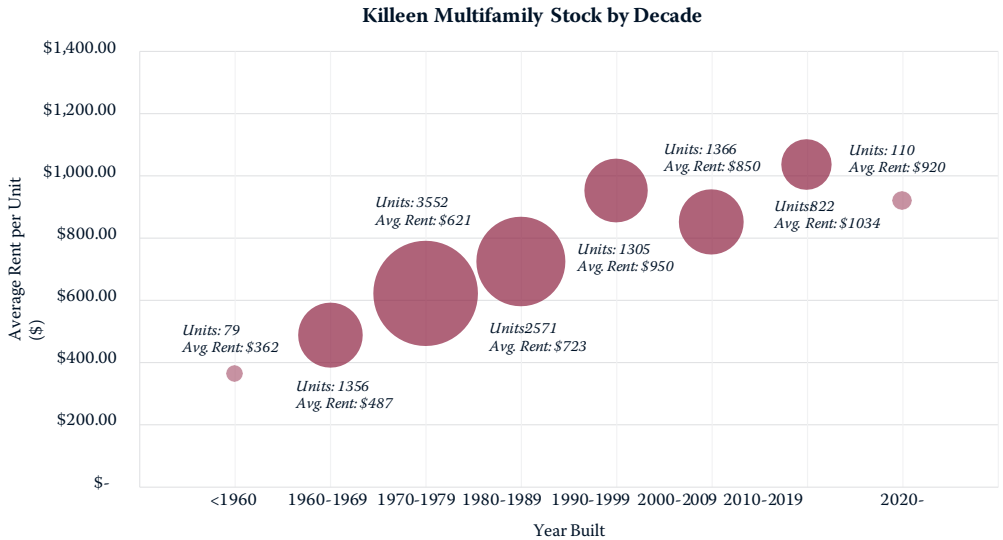
Source: Costar

Residential| Multifamily

Killeen's rental housing stock is older and offers a wide array of affordable units. Even though many of the units built after 2000 are rent restricted, newer units developed without such restrictions are exceeding market rates.

Killeen's multifamily rental housing stock is older, with limited market rate new development. Over two-thirds of Killeen's multifamily units were built between 1970 and 1990.
These older units tend to be located near Downtown Killeen, and are organically affordable, renting well below market rate.

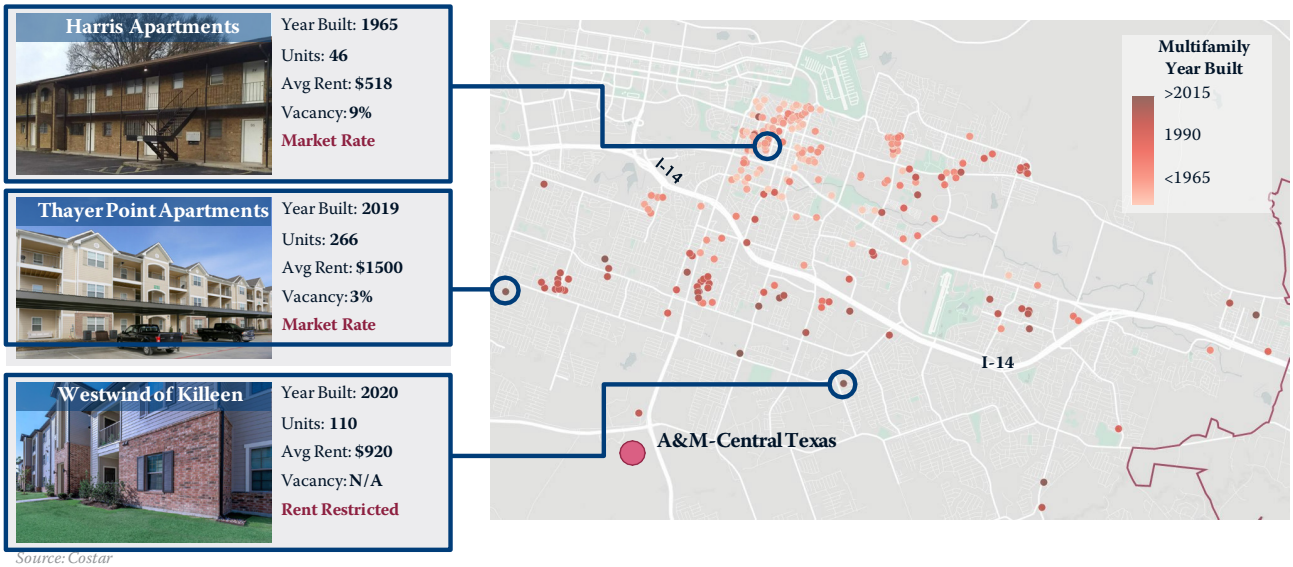
Newer units are located further south, and while are many are renting at or above market rates, 37% of the units built post-2000 are rental restricted. The most recent example is Westwind of Killeen, a 110-unit rent restricted development that delivered in 2020 with an average rental rate of $920.



Source: Costar

Residential| Multifamily

Like other commercial real estate, new multifamily development has trended southward toward the A&M-Central Texas campus and is performing well.



Source: Costar

Residential| Home Ownership

Killeen's residential market has seen strong growth on par with Texas, but the low cost of housing in Killeen is an important opportunity to capture some of Austin's growing young professional population.

Between 2010 and 2021, homeownership in Killeen rose 200 basis points to 49%. This is still over 10% lower than in Greater Killeen, where the homeownership rate stands at 60%, and 13% below Texas's homeownership rate.

Killeen, like many markets across the US, has had strong growth in home prices over the last year. In 2021, Killeen experienced a 21% increase in the median sale price year-over-year, on par with Texas overall. However, home sales in Killeen vastly outpaced the state, with Killeen experiencing a 35% increase in the number of houses sold, while the number of houses sold fell 0.4% in Texas as a whole.

4504 DONEGAL BAY CT
Price: **$225k**
BR/BA: **3/2.5**
Year Built: **2007**

1605 PRESTIGE LOOP
Price: **$215k**
BR/BA: **3/2**
Year Built: **2003**

9704 SHIMLA DR
Price: **$234k**
BR/BA: **3/2**
Year Built: **2011**

KILLEEN
$215k
Median price Dec. 2021
+21% Y-O-Y

TEXAS
$276k
Median price Dec. 2021
+22% Y-O-Y

Median Price, Dec 2021. Zillow, 2021.

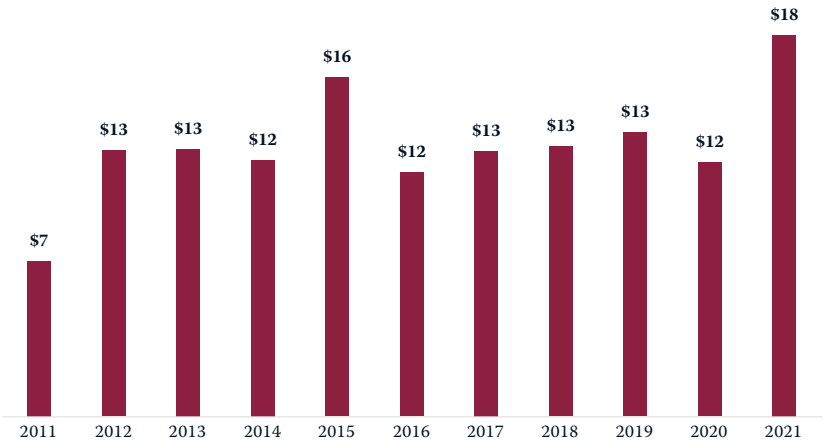
Office| Supply

New office space development at the research park would likely require rents that exceed the existing market in Killeen, suggesting that alternative delivery and funding mechanisms may be warranted.

The Killeen office market is relatively small and totals 1.7M SF of office space. This includes no class A space and 944k SF of class B office space. Due to the small size of the office market, a single lease execution can impact market metrics.

In 2021 there were 49k SF of lease transactions, 85% of the level of lease activity in 2019 prior to COVID. However, the ongoing level of lease transactions along with the rise in rents and relatively low vacancy suggests that there may be unmet demand for office space in Killeen.

Killeen Primary Study Area Office Base Rent Overall ($PSF*)

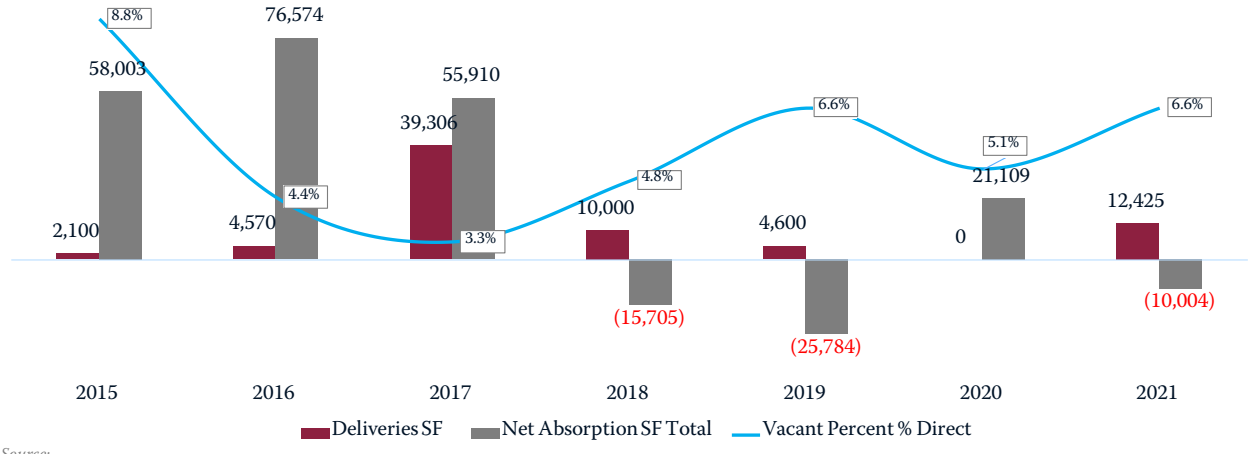


Source: Costar; Note: In the Killeen office market, there is a mix of rental structures including triple net rent, full-service rents, and partial service rents.*

Office| Demand

Despite relatively limited growth in traditional office users in Killeen, the region's vacancy rate has remained relatively low over the last 7 years. But low market rents have likely made new development financially infeasible.

KILLEEN OFFICE INVENTORY ABSORPTION



Source: Costar

Office| Opportunity

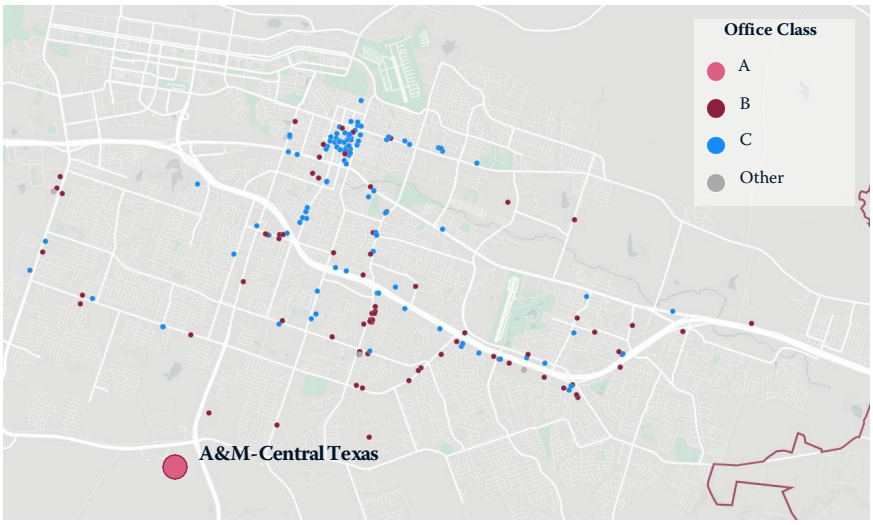
The research park at A&M-Central Texas could deliver the only class A space in Killeen, attracting more professional companies and government contractors.

Stakeholders frequently mentioned the lack of quality office space in Killeen. There are currently no Class A office spaces in Killeen outside of A&M-Central Texas.

Similar to multifamily, almost all office space built the last 20 years has been located near I-14. Downtown is heavily weighted toward lower- class office space; nearly a third of all Class C office space is located downtown while only 1/5th of all office space is located downtown.

Economic Trends

Killeen has added almost 2,000 health care industry jobs since 2010--the largest growth of any industry in Killeen. This is undoubtably correlated with all of the class A office space being medical office space.

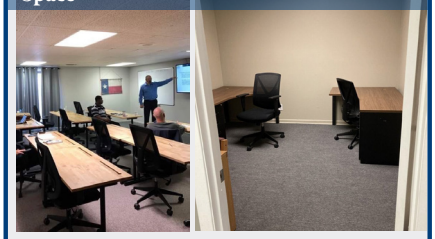


Source: Costar

Office| Lab and Innovation Opportunities

Killeen has limited existing innovation space, and almost all existing lab and innovation space is on A&M-Central Texas's campus. But there have been some promising coworking and job training developments recently.

Scale Up CoConnect Entrepreneur Share Space



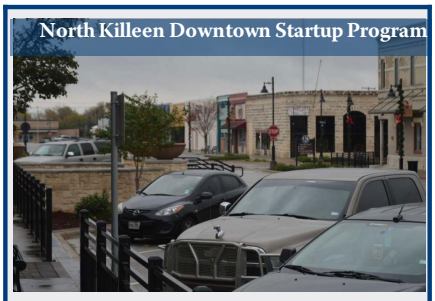
Scale Up CoConnect is the first of its kind coworking space located in downtown Killeen. The space is not only a coworking space, but also holds networking events. The space offers drop-in rates, monthly memberships, dedicated desks, and individual offices. The space is new to Killeen but is an indication that there is demand for innovative spaces.

KISD Career Center

The Career and Technical Education (CTE) program in Killeen gives students the opportunity to receive industry skills in 16 fields including STEM, logistics, and information technology.

The program is housed in the KISD Career Center which offers state of the art facilities for students to train.

North Killeen Downtown Startup Program

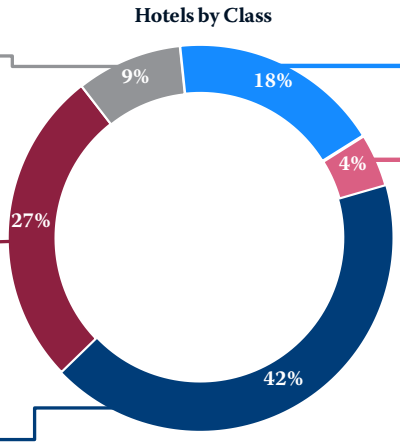


In 2022, the City of Killeen announced a grant program that aims to build businesses in Downtown Killeen with equity in mind. Recipient businesses must be small businesses located in Downtown Killeen with a goal to help improve the built environment and provide economic opportunity in Killeen. Programs like this help build a culture of innovation.

Source: Scale Up CoConnect, KISD

Hospitality| Supply

Killeen is home to over 45 hotels, but over 2/3rd of hotels are economy or independent.



Source: Costar

Hospitality| Demand

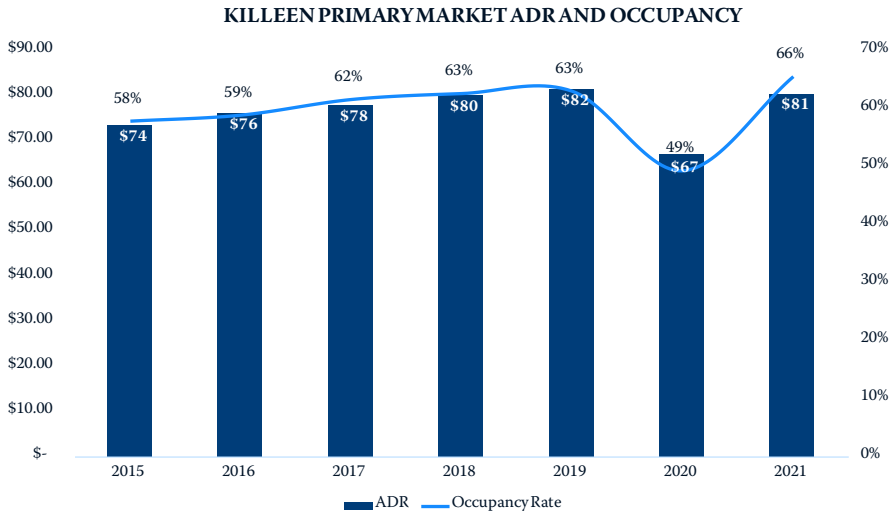
Unlike most hotel markets, Killeen's hotel market has seen a 100% recovery from COVID--the Average Daily Rate (ADR) has surpassed pre-COVID levels.

Like the rest of Killeen's economy, the hotel market is primarily government driven. Prior to pandemic, one hotel manager estimated that 70% of their customers were travelling for a government job.

Many of the hotels rely on corporate contracts, especially with airlines, to fill rooms. Unlike corporations, the government instead has a standard per night accommodations per diem that partially dictates the rates and hotel **n**fix Killeen.

$96

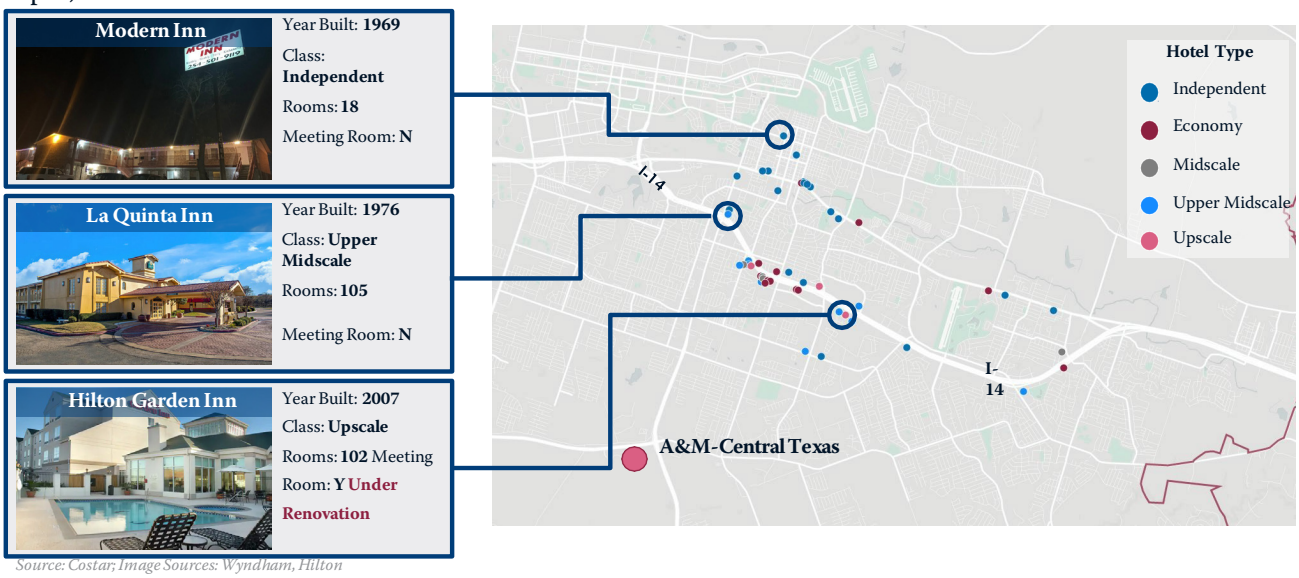
Per night max hotel per diem



Source: Costar; Defense Travel; KDH News

Hospitality| Opportunity

Hospitality is clustered along I-14, near Killeen's mall. There are limited options near the A&M-Central Texas campus, but most of the hotels are within a 15 minute drive.



Source: Costar; Image Sources: Wyndham, Hilton

Retail| Places of Convergence

Innovation districts and research parks often use retail as an essential ingredient in placemaking and an amenity to encourage the convergence of people and ideas.

Source: ESRI, HR&A Analysis.

Retail| Potential Users

The A&M-Central Texas community likely includes students, industry partner workers, non-student residents, and visitors; the research park should offer convenient retail options to serve each user group while creating opportunities for convergence and collaboration.

POTENTIAL A&M-Central Texas RETAIL USERS

STUDENTS

- Master plan target enrollment: **15,000 students**
- **Daytime/evening users**
- Users of **fast casual restaurants, convenience retail, school bookstores, and places to collaborate**

WORKERS AND FACULTY

- Worker **population could grow significantly** with the addition of the research park
- **Daytime users**
- Users of **fast casual and fine dining restaurants, convenience retail, and places to collaborate**

RESIDENTS

- Killeen's **growing residential population** continues to expand south towards A&M-Central Texas
- **Evening/weekend users**
- Users of **fast casual and fine dining restaurants, convenience retail, and entertainment**

VISITORS

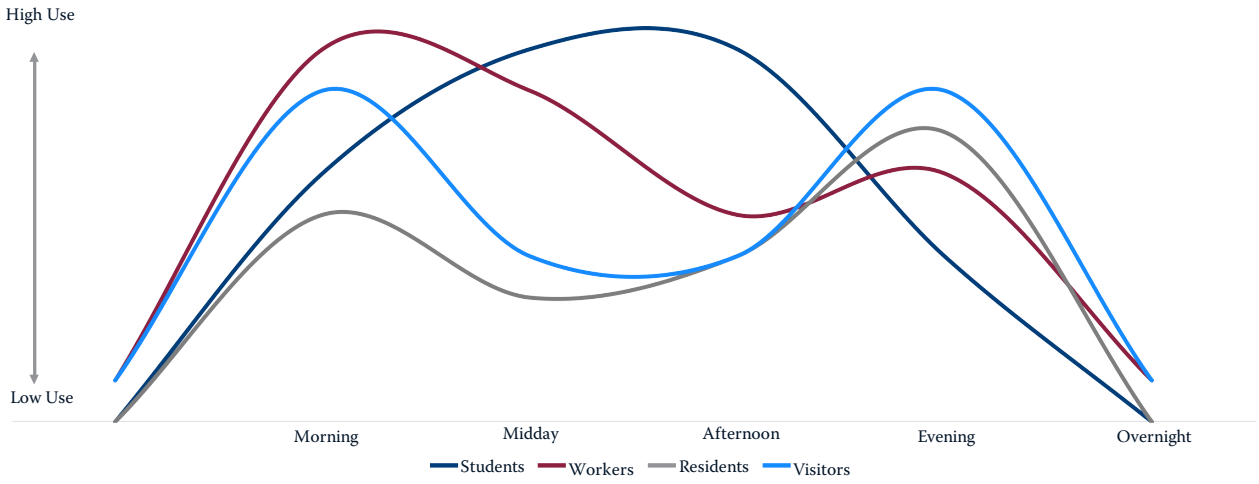
- A&M-Central Texas's research park may bring more **day and overnight visitors**
- **Daytime/evening users**
- Users of **fast casual and fine dining restaurants, convenience retail,** and **entertainment**

Source: ESRI, HR&A Analysis.

Retail| Visitation

With the research park attracting a wide variety of users, visitation is estimated to be steady throughout a 12-hour day, before tapering overnight.

Potential Level of Visitation to A&M-Central Texas Campus by Users



Retail| Typology

A&M-Central Texas's retail offerings should not only serve each user group's immediate needs, but also act as places for user groups to come together in a meaningful way that spurs innovation.

POTENTIAL A&M-Central Texas RETAIL OPPORTUNITIES

RESTAURANTS

Fast Casual | Students and workers are daytime users of fast and convenient food options throughout the day

Fine Dining | Places for workers to take clients and residents or visitors to enjoy evenings out

Coffee Shops | Important assets for people to take a break and collaborate

CONVENIENCE RETAIL

Convenience Stores | Places for students and workers to run midday errands or pick up a snack

College Bookstores | Provides a place for students to build college pride and purchase essentials

Food Stores | Important assets for providing access to healthy food and developing a vibrant community

ENTERTAINMENT

Gathering Spaces | Can be formal or informal event spaces, restaurants, or greenspace, designed to encourage organic interactions through programming and site activation events

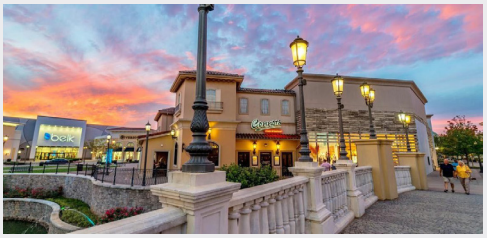
Recreation Spaces | Offers a place to meet people and exchange ideas outside of work and often includes dining and drinking options

Source: ESRI, HR&A Analysis.

Retail| Example: Cummings Research Park

Cummings Research Park has grown its retail offerings beyond the immediate needs of the research park, and serves as a retail destination for Huntsville, offering a wide variety of restaurants, shopping, entertainment and recreation options

Best Practices: Cummings Research Park



Number of Shops and Restaurants: **80**

Other Amenities: **Movie theater, 5-acre lake, carousel, train ride, walking trail, and frequent live music**

Design: **Restaurants and shopping are concentrated in the Bridge Street Town Centre, but there are restaurants throughout the park**

Source: Retail Coach; Image Source: Huntsville.com

Retail| Existing Retail

Larger, big box retailers are located along I-14, while some smaller retailers are in downtown Killeen. All the retailers in Killeen are within a 15-minute drive of A&M-Central Texas, but there are currently no retailers within walking distance of campus

Eastlake Shopping Center

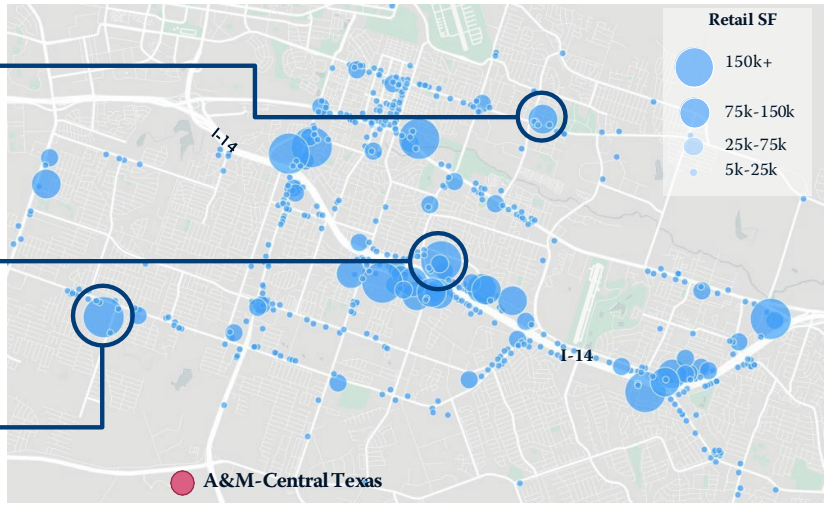
Year Built: **1965**
SF: **128k SF**
Parking: **725**
Vacancy: **91%**
Sherwin Williams

Killeen Mall

Year Built: **1981**
SF: **559k SF**
Parking: **3525**
Vacancy: **0%**
JCPenney

Walmart Supercenter

Year Built: **2016**
SF: **193k SF**
Parking: **840**
Vacancy: **N/A**



Source: Costar. Image Sources: Quine and Associates, KHD News, Google Maps

3. Design Guidance

The Design Guidance section elaborates on the concept plan to describe in more detail how buildings, spaces, networks, are intended to be composed. For any individual element, this may include functional aspects, sustainability goals, scale, materials, or aesthetic considerations.

By avoiding providing strict standards or requirements on these elements, but instead demonstrating the intent of the Forge with this design guidance element, future development can be shaped to adhere to the spirit of this document without overly constraining the creativity of future design.

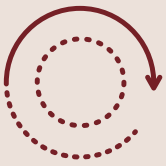
Perkins&Will

Living System Framework

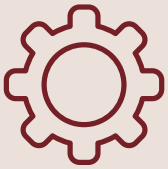
The following key goals guide the design:

Protect
Preservation & Enforcement

Adapt
Resilience & Flexibility



Replenish
Regeneration

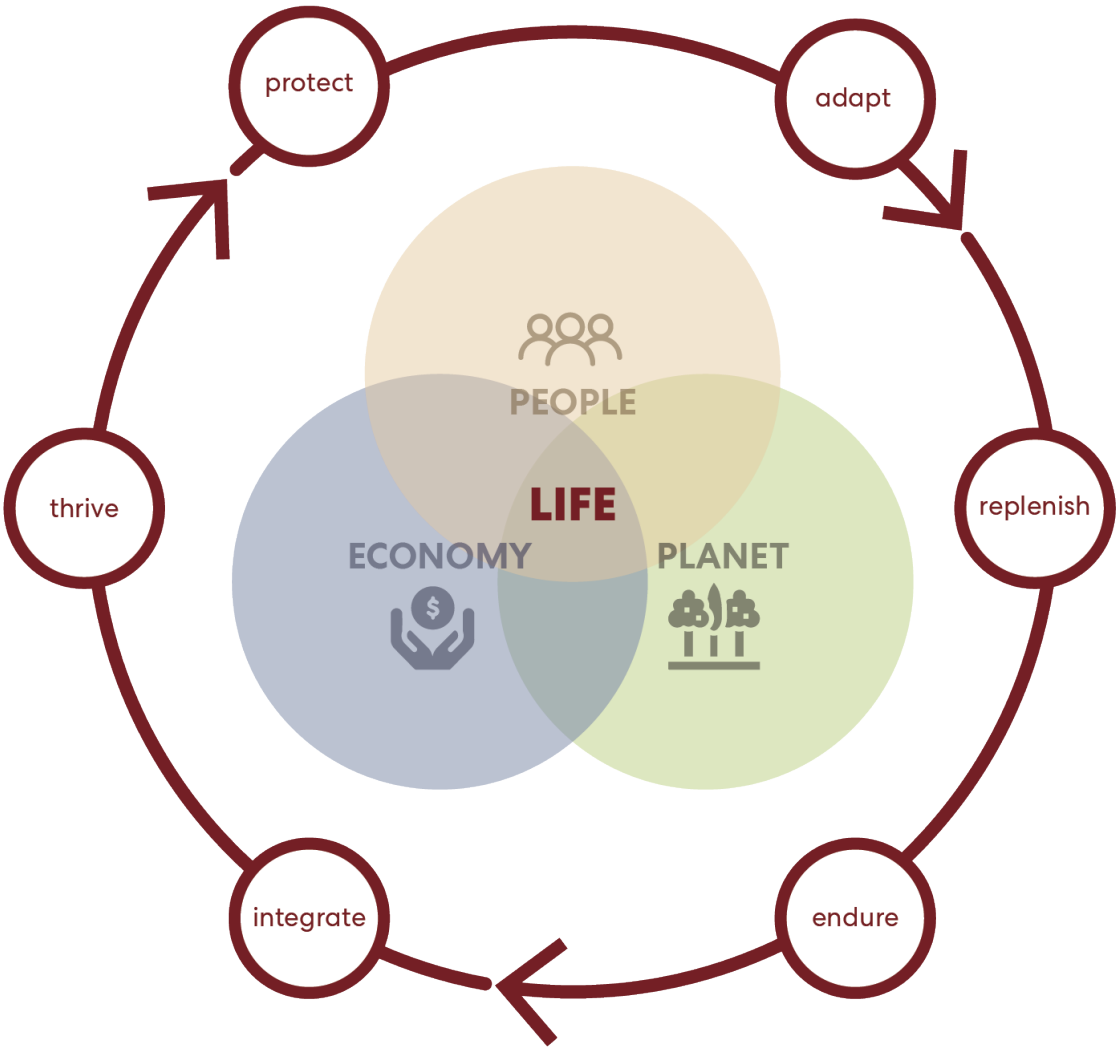


Endure
Sustainability & Maintenance

Integrate
Cohesion, Diversity, & Fairness

Thrive
Vitality & Well-being

Developing and sustaining a truly thriving living system relies on the implementation of a circular approach to design, following the "pattern of life". The Living System Framework shall guide the A&M-Central Texas development so that the people, planet and economy may thrive over time.



Open Space

Open spaces are important in strengthening the A&M -Central Texas campus identity as well as adding to its dynamism and active spirit. The unique campus setting, and regional climate encourages many aspects of its campus life to be conducted outdoors.

The landscape design intends to respond to the native regional landscapes of the Texas Hill Country's ecosystems. The campus sits at the edge of two landscape ecoregions, the Cross Timbers region (also known as the Osage Plains) and the Blackland prairie region. The Cross Timbers region is characterized by varied savannah and woodlands and shorter mixed-grass prairie. The Blackland prairie region is characterized by fertile black soils that once supported a tallgrass prairie. These regional landscapes will enhance the diverse campus open spaces in terms of character, type, scale, and learning opportunities for students.

A variety of outdoor spaces created by a system of collaboration quads, secondary quads, campus quads, building courtyards, open space/ green areas, and service areas that are weaved together by a pedestrian prioritized malls and a multimodal street network.

The formal open space typologies (collaboration quads, secondary quads, and campus quads) are purposeful and specifically designed spaces to support a variety of events and campus programming.

While the smaller courtyard areas and green zones will have more articulation in their plantings and designs, the larger open spaces will be flexible for both active and passive recreational use.

More informal open space typologies (building courtyards, open space/green areas) should balance privacy and intimacy with porosity and visibility from pedestrian malls and pathways and other open spaces in order to allow for a private setting that is safe and secure.

The connections between these spaces, and with the buildings surrounding them, will add vitality and vibrance to the campus and its identity.

An extensive trail network connects the interior of campus to the exterior edges will provide for added recreation amenities, health/wellness opportunities, and broader connection to natural habitat/outdoor spaces

The character of the landscape transitions from more formal designed landscapes at the interior of campus to less formal at the exterior edges of campus that gradually merge with the surrounding native landscape.

This chapter offers landscape design recommendations for developing the campus's regional identity in recognition that the various open space typologies, native landscaping, and pedestrian amenities, will knit the campus together under a unified character to create a distinct and memorable experience.

The guidelines assume that the scale and distinct design of each open space typology, and the buildings associated with them will vary, to enhance the surrounding campus context and uses.

Open Space Typologies

1. Collaboration Quad:

The collaboration quads are the primary public gathering spaces on campus.

Type:

- Designed as semi-formal public space that includes a variety of different gathering areas and elevated public realm amenities.

Characteristics and features:

- A central water feature, derived from the site's natural topography and drainage patterns, acts as an inviting element, connecting the campus to the natural environment, while offering enhanced opportunities for activation and gatherings.
- Primary open space framed by multiple building edges and/or tree canopies.
- Buildings provide the structure and form of the quads and will provide strong frontages along these spaces to create an outdoor "room" feeling.
- Defined primarily by hardscape materials with landscape/soft-scape areas.
- Primary public space on campus for all campus users
- Connected through out by a pedestrian oriented network of pedestrian malls, trails, plazas, and open spaces.
- Designed to be flexible to support daily use and larger scaled campus events.
- Character of the space and vary based on the adjacent building uses.

Function:

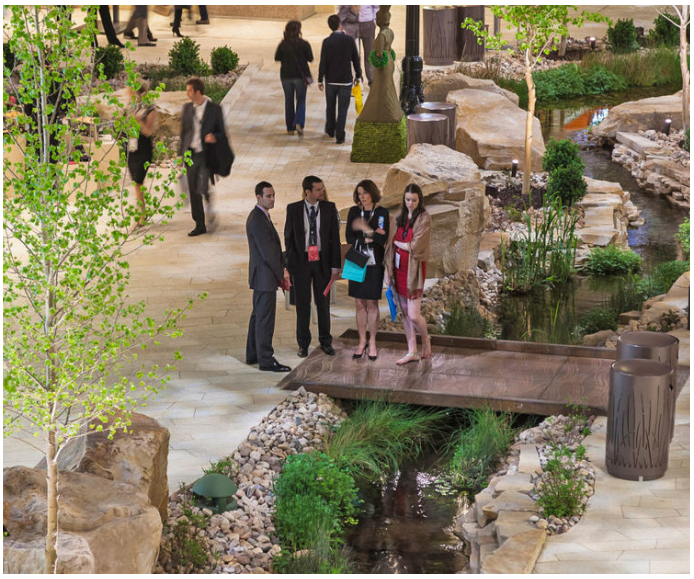
- Supports diverse activities and programming due to the prominent locations on campus and orientation to more active building frontages and uses.
- The quads act as a transition zone between formal and natural landscape setting.
- Offers opportunities for users to sit, interact, collaborate, engage, and converge.

Scale:

The quads will be the largest activated spaces on campus.

Design Features:

- Lighting: The collaboration quad should provide higher lighting levels to prioritize nighttime activation and increased level of personal safety/ security. Overall lighting strategy should include signature lighting, pedestrian scale lighting, and low voltage lighting. Lighting should be full cut-off and dark sky compliant.
- Seating: A variety of seating options should be provided that include permanent structured seating, flexible/moveable furniture, and informal seating areas.
- Landscaping: Landscaping should include native ground level plantings and overstory trees. Turf lawn areas should be provided as flexible areas for programming and activation Trees and other vertical elements should be provided primarily along the periphery of the quad. Trees and shade structures should create shady areas and shelter from intense weather.
- Stormwater management: Stormwater management BMPs (stormwater best management practices) should be integrated into the design of the quad to capture/ store surface stormwater runoff, provide rate control, and infiltrate stormwater back into the aquifer.



Collaboration Quad

Open Space Typologies

2. Secondary Quad:

The secondary quads are important public gathering spaces that serve daily campus users.

Type:

- Designed as semi-formal public space that includes a variety of different gathering areas and public realm amenities.
- Characteristics and features:
- Secondary open space framed by multiple building edges and/or tree canopies
- Defined primarily by hardscape materials with landscape/soft-scape areas.
- Secondary public spaces on campus for daily campus users
- Buildings provide the structure and form of the quads and will provide strong frontages along these spaces to create an outdoor "room" feeling.
- Connected through out by a pedestrian oriented network of pedestrian malls, trails, plazas, and open spaces.
- Designed to be flexible to support daily use and larger scaled campus events.
- Character of the space and vary based on the adjacent building uses.

Function:

- Supports less activities and programming due to the prominent locations on campus and orientation to more active building frontages and uses.
- The quads act as a transition zone between formal and natural landscape setting.
- Offers opportunities for users to sit, interact, collaborate, engage, and converge.

Scale:

- The quads will be the second largest activated spaces on campus.

Design Features:

- Lighting: The secondary quads should provide some higher light levels to promote some limited nighttime activation and a sense of campus safety/security. Overall lighting strategy should include pedestrian scale lighting, and low voltage lighting. Lighting should be full cut-off and dark sky compliant.
- Pathway connections along the perimeter of quad spaces should connect all buildings facing quads and important connections and pathways across quad spaces should not unnecessarily interrupt primary lawn areas.
- Seating: A variety of seating options should be provided that include permanent structured seating, flexible/moveable furniture, and informal seating areas.
- Landscaping: Landscaping should include native ground level plantings and overstory trees. Turf lawn areas should be provided as flexible areas for programming and activation. Trees and other vertical elements should be provided primarily along the periphery of the quad. Trees and shade structures should create shady areas and shelter from intense weather.
- Stormwater management: Stormwater management BMPs (stormwater best management practices) should be integrated into the design of the quad to capture/store surface stormwater runoff, provide rate control, and infiltrate stormwater back into the aquifer.

Secondary Quad

Open Space Typologies

3. Campus Quad:

The campus quads are smaller public gathering spaces associated with buildings that serve daily campus users.

Type:

- Designed as semi-formal public space that includes a variety of different gathering areas and public realm amenities.

Characteristics and features:

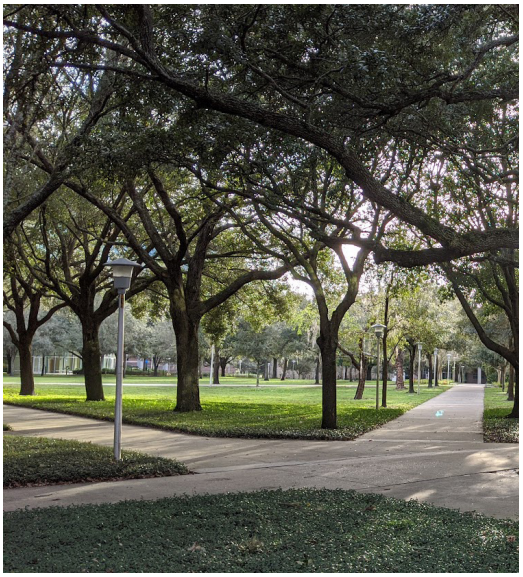
- Smaller campus open space framed by multiple building edges and/or tree canopies
- Defined primarily by hardscape materials with landscape/soft-scape areas. Will incorporate more lawn areas. Contains a richer palette of plant material than the surrounding open space.
- Smaller internal focused public spaces that support daily campus users
- Buildings provide the structure and form of the quads and will provide strong frontages along these spaces to create an outdoor "room" feeling.
- Connected through out by a pedestrian oriented network of pedestrian malls, trails, plazas, and open spaces.
- Designed to be flexible to support daily use and smaller campus events/ gatherings.
- Character of the space and vary based on the adjacent building uses.
- Function:
- Supports some daily activities and programming.
- The quads act as a transition zone between formal and natural landscape setting.
- Offers opportunities for users to sit, interact, collaborate, engage, and converge.

Scale:

- The quads will be the smaller to medium sized spaces on campus.

Design Features:

- Lighting: The campus quads should provide some higher light levels to promote some limited nighttime activation and a sense of campus safety/security. Overall lighting strategy should include pedestrian scale lighting, and low voltage lighting. Lighting should be full cut-off and dark sky compliant.
- Pathway: Pathway connections along the perimeter of quad spaces should connect all buildings facing quads and important connections and pathways across quad spaces should not unnecessarily interrupt primary lawn areas.
- Seating: A variety of seating options should be provided that include permanent structured seating and informal seating areas.
- Landscaping: Landscaping should include native ground level plantings and overstory trees. Turf lawn areas should be provided as flexible areas for programming and activation
- Stormwater management: Stormwater management BMPs (stormwater best management practices) should be integrated into the design of the quad to capture/ store surface stormwater runoff, provide rate control, and connect to the large stormwater management system.



Campus Quad

Open Space Typologies

4. Building Courtyard:

The building courtyards are smaller public gathering spaces associated with individual buildings that serve daily campus users.

Type:

Semi-Formal to informal

Characteristics and features:

- Defined primarily by hardscape materials with landscape/soft-scape areas. Will incorporate more lawn areas. Contains a richer palette of plant material than the surrounding open space.
- Smaller internal focused public spaces that are more intimate in nature and support daily campus users. These spaces should be designed to ensure that these spaces stay vital, safe, and interesting and attract users.
- Connected through out by a pedestrian oriented network of pedestrian malls, trails, plazas, and open spaces.
- Smaller intimate spaces that are less flexible and support daily campus use
- Character of the space and vary based on the adjacent building uses.

Function:

- Supports daily activities involving single building with limited activation.
- Acts as a convergence zone between formal and natural landscape setting.
- Offers some opportunities for users to sit, interact, collaborate, engage, and converge.

Scale:

- The quads will be the smaller sized spaces on campus.

Design Features:

- Lighting: The building courtyards should provide light levels to promote a sense of campus safety/ security. Overall lighting strategy should include pedestrian scale lighting, and low voltage lighting. Lighting should be full cut-off and dark sky compliant.
- Pathway: Pathway connections along the perimeter of courtyards should connect all buildings and important connections and pathways across public spaces should not unnecessarily interrupt primary lawn areas.
- Seating: A variety of seating options should be provided that include permanent structured seating and informal seating areas.
- Landscaping: Landscaping should include native ground level plantings and overstory trees. Turf lawn areas should be provided as flexible areas for programming and activation
- Stormwater management: If feasible based on scale of the courtyard, stormwater management BMPs (stormwater best management practices) should be integrated into the design of the space to capture/ store surface stormwater runoff, provide rate control, and connect to the large stormwater management system.

Building Courtyard

Open Space Typologies

5. Natural Open Space

The open spaces/green areas are varied scaled campus spaces that serve daily campus users.

Type:

- Informal to naturalized

Characteristics and features:

- Tertiary open space framed by loosely aligned building edges (generally on at least two sides)
- Naturalized spaces with irregularly placed tree canopies and native vegetation.
- Limited programming and activation
- These spaces should be designed to ensure that these spaces stay vital, safe, and interesting and attract users.
- Outward oriented spaces focused primarily on habitat and ecology
- Connected by interior trails.

Function:

- Supports informal daily activities
- Acts as a transition zone between semi-formal and natural landscape setting
- Offers opportunities for users to relax and connect with nature.
- Supports more site biodiversity.

Scale:

- Varies in scale.

Design Features:

- Lighting: The designated campus open spaces/green areas should provide light levels to promote a sense of campus safety/security. Overall lighting strategy should include pedestrian scale lighting. Lighting should be full cut-off and dark sky compliant.
- Seating: Based on location, some limited seating should be provided that includes benches and informal seating areas.
- Landscaping: Landscaping should include native ground level plantings (prairie areas) and overstory trees.
- Stormwater management: Stormwater management BMPs (stormwater best management practices) should be integrated into the design of the open space/ green areas to capture/store surface stormwater runoff, provide rate control, and connect to the large stormwater management system.

Natural Open Space

Open Space Typologies

6. Main Pedestrian Mall:

Pedestrian malls are designed public spaces that prioritize campus circulation and provides some opportunities for public realm programming and activation.

Type:

- Formal to semi-formal

Characteristics and features:

- Linear open space defined by aligned building edges (on multiple sides).
- Primary, pedestrian-oriented corridor connecting the campus buildings and other open spaces.
- Defined by unique hardscape materials when compared to other pedestrian paths.
- Creates visual corridors throughout the campus.
- Internal oriented pedestrian thoroughfare.
- Very flexible in use due to a variety of edge conditions
- Designed to have similar character throughout the campus.
- Formal planting and seating areas.

Function:

- Primarily functions as a pedestrian thoroughfare.
- Supports a variety of activation and programming.
- Acts as a transition zone between building edges and other open space typologies
- Offers diverse opportunities for users to sit, interact, collaborate, engage, and converge.

Scale:

- Varies based on distance between buildings

Design Features:

- Lighting: The campus pedestrian malls should provide some higher light levels to promote some limited nighttime activation and a sense of campus safety/security. Overall lighting strategy should include pedestrian scale lighting, and low voltage lighting. Lighting should be full cut-off and dark sky compliant.
- Seating: A variety of seating options should be provided that include permanent structured seating and informal seating areas.
- Landscaping: Landscaping should include native ground level plantings and overstory trees.
- Stormwater management:
- Stormwater management BMPs (stormwater best management practices) should be integrated into the design of the quad to capture/store surface stormwater runoff, provide rate control, and connect to the large stormwater management system.

Main Pedestrian Mall

Integrated Green Infrastructure

Integrated green Infrastructure provides potential for strengthening broader ecological connections, embracing the bones of the existing ecological features of the stream and the mature tree canopy, enhances ecological function, integrates living infrastructure that provides multiple benefits, and creates an aesthetic rooted in the ecological context of place.

What is green infrastructure?

Green infrastructure is strategically planned and managed networks of natural lands, working landscapes and other open spaces that conserve ecosystem values and functions and provide associated benefits to human populations. -Conservation Fund (broad scale, landscape planning)

Green infrastructure is an approach to wet weather management that is cost-effective, sustainable, and environmentally friendly. Green Infrastructure management approaches and technologies infiltrate, evapo-transpire, capture and reuse stormwater to maintain or restore natural hydrology. -US EPA (site scale, stormwater management)

Low Impact Development

Low impact development (LID) refers to systems and practices that use or mimic natural processes that result in the infiltration, evapotranspiration or use of stormwater in order to protect water quality and associated aquatic habitat. - US EPA (Urban Runoff: Low Impact Development)

Integrated stormwater management techniques can be applied across the A&M-Central Texas LID Commons landscape with different strategies appropriate in different development typologies.

Strategies should be chosen appropriate to the typology. For instance, along sidewalks and other paved surfaces integrated planting and retention strategies can manage water running off those surfaces in adjacent spaces. Buildings may opt to manage water within the building footprint (on the roof or through collection in cisterns for reuse) or in the vicinity of the building on the ground plane. Each specific typology may have a variety of appropriate LID stormwater management practices to choose from based on adjacent conditions, space available, and design intent.

The opportunity to make stormwater visible in the campus landscape is particularly valuable in the academic space, further expanding student, faculty, staff, and visitors' relationship with and understanding of the regional landscape context. Rather than being hidden in a pipe system, stormwater is visible and part of the campus experience, reinforcing the community's relationship to the regional natural water systems.

Green Infrastructure/ Low Impact Development Opportunities by landscape typology

Quadrangles, Open Spaces, Athletic Fields

Photo copyright Biohabitats

Common Stormwater Issues

- Degraded stream habitat
- Nutrient loads to waterways
- Thermal impacts
- Heightened bacteria levels
- Pesticides and other contaminants
- Conditions that promote establishment of invasive species

Green Infrastructure Benefits

- Stormwater treatment closer to source
- Integrated practices provide landscape amenities
- Enhanced ecological function
- Reduced maintenance (mowing)
- Research opportunities
- Sustainability

Green Infrastructure/ Low Impact Development Opportunities by landscape typology

Streets, Parking Lots, Buildings, Interstitial Spaces

Integrated low impact development stormwater strategies are features or amenities in the landscape that further define the campus identity and its connection to place. The US EPA defines low impact development as "systems and practices that use or mimic natural processes that result in the infiltration, evapotranspiration or use of stormwater in order to protect water quality and associated aquatic habitat."

In the campus context, the goal is to weave these water management practices seamlessly into the landscape, managing water from impervious infrastructure like paths, streets, parking, buildings and other facilities. Given the regional climate, any water on the property will want to be managed responsibly, ensuring that runoff is clean before it enters the North Reese Creek tributaries on campus. This is particularly important along roads and parking lots where contaminants need to be filtered out before the runoff joins the natural drainages on the property.

Rather than directing stormwater into pipes, the intent is to help the water stay closest to where it falls and allow it to play a functional and visible role in the landscape. In the campus context this may result in features like rain gardens that may support infiltration or planted bioswales that help direct flows across the landscape. Water may also be collected in cisterns for directed uses like irrigation. These native landscape features will thrive, with the stormwater runoff supporting native plants and creating habitat for local wildlife. Green roofs can hold and use this water to create gardens within the vertical space, while helping keep energy costs down within the building envelope.

Regenerative stormwater conveyance manages water flows in a stream-like flow path with riffles and plantings along a flow path that can seamlessly connect into the natural landscape.

Bioswales

Photo copyright Biohabitats

Bioretention/ Streetscapes and Parking

Photo copyright Biohabitats

Green Roofs

Photo copyright Biohabitats

Cisterns

Photo copyright Biohabitats

Rain Gardens/ Wetlands

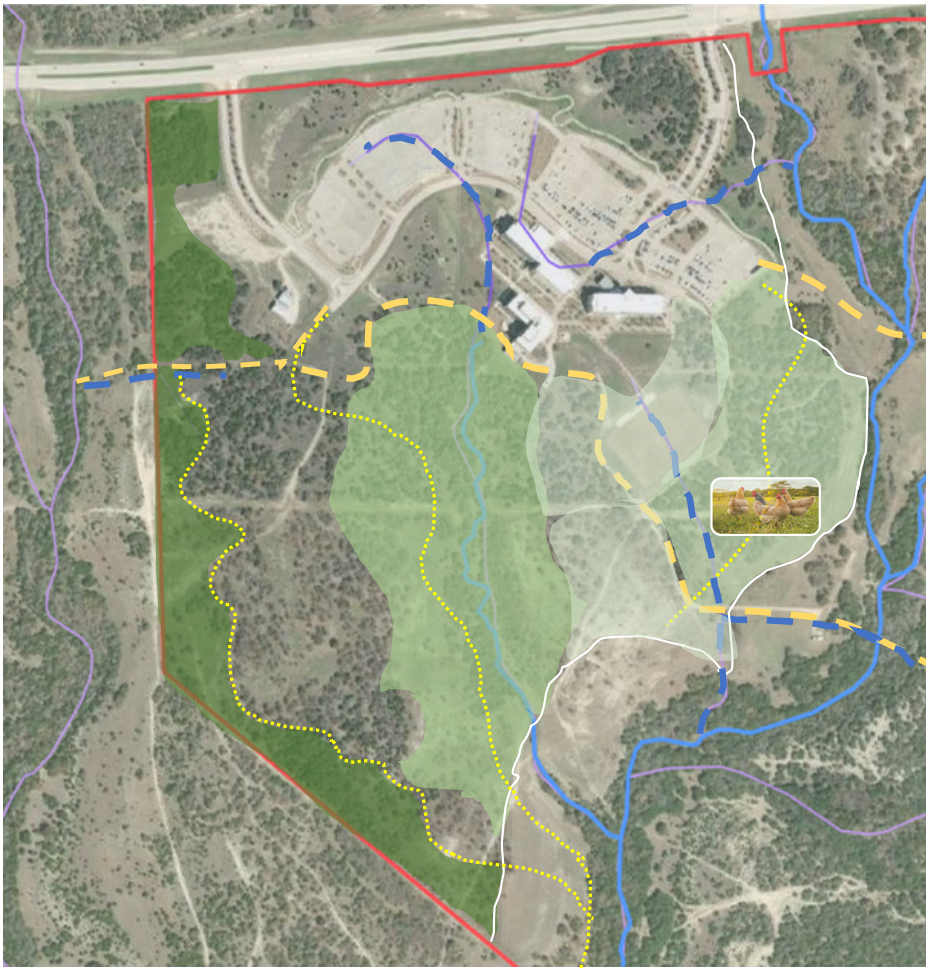
Photo copyright Biohabitats

Exploring the natural potential of the built environment and campus open space:

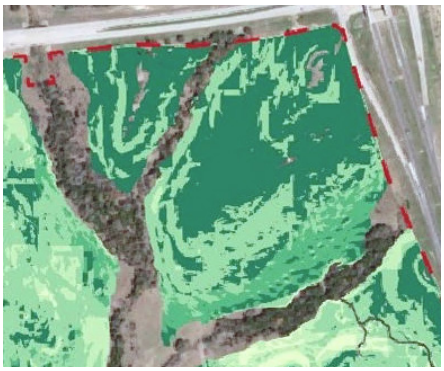
- Functional Landscapes
- Multiple/Stacked Benefits
- Education and Stewardship
- Sense of Place/Identity

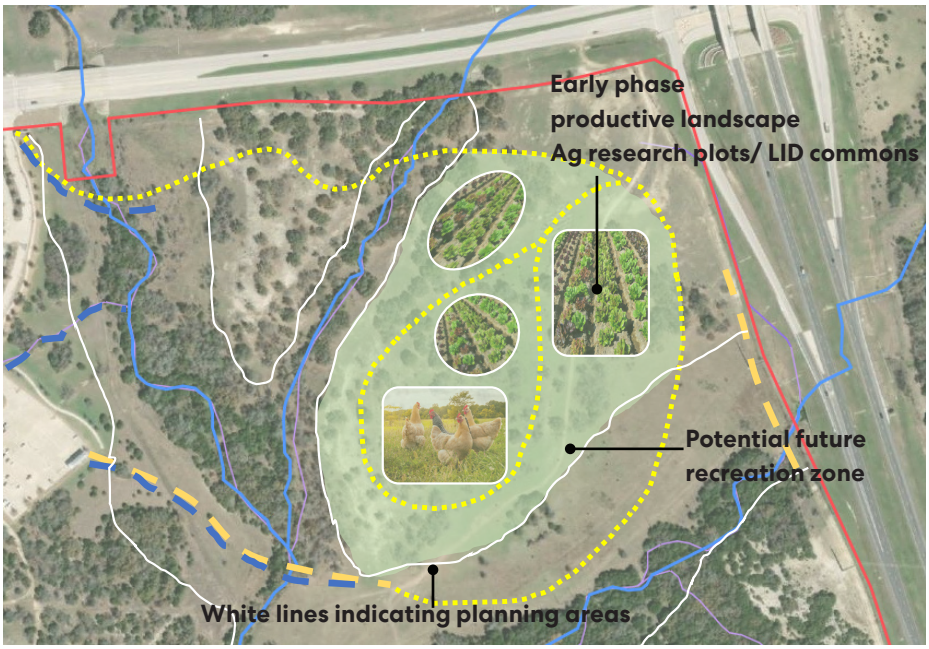
Campus-wide Green Infrastructure Overlay

Ecological Opportunities

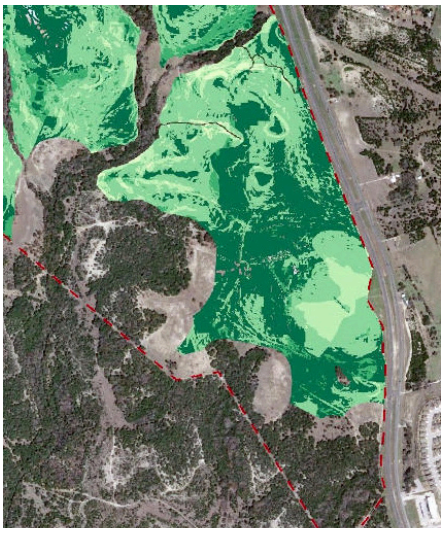


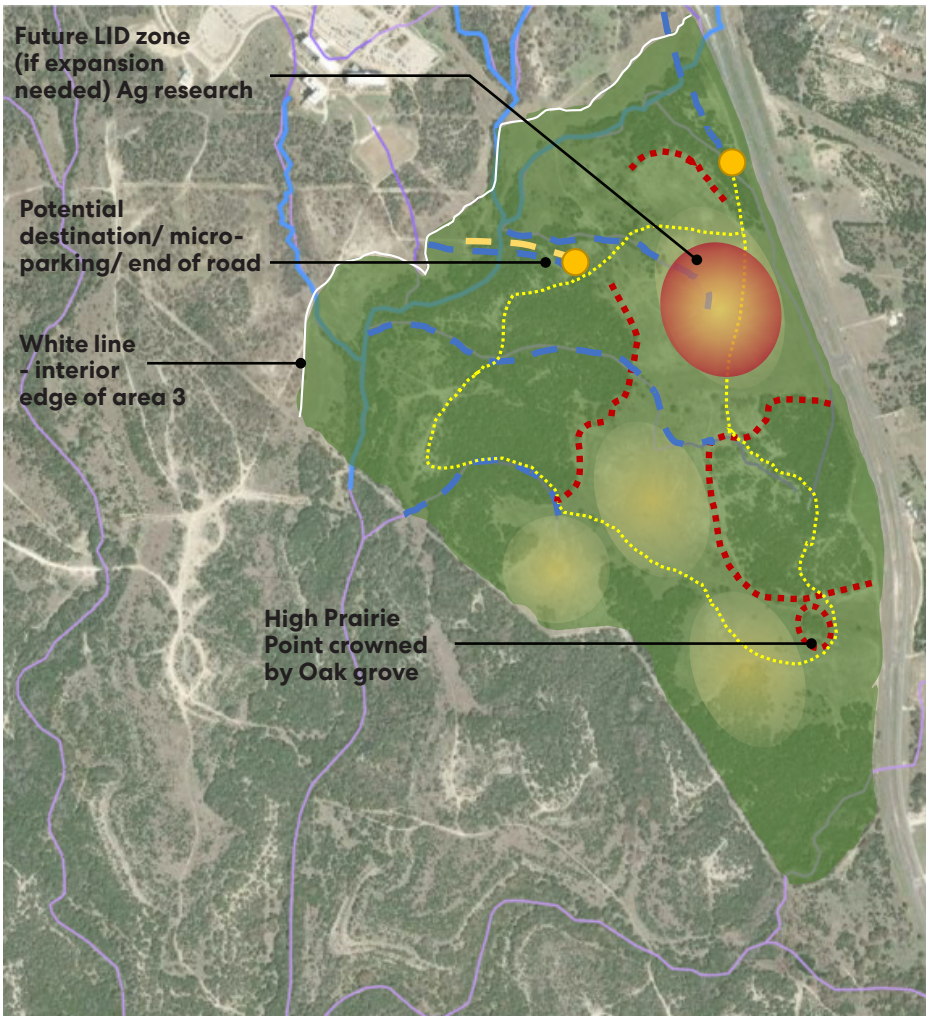
- Buffer Preserve
- Green Conservation Spine
- LID Commons
- Road
- Living Infrastructure Network (stormwater) traces ephemeral drainage
- Stream Centerline
- Trail Network (conceptual)





- LID Commons
- Road
- Living Infrastructure Network (stormwater) traces ephemeral drainage
- Stream Centerline
- Trail Network (conceptual)



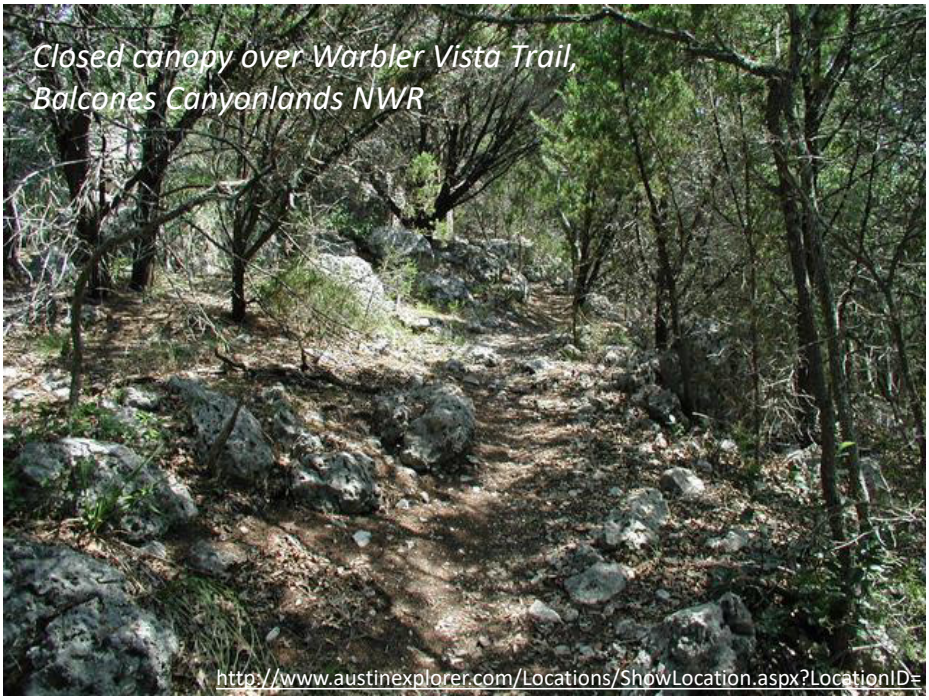


- Ecological Preserve
- Road
- Blue Infrastructure Network (stormwater) traces ephemeral drainage
- Expansive Prairie Landscape/ Experience
- Forest Edges Diversify Habitat & User Experience
- Trail Network (conceptual)

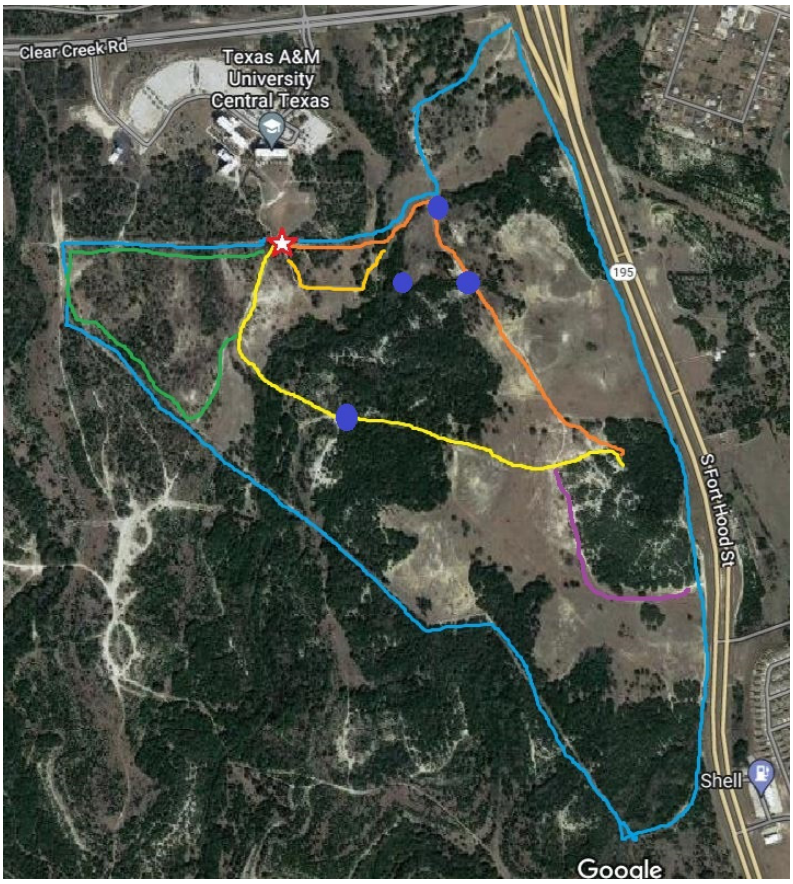
Best Practices for Trails in Protected Areas

There are some general guidance for trails in protected areas, however any trail construction will need more detailed guidance:

- All features in GCW habitat need to be in compliance with 2009 Biological Opinion (USFWS). Additional design guidelines available through TPWD.
- Minimize new disturbance by utilizing existing trails/roads.
- New trails need to maintain closed canopy (see example, right). Repurposed trails (e.g., on historic roads) should restore canopy.
- Trails must be unpaved.
- If trees are removed for trails there should be no more than 16' between tree trunks on opposite sides of the trail; remove only junipers <15' tall and <5" dbh.
- Lighting should be directional; Texas Lights Out recommends no lights during migration (Aug 15-Nov 30, Mar 1-Jun 15). Lighting is also addressed by the BO (FWS 2009).
- More detailed guidance includes which activities are allowed during nesting season (Mar-Aug).



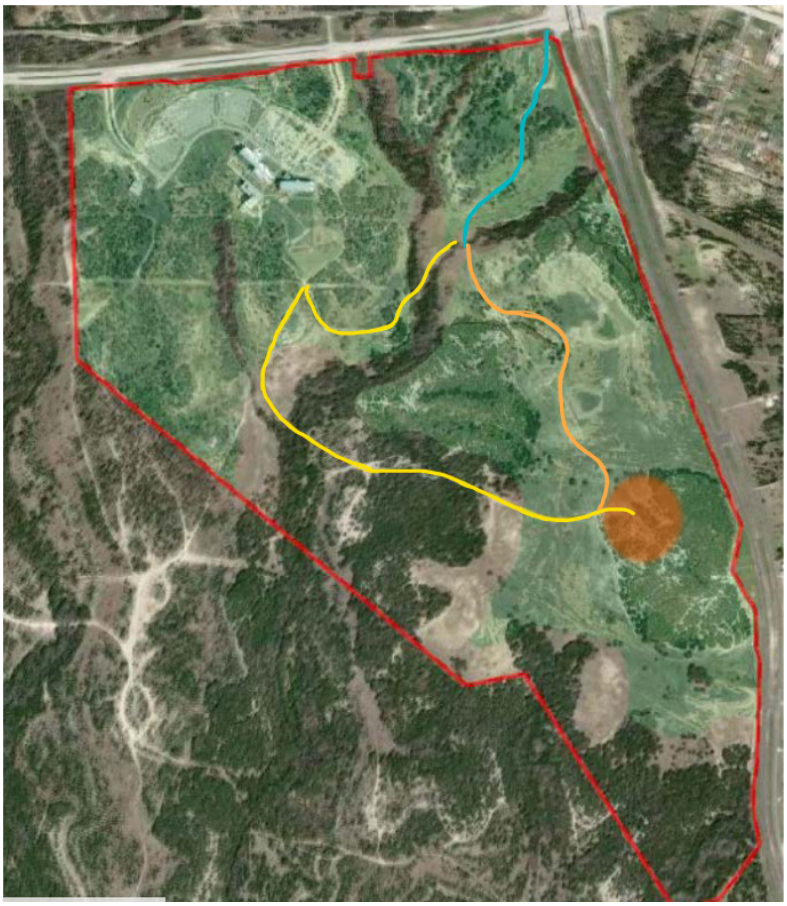
Closed canopy over Warbler Vista Trail, Balcones Canyonlands NWR



- Fence Line
- Primary Bald Knob Hike Route
- Secondary Bald Knob Hike Route
- Wet Weather Alternate Loop
- Trail to the back side of Bald Knowb
- Pedestrian Fence Crossing
- Common Seasonal Water Crossings

Guidance for developing future trails or modifying existing routes:

- Align with existing trails/roads and avoid new clearing (e.g., turquoise).
- The north slope of Bald Knob is highly erosion-prone: design a single, highly-controlled trail with signage explaining its vulnerability to users.
- Avoid low-suitability, high-conservation value areas (referring to suitability analysis) where possible.



Disc Golf Recommendations

Disc golf significantly increases soil compaction, which yields greater soil erosion and a decrease in vegetation cover.

Trendafilova & Waller (2011) International Journal of Sport Management, Recreation and Tourism

[above, plus…] significant trampling of undergrowth… as well as persistent damage to trees, such as the stripping of bark, leaves, and branches and indentations and nicks made by the discs, which can result in tree death. Results of this study indicate that there is a high demand for disc golf… players value course maintenance positively and are willing to change their behavior to offset negative impacts.

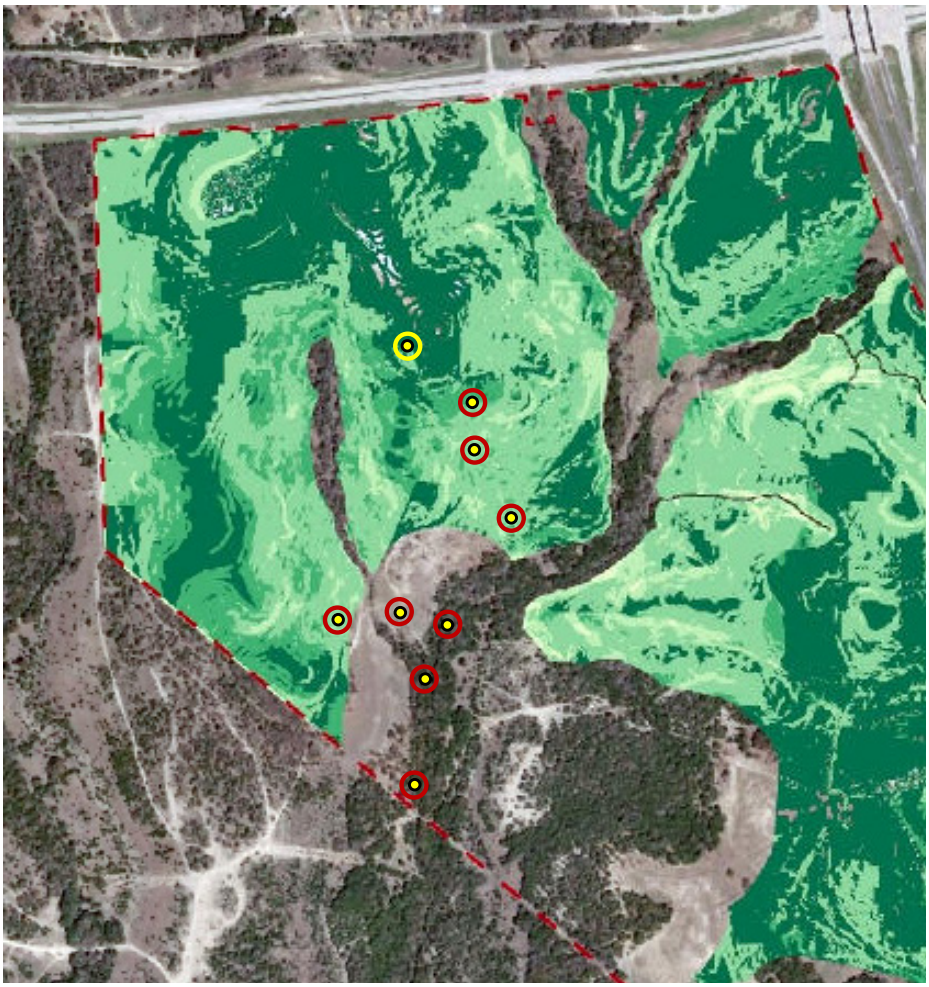
Mahoney (2014) Nat'l Conf on Undergrad Rsch

Pros: Live oaks thrive w/ removal of understory & vines

Cons:

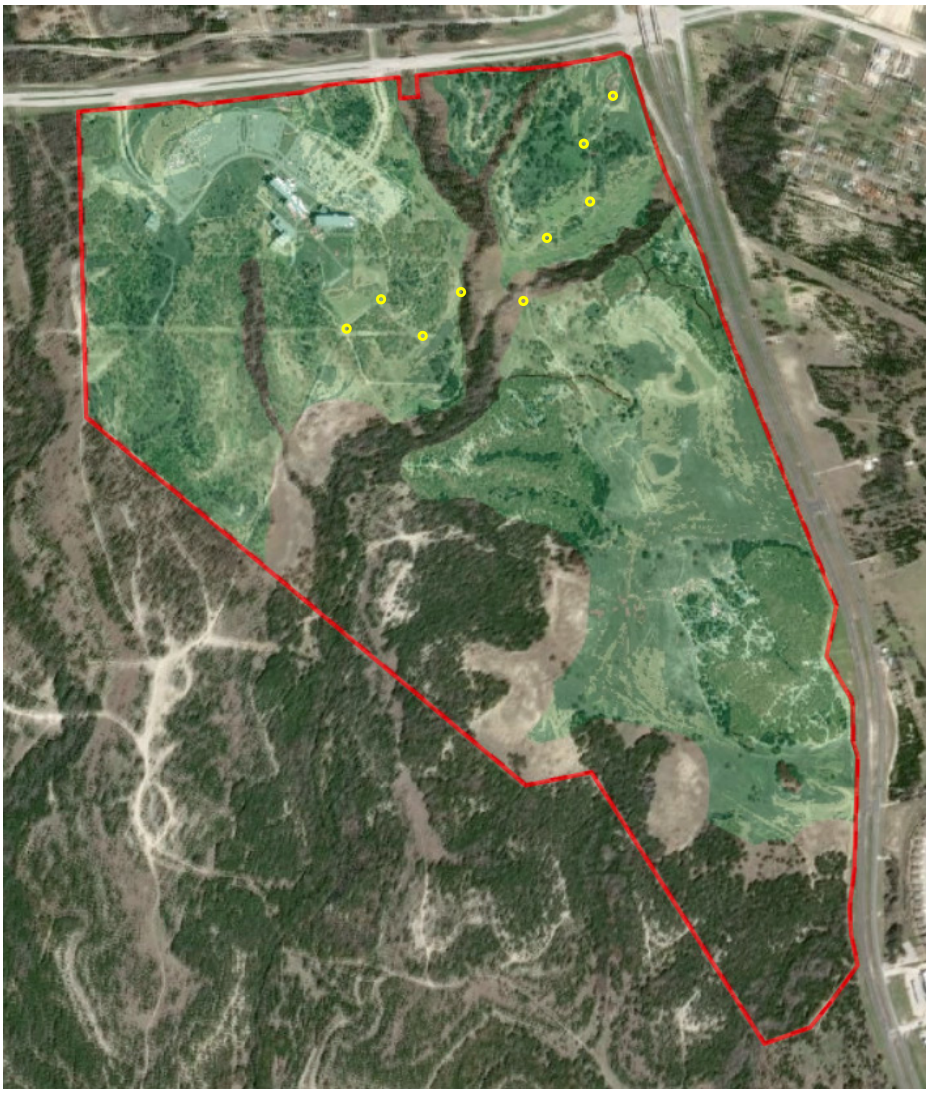
- Less wildlife overall
- Erosion
- Soil compaction esp. at tees & baskets
- Tree damage from taking hits

GBLambert (2016), Member, Disc Golf Course Review, San Marcos, TX



Observations:

- 1 disc golf basket in most suitable area for development
- 8 baskets are in more sensitive ecological areas



Disc Golf recommendations (map is illustrative):

- Keep disc golf course out of GCW habitat.
- Utilize existing trails/roads for tees/baskets to minimize additional erosion and compaction.
- Prioritize tees/baskets for high-suitability areas (darker green) for development.
- If floodplain (unmasked area in suitability analysis, right) is unavoidable for portions of disc golf, use unforested areas to spare trees.
- Design fairways for existing unforested areas.
- Place first tee in NE ("Recreation & Innovation") parcel and have the course progress toward main campus area. This will keep discs on campus and confine impacts to more resilient areas (i.e., outside of Southern Preserve).

Living System Framework : Open Space

	Protect *(Preservation & Enforcement)*	Adapt *(Resilience & Flexibility)*	Replenish *(Regeneration)*	Endure *(Sustainability)*	Integrate *(Cohesion, Diversity, & Fairness)*	Thrive *(Vitality & Well-being)*

PEOPLE	▹ Outdoor Education
	▹ Celebrate Ecological History
	▹ Protect Farmland for Farmers
	▹ Stewardship & Citizen Science
	▹ Highlight Green Spine & Buffer Preserve through Wayfinding
		▹ Employ RELi Strategies*
		▹ Food Production
		  ▹ Community Gardens
		  ▹ Rooftop/Patio Gardens
		  ▹ Greenhouses
		▹ Water Availability
		▹ Food & Water Quality
		▹ Flexible Outdoor Spaces
		▹ Outdoor Shelter
		▹ Minimize Urban Heat Impact
		▹ Winter Weather Adaptation
			▹ Regeneration Education
			▹ Innovation Opportunities
			▹ Research Opportunities
				▹ Water Use Reduction
				▹ Material Waste
				▹ Noise Pollution
				▹ Natural Pest Control
				▹ Eliminate Use of Pesticides & Fertilizers
					▹ Community Cohesion
					▹ Universal Design
					▹ Celebrate Site History
					▹ Appealing Site Edges
					▹ Provide for Chance Encounters
					▹ Local Craft/Art Integration
					▹ Provide Spaces for Markets
						▹ Outdoor Recreation
						▹ Connection to Nature
						▹ Quiet Zones
						▹ Restorative Spaces
						▹ Multi-Sensory Experiences

PLANET	▹ Establish Conservation Zones
	  ▹ Protect Critical Natural Resources
	  ▹ Protect Critical Wildlife Habitat
	▹ Consult Wildlife Agencies
	▹ Protect Site Hydrology*
	  ▹ Limit Development Near Riparian Zone(s)
	  ▹ Strengthen Riparian Buffers
	▹ Protect Native Soils
	▹ Protect Biodiversity*
	▹ Protect Tree Coverage
	▹ Install Dark Sky Lighting*
	▹ Protect Site History
		▹ Increase Biodiversity*
		▹ Develop a Fire Management Plan*
		▹ Develop Stormwater Pollution Management Plan (SWPPP)
		▹ Drought Tolerant Planting
		▹ Conserve Biomass
		▹ Flooding Prevention
		  ▹ Maintain Open Spaces
		  ▹ Maintain Natural Hydrology
		▹ Steep Slope Protection
		  ▹ Maintain/Enhance Supportive Vegetation
		  ▹ Prevent Soil Disruption
		▹ Develop Erosion & Sedimentation Control Plan
			▹ Restore Disturbed Soil
			▹ Restore Aquatic Systems
			▹ Restore Riparian Corridors*
			▹ Restore Ecosystems
			▹ Infiltration via Landscape*
			▹ Renew Site Habitat
			▹ Carbon Sequestration
			▹ Eliminate Invasive Species
			▹ Pollutant Removal
			▹ Enhance Landscape Connectivity
			▹ Employ Adaptive Management Strategies*
				▹ Follow SITES Certification Standards*
				▹ Sustainable Water Management
				▹ Reduce Resource Use
				  ▹ Water Use
				  ▹ Energy Use
				▹ Mitigate Material Waste
				▹ Embodied Carbon Reduction
				▹ Mitigate Noise Pollution
				▹ Mitigate Light Pollution*
				▹ Maintain Soil &Water Quality
				▹ Sustainable Planting
				  ▹ Follow Seasonal Planting Schedule
				  ▹ Use Native Plant Palette
				  ▹ Minimize Invasive Species
					▹ Engage Surrounding Sites*
					▹ Inclusive Site Stewardship*
					▹ Community Education/ Activities
						▹ Improve Surrounding Sites*
						▹ Continued Site Stewardship*
						▹ Multi-functional Landscapes

ECONOMY	▹ Long-Term Conservation Management Plan
	▹ Biodiversity Maintenance
	▹ Educational Resources
		▹ Disaster Recovery Plan
		▹ Emergency Preparedness Plan
		  ▹ Extreme Heat
		  ▹ Winter Weather
		  ▹ Fire
		  ▹ Extreme Rain (Flooding)
		  ▹ Drought
		  ▹ Tornado
			▹ Regeneration Plan	▹ Water Use Reduction
				▹ Energy Use Reduction
				▹ Site Maintenance Plan
					▹ Prioritize Local Materials
					▹ Support Local Businesses
					▹ Use Local Labor
					▹ Community Engagement & Outreach
						▹ Institutional Reputation
						▹ Marketing Opportunities
						▹ Research & Innovation Opportunities

* More information on following pages.

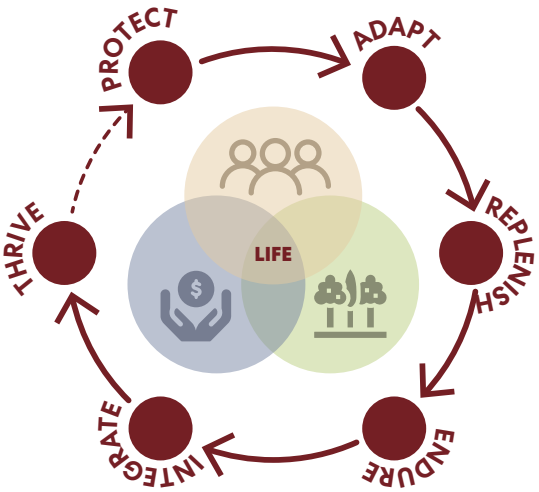
The sustainability approach to Open Space at A&M-Central Texas is rooted in the tremendous opportunities found in the campus' natural areas and open space. With its expansive, relatively pristine, and high-functioning habitat present on the site, as indicated by the presence of endangered and rare wildlife species (golden-cheeked warbler and Townsend's solitaire) and one de-listed species (black-capped vireo, still of concern), prioritizing habitat quality and function is an unmistakable opportunity. Water is also infrequent in this arid region, so the presence of North Reese Creek on campus, which ultimately converges with the Lampasas and Balcones Rivers, diversifies the landscape and establishes regional connectivity and resilience potential.

Focused protection and enhancement of:

- Biodiversity including sensitive species
- Landscape connectivity
- Research, learning, & stewardship outreach
- Multi-functionality
- Resilience and adaptation
- Ecosystem services
- Low-Impact Development (integrated green stormwater infrastructure practices) within development footprint

Both large and small scale connectivity is essential to long-term adaptive capacity, regeneration, and uninterrupted ecological function. A healthy and functional landscape in turn supports the curricular, recreational, and social functions of the campus community.

The presence of the respected A&M-Central Texas institution in this unique place is an unmatched opportunity for sustainability planning. There is not a more receptive or attentive community than that led by University leadership setting conscientious goals. As the site steward, the University benefits from continued ecosystem services (supporting, cultural, provisioning, and regulating) providing basic and often unrecognized needs. The educational and learning opportunities are myriad, especially considering the diversity of topography, hydrology, land cover character, and species diversity within the campus natural areas and the vicinity. The development footprint and programmed open space areas integrate Low-Impact Development strategies that help transition to the relatively intact habitat outside of these zones, highlighting a native plant palette and a variety of innovative stormwater management strategies. A balance of functional landscapes integrated into the campus environment not only extends the community experience of the campus but is also an open invitation for all to explore and connect.



As a regional and landscape amenity, A&M-Central Texas provides an important resource with singular health and recreation opportunities and natural and cultural history. In addition to immediate university interests, Killeen and the larger community benefit from the continued protection and stewardship of these unique natural resources as a dedicated public open space. This affords the City a value and investment advantage by virtue of the space as well as the vision and ethic that established the program. As the benefits are further understood and enjoyed, the broader community will continue to be invested in its continued existence, enhancement, and protection.

Protect & Improve Site Hydrology: Preserve and improve water resources by preventing pollutants from contaminating surface water and groundwater and monitoring impacts during construction and operations. Groundwater is a widely used source of drinking water. Protecting wellheads and groundwater recharge areas reduces the chances of groundwater contamination and protects natural water purification processes. In addition, aquatic ecosystems depend on a particular set of water conditions. Changes to any of these factors can adversely affect aquatic life and groundwater quality. Aquatic ecosystems are threatened by changes in pH, decreases in water clarity, and increases in temperature, dissolved solids, coliform bacteria, toxic substances, and nutrients (especially phosphorus and nitrogen). Leaks, spills, and other sources of contamination have serious environmental, social, and economic costs with prevention almost always being more economical than clean-up. Contamination takes many forms but can kill flora and fauna, destroy habitats, and cause illness or premature death in humans. Concerns regarding equipment and facilities containing potentially polluting substances include fuel and chemical storage, pipelines, piles of raw materials, and process areas.

Protect & Improve Biodiversity: From the unique genetic diversity found within a species to the multitude of ecosystems that support life globally, biodiversity is at the heart of resilience. One million species worldwide are threatened with extinction, with approximately one in eight species projected to be lost in the next 80 years.* The number one cause of biodiversity loss is habitat destruction and fragmentation, making every design decision crucial when planning new development. By ensuring that the widest representation of native plant and wildlife species' needs are met on the campus, A&M-Central Texas will stem biodiversity loss and build resilience at the site scale. This includes prioritizing a native plant palette for all landscape features on the site, from the natural areas to the development footprint, landscape amenities, and landscaping. The removal and long-term management of nonnative invasive plant species on the site is also crucial for biodiversity support. *United Nations Convention on Biological Diversity (https://www.cbd.int/)

Mitigate Light Pollution /Dark Sky Lighting: Light pollution has the potential to disrupt circadian rhythms and human sleep patterns, which effects human health. It also creates an abundance of environmental problems. Wildlife species that hunt or forage at night may be unable to feed. Some flora and fauna are unable to adjust to seasonal variations when exposed to light pollution, which can effect reproductive cycles. Migratory birds that rely on stars to guide them during migration may become disoriented. Also, the cumulative exterior light directed upward into the sky because of inappropriate lighting represents a massive waste of energy and therefor money. Well-designed lighting can maintain adequate light levels on the ground while reducing light pollution by using lighting more efficiently. Good lighting design involves reducing three forms of light pollution - uplight, glare, and light trespass.

Follow the guidelines of the Model Lighting Ordinance issued by the International Dark-Sky Association and the Illuminating Engineering Society (IES). The template utilizes the IES TM-15-11 "BUG" (Backlight, Uplight, and Glare) classification of outdoor lighting fixtures and is designed to help municipalities develop outdoor lighting standards that reduce glare, light trespass, and skyglow. Consider

the following recommendations:

- Identify lighting needs and sensitive community and environmental areas potentially impacted by light pollution during operations.
- Reduce light pollution following a mitigation hierarchy of avoidance, minimization, protection, and offsetting.
- Implement a master lighting plan establishing lighting zones. For each zone, the plan outlines lighting goals, safety and security needs, specifies environmental conservation, and reduces lighting when no longer needed.
- Light emission beyond 90 degrees should be prevented. All project lighting should meet BUG rating uplight requirements with no light emitted above 90 degrees.

Fire Management Plan: The fire frequency in the pre-development Killeen region may have been as frequent as every 6-7 years.* Controlled burns continue to be used as an organizing tool by current site managers. The collaboration among A&M-Central Texas, the City of Killeen, and Fort Hood is a new moment in the management of this native landscape and an opportunity to use the best knowledge and tools to develop a 21st-century fire management plan. Instituting a collaborative process to develop a plan, without interruption in current efforts, will be important to optimize the health of the landscape and its wildlife populations. The process should include current managers for landscape knowledge, to help inform future goals, to best understand resources and constraints, and to consider all options with a fresh perspective. Ideally the fire management plan will be developed within one calendar year and adhere to principles of adaptive management.
*Reidy et al. 2021

Restore & Enhance Riparian Corridors: Riparian habitat is that which depends on the hydrology of local surface water and occurs on the banks of a waterway. In the A&M-Central Texas landscape, riparian ecosystems are associated with North Reese Creek as well as several unnamed, ephemeral drainages. As discussed elsewhere in the Master Plan, the hydrologic connections among these drainages are paramount for habitat diversity, aquatic ecosystems, water infiltration and aquifer recharge, and ultimately watershed health. The waters in turn are inextricably dependent on local riparian systems, which ensure water quality and aquatic ecosystem function in addition to further diversifying the landscape. The dense root networks, canopy cover, and plant species diversity of riparian zones ensure stream health and water quality by filtering landscape runoff; preventing erosion; and providing shade, organic matter, and wildlife habitat that is the basis for local food webs. Preservation of existing riparian zones, restoring riparian function with revegetation and other bank stabilization measures, and reconnecting riparian corridors will not only elevate the landscape ecologically but will make A&M-Central Texas a leader in stewardship and education opportunities.

Infiltration via Landscape: Designing and maintaining a landscape to receive and infiltrate water closest to where it falls supports the natural function of the water cycle and the water-landscape relationship. Strategies to achieve on-site water infiltration include low impact development, green infrastructure, and other stormwater management landscape features. Integration of these features throughout the landscape allows plants, soils, and their interactive properties to filter pollutants from runoff; increase landscape diversity and hydrologic connectivity; provide habitat resources for insects, birds, and small mammals; support aquifer health and function; and minimize local heat island impacts.

Employ Adaptive Management Strategies: responds to the inherent changes and uncertainty fundamental to natural resource management, the ecological processes that encompass them, and potential changes in goals, intended outcomes, support and available funding over time. The goal of adaptive management is to build resilience into both the resource conditions as well as the management system, allowing for flexibility and the incorporation of new information in the process. It is the integration of design, management, and monitoring in order to adapt to and learn from the unique functions of any local habitat, using observations to inform resource management or policy changes over time. One conceptual framework for adaptive management (Blann et al. 2003) includes the following steps: (1) establish a clear purpose, (2) design an explicit model, (3) develop a management plan that maximizes results and learning, (4) develop a monitoring plan to test assumptions, (5) implement monitoring and management plans, (6) analyze data and communicate results, and (7) use results to adapt and learn.

SITES: SITES rating system is a sustainability-focused framework that ushers landscape architects, engineers and others toward practices that protect ecosystems and enhance the mosaic of benefits they continuously provide our communities, such as climate regulation, carbon storage and flood mitigation. SITES-certified landscapes help reduce water demand, filter and reduce stormwater runoff, provide wildlife habitat, reduce energy consumption, improve air quality, improve human health and increase outdoor recreation opportunities.*
*https://www.sustainablesites.org

Engage & Improve Surrounding Sites: A&M-Central Texas is singular not only in having a wealth of native landscape resources but also through its connectivity to extensive natural areas and green spaces to the west and south (i.e., Fort Hood and the Central Texas State Veterans' Cemetery). Understanding that the management objectives of these adjoining spaces are different from each other, they still are fundamental to large-scale ecological function beyond the campus. Indeed, golden-cheeked warbler and black-capped vireo habitat is contiguous between A&M and the other properties, and North Reese Creek drains into Fort Hood. A&M-Central Texas could be a leader in local conservation by engaging with other landscape managers and preparing a collaborative plan prioritizing the identification, preservation, and restoration of aquatic, wetland, and bird species habitat and mutually supporting the efforts of each partner. A landscape collective formed in this way could be a model for other institutions attempting to transcend boundaries.

Inclusive & Continued Site Stewardship: Opportunities to develop a deeper understanding of the natural environment and our relationship with it inspires active and ongoing stewardship by community members, students, staff and faculty. The A&M-Central Texas campus offers incredible opportunities as a living laboratory for citizen science, learning, respite, and research, laying the foundation for stewardship that supports ecological resilience and regeneration. Whether through organized programming or a variety of unique activities that engage the community in the understanding and management of these natural areas, an involved community develops a land-based sense of identity, reciprocity, and protection.

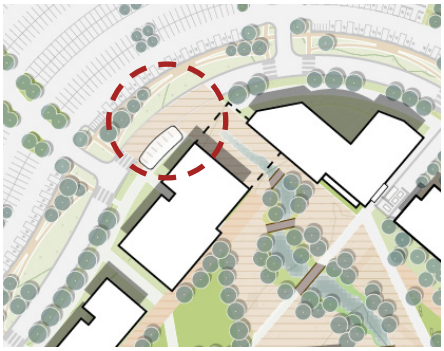
Mobility Framework

Texas A&M-Central Texas master plan envisions a walkable, pedestrian-friendly campus in order to emphasize the student experience along with providing a thriving environment for chance encounters between industry partners and academia. A thriving campus environment is created by ensuring parking lots are located at the periphery and minimizing vehicles in the campus core.

The mobility framework proposes street design concepts that emerge from a multi-modal approach to transit. Some key ideas include redesigning the Leadership Place Loop to enhance pedestrian experience from the parking lots to the campus core along with facilitating biking and scooters. The main pedestrian mall will only have slow moving traffic while presenting an enhanced pedestrian experience with amenities that spill over from the abutting buildings, tree-lined shaded pathways, and moments of visual respite in the form of openings and views to the central green zone.

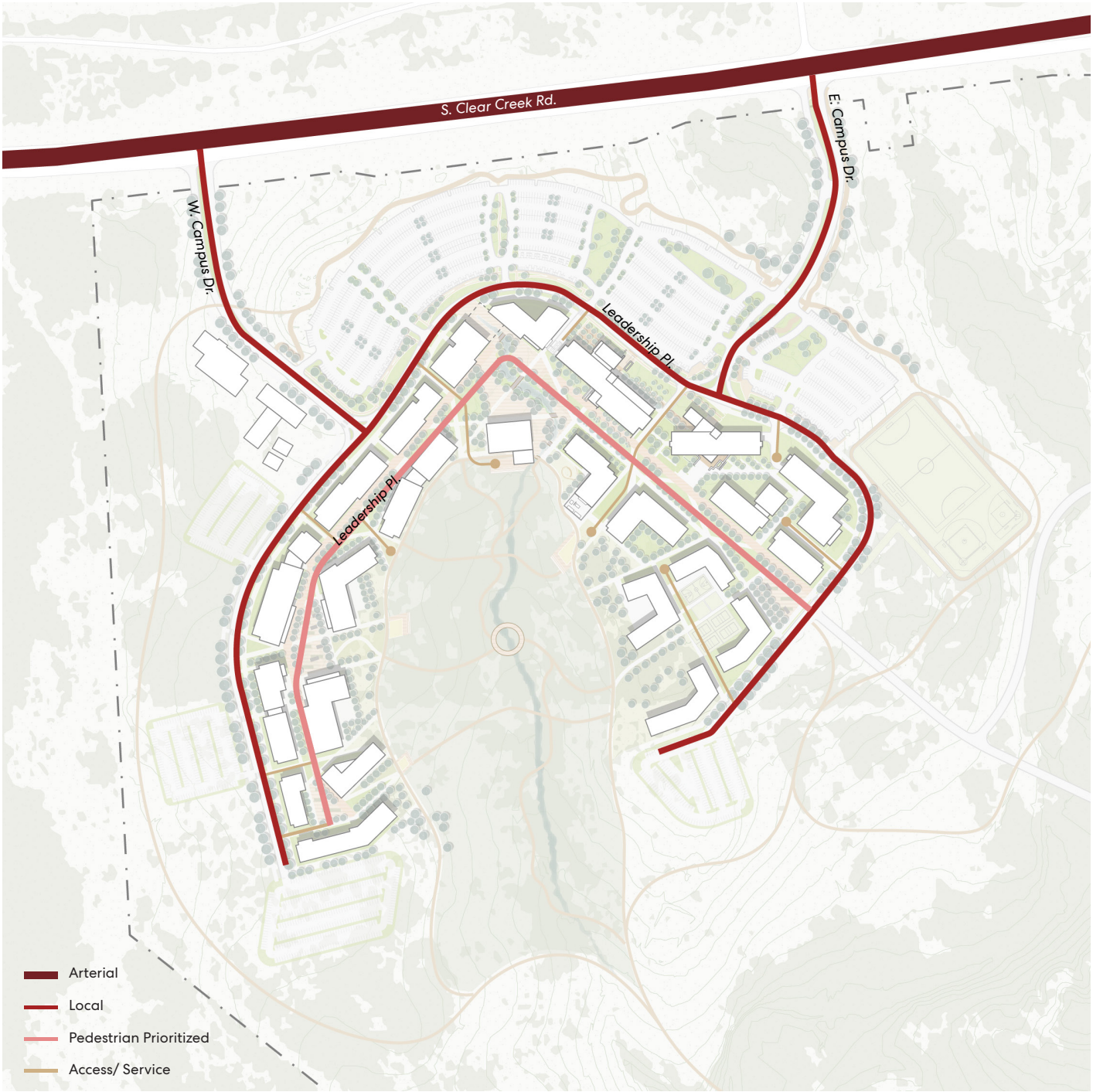
The recommendations elaborate on the following:

- Street Design
- Parking Strategy
- Alternate Transit Modes



Potential Future Transit Hub

As alternative mobility strategies are planned for, the area in front of the gateway buildings at the main entry of the collaboration quad, presents a perfect opportunity for establishing a transit/mobility hub to serve alternative mobility requirements. Some additional land could be opened up by redesigning the parking lot in the same area if needed.



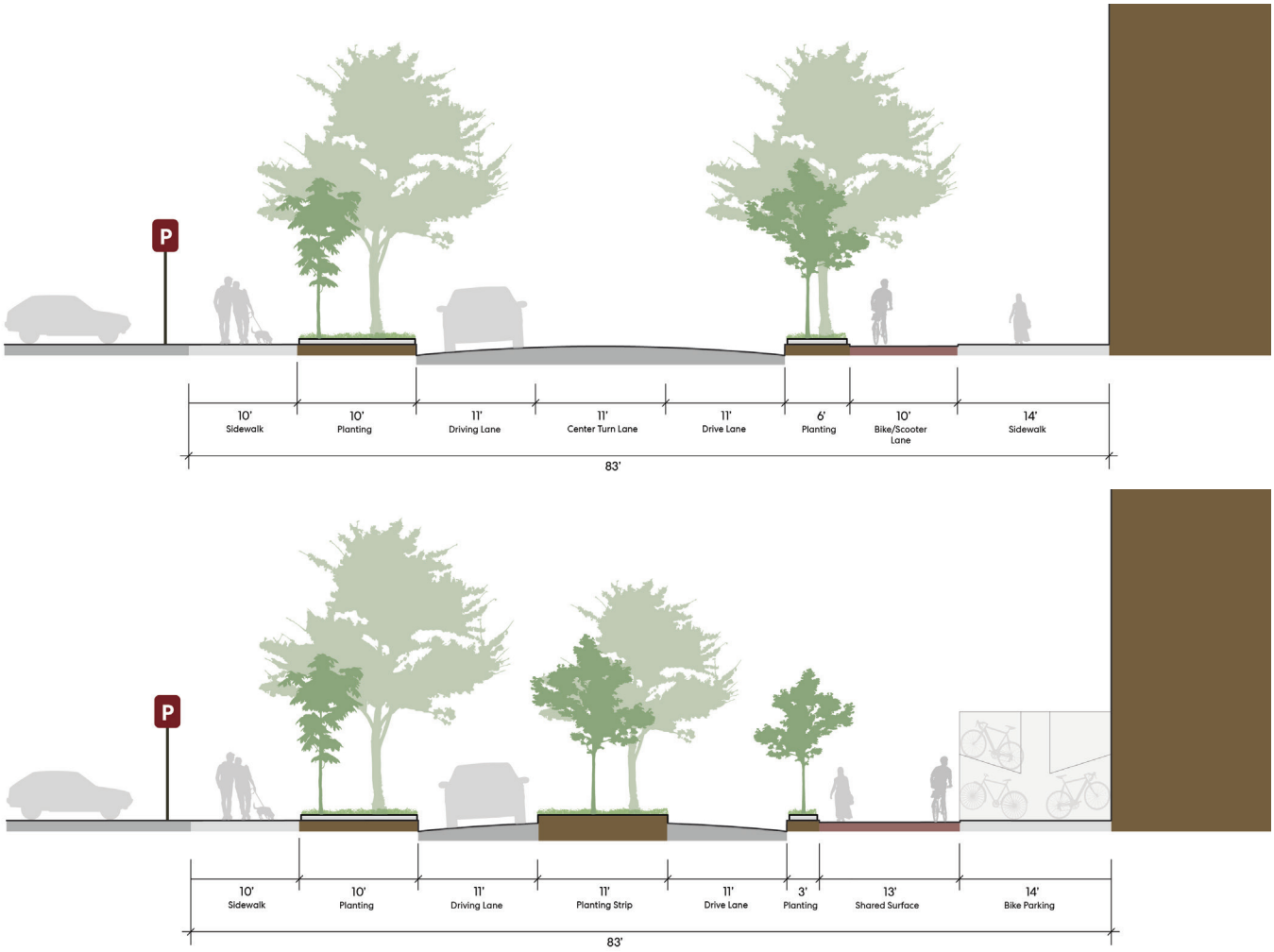
Street Hierarchy

Streets are designed to minimize vehicle movement along the campus core.

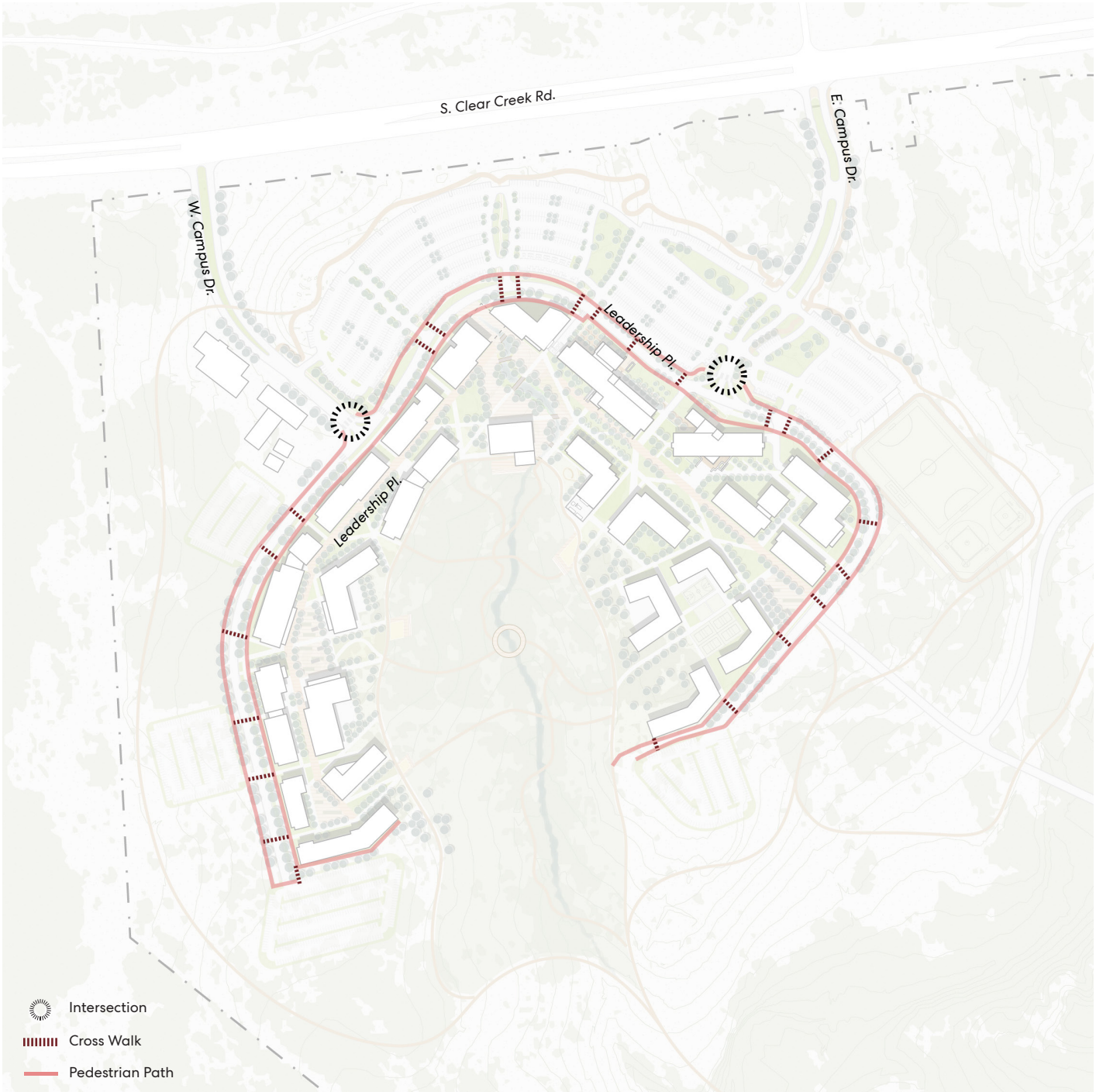
Street Design

The campus plan envisions a walkable, bikeable, campus that leverages parking lots on the periphery while minimizing vehicles in the campus core. Recommendations as follows:

- Redesign Leadership Place loop road to facilitate slow-moving vehicle access but include robust facilities and amenities for pedestrians.
- Enhanced connections to and from the parking lots, including:
- Sidewalks of 6-10’ along both sides of Leadership Place
- High-visibility and raised crossings at intersections and mid-block crossings, reduced crossing distances, smaller curb radii, and removal of vehicle slip lanes at major intersections along Leadership Place
- Provision of pedestrian-scale lighting and trees
- Provision of active trip amenities, including bike parking, showers, and lockers



Leadership Place Street Sections



Enhanced Connections

The design proposes an extension of the Leadership Pl. Road along with enhancing the pedestrian environment along this street.

Living System Framework : Mobility & Parking

	Protect *(Preservation & Enforcement)*	Adapt *(Resilience & Flexibility)*	Replenish *(Regeneration)*	Endure *(Sustainability)*	Integrate *(Cohesion, Diversity, & Fairness)*	Thrive *(Vitality & Well-being)*

PEOPLE	▹ Bike Lane Buffers
	▹ Shaded Sidewalks
	▹ Noise Pollution Mitigation*
		▹ Employ RELi Strategies*
		▹ All-Weather Circulation Routes
		▹ Bike Repair Resources
		▹ Bicycle Network Safety*
		▹ Transit Shelters
		▹ Walkability Audits
		▹ Discourage Speeding
		  ▹ Tree-lined and Shaded Streetscapes
		  ▹ Legible Signage
			▹ Innovation Opportunities
			▹ Research Opportunities
				▹ Complete Streets*
				▹ Transit Oriented Development*
				▹ Continuous Sidewalks/Trails
				▹ Bicycle Network
				  ▹ Connectivity to Entrances
				▹ Short-term and Long-term Bike Storage*
				  ▹ Bike Storage at Transit Stops
				  ▹ Bike Storage at Building Entries
				▹ Ride Share Program
				▹ Bike Share Program
					▹ Community Connectivity
					▹ Universal Design*
					  ▹ ADA Compliance
					  ▹ Legible Wayfinding
					  ▹ Accessible Transit Stops
					  ▹ Wide Sidewalks
					  ▹ Paratransit Services
					▹ Appealing Street Edges
					▹ Sidewalk/Trail Seating
					▹ Entrances for People vs. Cars
					▹ Bike Entrance Sequence
					▹ Provide ADA EV Parking
					▹ Preferred Parking for Carpool/ Shared Vehicles*
						▹ Walkable Streets*
						▹ Safe Streets
						  ▹ Pedestrian Lighting
						  ▹ Emergency Call Kiosks
						▹ Seating at Key Nodes
						▹ Outdoor Walking Trail Network
						  ▹ Meandering Pathways
						▹ Transit Stop Network Connectivity

PLANET	▹ Develop Construction Management Plan
	▹ Respect Conservation Zones
	▹ Protect Adjacent Landscape
	▹ Minimize Parking Lot Coverage
	▹ Optimize Species Mobility*
	▹ Align with Dark Skies Initiative
	  ▹ Install Dark Sky Lighting
	▹ Noise Pollution Mitigation*
	▹ Clean Streets
	▹ Mitigate Runoff Pollution
	  ▹ Stormwater Filtration
		▹ Balance Impervious Surfaces
		▹ Mitigate Erosion Potential
		▹ Heat Island Effect Mitigation*
		  ▹ Shaded Pavement
		  ▹ High Albedo Pavement
		▹ Stormwater Management
			▹ Restore Disturbed Soil
			▹ Reuse/ Re-purpose Demolished Infrastructure Waste*
			▹ Infiltration via Landscape
			▹ Carbon Sequestration*
			▹ Enhance Landscape Connectivity
			▹ Enhance Biodiversity
			  ▹ Native Plant Palette at Streetscape
				▹ Energy Efficient Site Lighting
				▹ Follow LEED for Neighborhood Development Standards*
				▹ Sustainable Paving Materials
				  ▹ Recycled Content
				  ▹ Local Materials
				  ▹ Bio-based Materials
				▹ Reduce Infrastructure Waste
				▹ Provide EV Charging Network
						▹ Tree-lined and Shaded Streetscapes
						▹ Improve Surrounding Sites
						▹ Multi-functional Landscapes

ECONOMY	▹ Biodiversity Maintenance
	▹ Educational Resources
		▹ Conduct Transit Surveys
		▹ Paving Maintenance
		▹ Trail System Maintenance
			▹ Renewables on Parking Structures	▹ Alt. Transit Incentivization
				  ▹ Employ Parking Fees
				  ▹ Provide Transit Subsidies
				  ▹ Transit Employee Benefits
					▹ Prioritize Local Materials
					▹ Support Local Businesses
					▹ Use Local Labor
					▹ Community Engagement
						▹ Transit Efficiency & Reliability

* More information on following pages.

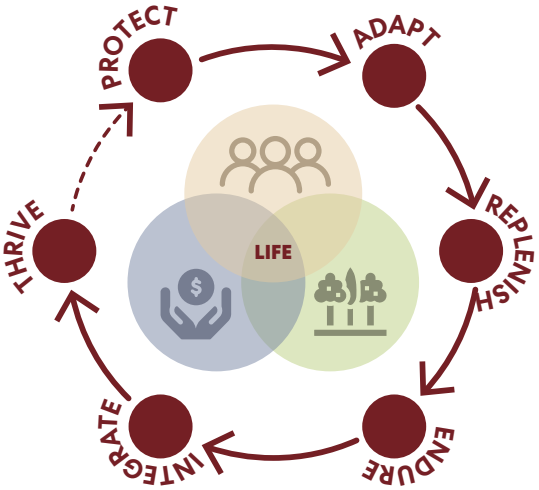
The sustainability approach to Mobility at A&M-Central Texas is focused on creating a holistic connection of pedestrian and natural environments. The campus development shall foster the enhancement of equitable, accessible, safe and comfortable community connectivity. The campus mobility plan is centered around reducing vehicular dependency. Walking and cycling are promoted and supported as main means for travel, which encourages daily physical activity, improving and sustaining public health, and reduces negative effects on the environment such as air, noise and water pollution and greenhouse gas emissions. This is followed by the support for alternative, more sustainable transit options such as buses or shuttles.

Focused protection and enhancement of:

- Sustainable transit services
- Landscape connectivity
- Community connectivity
- Human health & safet
- Ecosystem health & safet
- Resilient infrastructure
- Low-Impact Development (LID)

As these transportation networks are developed, it is critical to the protection and preservation of the entire site to respect the identified conservation zones and be cognisant of construction impacts. It is recommended that a Construction Management Plan (CMP) be developed and reviewed by relevant experts. Protect soil quality, existing vegetation/ tree canopy, and habitats (from noise, light, etc.). Also be cognisant of the waste developed through the construction process. Consider how waste will be diverted from the landfill and how items might be reused thoughtfully.

To ensure the mobility network sustains integrity over time, it's important to design with the local climate in mind. The project is located in a hot-humid climate, and projections predict an increase in extreme hot days and extreme rain events over time. Reducing and mitigating heat-island effect and stormwater management are critical strategies to plan for and address. Efforts should be made to employ Low Impact Development strategies to slow and filter runoff, minimize parking lot coverage, maximize pervious surface coverage, use light-colored surfaces, provide an abundance of shade, and an abundance of green space around and on buildings using a native planting palette.



A sustainable mobility network also relies on the introduction and maintenance of supporting infrastructure and amenities such as traffic control, wayfinding and signage, seating, bike storage, sheltered transit stops, charging stations, lighting, public art, emergency kiosks, and more. Consider what occupants need and desire and perform regular audits to ensure continued satisfaction and safety. Apply universal design principles as much as feasible; accommodate all abilities.

It is recommended that resources such as LEED for Neighborhood Development (LEED ND), the RELi Resilience Action List, SITES Initiative, Dark Sky Initiative, and NACTO Urban Bikeway Design Guide all be used for additional guidance.

Species Mobility: At present, the most high-profile species at A&M-Central Texas is the golden-cheeked warbler (Endangered), possibly followed by the black-capped vireo (de-listed). These species' habitat needs should inform landscape planning of trails and recreational amenities such as disc golf, which can cause local degradation of trees and soils, and mountain biking. Best practices to ensure habitat integrity and species movement include (1) understand species nesting and migration constraints, (2) refer to the conservation suitability analysis to avoid sensitive areas such as those prone to erosion, (3) align trails with existing trails and ROWs and avoid new clearing or other habitat fragmentation, (4) maintain and/or restore a closed canopy throughout, (5) do not pave trails, and (6) ensure that all features considered for habitat is in compliance with the USFWS 2009 Biological Opinion.

Noise Pollution Mitigation: Noise pollution can cause health issues for people and wildlife. It's important to mitigate noise pollution from traffic and construction as much as possible. Consider the following recommendations for mitigation: noise barriers (preferably dense vegetation along streetways), limitation of vehicle speeds, alteration of roadway surface texture, limitation of heavy vehicles, and use of traffic controls that smooth vehicle flow to reduce braking and acceleration. Consider setting target noise levels and conducting regular assessments to ensure compliance.

RELi Guidelines: It is recommended that the RELi Resilience Action List is used to guide the development of the A&M-Central Texas campus. RELi provides guidance for creating a shock-resistant, healthy, adaptable and regenerative communities.

Bicycle Network Safety: A well-planned bicycle network helps to facilitate safe efficient travel, promote physical activity, while reducing energy use, CO2 emissions, and noise pollution. Well-designed bikeways establish unbroken routes linking residential areas, neighborhoods, district and employment centers, and public transit. Reference the NACTO Urban Bikeway Design Guide. Consider the following safety recommendations:

Buffers - Separate bike lanes from street traffic or the door swing radius of parked cars. Buffer may be in the form of a curb, hatching or striping on the road, vegetation, planters, etc. Buffers should be at least 18" wide.

Intersections - Bike lanes should be transitioned to a through bike lane at right turn only lanes, or a combined bike lane/turn lane. Consider the use of a bike box at these locations. Install "yield to bikes" signs, active warning beacons, bike traffic lights, and/or signal detection at intersections or driveway crossings.

Wayfinding - Colored, slip resistant, pavement can be utilized either as a corridor treatment along the length of a bike lane, or as a spot treatment, such as a bike box, conflict area, or intersection crossing marking. The color green is recommended. Use road markings to delineate direction of travel, upcoming hazards, and/or right-of-way.

Heat Island Mitigation: Increased human activity with land paved and covered with buildings – generates a "heat island effect", an area warmer than its rural surroundings. Consider the following recommendations for mitigation:

– Reduce solar absorption – use "cool" or light colored surfaces vs. dark surfaces, black roofs, and asphalt paving. Cool surfaces have a high solar reflectance, and possibly high thermal emittance.

– Increase tree canopy & vegetative cover – each 10% increase in canopy cover reduces maximum mid-day air temperature about (1.8°F). Plant street trees 20-40 feet apart; require parking areas to be at least 50% shaded. Increase vegetative cover via vegetative pavement, green roofs, and/or grass and shrubs.

While tree canopy cover can have a mitigating effect on heat islands, it's important to first strive to avoid the potential for heat islands in the design process. If landscaping strategies are used to moderate increased local heat intensity, species utilized for this purpose should be chosen from a locally native plant palette so other ecological functions are not also compromised. For example, if a non-native shade species is chosen for a landscaping area, it may be host to non-native insects or birds, which would then present an additional stress to locally native fauna. Another impact could be that the water demands of a non-native plant species may divert from the water budget of the native landscape. Using locally native species, however, would be consistent with larger-scale landscape function. Minimizing overall heat island impact of any new development on the site should be prioritized through the integration of green infrastructure practices like green roofs and minimizing surface parking lot areas.

Reuse/ Re-purpose Demolished Infrastructure Waste: Re-purpose demolished concrete and stone on site by cleaning and/or crushing for seating areas, pathways, parking and trails. This prevents the CO2 emitted from offhauling.

Carbon Reduction & Sequestration: Many paving products, such as concrete, take a lot of energy to produce and therefore emit heavy amounts of CO2. Consider the following strategies for reducing the embodied carbon of paving materials within the development:

Boardwalks & Decking - Minimize the amount of concrete and steel supports/ footings. Substitute concrete, stone, or concrete pavers for wood, a naturally carbon sequestering material. Do not use tropical hardwoods; use local sources.

Pathways & Roads - Use decomposed granite with eco-friendly/organic binders, natural aggregates, or high % recycled content unit pavers instead of typical concrete, stone, or concrete unit pavers. These products have a smaller carbon footprint and may be permeable. For roadways using asphalt, use local or recycled aggregates.

Concrete Alternatives - Use CO2 sequestering concrete or concrete with high supplementary cementitious material (SCMs) such as slag, fly ash, glass pozzolan, or silica fume.

– Play Areas - Use Engineered Wood Fiber (EWF) in lieu of rubber surfacing.

Complete Streets: Complete streets allow pedestrians, cyclists, motorists and public transit to move comfortably and safely in unison. Streets designed primarily for cars make walking, bicycling, and public transportation inconvenient, uninviting, and potentially dangerous. Complete streets balance competing needs and support safe travel by all users. Consider the following recommendations:

Pedestrian circulation - Sidewalks shall be 6 to 10 feet in width for walking paths and at least 3 feet for amenity zones (street furniture, trees, bus shelters). Provide universal access curb cuts, pedestrian crossing signs, and high-visibility crosswalks. Or, for major roads, provide pedestrian over/underpasses.

Bike circulation - Separated bike lanes shall be located 6 feet from the curb, 18 feet from the curb for bike lanes where there is on-street parking, 14 feet from the curb for lanes sharing use with automobiles, and/or 16 feet from the curb for shared-use bike/bus lanes. Lanes should be 5 to 7 feet in width.

Vehicle circulation - Traffic lanes shall be at least 11 feet in width for automobiles.

Public transit - Ensure transit stops are located no more than 1/4-1/2 mile walking distance from building entrances.

Transit Oriented Development (TOD): Transit-Oriented Developments are a mix of housing, retail and/or commercial areas and amenities within walking distance of public transportation. TOD's are established within ¼ – ½ mile walking distance of public transit with areas near transit increasing in density. TOD's conserve land, encourage walking and bicycling, while reducing infrastructure costs and energy consumption.

Bike Storage: A well-functioning bicycle network requires sufficient short-term and long-term bike storage. Consider the following recommendations:

Non-Residential Buildings - Provide short-term bicycle storage for at least 2.5% of peak visitors. Provide long-term bicycle storage for at least 5% of all regular building occupants. Ensure bike storage is located within 100 feet walking distance of main entrances. Provide at least one on-site shower with changing facility for the first 100 regular building occupants and one additional shower for every 150 regular building occupants thereafter.

Multi-unit Residential Buildings - Provide short-term bicycle storage for at least 2.5% of peak visitors. Provide long-term bicycle storage for at least 30% of all regular building occupants.

LEED for Neighborhood Development (ND): It is recommended that the LEED ND rating system be used to guide the development of the A&M-Central Texas campus. LEED ND is engineered to help create better, more sustainable, well-connected communities.

Universal Design: Universal design is the design and composition of projects and sites so that they can be accessed, understood and used to the greatest extent possible by all people regardless of their age, size, or ability.

Preferred Parking: To incentivize more sustainable travel, consider the following recommendations. Provide preferred parking (spaces closest to building entrances) for: Carpool or shared-use vehicle parking spaces, EV/ Alternative Fuel vehicles spaces, and/or ADA EV parking spaces.

Walkable Streets: Walkability is a key characteristic of any sustainable community. Walkable streets help to sustain and improve public health by providing safe, appealing, and comfortable street environments that encourage daily physical activity and avoid pedestrian injuries. Consider the following recommendations:

- Facades - At least 50% of the total linear distance of building façades facing the circulation network in the project should be no more than 18' from the property line and within 1' of a sidewalk/walking route. At least 40% of the block length of the network should have a minimum building-height-to-street-centerline ratio of at least 1' to 1.5'.
- Ground-Level Transparency - All ground-level retail and service uses that face a public space should have clear glass on at least 60% of their façades between 3-8' above grade. *Note that the ideal total Window to Wall Ratio in this climate is less than 40%.
- Ground-Level Use - Continuous sidewalks for walking are available along both sides of the entire circulation network within the project, including the project side of the circulation network bordering the project. New sidewalks must be at least 10'wide on retail or mixed-use blocks and at least 5 feet wide on all other blocks. Functional entries to buildings occur at an average of 75' or less along nonresidential or mixed-use buildings or blocks. At-grade crossings with driveways account for no more than 10% of the length of sidewalks within the project.

Architectural Character

Forging a Distinctive Future

Key to creating a sense of identity for the A&M-Central Texas Campus is reflecting, first and foremost, that the campus is “of a place” – located as it is in a unique setting, situated in the Texas hill country, sited in larger habitats both natural and that of the Killeen community and neighboring Fort Hood.

In master planning and designing as a response to those local environs as much as to the aspirations of its charter, the campus identity will be as rooted in the rich heritage of its place as it is in forging its own distinctive future.

This chapter provides guidance in achieving that campus identity through built form, architecture, material, and space to create an experience entirely of its place. The guidelines have been organized to address these primary criteria:

- Building Typologies
- Building Siting & Massing
- Experience - Interface & Amenity
- Architectural Character
- Environmentally Responsive Design

Collaboration Quad Architecture

Tem quat. Agnimus. Obit, ut reptas aut quiae vidi rest renihil et volo omnihic tem intet hilibus enessi sus voluptae militias accupta.

Building Typologies

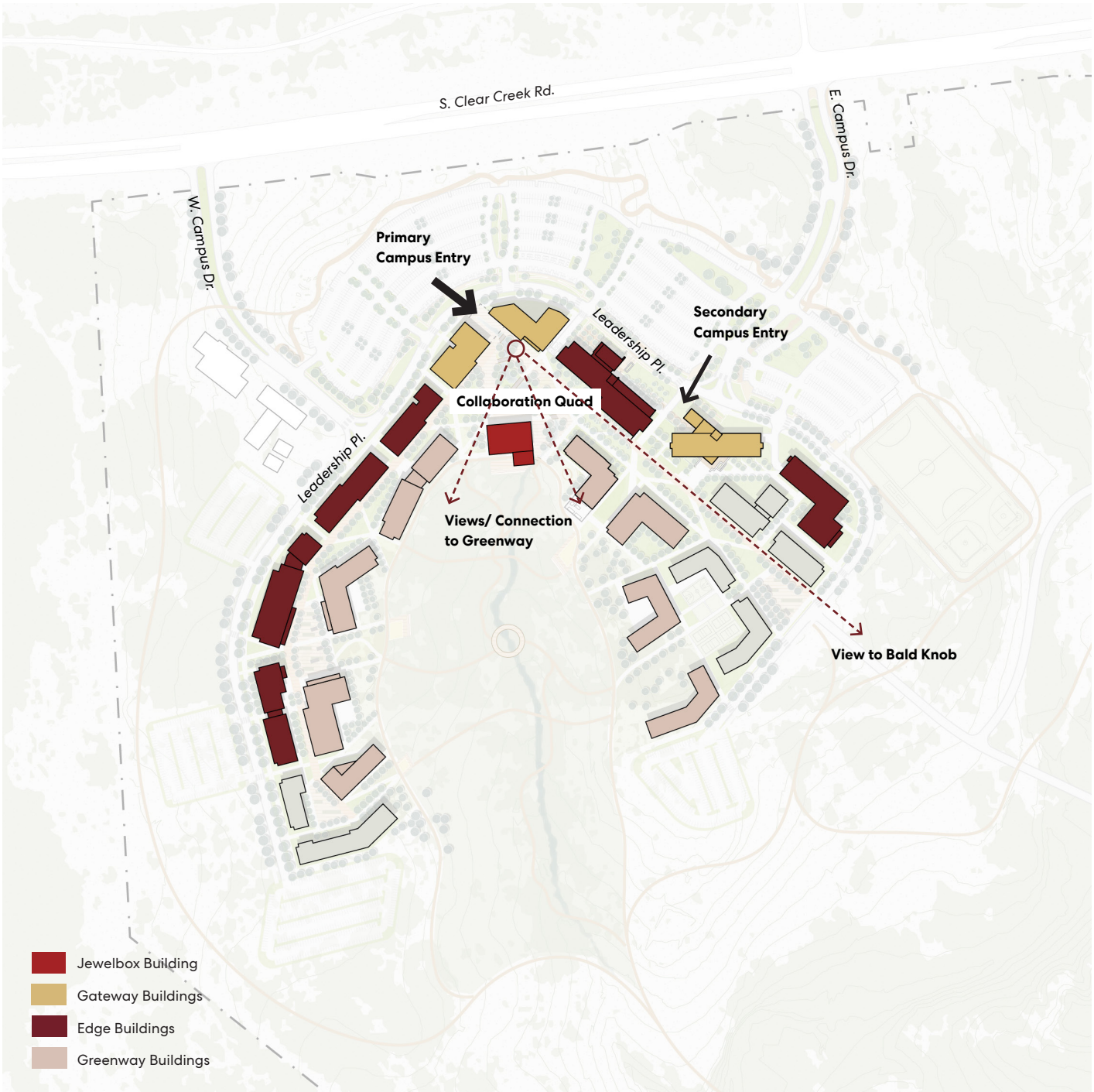
The research park plan proposes a variety of building typologies that respond to the existing site conditions while providing for the programmatic requirements and functional framework of the campus. Of those building types, the 'significant buildings' - those of a more singular architectural character - are strategically situated at prominent locations to take fullest advantage of the unique natural environment of the site. Serving as landmark architecture for the campus, these Significant Buildings will not only signal arrival, provide clarity for access and wayfinding, and reinforce key views and circulation paths, but will ultimately frame a center of activity at the campus core.

The research park plan proposes three such buildings of primary significance; the existing Founders Hall currently serving as "front door" to the campus, and two new buildings - the "Gateway Building" and the "Jewelbox Building" - intended to establish a new front door to the campus by re-orienting the primary arrival sequence around the more public programming of the Collaboration Quad.

- **Gateway Building:** Serving as the front door to the campus, the Gateway Building is composed of two independent structures and is proposed to be joined visually by a single connecting roof spanning over a gracious outdoor entry to create a welcoming gateway, opening immediately to the campus core, framing key views and orienting visitors to primary circulation spine.
- **Jewelbox Building:** Serving as a center of activity at the interior side of the Collaboration Quad, the Jewelbox Building - 'Forge Hall' - pulls visitors into the unique natural setting of the site. Nested at the edge of the existing greenway tree canopy, the Jewelbox Building provides an enhanced sense of place through it's connectedness to the unique natural setting.

In contrast to the significant buildings the remaining campus structures - referred to as 'edge buildings' and 'greenway buildings' - serve to define the general character or "field condition" of the campus. These buildings visually ground the 'significant buildings' in a uniform campus identity, functioning as backdrops to the outdoor quads, plazas and pedestrian corridors that comprise an activated visitor experience.

- **Edge Buildings:** Arranged radially along the existing surface parking lots, the Edge Buildings establish a public face upon approach to the campus. The taller height of the buildings establish a strong edge and public threshold to the campus.
- **Greenway Buildings:** Situated strategically along the green zone, the Greenway Buildings provide a porous interior edge to the campus that opens to greenway views and trail access.

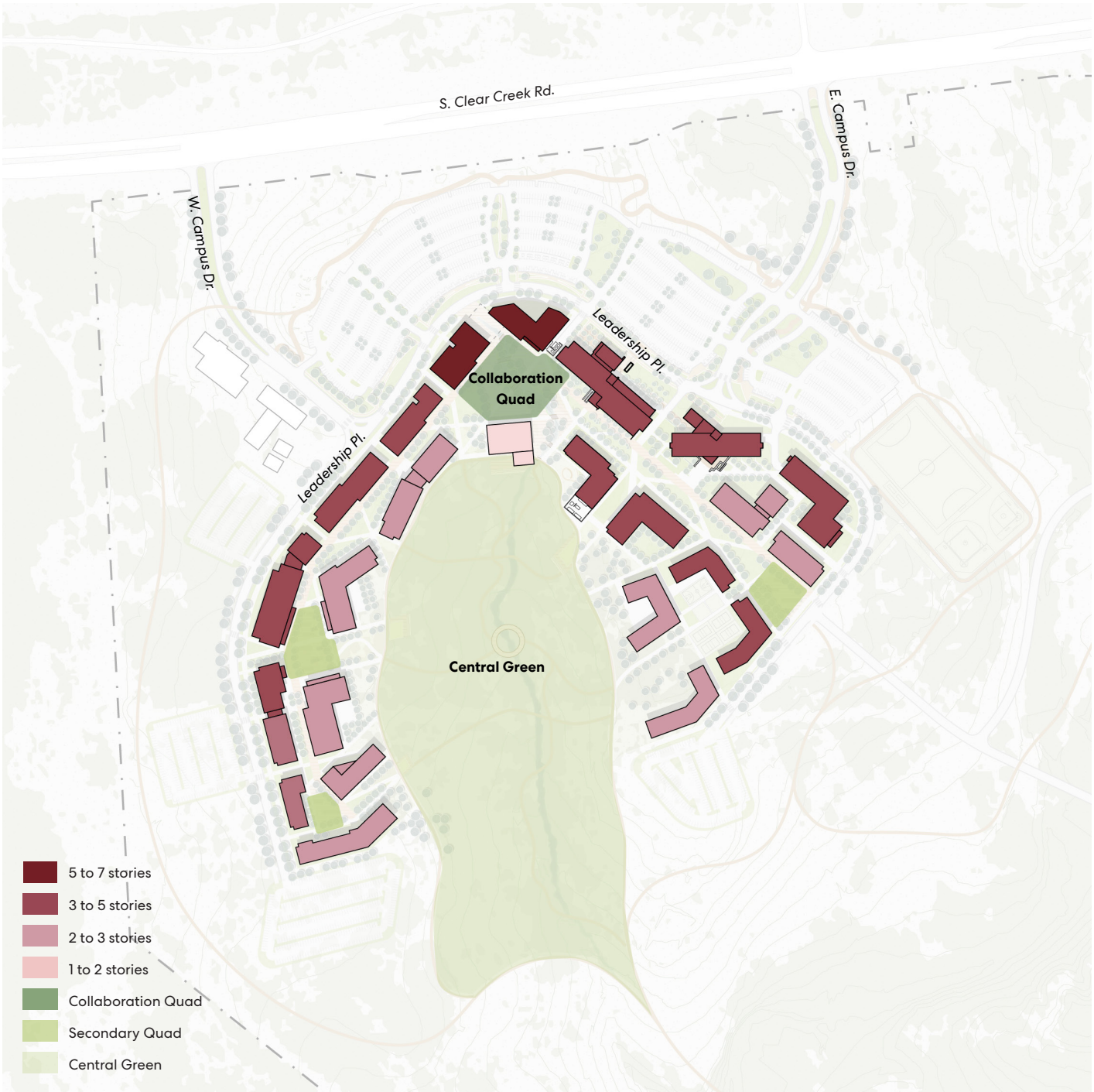


Building Typologies

Four main buildings typologies are proposed that respond to the existing site and proposed programmatic framework. These buildings are designed to support important public realm features, reinforce key views, signal arrival and to serve as iconic elements for the campus.

Building Siting & Massing

- **Siting:** In order to ensure appropriate protection of the on-site endangered bird habitat and stewardship of the existing land resources, native trees, streams and flood plains, buildings should be located outside of these high-value areas. With this siting approach, building construction simultaneously benefits from more optimal development conditions, site topography and soil characteristics.
- **Grading:** In order to preserve the natural site drainage ecologies, existing natural grades should be maintained to the greatest degree possible. To this end, buildings and structures should be located and oriented to interact with the natural topography of the site, minimizing soil excavation and site disturbance during construction.
- **Ground Floor Height:** In order to create this uniform building base condition and visual consistency throughout the campus, ground floors should be 15-ft. floor-to-floor minimum height.
- **Building Length:** In order to ensure an appropriate campus scale, amenable physical circulation and visual access, building lengths have been limited as represented - with minor variance as necessary; creating a porosity and greater flexibility in responding to siting and grading conditions.
- **Building Base:** In order to visually ground buildings in the site - providing a firm foundation in this place - buildings should be designed with a material base condition that is distinctive from the upper register of the building, delineating a clear horizontal break in the material massing. To further enhance this base condition, building massing may integrate stepbacks or full-level glazing as visual "gasket" between the base and upper register materials. To afford design license, the base condition may span one-to-three levels, as is proportional to the total height; and may, as a vertically proportioned massing element (e.g. tower) span full-height, as is compositional to the building as whole or in specific response to singular site conditions.
- **Building Heights:** In order to fit the scale of the site without diminishing the unique natural character of the place, building heights are limited as represented - with minor variance as necessary; creating a dynamic variety of visitor experiences - both public and private, approach side, campus interior, and greenway connectivity. Organized generally as a radial gradient, Edge Buildings are taller at 4-5 stories while Greenway Buildings are lower at 2-3 stories. In contrast, the Gateway Building - being a Significant Building - is higher yet at 5-7 stories, anchoring the overall development while denoting prominence of the primary campus entry point
- **Setbacks:** Buildings are setback at 40' from the main road with the intervening space dedicated to local vegetation, ADA amenities and signage.



Building Heights

Experience - Interface & Amenity

With that established architectural character, the buildings materially reflect their relationship with users and with those visiting the campus. The stone base presents an immediate point of welcome, a tactile quality and scale of human interface that, along with landscape, defines the ground plane experience. Where building access is located, the stone base is carved to emphasize point of entry for intuitive visual wayfinding. In contrast, the sheer and reflective facades of the building's glass and metal upper register are representative of the modern functionality and the innovation occurring at the building interior.

Where multiple buildings are located in relation to one another – around a courtyard, plaza, quad or yard – that materiality creates a visual continuity to frame the space and a consistent identity as one moves throughout the campus.

- **Active ground Floor Use:** In order to create a dynamic experience of outdoor campus environment - the quads, plazas and primary circulation paths, buildings should be planned such that public-serving programs occur at ground level, fronting-on, visually open-to, and activated-by those open spaces.
- **Entrances:** Reinforcing that ground floor activation, primary building entry points should be located along the main pedestrian mall while secondary entries may be located to face ancillary spaces (parking, greenway trails, service areas, side yards, etc). Primary building entries should be designed so as to pronounce their presence. Whether through projecting element, change in material, or change in plane in relation to primary building facade, the primary entry should make wayfinding intuitive and access clear.
- **Ground Glazing:** Further contributing to that activation, ground floors of buildings along the main pedestrian mall should offer increased transparency through glazing; enhancing the visual connectivity from inside-to-outside.
- **Utilities Screening:** All mechanical equipment, utility area, or storage areas outside the building along the public realm should be screened with architectural detailing equivalent to that of the rest of the building.

Active Frontages

Building frontages play a key role in contributing to the campus experience by enhancing public space amenities. The building frontages can be categorized into two types depending on the type of public space they front. 'Primary Active' frontages are those that face main public spaces and house active commercial programs with enhanced ground glazing; while 'Secondary Active' frontages are those facing the main pedestrian mall and include functions like main lobbies and entrances.

Architectural Character

The architectural character of the existing campus buildings serves as a strong foundation on which the campus identity can continue to develop, functioning as a built example for the massing, material and articulation and an established precedent for new development.

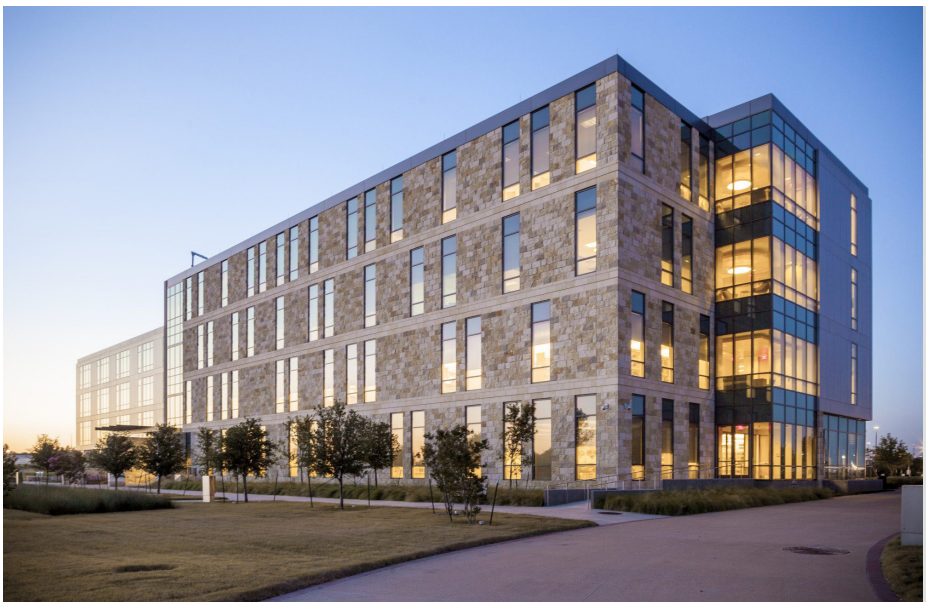
The existing building's use of regional limestone as base condition firmly seats the architecture within the stone terracing of the immediate terrain and rolling topography of the hill country. That stone base serves then both as a material connection to the site as well as a solid support for the visually lighter materials of glass and metal at the upper register of the buildings. This contrast in materials between the base condition and that of the building's upper register – from solid-to-light, from rusticated to sheer, from traditional material to more contemporary – reinforces the role of the campus architecture in projecting the mission of knowledge and research and innovation in the context of a timeless environment.

- **Facade:** Buildings should not be designed to have solid blank walls, or opaque glass on street frontages longer than 40 feet with the majority no more than 10 feet apart. They should be designed with openings that allow visibility into the building interior from the public realm to ensure visual connection. This guideline applies to the entire building facade.
- **Rhythm:** Building façades longer than 50 feet should have a rhythm and sequence of articulations that provide architectural relief and contrast, to prevent monotony. This is achieved with a sequence of projections, recesses or changes in plane from the primary facade.
- **Architectural Elements:** Elements such as louvres, sunscreens, trellises, and canopies are encouraged and may be added to building façades.
- **Local Materials:** Building facade materials and finishes should be durable and high quality. They should take cues from the natural palette of the region to ensure they fit in with the context. The recommended primary building materials are limestone, concrete, steel, treated wood and glass.
- **Roof Design:** Roof spaces are to be designed with the same effort and consideration as the primary facades. Rooftop mechanical elements need to be setback by at least 10 feet from building edges, and screened such that it cannot be seen from street level or neighboring buildings.
- **Glazing:** Glass should be light in color and non-reflective. Clear glass allows for greater transparency between building interiors and outdoor spaces. The upper faces of buildings facing the main pedestrian mall need to have a minimum of 40% glazing.

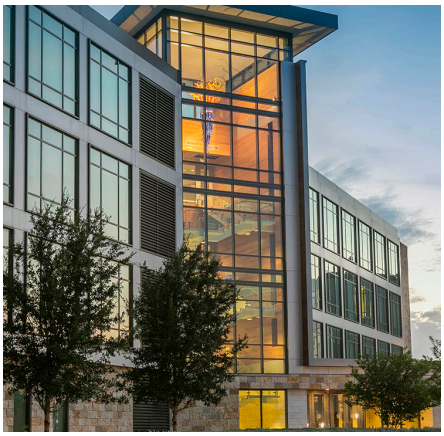
Example of Facade Articulation

Example of Building Opening into the Public Realm

Existing Campus Identity
Founders Hall



Existing Campus Identity
Warrior Hall



Proposed Architecture Quality

The proposed design palette builds upon the architecture quality of the existing buildings and the natural landscape.

Living System Framework : Architecture

	Protect *(Preservation & Enforcement)*	Adapt *(Resilience & Flexibility)*	Replenish *(Regeneration)*	Endure *(Sustainability)*	Integrate *(Cohesion, Diversity, & Fairness)*	Thrive *(Vitality & Well-being)*

PEOPLE	▹ Prevent Noise Pollution
	  ▹ Quiet Equipment
	  ▹ Smart Building Placement
	▹ Responsibly Source Materials*
		▹ Make Health & Safety Priority
		  ▹ Provide Quality Security
		  ▹ Avoid creating "dead zones"
		▹ Allow for Sheltering in Place
		  ▹ Storm Shelters
		  ▹ Lockdown Procedures
		▹ Maintain Food/Water Quality
		▹ Minimize Urban Heat Impact
		▹ Provide Cooling Center(s)
		▹ Winter Weather Adaptation
		▹ Maximize Flexible Spaces
			▹ Building Systems Education
			▹ Innovation Opportunities
			▹ Research Opportunities
				▹ Reduce Material Waste
				  ▹ On-site Recycling
				▹ Reduce Food Waste
				  ▹ On-site Composting
				▹ Natural Pest Control
				▹ Provide Water Storage
				▹ Community Resource Reuse/ Swap Space
					▹ Community Cohesion
					  ▹ Engage in Design Process
					  ▹ Vernacular Architecture
					  ▹ Integrate Local Arts/Crafts
					  ▹ Provide Unique Programs
					  ▹ Joint Use Facilities
					▹ Universal Design*
					  ▹ ADA Compliance
					  ▹ Gender-Neutral RR
					  ▹ Multi-lingual
					  ▹ Neurodiversity
					▹ Celebrate Diversity
					▹ Appealing Building Edges
					▹ Design for Chance Encounters
					▹ Organizational Transparency
					▹ Improve Construction Safety
						▹ Incentivize or Require Healthy Building Certification*
						  ▹ WELL
						  ▹ Fitwel
						▹ Indoor Environmental Quality
						  ▹ Thermal Comfort
						  ▹ Air Quality
						  ▹ Daylight, Views, & Glare
						  ▹ Acoustic Comfort
						▹ Use Healthy Materials*
						▹ Employ Active Design Strategies*
						▹ Provide Amenity Spaces
						  ▹ Support Mental Health
						  ▹ Support Physical Health
						▹ Provide Restorative Spaces
						▹ Provide Access to Healthy Food
						▹ Tobacco Smoke Control

PLANET	▹ Construction Activity Pollution Prevention
	  ▹ Erosion & Sedimentation Control Plan
	▹ Bird Friendly Design*
	▹ Align with Dark Skies Initiative
	  ▹ Install Dark Sky Lighting
	▹ Responsibly Source Materials*
	▹ Respect Conservation Zones
	▹ Protect Site Hydrology
	▹ Protect Site History
	▹ Mitigate Noise Pollution
		▹ Passive Design
		  ▹ Cooling Vegetation
		  ▹ Cool Roofs
		  ▹ Natural Ventilation
		  ▹ Daylighting
		  ▹ Building Orientation
		  ▹ Shading
		▹ Stormwater Management*
		▹ Incorporate District Heating/ Cooling System
		▹ Design for Disassembly*
		▹ Wildfire Preparedness
		  ▹ Fire Safety
		▹ Flooding Preparedness
		▹ Provide Emergency Back-up Power
			▹ Renewable Energy*
			  ▹ On Site
			  ▹ Off Site
			▹ Provide Habitat
			▹ Carbon Sequestration*
			▹ Retrofit Existing Buildings
				▹ Develop & Employ Sustainable Building Standards for all Campus Buildings
				▹ Require Green Building Certification*
				  ▹ LEED
				  ▹ PHIUS
				▹ Sustainable Materials*
				▹ Conserve Resources
				  ▹ Water Use Reduction
				  ▹ Energy Use Reduction
				▹ Reduce Material Waste
				  ▹ Recycle Building Materials
				▹ Embodied Carbon Reduction*
				▹ Operational Carbon Reduction
					▹ Community Education/ Activities
					▹ Biomimicry Design Principles
						▹ Integrate Biophilic Design*
						  ▹ Nature in Space
						  ▹ Natural Analogues
						  ▹ Nature of Space
						▹ Restorative Garden Access

ECONOMY	▹ Protect Systems Efficiency
	  ▹ Water Metering
	  ▹ Energy Metering
	▹ Educational Resources
		▹ Flexible Buildings
		▹ Emergency Response System
		▹ Emergency Preparedness Plan
		  ▹ Extreme Heat
		  ▹ Winter Weather
		  ▹ Extreme Rain (Flooding)
		  ▹ Drought
		  ▹ Fire
		  ▹ Tornado
		  ▹ Hail
			▹ Financial Payback	▹ Financial Efficiency
				▹ Building Operations Savings
				▹ Rentable Spaces
					▹ Prioritize Local Materials
					▹ Support Local Businesses
					▹ Use Local Labor
					▹ Diverse Workforce
					▹ Provide Affordable Housing & Retail Space
					▹ Community Engagement &Outreach
					  ▹ Community Development Plan
						▹ Institutional Reputation
						▹ Student/Employee Retention
						▹ Marketing Opportunities
						▹ Research & Innovation Opportunities

Focused protection and enhancement of:

- Vernacular architecture
- Passive design
- Innovative active systems
- Research, learning, & stewardship outreach
- Diversity and inclusion
- Resilience and adaptation
- Sustainable & healthy materials
- Supporting local

The sustainability approach to Architecture at A&M-Central Texas is focused on mitigating and reducing negative impacts on the environment and building occupants, resiliency and adaptability, as well as enhancing natural and human functioning. The Living System Framework is designed to help this community adapt to evolving conditions, reduce harm, and more readily, effectively, and efficiently recover from potential adverse environmental, social, and economic events in the future.

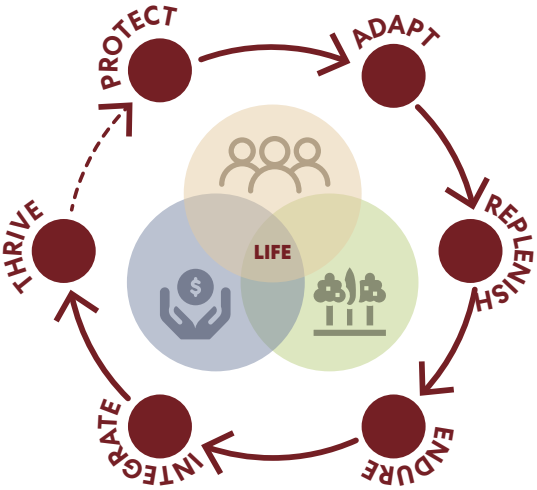
Investing in quality buildings is an investment in future growth and prosperity. All buildings on the A&M-Central Texas campus shall be high-performing, meaning they transcend expectations and bring added benefits through their functioning. They consume less and positively influence the environment(s) around them and those who interact with them. They're responsive yet adaptable and they maintain, if not improve their value, over time.

It is recommended that each building is carefully sited and designed based on the site, climate and resiliency analysis provided. Similarly to the mobility planning, great respect should be given to the identified conservation zones on site. Construction and operation of buildings can disturb the quality and resilience of the local landscape and associated ecosystems. Develop a CMP and Erosion and Sedimentation Control Plan to ensure the protection of the site and its integrity.

Passive strategies should be maximized first; they offer a low-cost way of meeting high-performance goals and have the potential to reduce dependence on energy and water intensive systems. Follow this by evaluating which active systems are most efficient for the campus and operations. Ensure an integrated design approach is taken; that all design and construction team members, and supporting consultants are involved early and often. Sustainability/performance goals or standards must be set early and tracked against to ensure optimization and mitigate any potential premiums. It is recommended that a certification system, such as LEED, is utilized for guidance and accountability.

Set Net-Zero as a target for all new buildings. Net-Zero water can be achieved via the use of high-efficiency indoor plumbing fixtures, water collection and reuse, and highly water efficient landscaping. Net-Zero energy can be achieved via optimized orientation and daylighting, the use of high-efficiency electrical and mechanical systems, optimized thermal performance, and renewable energy, among other things.

To support the occupants and the surrounding community, integrate universal design, active design, and biophilic design strategies throughout. Ensure special attention is given to indoor environmental quality through the use of healthy materials, thermal and acoustic optimization, glare mitigation, air quality optimization, etc. Healthy interiors are linked to improved recruitment, productivity, performance, and retention as well as lowered stress, depression, and sickness.



Responsibly Source Materials: Considering the full picture of where building materials come from and how they get to the site matters. The sourcing, manufacturing, transportation, and installation of materials effect human and the environmental health and well-being. Consider the following:

People - Prefer materials and products from manufacturers that secure human rights in their own operations and in their supply. Select those which comply with any of the following standards/certifications (reference LEED pilot credit Social Equity within the Supply Chain); Ethical Trading Initiative (ETI), Fair Labor Association (FLA), Fair Trade USA Standard, etc.

Planet - Prefer materials and products that respect and restore the health of the environment in their creation through the responsible use of natural resources. This includes non-destructive sourcing of raw materials and safe processes throughout the supply chain. Select those with any of the following standards/ certifications; Concrete Sustainability Council Certification, ResponsibleSteel Certification, Declare Label, Living Product Challenge, Cradle to Cradle, Forest Stewardship Certification (FSC), NSC 337 Stone Certification, etc.

Bird Friendly Design: Certain design measures can be employed to reduce bird injury and mortality from in-flight collisions with buildings. Reference the American Bird Conservancy Bird-Friendly Building Design Guide. Consider the following recommendations:

Glass - Use low reflectance glass (less than 15% is ideal), incorporate patterns (i.e. frits, films, decals, etc.) following the 2x4 rule, and/or use opaque or translucent glass (frosted, acid etched, sandblasted, etc.). There are also special bird-friendly glazing products on the market for consideration.

Netting, Screens, Grilles, Shutters, Shades - These common architectural elements can make glass safer for birds. Screens and netting should be installed at a distance from the glass that will not carry birds into the glass upon impact.

Stormwater Management: To mitigate flooding, pollution, and/or water damage to buildings and infrastructure, and to reduce the demand on wastewater treatment, it's recommended that stormwater runoff is managed sustainably. Consider incorporating water catchment systems which divert and store rainwater, providing a clean, free water source that reduces stormwater runoff as well as demand on potable water supplies. A typical system collects water from a roof piped to a storage tank where it can be used for both potable (drinkable) and non-potable purposes such as landscaping, toilet flushing and clothes washing. The larger the storage tank, the longer water will be available between rain events. Rainwater intended for potable use must be treated using appropriate filtration and disinfection methods. Reference the Texas Water Development Board's Manual on Rainwater Harvesting.

Design for Disassembly: Demolition and renovation activities are significant contributors to global waste. To sustain the lifespan of buildings and materials on site, consider more circular design strategies. Design new buildings with a

plan for future ease of disassembly or with a strategy for how the building may be reused. Early engineer engagement is essential. In particular, the structural engineer should be on board early in the process to help facilitate design for deconstruction. Consider the following strategies:

Separation of systems - from one another helps ensure that the building's MEP, IT, and other services can be removed or upgraded without damage to other systems and materials over time.

Durable high-quality materials - should be selected to help guarantee that materials are worth saving and have market value after deconstruction.

Lease materials or products - this is appropriate when uses are intended to be short-term, or with businesses that benefit from frequent changes in their facilities. This is fairly common for office furnishings and equipment.

Mechanical fasteners & Exposed connections- aid in deconstruction and reuse. Wood and steel structures are good candidates. Consider that materials, such as spray-foam insulation and concrete, adhere permanently.

Simplicity of systems—for example, making all the beams one standard size and avoiding complex composite systems combining more than one material type—can help with disassembly and marketability of materials.

Renewable Energy: Energy independency may allow for a more resilient and sustainable community. Renewable energy generation can reduce carbon emissions and offer local environmental benefits by reducing air pollution and stress on natural resources. It also has financial benefits. Some renewable energy systems capture wind or sunlight; others usefully employ materials that might otherwise be wasted. Ultimately, renewable energy production contributes to reducing the country's demand for imported energy. Renewable energy can be sourced on-site or off-site. Consider the following:

On-Site - Renewable energy produced on-site protects projects from energy price volatility and reliance on the grid while reducing wasted energy lost in transmission. Consider placement on building roofs, at parking as canopies, on building facades, etc. Pay special attention to orientation and proximity to surrounding objects.

Off-Site - Consider purchasing or leasing land outside of the main project area to install renewable energy systems. Alternatively, there may already be existing or planned renewable energy systems surrounding the project that are worth considering tying into. As a last resort, consider purchasing Renewable Energy Credits (RECs), which are supplied through a third-party system. Ensure they are Green-e certified if this is a preferred route.

Carbon Reduction & Sequestration: The global building inventory currently generates nearly 40% of annual global greenhouse gas (GHG) /Carbon (CO2) emissions. Sources of these emissions in the built environment include operational carbon (the carbon associated with the operations of a

building), refrigerants, embodied carbon (the carbon associated with the materials of a building), and site carbon. Embodied Carbon can be avoided through circular design, re-use/retrofit, material optimization, and renewable energy. Carbon can be sequestered and stored through certain materials such as wood, concrete via injection methods, planting on site, and long-term offsets. Reduce the use of high impact materials (concrete, steel, insulation, carpet, and gypsum board) as much as possible. Consider the following recommendations...

Concrete - Use less cement (replace with SCMs), use portland limestone cement (PLC), use local aggregates, consider longer strength days, and/or optimize structure (lighten weight of slabs, use reinforcement only where needed, etc.).

Steel - Using steel from electric arc furnaces is the best way to reduce embodied emissions in steel, because EAFs use high levels of recycled material and can be powered by renewable energy sources. Other strategies include using recycled steel, using braced frames vs. moment-resisting frames, and using joists or trussed members instead of rolled shapes.

Insulation - Using natural materials and blown-in applications are the best ways to reduce impact. Minimise the use of EPS, XPS, Polyiso, SIPS with foam insulation, and spray foam as much as possible. These are petroleum-based products that require significant energy to manufacture.

Gypsum Board - Specifying lightweight gypsum board products and eliminating waste material are the most impactful ways to reduce the carbon footprint of gypsum board.

Green/Healthy Building Certifications:
Consider requiring a certain level of performance prescribed by one of a combination of the following certification programs:

LEED - the world's leading green building project and performance management system. Use LEED for Building Design & Construction (BD+C) and/or LEED for Interior Design & Construction (ID+C) for buildings. It is recommended that if it is decided that several buildings within the campus are to pursue certification that the Campus Program be considered.

PHIUS - a climate-specific passive building standard. Passive building is a set of design principles for attaining a rigorous level of energy efficiency while also creating comfortable indoor spaces. These principles of thermal control, air control, radiation control, and moisture control can be applied to all building types.

WELL - a performance-based system for measuring, certifying, and monitoring features of the built environment that impact human health and well-being, through air, water, nourishment, light, fitness, comfort and mind.

Fitwel - a certification system that helps to optimize health and wellness among building occupants. The strategies included are proven to lower stress levels, reduce injury and absenteeism, and mitigate the risk of contagious disease transmission and chronic illness - ultimately improving occupant productivity.

Healthy & Sustainable Materials: Prefer materials and products that support and foster life throughout their life cycles and seek to eliminate the use of hazardous substances, that secure human rights in their own operations and in their supply chains, and that provide positive impacts for their workers and the communities in which they operate, that support and regenerate the natural air, water, and biological cycles of life, that reduce carbon emissions and ultimately sequester more carbon than emitted, and that are part of or have the potential to be part of a circular economy. Consider the following recommendations:

Human Health - Integrate VOC limits and emission thresholds, prefer products with transparency documentation (i.e. HPDs, Declare Label, BIFMA Level) and that are free of substances of concern (per Red List, Precautionary List, etc).

Social Health & Equity - Ask manufacturers for supplier codes of conduct. Reference previous page for standards.

Ecosystem Health - Prefer materials with Environmental Product Declarations (EPDs), biobased materials, and products with certifications that require environmental stewardship (Living Product Challenge, Cradle to Cradle, FSC, etc.)

Climate Health - Use low-carbon and carbon sequestering materials and prefer products with transparency documentation (i.e. EPDs).

Circular Economy - Use salvaged or reused materials and furnishings. Prefer products with take-back programs or long-term/life-time warranties.

Universal Design: UD is a concept that a building or space may be developed and designed in such a way that it is accessible to a wide range of people. UD principles include but are not limited to; equitable use, flexibility of use, simple and intuitive use, size and space for approach, perceptible information, tolerance for error, and low physical error. Consider the following recommendations:

Thresholds & Doors - Ensure door openings are a minimum of 32 inches wide. Use lever handles vs. twisting knobs.Implement anti-slip stair nosing at stairwells.

Wayfinding - Use large, high-contrast text for signage. Use change of color and texture for thresholds.

Easy & Safe Use - Implement easy-touch or hands-free switches for operating doors, lighting, and equipment. Install motion-detector lighting at entrances, hallways, stairwells and closets. Incorporate single-hand operation fire alarm pull stations. Reinforce bathroom walls for grab bars. Incorporate backlit doorbells and keyholes at entry doors and keyless or remote entry systems and security systems with visual and audible alarms. Install adjustable shelves, wall cabinets, etc. Provide glare-task lighting. Provide knee space under lavatories and a minimum of 9 inch clearance toe kicks.

Corridors & Ramps - Design ramps to slope between 5-8%. Use slip-resistant *surfaces. Use low-pile, hard-surface flooring that* provides easy passage for wheelchairs or walkers. Incorporate color and texture contrast between surfaces and trim.

Adjustable Spaces - Spaces can be

adjustable to serve everyone's needs. Include ways for occupants to control their environment's noise and light levels. Provide adjustable furniture and lighting.

Active Design: Active design principles are meant to encourage and support more movement through and around buildings. Consider the following recommendations:

Stairs - Encourage use by focusing building circulation on stairs vs. elevators. Make stairs visible, easy to access, appealing and/or interactive.

Elevators - Design elevators to be less prominent and install signage at elevators to encourage stair use.

Building Programming - Locate building functions to encourage walking to commonly used amenities (restrooms, break lounges, coffee stations, etc.). Consider locating lobby functions on the second floor to encourage use of grand stair or ramp.

Walking Routes - Give people a reason to walk around the buildings regularly. Provide visually appealing environments, daylighting, supportive infrastructure (i.e. benches), distance markers, etc. along paths of travel.

Building Facilities for Exercise - Include physical activity spaces in buildings (i.e. gym, studio, etc.). Provide views to outdoors from physical activity spaces. Provide bicycle storage, showers, and lockers to support these spaces. Provide easily accessible drinking fountains throughout.

Furniture - Provide active furniture (sit-stand workstations, treadmill desks, perch benches, etc.).

Biophilic Design: Biophilia is the humankind's innate biological connection to nature. Biophilic design can reduce stress, enhance creativity and clarity of thought, improve well-being and expedite healing. Reference Terrapin Bright Green 14 Patterns of Biophilic Design. Consider the following:

Nature in the Space - the direct, physical and ephemeral presence of nature in a space. Common examples include potted plants, flowerbeds, bird feeders, butterfly gardens, water features, courtyard gardens and green walls or vegetated roofs.

Natural Analogues - organic, non-living and indirect evocations of nature. Objects, materials, colors, shapes, sequences and patterns found in nature, manifest as artwork, ornamentation, furniture, décor, and textiles in the built environment. Mimicry of shells and leaves, furniture with organic shapes, and natural materials that have been processed or extensively altered (e.g., wood planks, granite tabletops), each provide an indirect connection with nature while they are real, they are only analogous of the items in their 'natural' state.

Nature of the Space - spatial configurations in nature. This includes our innate and

learned desire to be able to see beyond our immediate surroundings, our fascination with the slightly dangerous or unknown; obscured views and revelatory moments; and sometimes even phobia-inducing properties when they include a trusted element of safety.

Branding & Graphics

In finding a name for A&M-Central Texas's Research Campus we looked through the lens of Innovation, Process, Research, Opportunity, Forward Momentum, Invention, Ingenuity, Person-Powered/Self-Initiated, and Hands-On. We landed on the name Forge @A&M-Central Texas.

The definition of Forge is to make or shape by heating it in a fire or furnace and beating or hammering it. In addition it means creating a relationship or creating new conditions. The definition speaks directly to the key project differentiators;

- Research, Development, and Testing (MAKE/SHAPE)
- Talent Pipeline (NEW CONDITIONS)
- Proximity to Army Futures (CREATING NEW RELATIONSHIP)
- Applied Research/Innovation through Application (NEW CONDITIONS)

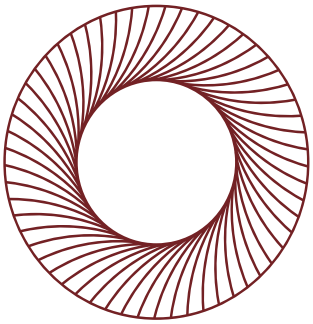
The name also directly relates and extends the Army Futures brand.

The name lends itself to a naming matrix that could serve the campus with a binding and memorable brand while delineating specific places and spaces within. Possible extensions include; The Forge, Forge Factory, Forge Innovation Factory, Forge Research Park (FRP), Forge Innovation District, Forge Innovation Forum, etc.

Identity Application

Minimal graphic elements allow the Forge brand story to take center stage and be recognizable in several orientations and configurations.

Logo Mark



FORGE

Rigid Square Medium

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890

Rigid Square Bold

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890

Primary Colors

FORGE Red
C33 M92 Y80 K42
R115 G33 B36

Black
C0 M0 Y0 K100
R0 G0 B0

FORGE Blush
C14 M22 Y25 K0
R217 G194 B182

Identity Application

The mark can provide patterning and graphic range.

4. Implementation

In order to make the vision of Forge a reality, certain steps needs to be taken for creating mechanisms of implementation. This includes a system of governance for Forge, initial steps to take, and planning the changes in future as the development of Forge moves on. This chapter reviews recommendations for these aspects of implementation based on studies reviewed earlier in the planning process.

The First Two Buildings:

The first two buildings to be developed on site betin to frame the Collaboration Quad, the heart of Forge @A&M-Central Texas, as well as creating a new gateway to this community space. The Forge Hall is designed to be a community asset, accessible by all that represnts the blended community. The first of the Gateway buildings will house a hybrid of academic and industry related uses to support the Forge community.


Large Auditorium
Lecture Set-up
6,000 SF
Functional Operations
710 SF
Office, Vice President
Research 1,120 SF
Aviation Program
(Flight Simulation) 800 SF
Industry
Support Flex
& Dry Labs
15,000 SF
Mechanical
Engineering
Labs
11,340 SF
Center for
Entrepreneurship
2,750 SF
Biology Labs +
Prep
11,340 SF
Dining Hall
20,000 SF
Gateway Building

First Movers Recommendations

Utilizing the findings from stakeholder engagement, the Killeen market analysis, and the programmatic drivers' analysis, HR&A has crafted "first mover" recommendations that identify development opportunities for the Forge @A&M-Central Texas. These first mover recommendations are designed to catalyze momentum at the Forge and create an ecosystem that is attractive to prospective industry and government partners. We explored a variety of development typologies to meet the immediate needs of key users, such as creative office, co-working facilities, dry labs and flex space, small-scale and convenience retail, and multifamily residential. The first mover recommendations below can support the types of interactions, funding opportunities and other entrepreneurship mechanisms that drive innovation and associated job creation.

In recent years, Killeen has attracted industry partners that have a need to connect with both A&M-Central Texas research and resources, as well as engage directly with Fort Hood and the Department of Defense to drive innovation in products being developed for military use that also have civilian applications. In developing programming for the Forge, the consultant team, led by Perkins&Will with support from HR&A, engaged in more than 30 stakeholder interviews to identify growth opportunities, evaluate existing assets and partnerships, and examine challenges to deepening and expanding partnerships between A&M-Central Texas, Fort Hood, industry partners, and the Greater Killeen community. HR&A also conducted a comprehensive market analysis of Greater Killeen to understand market trends and highlight opportunities to expand upon existing market dynamics to drive development at the Forge. What follows is a series of first mover recommendations that pulls together the input from key stakeholders in the region synthesized with the market analysis and goals and aspirations of A&M-Central Texas, to identify

"first moves" for the Forge, a series of strategic catalytic investment to spark interest among industry partners and talent, and ignite the region's nascent innovation ecosystem.

The Opportunity:

Overall, demographic data reflects what we heard in the stakeholder interviews – Greater Killeen has been growing at a pace that exceeds both state and regional trends, likely induced by an improved quality of life, a comparatively low cost of living, and the proximity to the growing Austin metropolitan area. In the past 10 years, Killeen has seen its population grow by almost 20%, yet the multifamily housing inventory has only grown by 8%. This demographic growth has put upward pressure on Killeen's housing market, with single-family home prices up more than 20% year-over-year and multifamily vacancy rates dropping below 5%, a 20-year low. In addition, A&M University – Central Texas continues its path toward growth and has a need for housing for its students, providing additional multifamily demand on the market. This upward housing pressure creates an opportunity for A&M University – Central Texas to develop additional multifamily at the Forge.

The population of Killeen also skews younger than that of the region and state, a reflection of the military families and soldiers that call Killeen home. This younger demographic provides a strong pool of potential talent, an extraordinary asset that can be leveraged to attract industry partners to the region and an opportunity for A&M University – Central Texas to offer programming to educate, develop and prepare this talent for the future jobs these industries will provide. Greater Killeen's labor shed extends to Austin and Waco, and as reflected in the housing market, Killeen and A&M University – Central Texas may continue to attract workers from each of those metros as a result of the rise in remote work opportunities and as industry partnerships and investment grow in the region.

Currently, approximately 44% of Killeen's workforce is engaged in defense or defense-adjacent industries, with continued growth in military and government contracting and aligned services/industries (i.e., healthcare, social services, supporting retail and personal services, etc.) projected. Location quotient analysis reveals that Killeen has a higher concentration of federal jobs (3.6x the national average), with a particularly strong concentration of military jobs (27.8x the national average), which further underscores the importance of military and defense-adjacent industries in the regional economy. However, while Killeen has a strong concentration of military jobs, it has much lower concentration of the technological and scientific jobs that support research and development broadly, and the defense sector, specifically.

Stakeholder interviews supported the desire to increase Greater Killeen's capacity to support defense-related R&D. Operational Test Command (OTC) cited increasing interest in

and development of public/private partnerships to advance military/defense related R&D, prototyping, testing and evaluation. In addition to cybersecurity and IT sectors, where A&M University – Central Texas has already developed successful partnerships with the Trideum Corporation and Centex Technologies, stakeholder engagement revealed a potential for A&M University – Central Texas to continue to expand its drone and solar energy technologies and research. A&M University – Central Texas' recent partnership with Trideum provides a blueprint for future industry partners, actively engaged in product development for civilian and military applications, who value being proximate to students, faculty, and Fort Hood.

First Mover Recommendations:

Office/Research Recommendation:

Development of 40,000 – 60,000 SF (2-3 story) hybrid facility including a mix of creative office and research/lab space that is privately developed and anchored by A&M University – Central Texas.

- Currently base rental rates in Killeen, at a blended average of $18 per square foot, do not support the development of new speculative creative office space; however, the lack of available creative and Class A space has also been cited by stakeholders as an obstacle to attracting private industry investment in the region.
- Not only is there a lack of newer creative office product, office vacancy rates in Killeen trend low, hovering between 3.3% and 6.5% over the last five years. Though Killeen's existing office market is small, the recent rise in rents and relatively low vacancy suggest an unmet demand for office space in Killeen.

- A privately developed building anchored by the university is an example of the type of catalytic investment with limited upfront capital requirement that has worked in other innovation districts to attract industry partners and follow-on investment. This approach would be in keeping with other university driven projects across the United States, such as North Carolina State University, Clemson, Georgia Tech, etc., where the university uses programs to drive a development scenario and stimulate a new market.

    – In this scenario, the university bears limited initial capital risk; rather, the university distributes its risk over the period of its lease in a new building, and that risk is coupled with an opportunity for additional privately-developed space as a proof-of-concept that the demand for this product type exists within the market. If the space is successful in leasing quickly, this initial investment will drive developer interest in creating similar product types to meet and grow tenant interest and demand.

    – New creative office space generated under this recommendation is estimated to generate asking rents in the mid-$20s per square foot, which is likely closer to the market-rate needed to drive private development of similar creative office product.

    – Though not the development of office space, Greenville's redevelopment of Falls Park on the Reedy is an example of how public-led infrastructure investment can ignite private investment. The City invested $13 million in public infrastructure and greenspace to create Falls Park, which then attracted over $100 million in additional private investment within two years. Similarly, A&M University – Central Texas has already invested in buildings, infrastructure, and parking to make the Forge a desirable place for growth.

- The proposed hybrid facility should include a mix of flex, dry lab, and office space spaces intended to capture untapped market opportunities. This hybrid facility absorbs and expands upon the requirements for the previously proposed Research and Testing Annex. For example, the first floor of the hybrid facility may include 20' ceiling heights to accommodate flex space for machinery and equipment related to prototyping, testing, and evaluation.

    – Flex and dry-lab space could also accommodate select academic programs and/or resources, including, but not limited to, those identified in the prior Research and Testing Annex POR: scanning electron microscopy, materials characterization equipment, renewable energy systems, Internet of Things (IoT)

equipment security, cyber security equipment, and immersive virtual reality (VR) technologies.

- Some shared conference/meeting space with the university may be desirable, though the building should function primarily as an office space versus the current arrangements with Trideum and Centex where each firm is creating office space in an otherwise classroom/academic building.
- Flexible space could include options for small offices, coworking spaces, and shared meeting and conferencing spaces that operate on short-term leases and are subsidized by public funding.
- Similar arrangements have been utilized to provide entrepreneurial support and resources to foster innovation and grow local businesses. The Frontier facility in Research Triangle Park is a great example. The Frontier offers:

  – A range of programming, including educational opportunities and networking events

  – Free meeting and conferencing spaces for members of the Frontier Community

  – Private offices, coworking, classrooms, and wet lab space for lease

Residential Recommendations:

Development of 100-150 units of mixed housing.

- In the last five-years, the Killeen market has absorbed 1,300 units of multifamily housing (roughly 10% of the existing multi-family stock), an indication of increased housing demand in the market that is reflected in the region's sub-five percent vacancy rate.
- Currently, average rental rates are well below military housing stipends, though the stipends are often cited by stakeholders as a key factor suppressing rental rates.

- Evidence from recently constructed market-rate multifamily complexes suggests that the market can support rates from $1,000 to $1,400 for newly constructed 1-, 2-, and 3-bedroom units.

  – While there is evidence of support in the market for the development of market-rate housing, A&M University – Central Texas may consider a mix of market and student housing the first phase of development to support both enrollment goals and industry partner attraction.

  – A meaningful level of residential development in a first phase will be important for creating a sense of place at the Forge. Residents on campus will create energy beyond the typical "9-to-5" workday. Subsequent development on-site should lead with additional residential units to bolster this placemaking goal.

Retail Recommendations:

Development should include ground-floor, small-scale and convenience retail amenities within the office and student housing developments to service office users, residents, visitors, students, and the local community.

• The Killeen market is currently serviced by a major mall and strip centers which offer a wide variety of retail options, though none are located within walking distance of A&M University – Central Texas' campus.

• The retail market analysis for Killeen identified a number of potential user groups for the research park and suggested the types of retail these users would support.

• As a first move, the research park should focus on small-scale and convenience options located on the ground-floor of the office and student housing developments proposed to meet the immediate needs of these users and provide spaces for collaboration.

• Immediate recommendations include fact-casual restaurants, an independent coffee shop, and small-format convenience store to allow affordable and convenient dining options, informal spaces for collaboration, and access to convenience items.

Phasing

The first stage of creating Forge at A&M-Central Texas is to shape the heart of the campus. This mainly includes creating the facilities that encompass the collaboration quad including Forge Hall and the Gateway building. Additional academic spaces and some housing buildings get developed within this phase as well all supported by existing infrastructure and parking lots on site.

As the heart of the campus gets developed and the academic institution grows opportunities for creating additional facilities to grow out the first phase become available with a mix of facilities supporting academic, residential, and industry related activities. At this stage, the existing recreational sites are relocated to create the long-term recreational facilities. Also, this stage will require an expansion of the existing road with an additional parking lot to serve the housing cluster in the east wing.

In the long-term, as the research park gets well established, the demand for new facilities would support the development of the west wing of the concept plan with a new set of clusters of various uses and a secondary quad to serve as a supporting large community gathering space to the collaboration quad. This new phase will require all new parking lots and infrastructure to be developed in coordination with the existing resources.

Phasing Plan

The three phases of building out the Forge at Texas A&M University-Central Texas

Existing
Academic/Research: ~300k

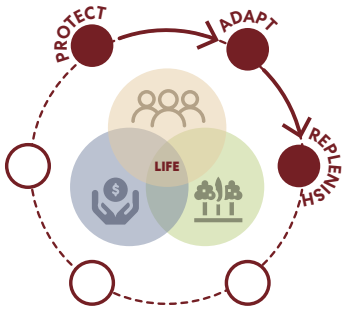
Phase 1
Academic/Research/Industry: ~310k
Residential: ~110k (~150 units)

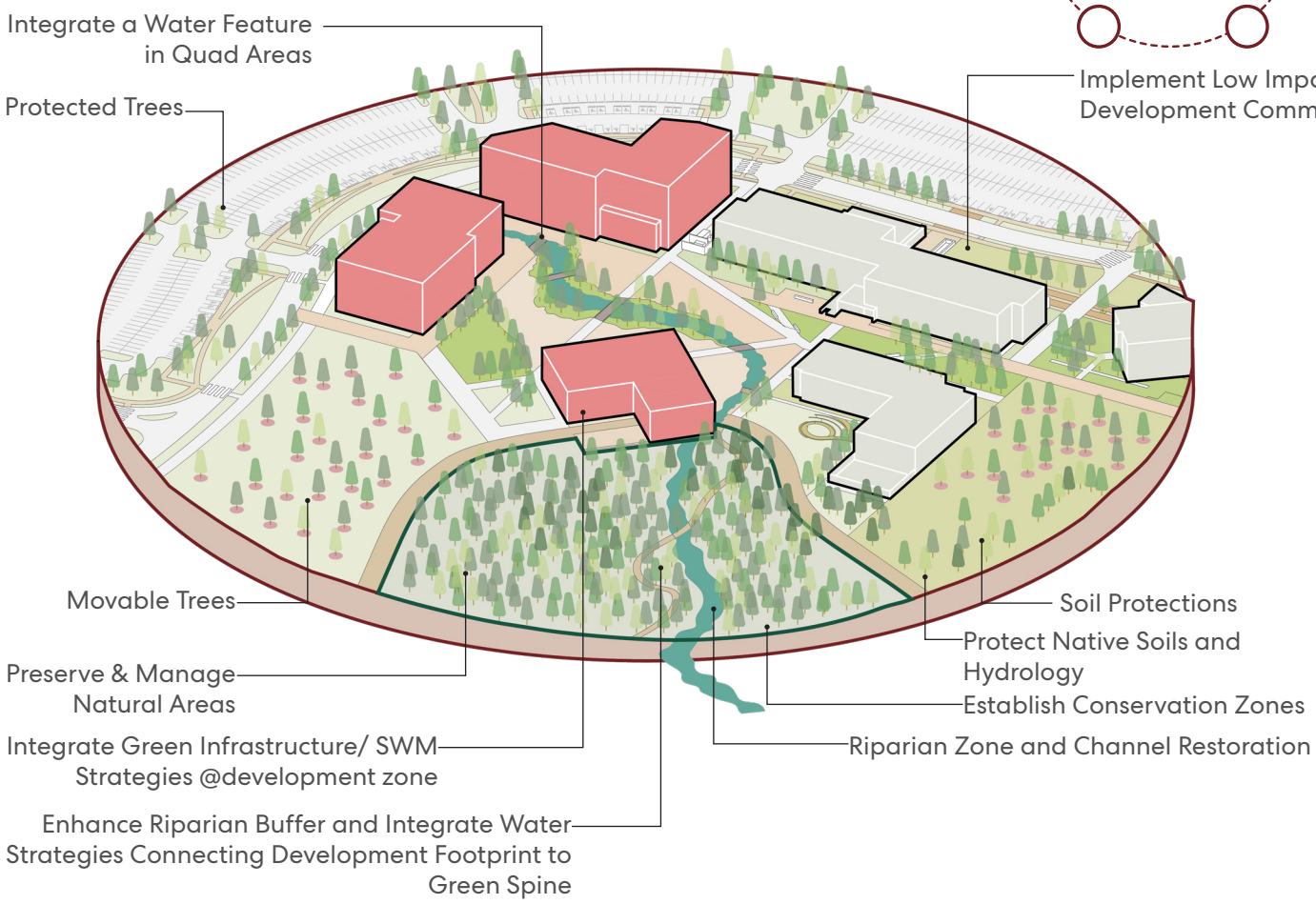
Phase 2
Academic/Research/Industry: ~325k
Residential: ~120k (~160 units)

Phase 3
Academic/Research/Industry: ~465k
Residential: ~170k (~225 units)

Totals
Academic/Research/Industry: ~1.4 M
Residential: ~400k (~535 units)
Total: ~1.8 M

Initial Construction and Site Preservation (0-1 year)

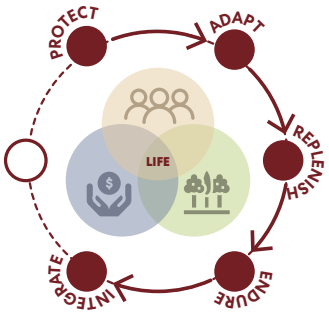


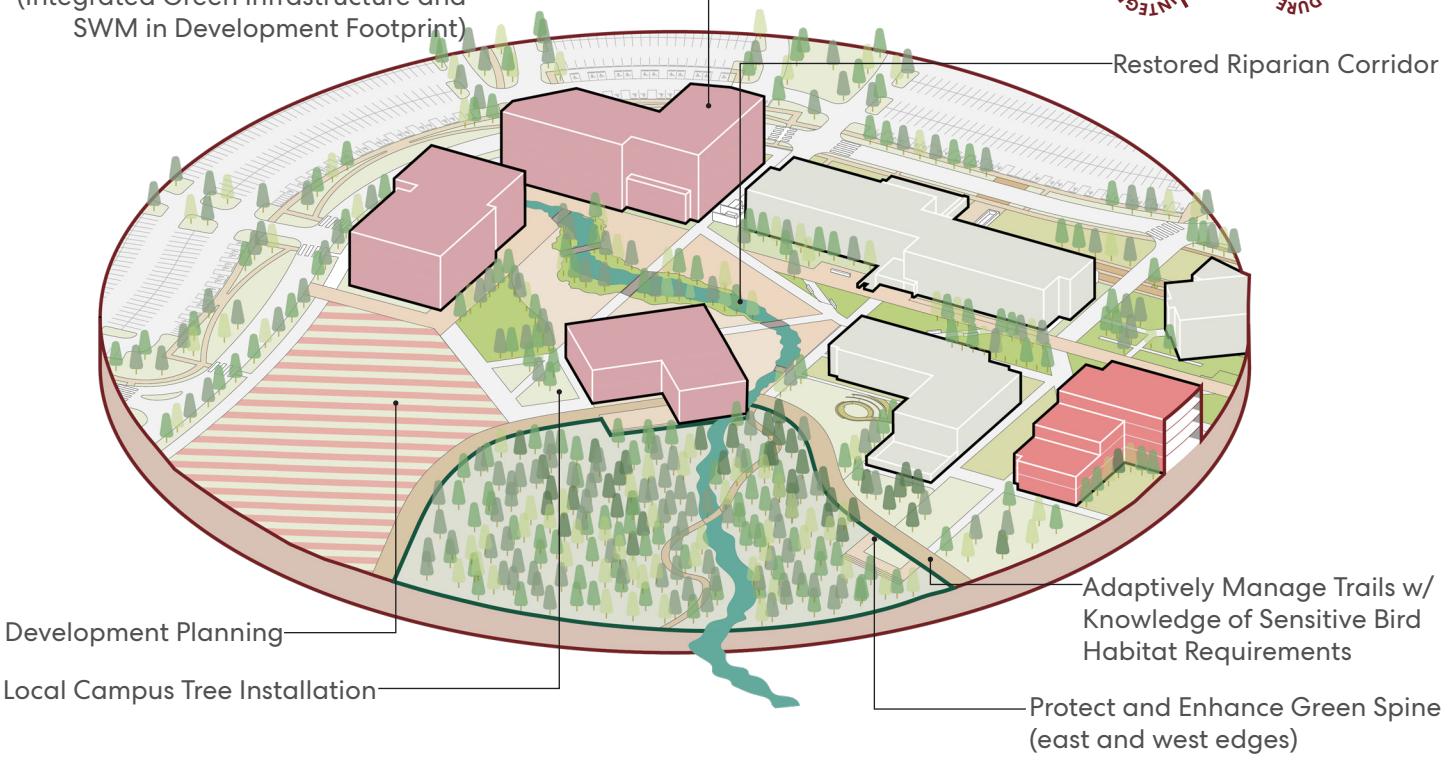


INITIAL CONSTRUCTION & SITE PRESERVATION — 0 - 1 YR COMPLETE

- PRIMARY INFRASTRUCTURE — SUSTAINABLE SYSTEMS INTEGRATION
- SUSTAINABLE SOIL USE IMPLEMENTATION — SOIL REUSE + REGENERATION
- RIPARIAN ZONE DESIGNATION — RIPARIAN ZONE RESTORATION
- BIOLOGICAL ASSESSMENTS + PROTECTION — NATURAL AREAS RESTORATION
- PLANT SALVAGED TREES

Early Establishment (1-5 years)





EARLY ESTABLISHMENT — 2 - 5 YRS COMPLETE

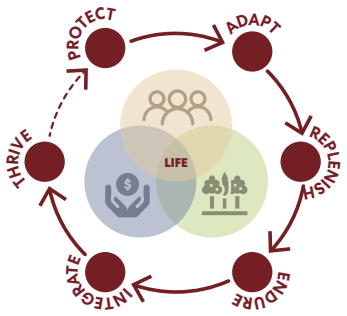
SUSTAINABLE WASTE STREAMS — REPLENISH & AMEND SOILS

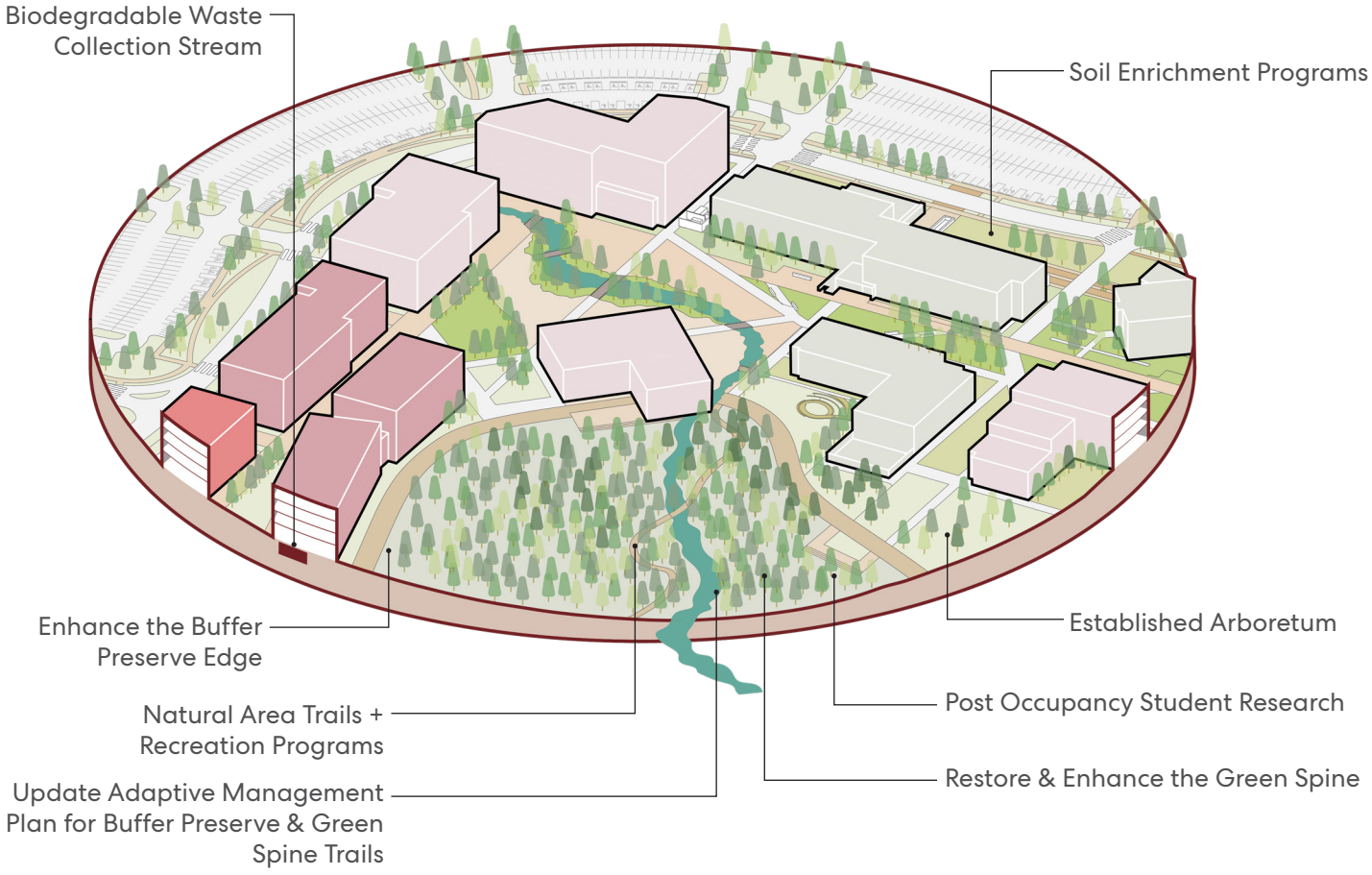
RIPARIAN ZONE STUDENT RESEARCH

NATURAL AREAS RECREATION PROGRAMS — SUSTAINABLE CONNECTIVITY

MAINTAIN & ENHANCE CANOPY

Long-Term Objectives (5+ years)

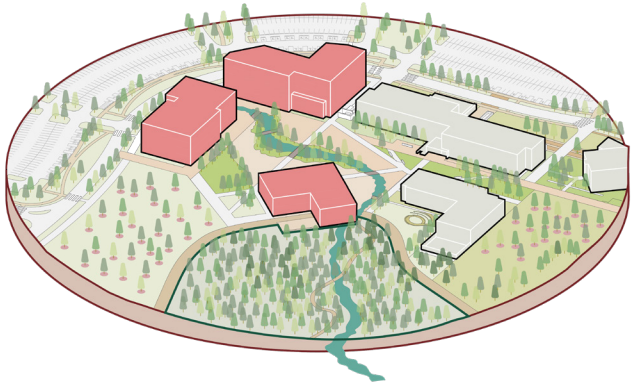




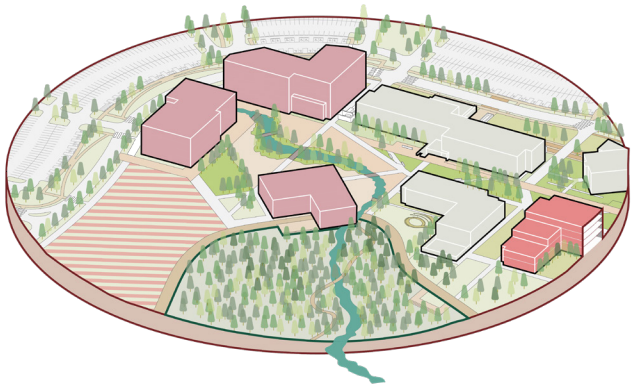
LONG-TERM SUSTAINABILITY

5+ YEARS...

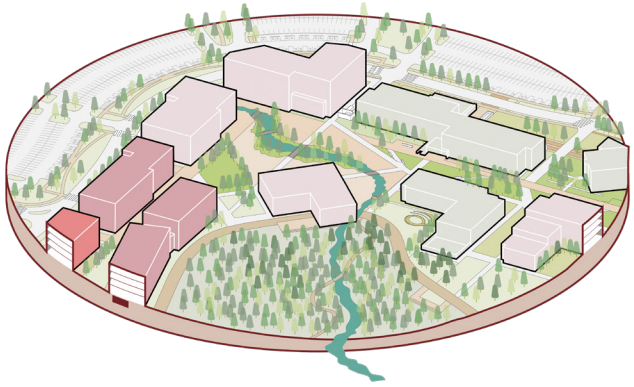
- ENHANCE RIPARIAN ZONE — POST OCCUPANCY EVALUATIONS
- NATURAL AREAS TRAILS SYSTEM — SITE STEWARDSHIP
- MAINTAIN & ENHANCE BIODIVERSITY — IMPROVE SURROUNDING SITES



Initial Construction and Site Preservation (0-1 year)



Early Establishment (2-5 years)



Long-Term Sustainability (5+ years)

It will take time to establish a thriving ecosystem that is regenerative over time. The ultimate goal for the Texas A&M-Central Campus is to be self-sustaining; to maintain capacity over time as social, environmental, and economic dynamics change and evolve.

1. First and foremost: protect, enhance, and steward the sensitive existing natural resources on site, including sensitive species habitat, riparian corridors, other unique geological or ecological site features; avoid impacts by keeping the development footprint tight and oriented toward previously developed northern edge of site.

2. Planned future development should adhere to the site-wide ecological framework and green infrastructure network: a green spine is protected and enhanced with native plantings; within the focused development footprint green infrastructure treats water in the development zone before it enters the green spine or the native habitat buffer zones of the campus property. Ensure buildings are sustainable and resilient following the Living Systems Framework. Incorporate sustainable systems that will allow the community to be independent from outside resources (energy, water, materials, etc.).

3. Strengthen regional landscape connectivity using sustainable materials.

4. For all future new development, integrate native landscape plantings and integrated green infrastructure (bio-retention, rain gardens or wetlands as appropriate) to manage stormwater closest to where it calls (i.e. Low Impact Development strategies).

5. Employ sustainable and regenerative management and maintenance practices across the campus landscape to support long-term health and function (avoiding fertilizers and pesticides).

6. Integrate learning and research opportunities connected with curriculum focused on ecosystem services, ecosystem management, sustainable building systems, climate change and resilience in arid landscapes, etc.

Governance

This section introduces a governance structure for both the start-up phase of the innovation community and its stabilized operation. This recognizes that there are a variety of potential governance and management models available, which reflect different priorities around oversight expectations, risk tolerance, private participation, market orientation, and development structures.

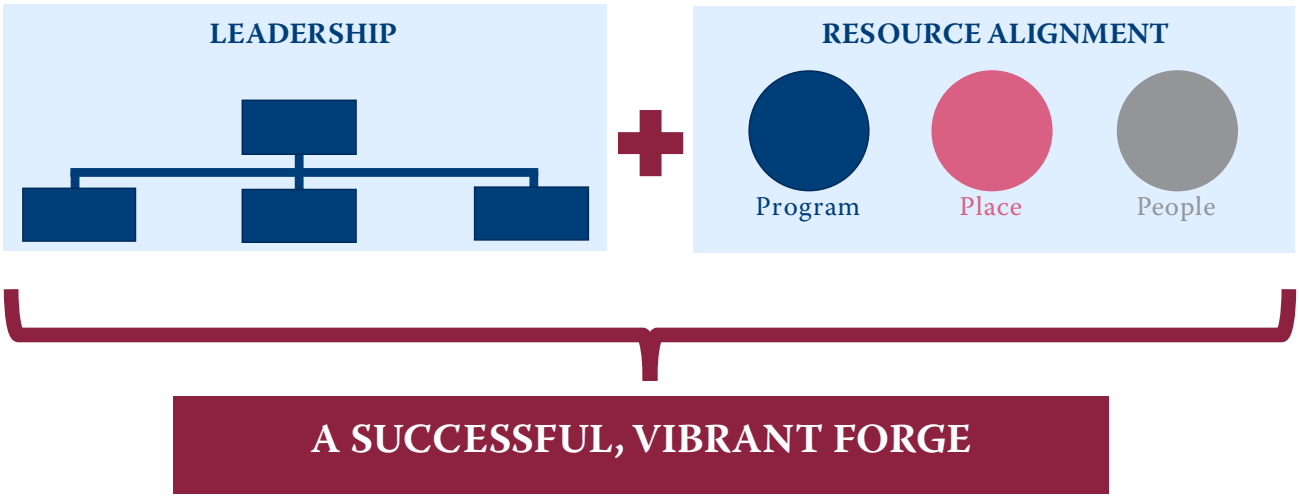
Also, provided is a recommended staffing plan for the project management and governance, based on an understanding of opportunities and challenges identified via stakeholder engagement, as well as studies of best practices from other institutionally anchored communities of innovation.

GOVERNANCE

Governance provides **clarity of leadership**, **decision-making**, and **resource alignment**.

Texas A&M-Central Texas leadership should establish a governance model for the Forge that reflects its goals and capacities.

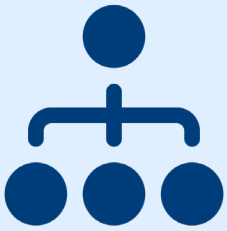
A leadership framework and alignment of resources are the first two steps in governance at the Forge.



Governance will give the Forge clear decision-making pathways.

KEY ROLES OF A SUCCESSFUL GOVERNANCE STRUCTURE

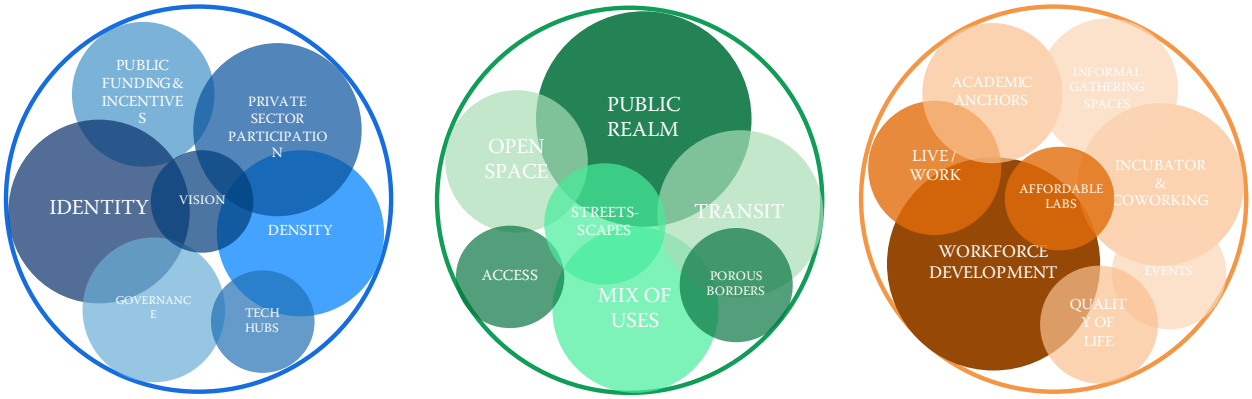
Responsible for being the **keeper of the vision** and ensuring that it is achieved. Public and private entities require **clear accountability**



Provides a **clear hierarchy** to settle conflicts and allow for efficiency in vision implementation

Critical in **leveraging** and **partnering** with the local innovation ecosystem and entities and **securing investments**

Strong innovation economies have an alignment of three key asset types.



PROGRAM
Partnerships
Financing & Tools

PLACE
Infrastructure
Urban Realm

PEOPLE
Talent & Collaboration
Identity

Source: The Rise of Innovation Districts: A New Geography of Innovation in America. Brookings Institute. 2014.

There are multiple examples of governance models with their respective tradeoffs.

	UNIVERSITY-LED	PRIVATE DEVELOPER	NON-PROFIT ENTITY
Example	***NC State Centennial Campus***	***American Tobacco Campus***	***Cortex***
Real Estate Ownership and Governance	• University controlled and operated	• Privately owned and operated • Regional development effort	• Highly organized board of directors • Includes multiple and diverse University leadership • 501(c)3 operating entity
Development	• Driven by state approvals and procurement • Public ownership and control of land • Limited flexibility for uses and private sector partnerships	• Owned by developer • Developer curates tenants to align with economic and community expectations • Distribution of risk and control • Must confirm mission alignment is sustained	• Independent non-profit foundation as a driver • Considerations of credit and balance sheet impacts • Considerations for ultimate responsibility and authority
Funding Structures	• Public funding provided by state government	• Privately developed with public infrastructure investments in structured parking and early space lease up by Duke University for financial feasibility	• Anchor institutions pledged patient capital alongside public buy-in

A&M University– Central Texas leadership should determine which tradeoffs it is comfortable with.

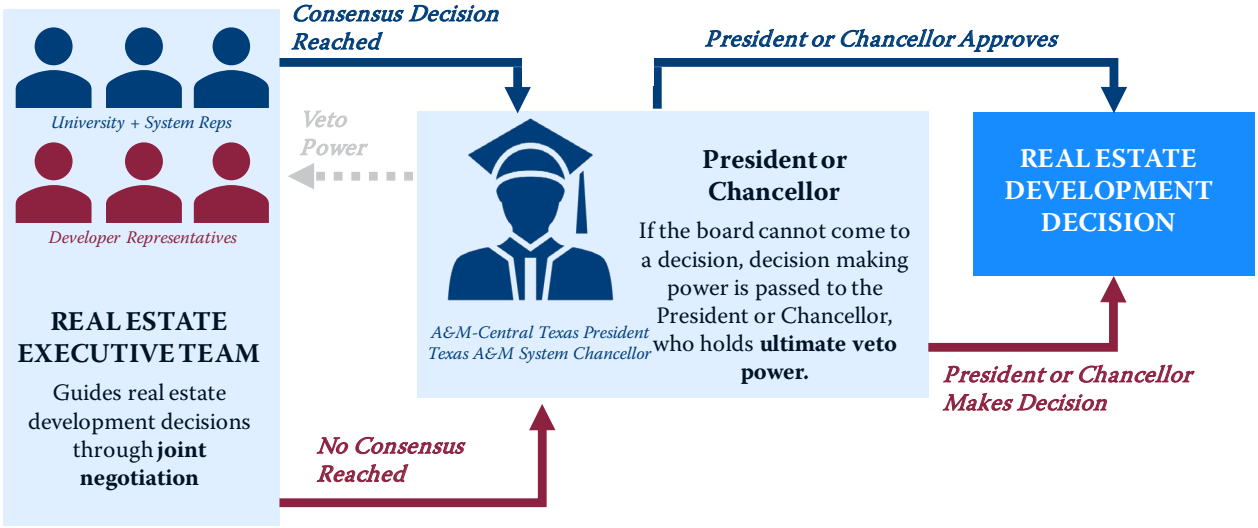
	UNIVERSITY-LED	PRIVATE DEVELOPER	NON-PROFIT ENTITY
Example	***NC State Centennial Campus***	***American Tobacco Campus***	***Cortex***
Strengths	• Clear programmatic drivers • Stable leadership • Easy access to funding	• Robust ownership entity with personal commitment • Development occurs at a faster pace	• Strong leadership • Strong community ownership
Weaknesses	• Development occurs at a slower pace, driven both by University governance, funding and multi-institutional obligations.	• Organizations with that commitment are hard to find • Require visionary local developer with strong government partner	• Requires constant engagement with multiple partners to ensure development, programming and operations momentum.

BUILDING CAPACITY

A&M-Central Texas will require **expanded staff capacity** to achieve its goals for the Forge.

A new executive leadership team for the Forge should work closely with A&M-Central Texas leadership.

A Real Estate Executive Team should drive early decisions about planning and development.



Capacity should reflect the shifting demands of the Forge as it grows and transforms.

Pre- Startup | Years 1-2

Staffing for The Forge is supported by an external, neutral third party offering embedded management services targeted to address the University's staffing gaps and needs.

Startup | Years 3-4

During The Forge's Growth Phase, staffing begins to transition from external embedded management to include more permanent local staff employed by The Forge.

Stabilization | Year 5+

As The Forge reaches maturity, the staffing transition should near completion, with The Forge fully staffed with dedicated, local employees.

A&M-Central Texas should engage external management in the early phases of work.

Bring in external management to help govern and organize the Forge as permanent leadership is being recruited, onboarded, and trained.

Conduct Engagement

- **Develop a messaging strategy** for immediate engagement with stakeholders.
- **Continue regular outreach and partner engagement** to ensure continued support for The Forge's strategy.
- **Refine vision** to reflect feedback and align stakeholders.

Develop Governance

- **Develop a leadership structure to govern** the Forge
- **Create advisory boards** around real estate and defense and include A&M-Central Texas faculty on the governing board.

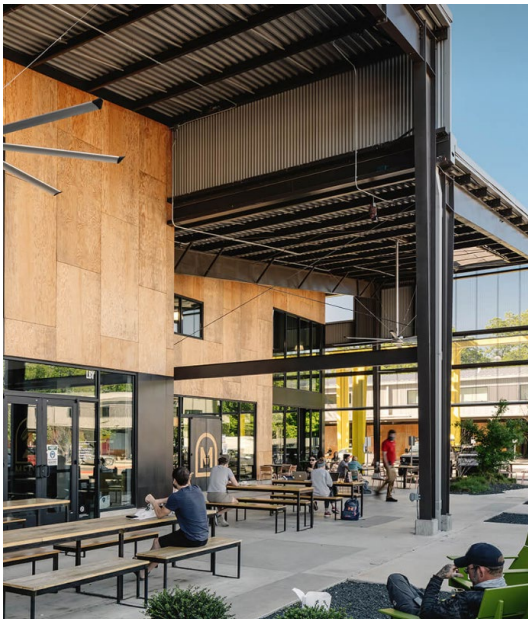
Initiate Planning

- **Formulate financial and business plans for strategy,** including a 10-year capital plan and 5-year operational plan.
- **Develop a dedicated set of staff** that will eventually lead The Forge.

PROGRAM STRATEGY ACTIVATION

The Forge should allow for **activation** driven by both the **community** and the **University**.

Activation can take a variety of forms—ranging from outdoor activities to student engagement programs.



Program activation should be led by the Partnership Staff with help from Operational Staff.

Partnership Staff

- Design space activation events
- Identify event partners
- Confirm strategy supports the Forge's identity

Operational Staff

- Execute The Forge's day-to-day operations
- Assist Partnership Staff with logistics and event planning to support activation

Programmatic Activation

- Innovation & Entrepreneurship Seminars, Lectures, and Classes
- Networking and Professional Development Events for students, community, and industry partners
- Arts & Cultural events celebrating and convening the community
- Outdoor events focused on health & wellbeing
- Community service and fundraising events to support the broader community
- Thought Leadership events to engage industry, university, students, and the community around shared research and innovation interests

Early activation of open spaces at A&M-Central Texas will create a vibrancy that can jump start the campus.

IMPLEMENTATION

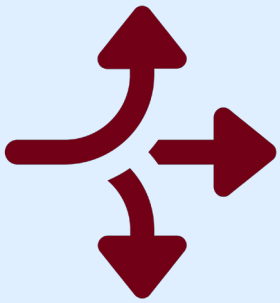
The Forge should be led by an **adaptable** and **nimble** governance and management structure.

The initial capacity building stage for the development of the Forge should take roughly five years.

The Forge should utilize a hybrid university and non-profit entity-led model.

BENEFITS OF HYBRID GOVERNANCE STRUCTURE

University maintains **strong control of The Forge.** A&M-Central Texas will maintain full ownership of the land.



Hybrid structure allows for **flexibility** as The Forge grows.

A&M-Central Texas should build on the existing community programming to offer additional industry-focused events to campus.

Veterans Appreciation and Benefits Expo

Hispanic Heritage Month 2022

Cyber Camp

Military History Symposium 2022

Higginbotham Obstacle Course Grand Opening

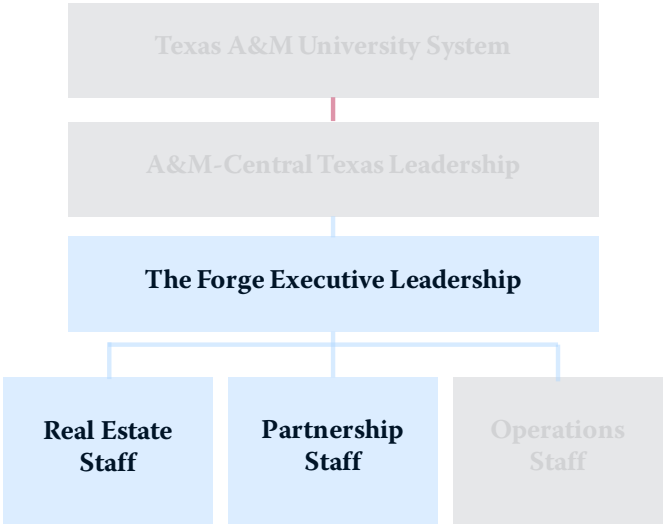
Startup *Years 1-2* | Growth *Years 3-4* | Maturity *Years 5+*

Immediate steps should be taken to build up staffing capacity to support the Forge

Building staff capacity within A&M-Central Texas should focus on developing **real estate** and **partnership** focused staff, as well as **executive leadership**.

These roles should be **initially housed in the university** but be prepared to be **transferred into the Forge Research Foundation**.

The capacity can initially be built up either with the help of **embedded management or internally**.



Startup *Years 1-2* | Growth *Years 3-4* | Maturity *Years 5+*

Create the Forge Research Foundation—a non-profit entity created to support the development and operations of The Forge.

OBJECTIVES OF THE FORGE RESEARCH FOUNDATION

Real estate and mixed-use knowledge community expertise

Partnerships and programs

Fiscal stewardship and operations

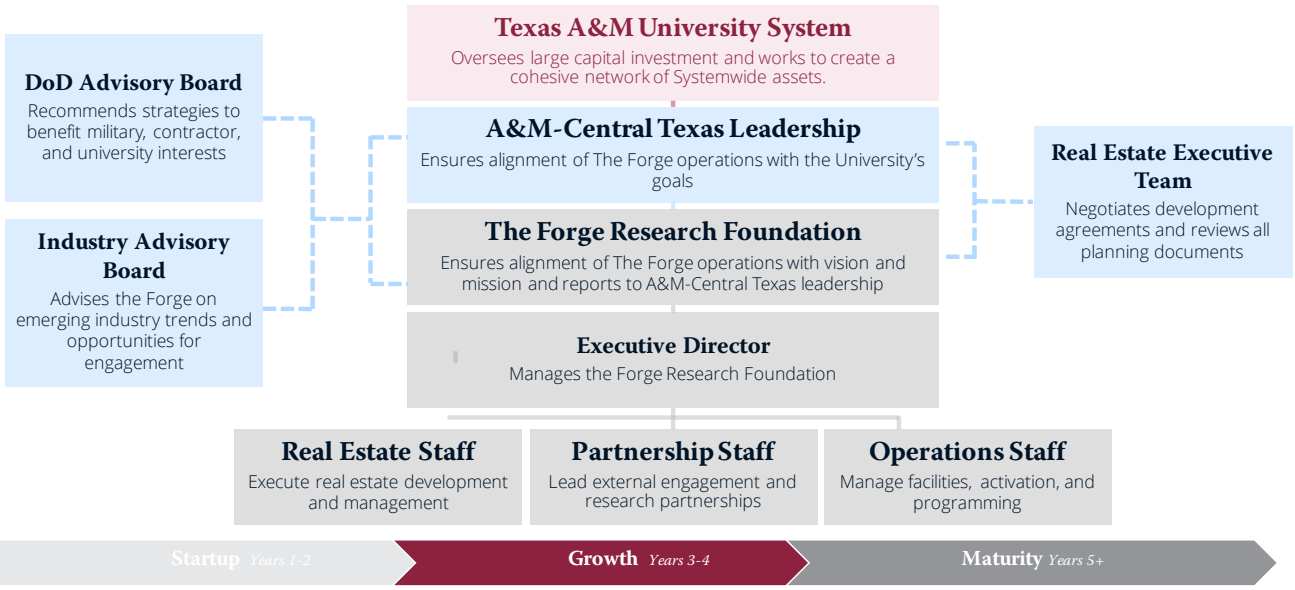
Startup *Years 1-2* | **Growth** *Years 3-4* | Maturity *Years 5+*

The Forge Research Foundation should operate as a 501 (c) 4.

MAIN OPERATION STRUCTURE	SUBSIDIARY STRUCTURES
501 (C) (4) • Membership-based business league • Allows the Forge to collect membership dues and fund operations • Tax-exempt non-profit	**501 (C) (3)** • Charitable organization structure • Allows the Forge to accept tax-deductible donations **C - Corporation** • Wholly owned subsidiary of the Forge to promote certain activities • Will allow the Forge to generate revenue from technology licensing and investments in tech start-ups • Taxed separately from the main entity

Startup *Years 1-2* | **Growth** *Years 3-4* | Maturity *Years 5+*

The Forge Research Foundation should absorb the Forge staff.



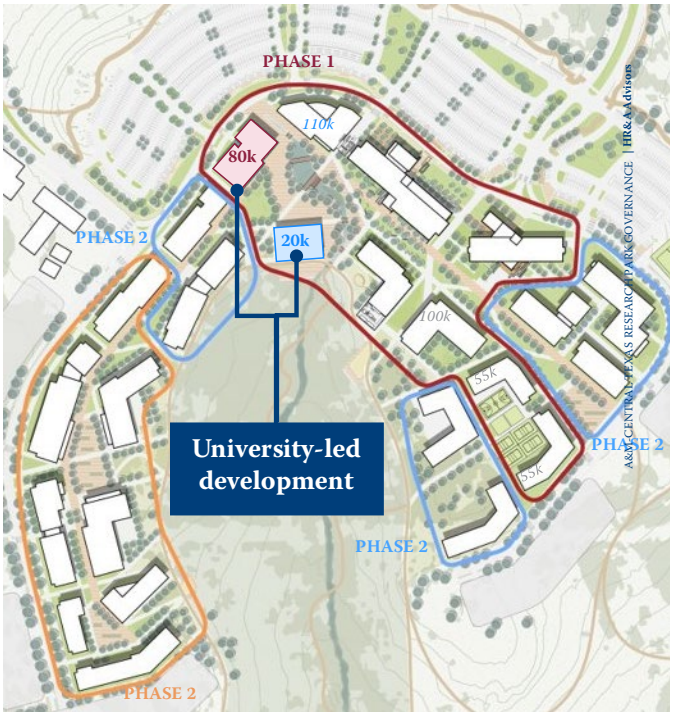
Startup *Years 1-2* | **Growth** *Years 3-4* | Maturity *Years 5+*

The initial development of The Forge should be led by the University and can be done in tandem with the creation of the Forge Research foundation.

EXISTING
Academic/Research: ~300k

PHASE 1 (UNIVERSITY-LED WITH PARTNERS)
Academic/Research: ~20k
Industry: ~80k

PHASE 1 (PARTNER-LED)
Academic/Research: ~210k
Residential: ~110k (~150 units)



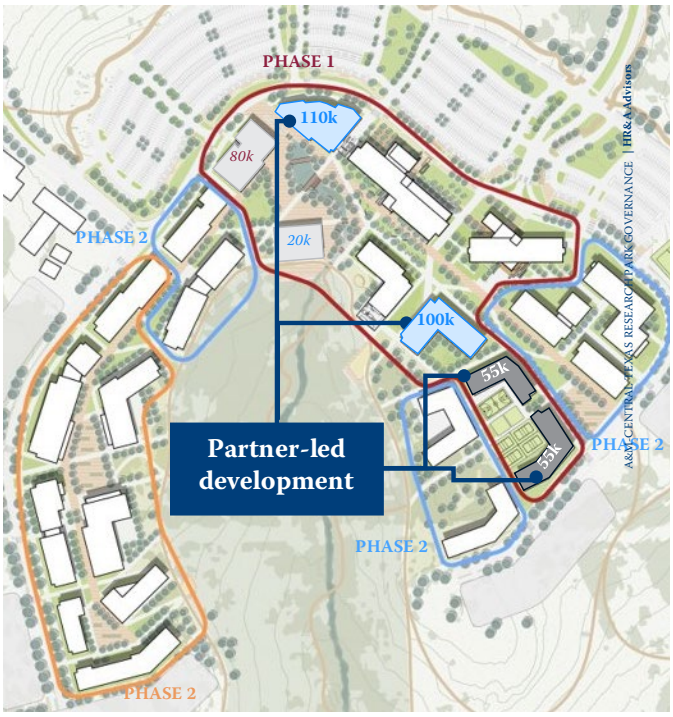
Startup *Years 1-2* | **Growth** *Years 3-4* | **Maturity** *Years 5+*

Parcels should be leased to the foundation so private partners and the foundation can further develop The Forge.

EXISTING
Academic/Research: ~300k

PHASE 1 (UNIVERSITY-LED WITH PARTNERS)
Academic/Research: ~20k
Industry: ~80k

PHASE 1 (PARTNER-LED)
Academic/Research: ~210k
Residential: ~110k (~150 units)



Startup *Years 1-2* | **Growth** *Years 3-4* | **Maturity** *Years 5+*

Programmatic Drivers

The following section evaluates the competitiveness of local market, inclusive of local and partner resources such as Texas A&M-Central Texas, Fort Hood, etc., as it relates to generating spin-off commercial activity from core programmatic strengths. This analysis focuses on identifying strategies to pivot off the core academic and research strengths of the institution to generate economic opportunities that are aligned with the Killeen/Central Texas's industry clusters and innovation ecosystem.

THE ECONOMIC CONTEXT

Killeen's economy reflects the trends and changes of **Fort Hood** and the **defense industry.**

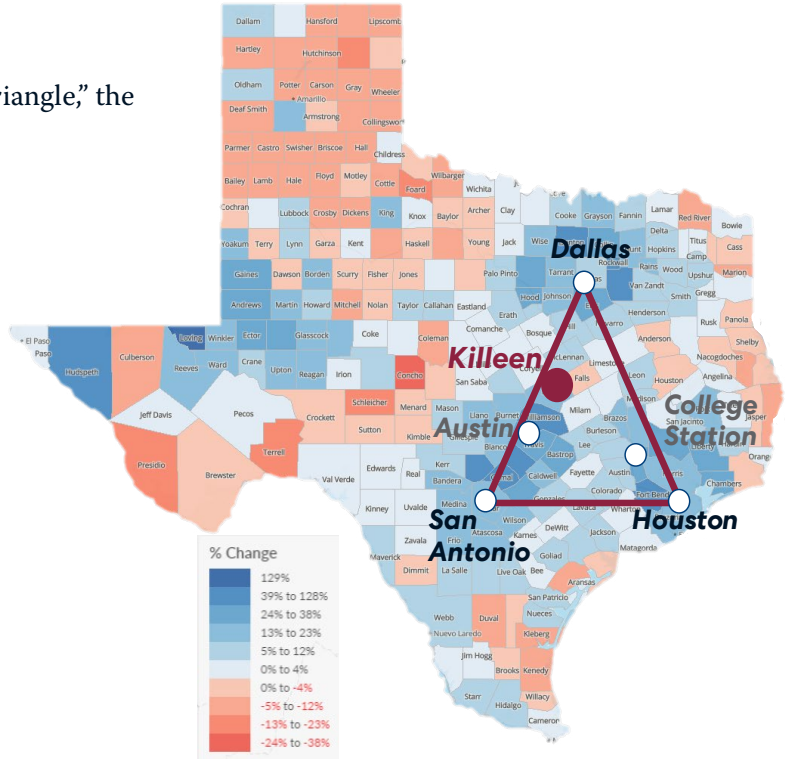
The Economic Context

Killeen is in the center of the "Texas Triangle," the economic hubs of the state.

The "Texas Triangle" is an area of Texas that has seen not only robust population growth, but also economic growth and prosperity. The area is anchored by San Antonio, Austin, Houston, and Dallas.

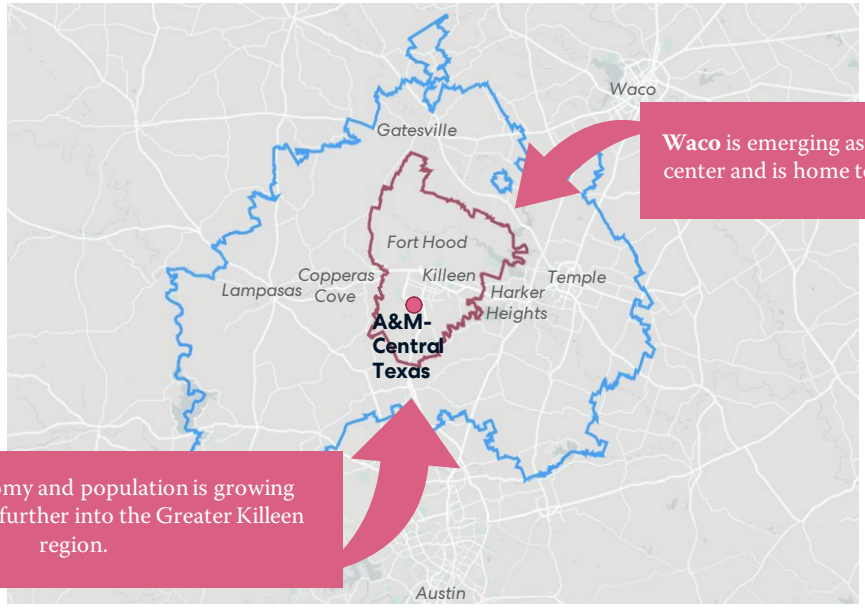
In addition to being in the center of the Texas Triangle, Killeen is located within a two-hour drive of College Station, putting the Forge in driving distance of system assets including:

- RELLIS and the Bush Combat Development Complex
- Texas A&M Engineering Experiment Station (TEES)
- Texas Engineering Extension Service (TEEX)



The Economic Context

Killeen is an hour north of Austin – one of the nation's fastest growing economies – and Waco – an emerging regional population center.



Waco is emerging as a Texas population center and is home to Baylor University.

Austin's economy and population is growing rapidly, spilling further into the Greater Killeen region.

The Economic Context

Killeen's population is generally younger and has less education attainment than regional counterparts but continues to experience strong population growth.

POPULATION

529k

The region has seen 2% annual population growth between 2011 and 2021, similar to Austin's growth rate.

MEDIAN INCOME

$55k

In 2021, Killeen's median income was more than $20k lower than Austin's and almost $10k lower than Texas median.

EDUCATIONAL ATTAINMENT

12%

of residents have **Associate's degrees**, higher than Texas as a whole. Killeen's population with a Bachelor's or higher is 24% while Austin's rate is 53%.

AGE

38%

of Killeen's population is between the ages of 20 and 39 because of the military's presence — this age cohort is typically conducive to innovation and research.

Source: Emsi. ACS 2020.

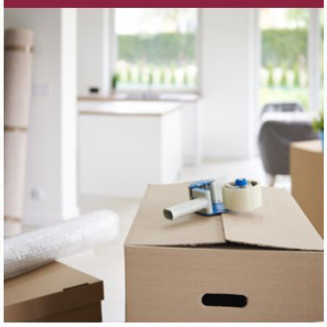
The Economic Context

Killeen is home to Fort Hood, one of the largest military installations in the nation and a major driver of economic trends in the region.

BASE STABILIZATION

- Fort Hood is presently stabilized from a BRAC perspective.
- Operational Test Command (OTC) is headquartered here and with four of the eight directorates being based in Fort Hood, there are numerous potential opportunities.

TRANSIENCE



- Soldiers and their families regularly move in and out of Killeen.
- Nearly 30% of soldiers departing the army at Fort Hood would like to stay in Killeen, but there is a lack of economic opportunity.

MILITARY POPULATION

- The military population skews towards young males with a lower level of educational attainment.
- PTSD in both soldiers and their families is a top concern.

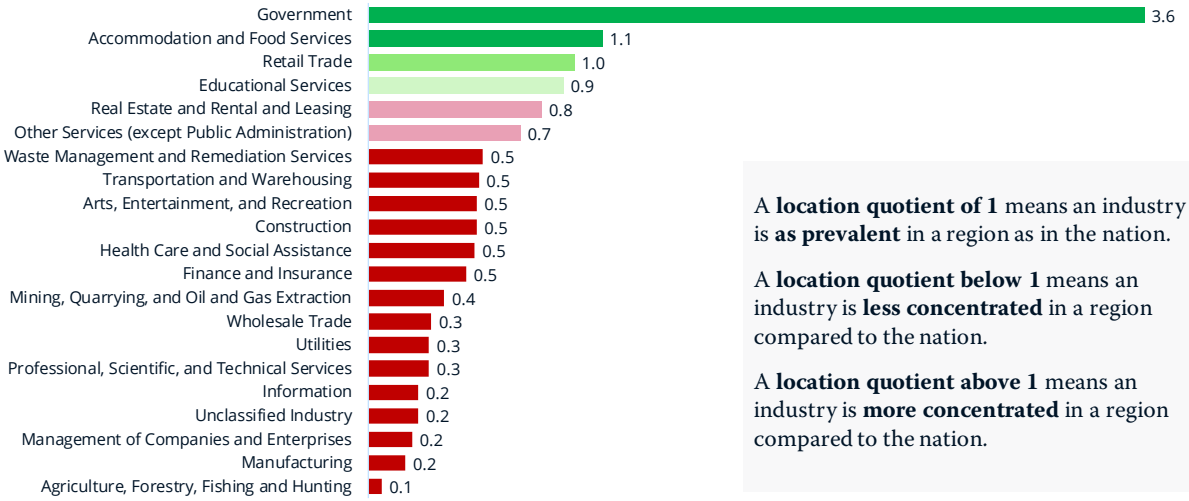
INFRASTRUCTURE

- Killeen is well-connected both in terms of a road networks and a regional airport.

The Economic Context

Killeen's economy is heavily concentrated in government (which includes military), accommodations and food services, and the retail trade.

Location Quotient of All Killeen Industries, 2-Digit NAICS Level (2021)



A **location quotient of 1** means an industry is **as prevalent** in a region as in the nation.

A **location quotient below 1** means an industry is **less concentrated** in a region compared to the nation.

A **location quotient above 1** means an industry is **more concentrated** in a region compared to the nation.

Source: Emsi.

The Economic Context

Killeen's economy lacks some of the supportive industries necessary for an innovative, defense-led ecosystem, but nearby Austin has a strong foothold in necessary industries.

Location Quotient (2021)	Killeen	Austin
Industry		
Government	3.59	1.02
Supportive Industries		
Federal Government, Military	27.84	0.34
Support Activities for Air Transportation	4.93	0.51
Federal Government, Civilian	4.54	0.65
Facilities Support Services	4.17	0.66
Scientific Research and Development Services	0.16	0.82
Management, Scientific, and Technical Consulting Services	0.21	2.08
Computer Systems Design and Related Services	0.29	2.69
Software Publishers	0	2.25
Architectural, Engineering, and Related Services	0.33	1.59

Source: Emsi. Government is classified at the 2-digit NAICS level; all sub-industries are classified at the 4-digit NAICS level.

The Economic Context

Market analysis of Greater Killeen revealed opportunities to make a new market for strategic office and lab but also complimentary product types that can drive activation of the research park.

OFFICE

0 SF

Of Class A Office in Killeen Today

RESIDENTIAL

+20%

Population Growth 2010-2020

RETAIL

0 SF

Of Retail within Walking Distance on A&M-Central Texas

INNOVATION

Limited

Innovation and co-working spaces in the region, but some companies have grown, such as Centex.

Source: Costar, 2022; ACS 2020.

The Economic Context

A mix of office, lab, multi-family residential, convenience retail, and innovation spaces scaled to the needs of Killeen's economy are likely market-feasible at the Forge.

OFFICE

The Forge could deliver the **quality creative office space in Killeen**, attracting more professional companies and defense contractors.

RESIDENTIAL

The Forge may be **bolstered by multifamily housing**; the supply of multifamily housing has become very tight with few new deliveries in recent years. Additionally, A&M University-Central Texas is seeing more requests for housing

RETAIL

The Forge's retail offerings should not only serve each user group's immediate needs, but also act as **places for user groups to come together** in a meaningful way that spurs innovation.

INNOVATION

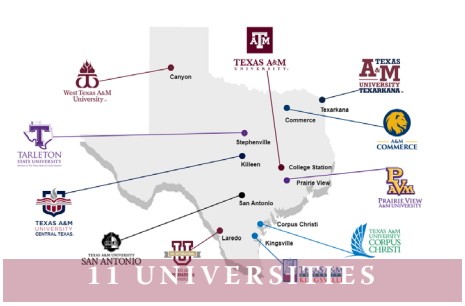
Killeen has limited existing innovation space, and almost all existing lab and innovation space is on A&M-Central Texas' campus. However, there have been **promising coworking and job training developments recently.**

THE TEXAS A&M UNIVERSITY SYSTEM

The **Texas A&M University System (TAMUS)** has a rich history of partnering with industry – and particularly the **defense industry** – to drive research and innovation.

The Texas A&M System

The TAMUS offers an extraordinary collection of programmatic assets that can shape the future of the Forge.



The Texas A&M University System

The TAMUS continues to evolve to best serve the State of Texas and its people by developing innovative research and developing new campuses and programs.

Over 90% of the TAMUS research expenditure is through A&M-College Station. A&M-Central Texas is located within a two-hour drive to A&M-College Station and can build off programming and opportunities located at College Station.

The TAMUS is spread across Texas, creating economic and research opportunities for all Texans, more so than the UT System. A&M-Central Texas may be able to leverage some of these geographies and their respective programs and partnerships to expand its own programmatic offerings.

The Texas A&M University System

The TAMUS offers an extraordinary collection of programmatic assets that can shape the future of the Forge.

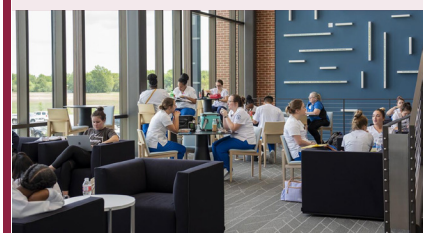
RELLIS

Established: 2016

Academic Partners: 12

Educational Space: 113,000

RELLIS offers precedent for strong collaboration with community colleges, a very important factor given it is an upper-level university, and the strong relationship with the Army.



TAMUS PRIORITIES

TAMUS priorities are to provide education, **conduct research**, **commercialize technology**, offer trainings, and deliver services to the people of Texas. As a land grant institution, this has traditionally been, and continues to be **research focused on the military**, supporting Texas needs, and agriculture. This can be seen through the systems focus on RELLIS, the Texas Division of Emergency Management, Agrilife research, and more

SYSTEM RESEARCH

45%

Of research funding is from the Federal Government (2020)

231

New invention disclosures (2021)

TEES

Has over 652 industrial sponsors, over $209M in research expenditure, and over 1700 students participating in research

TEXAS A&M – CENTRAL TEXAS

A&M-Central Texas has the only campus within the A&M System campus that is **contiguous to a military installation** – and, in the case of **Fort Hood**, the largest single site employer in the State of Texas.

A&M University– Central Texas

A&M University-Central Texas is an A&M University System institution that largely serves soldiers, veterans, and their families.

STUDENTS ENROLLED

2,900

Currently enrolled at A&M- Central Texas

VETERANS

~40%

Students are military affiliated or veterans

RESEARCH EXPENDITURE

$1.24M

In research expenditure (2021)

Source: A&M-Central Texas (FY22 unduplicated headcount) / TAMUS NSF Total R&D Expenditures

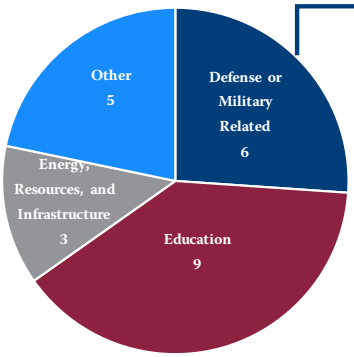
A&M University– Central Texas

A&M University-Central Texas has broad academic offerings, and its key strengths reflect its affinity to serving the defense community.

A&M – Central Texas

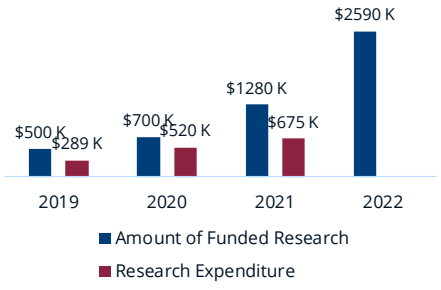
A&M-Central Texas has achieved success in grant and research funding across an array of areas that can bolster research partnerships and innovation at the Forge.

KEY RESEARCH AND CONTRACTS 2013-Present



- AFRL/Griffiss Institute (2020): *Evaluate performance of sensory systems*
- TEES ARC (2019-2021): *Study of cybersecurity education for a dispersed workforce*
- National Mounted Warfare Foundation (2019-2020): *Develop strategic and marketing plan for National Mounted Warfare Museum*
- Sanford Foundation (2018-2019): *Build a Warrior Community to significantly change the military-connected community in Central Texas and evaluate the community's effectiveness*
- Heart of Texas Defense Alliance (2016-2017): *Study of effects of force reduction on Fort Hood*

FUNDED RESEARCH AND EXPENDITURE AT A&M-CENTRAL TEXAS



In 2021 and beyond, sponsors have committed nearly $4.3 million in grant and contract funds for A&M-Central Texas researchers.

Source: A&M- Central Texas.

A PROGRAM-DRIVEN PLACE

There are **three key programmatic mechanisms** for making the Forge a reality.

THE FORGE

First Mechanism:
Capture and retain the **talent pipeline and research opportunities** from Fort Hood

A Program-Driven Place

Fort Hood is a natural programmatic driver for the Forge, offering an unrivaled talent pipeline with opportunities for additional workforce development through A&M-Central Texas.

WORKFORCE

600+

Soldiers exit monthly from Fort Hood, many with security clearance and transferable technical skills

CONTRACTOR

70+

Defense contractors located around Killeen

TALENT

Shortage

Of qualified workforce for many high-skilled jobs; greying workforce

Source: Stakeholder interviews

A Program-Driven Place

Current offerings at A&M-Central Texas can give soldiers exiting Fort Hood and other students the skills necessary to draw defense contractors and related employers.

UNDERGRADUATE

Computer Science, B.S: The Bachelor of Science in Computer Science provides theoretical and mathematical foundations of computing for development of problem-solving and programming skills.

Cybersecurity, Certificate: focuses both on the guiding principles and the hands-on techniques needed to deter, defend and respond to cybersecurity threats in the networked, global business world.

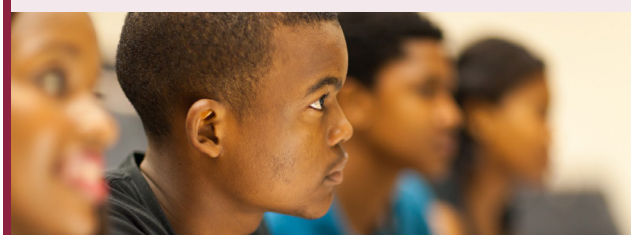
Micro-credentials: Existing micro-credentials, developed in partnership with industry, will be important assets for entrepreneurs and workers to gain vital skills that will help accelerate their careers.

GRADUATE

Applied Data Analytics, Certificate: This program could help prepare students for jobs in OTC, especially in the field testing industry.

Homeland Security, MS: The degree will be an important asset in preparing both graduated soldiers and civilians for work in defense-related jobs.

MBA: While the Forge will be programmatically driven by defense, defense is big business and having business and management skills is an important part of the industry. A&M-Central Texas's academic offerings focused on business will be a key part of the Forge's success.



A Program-Driven Place

Operational Test Command at Fort Hood drives research and engagement in support of combat-readiness and can drive demand for office and research space at the Forge.

The military is always working to leverage technology to create the best battlefield outcomes. The army's Operational Test Command (OTC) and Army Futures Command (AFC) may provide a unique opportunity to drive industry engagement and a tech economy in the Killeen region.

ARMY FUTURES COMMAND

AFC was established in nearby Austin due to the proximity to tech companies and research. AFC's role is to source new technologies for consideration by the army. **AFC has become a driver of tech production.** AFC also has a significant footprint at RELLIS.

OPERATIONAL TEST COMMAND

OTC is located at Fort Hood and takes the technologies AFC identifies and tests them for real-world combat scenarios. OTC has 4 directorates in Killeen: aviation test, mission command test, maneuver support, and sustainment test. **OTC is already a major employer of A&M-Central Texas students.** OTC seeks people with the latest training on various tech.

A Program-Driven Place

The Forge should create both programs and spaces that support OTC's needs and foster a clustering of industry and research.

OFFICE

The Forge can supply needed office space for defense contractors.

OTC cited that there is a shortage of high-quality space for defense contractors.

TALENT

The defense industry has an aging workforce and a lack of talent to fill roles. **A&M-Central Texas can craft curriculums to support their talent needs.** Programs like **the new Cooperative Ed.D** are already doing this.

RECRUITING

The Forge should create opportunities for talent recruitment.

OTC cited this as a key role they can play.

PROJECTS

The Forge can be home to collaborative research projects or internships with OTC. This will create opportunities for students, defense contractors, and OTC to solve defense problems in collaboration with University Research resources.

THE FORGE

Second Mechanism: **Train and develop the talent** to respond to industry and **offer spaces for industry** to connect with the talent.

A Program-Driven Place

A&M-Central Texas should work with the TAMUS to build off existing programs develop new and innovative programs that will support the System's mission.

Texas A&M Defense Cyber Leader Development Program(DCLDP)

DCLDP is a program that is a partnership with the Department of Defense (DoD) to prepare students for defense careers through a two-year program. At the completion of this program, students have:

- Minor in Cybersecurity
- At least two industry certifications (Security+, Network+, Certified Ethical Hacker, etc)
- Real world experience as a Cybersecurity Analyst in TAMU System Security Operations Center
- Leadership and Competition experience
- A cybersecurity-related internship

This program is well-suited to be brought to A&M-Central Texas because much of the student body already has Top Secret level security clearance and students are located next to Fort Hood, creating many research opportunities for students and develops qualified talent for Fort Hood. **This program will support the private sector industry located at the Forge as well because they will have access to qualified job candidates with high security clearance that are prepared to contribute to an innovative environment.**

Cooperative Ed.D in Educational Leadership with Cognate in Research & Testing

A&M- Kingsville and A&M-Central Texas have created a collaborative program that prepares students and working professionals for work in research and testing. This fully online degree is can help prepare **students to work at OTC, who relies heavily on a workforce that understands the intricacies of testing.**

Additionally, this program demonstrates how a program can be rolled out in two System schools at once. This type of programming will not only support the Forge, but the TAMUS in their goal to expand their service to the State of Texas and continue its proud tradition of producing and unrivaled quality of research.

A&M-Central Texas should work with the TAMUS to develop new programs that will support the local defense industry and create a pool of talent that will draw new defense contractors and research to the region.

A Program-Driven Place

Aside from A&M-Central Texas, Killeen is home or proximate to multiple education institutions that can partner with industry at the Forge.

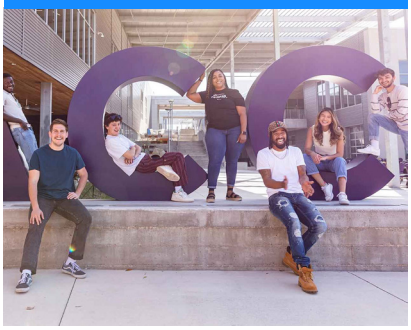
CENTRAL TEXAS COLLEGE(CTC)

- A&M-Central Texas already has a close relationship with CTC.
- The Forge can offer opportunities for CTC students to participate in internships and build a presence on

TEMPLE COLLEGE

- A&M-Central Texas can attract more Temple students by offering unique industry internships only found at the Forge.

AUSTIN C.C.



- The Forge will create a unique value proposition that can attract students from Austin Community College District looking to complete a bachelors while preparing for Austin's tech-driven economy.

A Program-Driven Place

Leverage local programs to create a hub of entrepreneurship and innovation at the Forge that is attractive to soldiers, students, and the broader community.

Scale Up CoConnect Entrepreneur Share Space

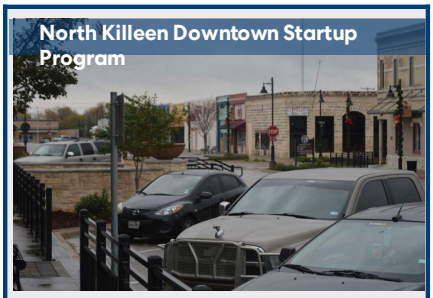
Scale Up CoConnect is the first of its kind coworking space located in downtown Killeen. The space is not only a coworking space, but also holds networking events. The space offers drop-in rates, monthly memberships, dedicated desks, and individual offices. The space is new to Killeen but is an indication that there is demand for innovative spaces.

KISD Career Center

The Career and Technical Education (CTE) program in Killeen gives students the opportunity to receive industry skills in 16 fields including STEM, logistics, and information technology.

The program is housed in the KISD Career Center which offers state of the art facilities for students to train.

North Killeen Downtown Startup Program



In 2022, the City of Killeen announced a grant program that aims to build businesses in Downtown Killeen with equity in mind.
Recipient businesses must be small businesses located in Downtown Killeen with a goal to help improve the built environment and provide economic opportunity in Killeen. Programs like this help build a culture of innovation.

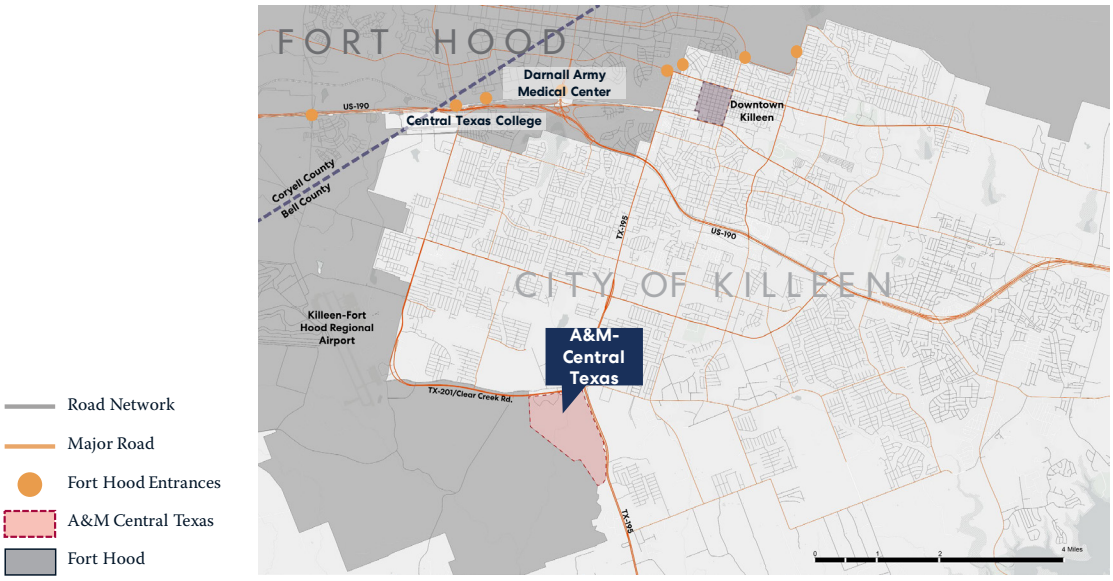
Source: Scale Up CoConnect, KISD

THE FORGE

Third Mechanism: Leverage the Texas A&M University System's connection to the military to **celebrate A&M-Central Texas' unrivaled proximity to Fort Hood.**

A Program-Driven Place

A&M-Central Texas is contiguous to Fort Hood and located near many regional assets including the Killeen-Fort Hood Regional Airport.



A Program-Driven Place

Partner with the military to offer community, exhibition, and conference space that may not be available "inside the fence".

ART

The National Museum of the US Army (Fort Belvoir, VA) has special exhibits and opportunities for soldiers to use art to share their experiences.

CONFERENCES

The Army conducts conferences and gatherings that may be easier to facilitate at the Forge and in coordination with industry partners on site.

EXHIBITION

Defense contractors can exhibit new technologies to other industries to promote alternative pathways to commercialization.

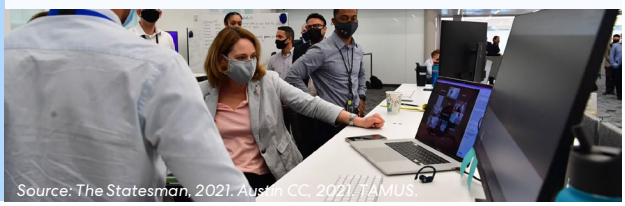
A Program-Driven Place

While AFC is not based at Fort Hood, A&M-Central Texas should capitalize on the existing relationship with the A&M System and proximity to AFC in Austin.

AFC IN AUSTIN

AFC is headquartered in Austin and has developed strong partnerships throughout the region. UT-Austin is the research hub for robotics and assured positioning, navigation and timing. UT has committed $20M to support collaboration with AFC on top of $30M strengthen research capabilities to support the Army. Additionally, AFC has created a software factory with ACC. The software factory welcomed its first cohort of 30 people in 2021, but over 15,000 service members expressed interest.

The Forge can capitalize on this proximity by creating channels for collaborative research and creating facilities that can support AFC's research in a local setting near Fort Hood.



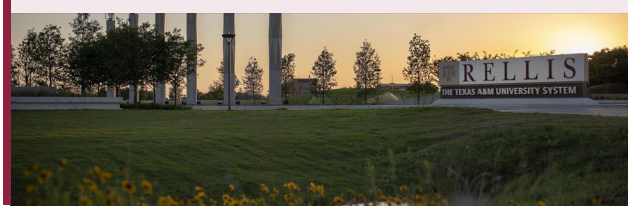
Source: The Statesman, 2021. Austin CC, 2021 TAMUS.

RELLIS

The partnership between Texas A&M and AFC in RELLIS at the Bush Combat Development Complex is the culmination of $195M of investment by the System, the State of Texas, and AFC:

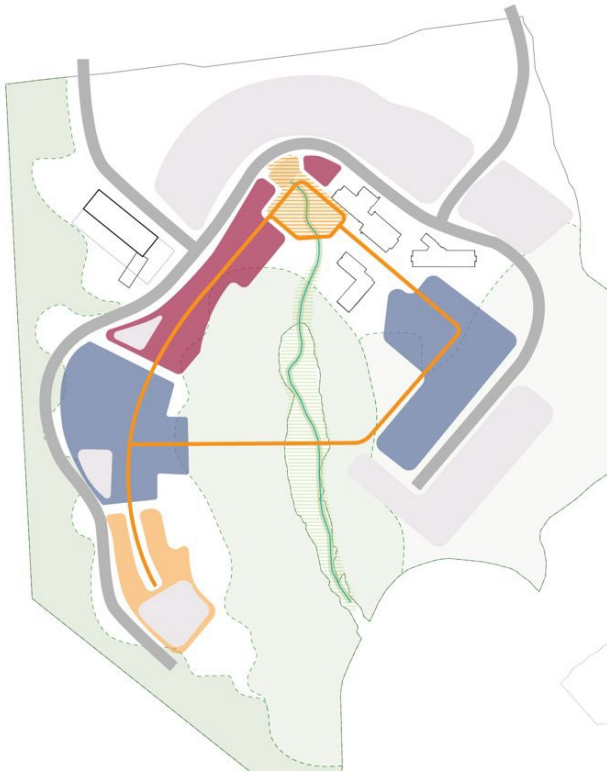
- **$80M** by Texas A&M System
- **$50M** by the State of Texas
- **$65M** by AFC

While a majority of the AFC relationship may continue to occur at RELLIS, the Forge's proximity to Fort Hood and its soldiers cannot be replicated at RELLIS and should be promoted as such.



SPACES FOR PROGRAMS AND PEOPLE

The Forge should be a dynamic, defense-driven research community that celebrates Killeen's unique context.



Spaces for Programs and People

As the defense industry shifts to be more focused on technology, spaces at the Forge should welcome tech-driven defense contractors, entrepreneurs, and should accommodate collaboration and innovation.

Industry Assets	Existing A&M-Central Texas assets	To be incorporated into the Forge
Proximity to Fort Hood	●	●
Industry-focused Academics	◕	●
Veteran-heavy student body	●	●
Office space for industry	◔	●
SCIF's	○	●
Collaborative research center	◑	●
Fort Hood student research opportunities	◑	●
Housing	○	◑
Supportive Retail	○	◕

Spaces for Programs and People

To support the defense industry and its connection to the talent pipeline, the Forge should offer secure and innovative spaces for collaboration.

INNOVATION SPACES

District Hall, Boston

- Innovation spaces includes both collaborative spaces to meet up and events

OFFICE SPACES

RTP, North Carolina

- Offering high-quality office space will house both defense contractors already located in Killeen and attract new ones.

HIGH-BAY SPACES

Research Integration Center, RELLIS

- High-bay spaces are important for research testing and prototyping

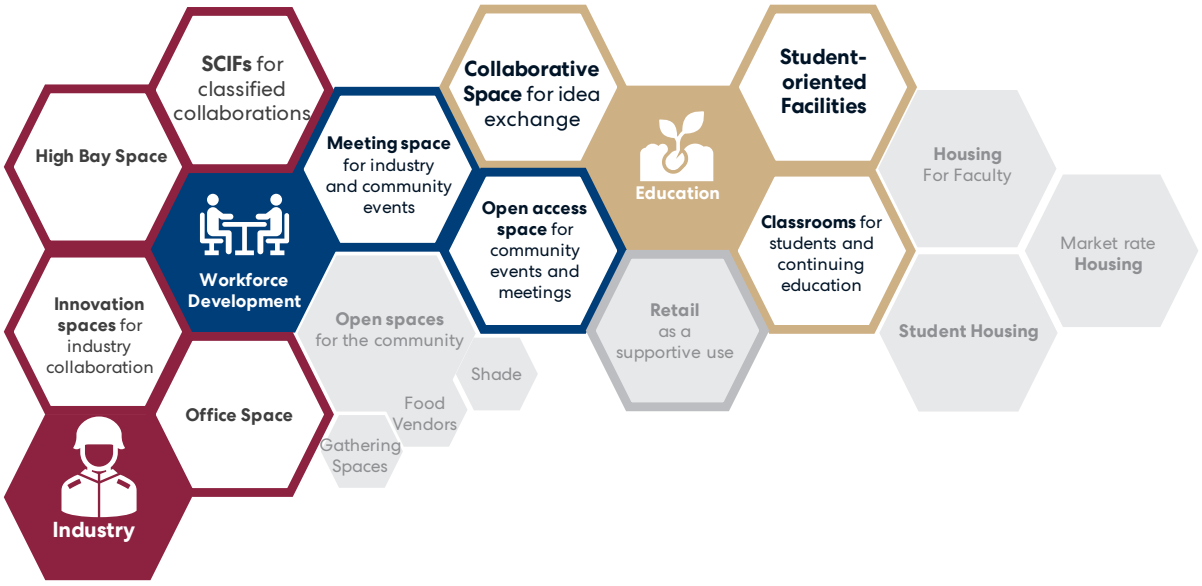
SCIF's

SCIF

- Building SCIF's in The Forge will be necessary to attract contractors who work on classified work.

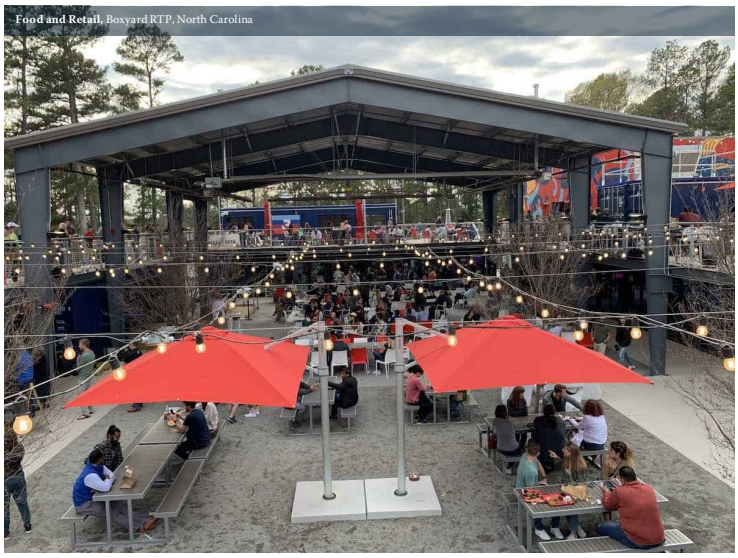
Spaces for Programs and People

The mix of spaces at the Forge should reflect the strategy of retaining talent, developing talent, and connecting the talent to industry.

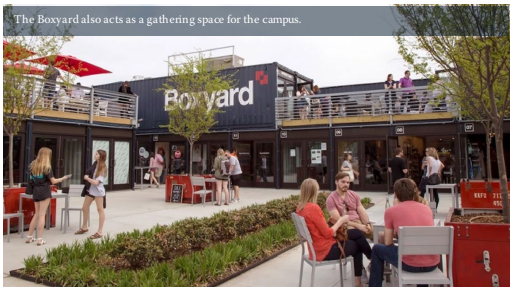


Spaces for Programs and People

Collaborative spaces are important to creating an environment at the Forge that will support talent retention and development.



Food and Retail, Boxyard RTP, North Carolina



The Boxyard also acts as a gathering space for the campus.

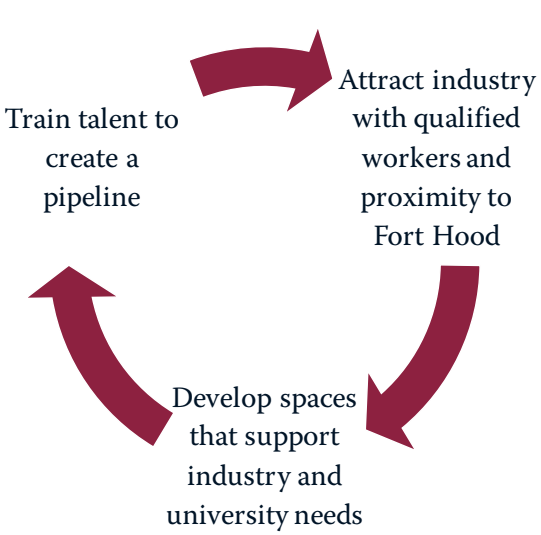
Student housing at Centennial Campus at NC State

CREATING A PLACE

A&M-Central Texas should begin by capitalizing on its **value proposition**: the ability to **create a talent pipeline** to attract industry.

Creating A Place

A&M-Central Texas will need to explore its commitment to space and programming to understand to what extent it can support this development cycle.



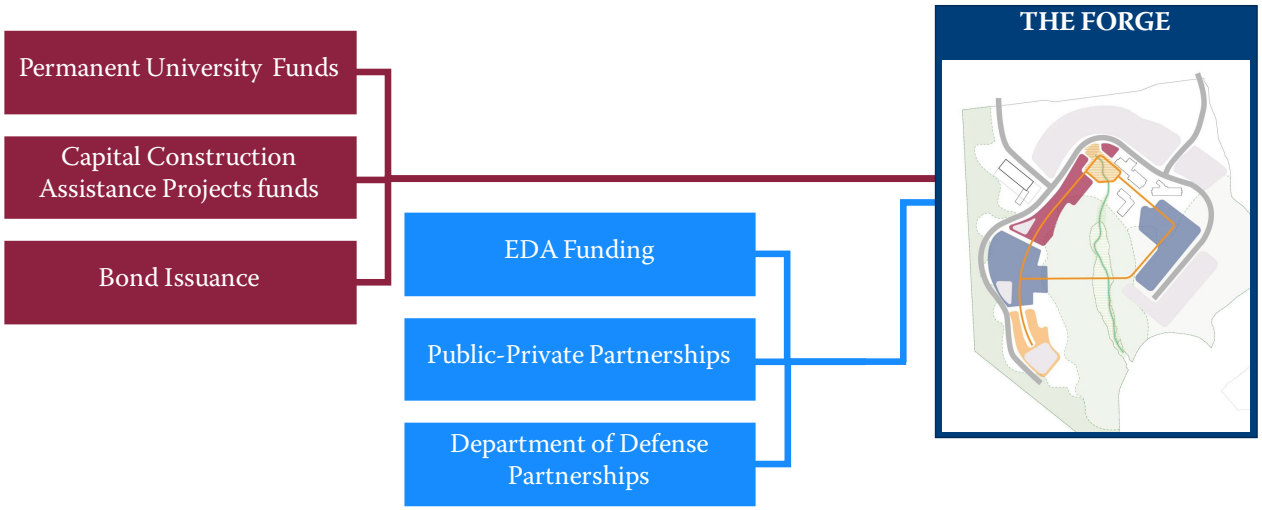
Gaining support from the TAMUS is the next step

CREATING A PLACE

Funding should include both traditional and **innovative mechanisms** to bring the Forge to **fruition**.

A Program-Driven Place

Developing the Forge will require traditional funding and a mix of public and private funding to support this defense-driven programmatic vision.



Stakeholder Interviews Memo

To best understand Killeen, A&M University- Central Texas, and Fort Hood, we have talked to more than 30 stakeholders. For a complete list of stakeholders please see Appendix A. The main purpose of stakeholder engagement is to understand the existing economic and social landscape of Killeen, A&M- Central Texas, and the Texas A&M University System (TAMUS) and to understand the opportunities for the Forge, gauge interest, and gain and understanding of university processes.

The stakeholders engaged fell into three categories: A&M University representatives, Fort Hood/Department of Defense stakeholders, and external partners ranging from private business owners located in Killeen to the Killeen Independent School District Superintendent. Stakeholders had a range of views on the opportunities and challenges facing industry and A&M- Central Texas, but key themes emerged:

1. Killeen's talent
2. The quality of space in Killeen
3. The need for amenities
4. Perceptions of Killeen
5. Killeen's opportunities and connections

Killeen's Talent

Many stakeholders expressed frustration with the current state of Killeen's talent pool. Roughly 600 soldiers exit Fort Hood each month, and many have a desire to stay in Killeen but do not see a future with opportunities in Killeen. Employers mentioned that even though former soldiers are good workers, many of them do not have the training and technical skills to succeed in the private sector. Those who are well trained are especially valuable workers to both the military and the private sector because many have top secret security clearance.

A&M-Central Texas has done a good job working with industry to develop programs that support the needs of industry. This has led to an increase in people enrolling in graduate programs and six standalone certificates have been created in conjunction with industry.

The Quality of Space in Killeen

Stakeholders across the board stated that the quality of space in Killeen, whether residential or commercial, as poor. Housing quality was a top concern with people mentioning the housing product that exists in Killeen as of extremely low quality and almost disposable. Stakeholders also noted there is a shortage of housing, which in some cases has made it difficult to attract students. Some stakeholders also mentioned they thought that the lack of student housing was a barrier to attracting students to A&M-Central Texas, both in terms of local students looking for a "college experience" and foreign students.

Industry stakeholders noted that other than A&M-Central Texas, there was no quality office space. This has been a barrier to attracting defense contractors to the region. Operational Test Command (OTC) also expressed concerns around the lack of quality office space in Killeen.

The Need for Amenities

While many stakeholders praised Killeen's community, almost all stakeholders mentioned that there were limited unique retail and restaurant offerings in Killeen, with some stakeholders going as far as saying Killeen can be perceived as "boring." There is currently nothing to draw people to living in Killeen in terms of amenities and entertainment. When people are looking for entertainment, they often have to leave Killeen to go elsewhere.

Perceptions of Killeen

All stakeholders raised the point that Killeen has a negative reputation that has been marred by the perception that there is high crime, violence, and that there is nothing to do. Some stakeholders saw this reputation as overblown, while others felt it was deserved. All stakeholders saw it as a barrier to Killeen's success and something that needs to be addressed. Many stakeholders also noted that there was an East-West county divide and that more resources went to the East side of the county.

Killeen's Opportunities and Connections

Stakeholders highlighted Killeen's many opportunities that can be leveraged and expanded. First and foremost, Killeen and A&M-Central Texas's success is currently tied to Fort Hood. There is no BRAC anticipated, and Fort Hood has seen a period of growth. Stakeholders noted that aligning programming with the needs of Fort Hood and the Department of Defense would likely be the Forge's "ace in the hole." Many stakeholders saw A&M-Central Texas's existing relationship with OTC as a good place to continue to build relationships and innovation assets.

Killeen has also experienced strong residential growth, especially in the south, in the area near A&M-Central Texas. Some stakeholders speculated that this trend will continue, especially as that area of Killeen is located closest to Austin. Some stakeholders thought that because of this growth, the University may have the opportunity to develop housing.

There are currently two private companies with a presence at A&M-Central Texas. Stakeholders noted that this is an important opportunity to expand. There may be some barriers in terms of expanding this in the deed restriction as the deed specifies that uses need to be educational. This needs to be solved. Generally, the System requires tenants to pay fair market rent. Any leases over five years to a third party must go to the TAMUS Board of Regents for approval.

There are significant opportunities to expand existing programming and research. The University's involvement with IUCRC (Industry University Collaborative Research Consortium) in solar research, cybersecurity, relationship with OTC, and strong relationship with general defense community will be important to continue to support these assets and relationships.

After talking with people within TAMUS, it became clear that it will be important to differentiate the Forge from other TAMUS assets. It will be especially important to differentiate from RELLIS. Fort Hood's proximity can be the differentiator because it is unable to be replicated elsewhere. There may also be opportunity to leverage the TAMUS's existing relationship with Army Futures Command (AFC).

TAMU		
Peg Gray-Vickery Provost	**Todd Lutz** VP Finance & Administration	**Dr. Russ Porter** VP for Research & Economic Development
Walt Murphy Executive Director for Research	**Dr. Fauza Khoja** Dean, College of Business Administration	**Dr. Jeffrey Kirk** Dean, College of Education & Human Development
Dr. Taylor Harvey Assoc. Professor, Department of Science & Mathematics & TEES Director	**Greg Hartmann** Chief Operating Officer (TAMU)	**Dr. Youseff Elabd** Vice Chancellor for Research (TAMU)
Brad Sharp Office of General Counsel (TAMU)	**Clint Cooper** Director of Real Estate (TAMU)	**Col. Rosendo "Ross" Guieb** Executive Director, George H.W. Bush Combat Development Complex (TAMU)
Fort Hood		
John Diem Former Executive Director, OTC	**Bill Adams** G5 Director, OTC	**Keith Sledd** Executive Director, HOTAD
External Partners		
Kent Cagle City Manager, Killeen	**Danielle Singh** Assistant City Manager, Killeen	**Michael Boyd** City Council Member
Judge David Blackburn County Judge, Bell County	**Adam Ward** IT Director, Bell County	**Bill Parry** City Manager, Gatesville
Dan Yancey Mayor, Copperas Cove	**Ryan Haveriah** City Manager, Copperas Cove	**Dr. John Craft** Superintendent, KISD
Jim Yenopolus Chancellor, Central Texas College	**Abdul Subhani** President & CEO, Centex Technologies	**Ron McNamara** Central Texas Oeprations Mgr., Trideum
Perry Cloud President & CEO, Cloud Construction	**Susan Kamas** Exec. Dir, Workforce Solutions of CTx	**Ben Powers** Program Manager, Geeks & Nerds
Tyrone McLaurin President, Solutions One	**Jay Walker** SVP & Regional Manager, VeraBank	**Bill Kliewer** Chairman, BKCW Insurance Agency

Programming in Design

This section reviews guidance for housing the identified potential users of innovation and research space that could comprise the programmatic “drivers” for physical space that would serve to activate the Research Park innovation ecosystem and establish its linkage to existing university and military related assets.

INTRODUCTION

In 2022, A&M-Central Texas engaged Perkins&Will and HR&A Advisors, Inc. to craft a strategy for establishing a research park on its campus. This work is part of a larger regional effort to bolster innovation and economic development.

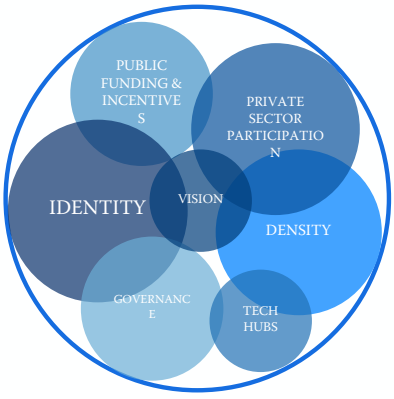
INTRODUCTION

A successful innovation district is **program-driven.**

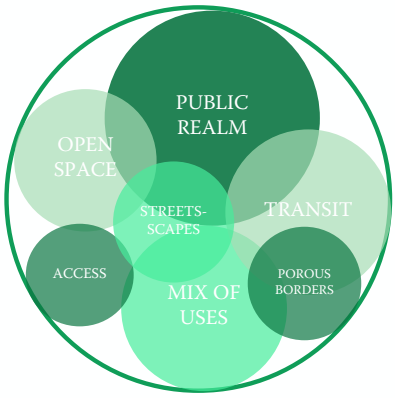
It starts with **mission-driven priorities** that inform campus development and shape the economic market. It requires a **university commitment** and **alignment of resources** to offer a value proposition that sparks market activity, attracts investment, and fuels job creation.

INTRODUCTION

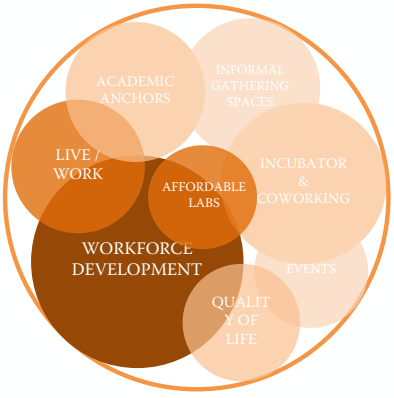
Strong innovation districts have a concentration and alignment of three key asset types: programs, places, and people.



PROGRAM
Partnerships
Financing & Tools



PLACE
Infrastructure
Urban Realm



PEOPLE
Talent & Collaboration
Identity

Source: The Rise of Innovation Districts: A New Geography of Innovation in America. Brookings Institute. 2014.

INTRODUCTION

Military and defense-related technologies are the programmatic key to weave together regional assets and context and create a vibrant research park at Texas A&M – Central Texas: **The Forge**

INTRODUCTION

A&M-Central Texas can achieve the mission of the Forge by capitalizing on the existing cluster of defense assets in the region that are attractive to research and industry.

KEY OPPORTUNITIES AT THE FORGE			
DEVELOP COMPANIES	**PROVIDE WORKFORCE**	**CREATE CONNECTIONS**	**RETAIN TALENT**
			
Local economic growth can be bolstered by **investing in companies researching and developing technology relevant to defense.**	The defense industry in Killeen benefits from institutions that **provide workforce development infrastructure**.	Industry initiatives should **occupy centralized space to facilitate connections and discussions** among their partners.	Education institutions can retain talent locally by **offering academic programs in coordination with defense-related industry.**

INTRODUCTION

Existing market conditions alone will likely not drive the economic results that local leadership seeks but show the potential for a vibrant programmatically-driven Forge that can attract private investment.

MULTIFAMILY

20%
Population Growth in Killeen in Last 10 years

8%
Housing Inventory Growth in Last 10 years

4.7%
Vacancy Rate

OFFICE

1.7M SF
Total Office Space in Killeen

0 SF
Class A Office in Killeen

6.6%
Vacancy Rate

HOSPITALITY

45
Hotels in Killeen

69%
Of Hotels in Killeen are Economy or Independent

$81
Current ADR in Killeen; $15 Below Ft. Hood Per Diem

RETAIL

0%
Vacancy in Nearby Killeen Mall

0
Retail Offerings Within Walking Distance of the Forge

Retail Amenities at the Forge Should Include F&B, Retail and Entertainment

Source: CoStar, Apartments.Com, HR&A

KEY TAKEAWAY #1

A&M-Central Texas should **invest in growing programs at the Forge** that align with military and defense-related industry areas and **drive enrollment** and **grow an attractive talent pool**.

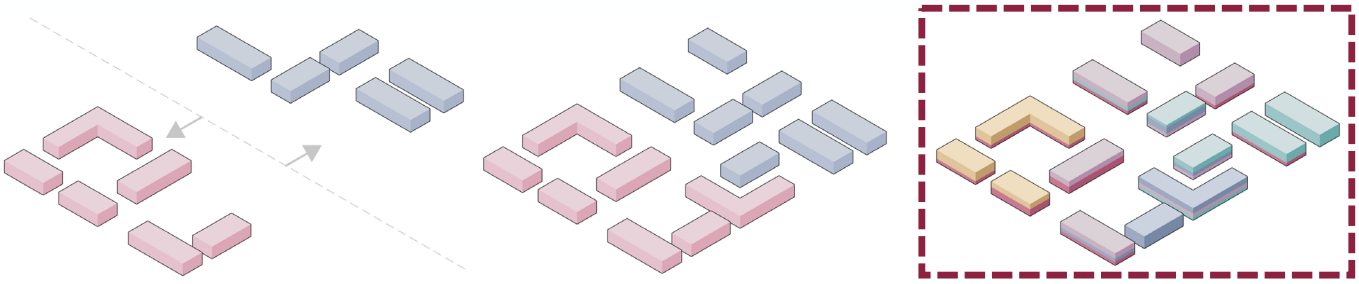
DESIGN FRAMEWORK

Development of the Forge should **facilitate the collision of people and ideas** while celebrating its context and assets.

DESIGN FRAMEWORK

Blending uses within the Forge will strengthen it's ability to facility collisions between people and ideas.

Separate **Adjacent** **Blended**



DESIGN FRAMEWORK

The Forge can leverage the physical plan of campus to provide diverse offerings.

DESIGN FRAMEWORK

Innovation districts across the U.S. are facilitating catalytic phase 1 development with engaging supportive uses including residential, hotels, and recreation.

Centennial Campus | North Carolina State University, Raleigh

- 2M SF of existing office and lab space, with plans to add another 4M
- Home to 75 university centers, institutes, and departments occupying 3M SF of university-owned space
- Hotel, market-rate and student housing
- Supportive restaurants & retail

Research Farm at Cherokee Park | University of Tennessee, Knoxville

- Development began with Institute for Advanced Manufacturing offering office, lab, and conference space
- Two other pads have been developed to date, featuring shared university and industry programming
- Development is driven by public-private partnerships

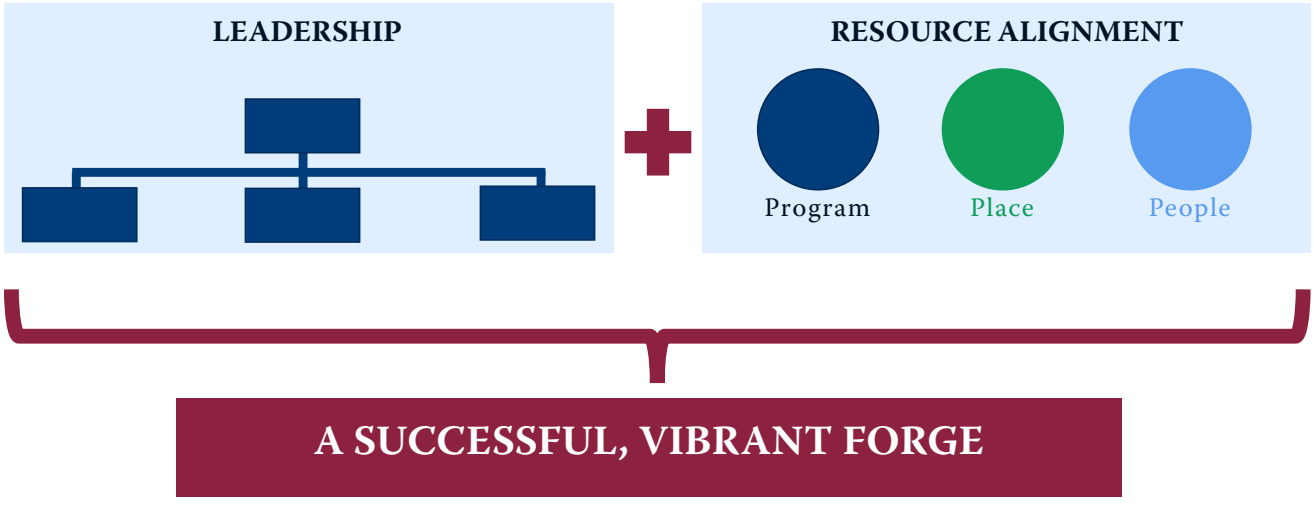
GOVERNANCE

Governance provides **clarity of leadership, decision-making**, and **resource alignment**.

Texas A&M–Central Texas leadership should establish a governance model for the Forge that reflects its goals and capacities.

GOVERNANCE

A leadership framework and alignment of resources are the first two steps in governance at the Forge.

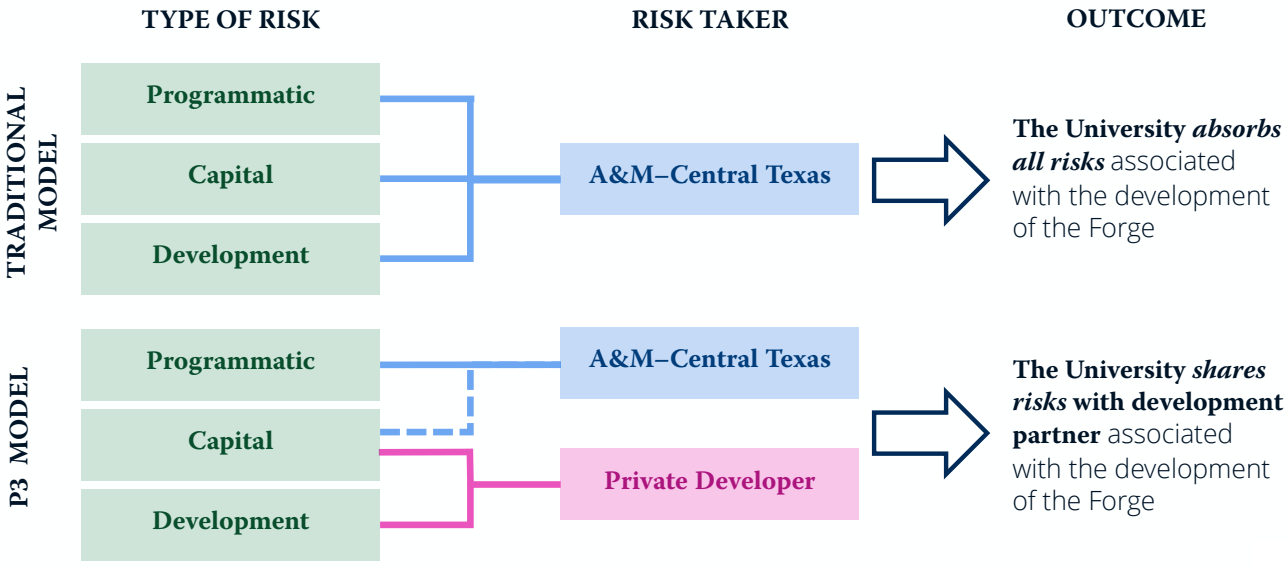


GOVERNANCE

A new executive leadership team for the Forge should work closely with A&M-Central Texas leadership and focus on aligning resources and driving development.

GOVERNANCE

The Forge and University leadership can align resources and appetite for risk with potential delivery mechanisms.



KEY TAKEAWAY #2

A&M-Central Texas leadership should explore how it can **leverage its programmatic resources and funding** to support alternative delivery mechanisms for the Forge.

CONCLUSION

The key to feasible development of the Forge is a **commitment from A&M-Central Texas** to invest in program, place, and people.

CONCLUSION

Three critical commitments from A&M University- Central Texas will greatly increase the likelihood of success at The Forge; the project can still move forward without these but will likely be far less impactful.

PROGRAM

A&M-Central Texas should invest in programs at The Forge (through growth or relocation) that align with military and defense-adjacent industry areas.

PLACE

A&M-Central Texas should create The Forge with placemaking strategies like density that drives collaboration, a mix of uses that activates the campus, and infrastructure that supports the military and defense industry.

PEOPLE

A&M-Central Texas should invest in people who are focused on The Forge and can drive the program and place forward.

CONCLUSION

The next phase of work should begin soon after completion of Phase I to align with the likely conclusion of the current economic cycle.

5. Mobility & Access

Planning for access and improved mobility options is integral for creating a successful knowledge economy. This chapter reviews future parking demands and proposes options for improved alternative mobility options to create a well connected community at Forge.

Parking Demand

Existing Parking Lots

Motorists primarily park in Lots A and B. Lots C, D, E are often unused.

Existing Parking Supply and Utilization

Today, there are over 1,500 parking spaces on campus, spread across five campus lots. Access to 90% of these spaces is managed through a priced parking permit system for students, faculty, and staff. Enrolled students are automatically included and charged for a parking permit. Non-permit spaces are designated as accessible parking, Purple Heart parking, visitor parking, and parking for university vehicles. A&M-Central Texas is responsible for parking enforcement.

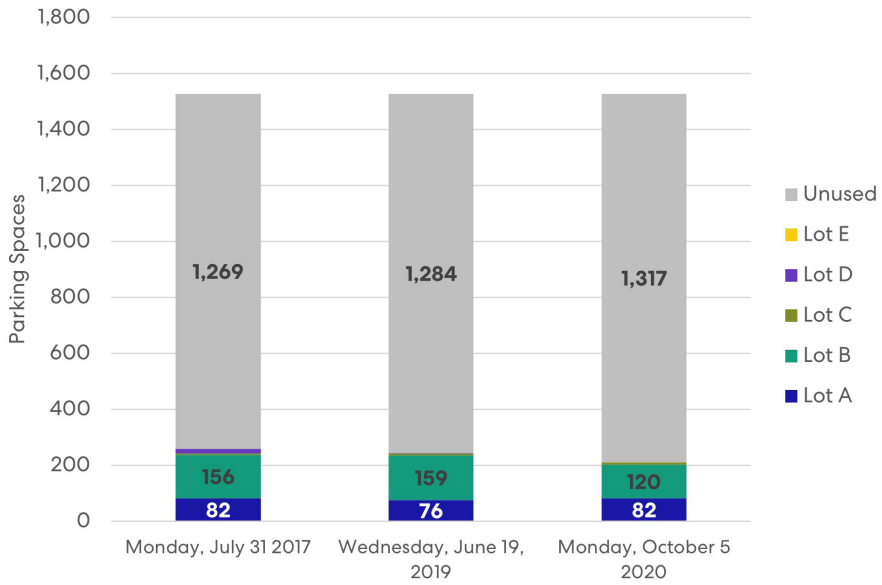
Parking utilization on campus is very low. Peak utilization is approximately 13-17% on weekdays—that means there are typically more than 1,200 empty spaces, even when campus is busiest. Lots A and B account for 90-95% of users, while lots C-E are rarely used.

A&M-Central Texas Parking Supply and Regulations

A&M-Central Texas Parking Permit Pricing (2022)

Permit	Price
Student - 1st permit	$30/ semester ($10 summer)
Student - 1st permit	$15/ semester
Staff/ Faculty	$60/ year

Existing Parking Regulations



Weekday Parking Utilization, 2017-2020

Source: *Nearmap Aerial Imagery Counts*

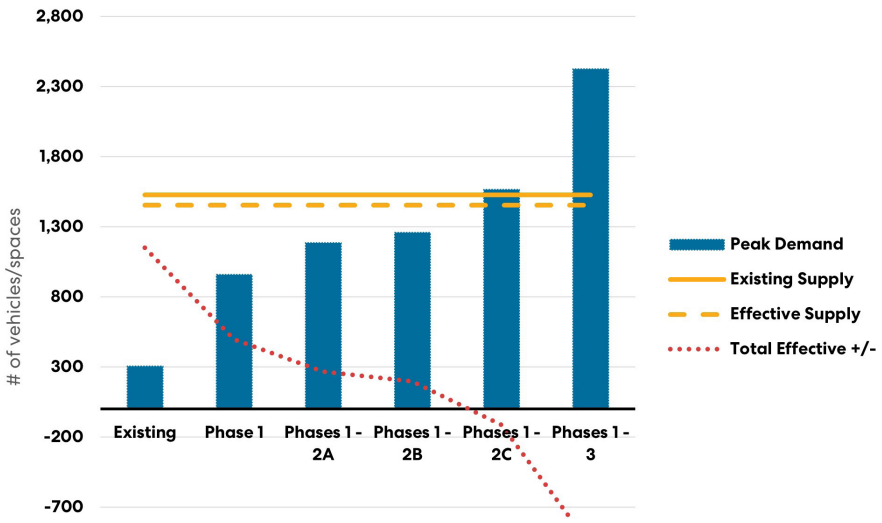
Future Parking Demand

As campus grows, future parking demand at the A&M-Central Texas campus will depend on a variety of factors which have yet to be determined. These include the types of future research and offices tenants, the residential unit size and target market of future residential components, the future proportion of full time, part time, and online students, and the future daily/weekly academic schedule. However, based on past campus travel patterns and parking demand trends, there is ample opportunity to accommodate parking demand for much of the planned future campus growth with existing parking spaces.

To estimate future parking demand and identify where and when new parking supply may be needed, the project team created a parking model. The model is based on historical parking use at A&M-Central Texas, observed regional travel behavior, campus shared parking opportunities, and industry-standard parking demand generation rates. Based on this analysis, the project team recommends leveraging existing parking spaces to support future campus development through all of the proposed Phase 1 and part of the Phase 2, and planning for up to four new parking lots at full build out. In all, it is recommended that a total of 1,020 parking spaces be constructed to support development in Phases 2 and 3.

These future parking recommendations are based on best available assumptions about future peak parking demand, plus an additional 5% buffer (which helps ensure that people can readily find an available space at peak times) to calculate the "effective supply" needed for each phase of campus growth.

The recommendations also reflect the benefits of a shared parking approach and the park-once nature of the campus, in which spaces are actively managed to meet the needs of multiple users over the course of the day and all uses are within a reasonable walk shed of shared parking facilities. For example, some of the same parking spaces can be shared between residents living in future campus housing, who have the greatest parking need in the evenings and overnight, and future employees working at the research park, whose parking need is greatest on weekdays between 9 a.m. and 5 p.m.



Future Parking Demand vs. Existing Parking Supply

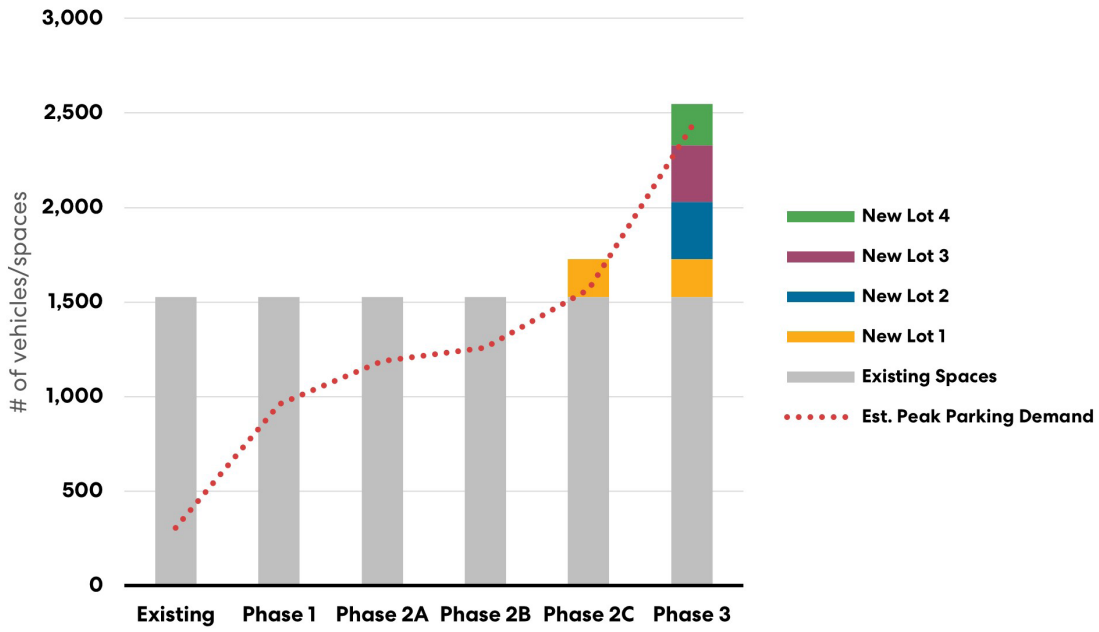
	Today	Phase 1	Phase 2	Phase 3
Existing Spaces	1,528	1,528	1,528	1,528
Peak Parking Demand	306	959	1,566	2,427
New Spaces Needed*	0	0	+116	+1,020
New Lot#1	-	-	200	200
New Lot#2	-	-	-	300
New Lot#3	-	-	-	300
New Lot#4	-	-	-	220
Total Parking Spaces	**1,528**	**1,528**	**1,728**	**2,548**
Est. Peak Utilization	20%	63%	91%	95%

* Estimates for new spaces needed include a 5% "buffer" to make it easier for motorists to find an available space even at peak times.

Existing and Proposed Parking, by Phase

Top Findings

- Today, there are over 1,500 parking spaces on campus. Utilization in those spaces is very low, ranging from approximately 13-17% on weekdays—which means there are typically more than 1,200 empty parking spaces even when campus is busiest.
- Parking is managed through a paid permit system. Enrolled students are automatically included and charged for a parking permit.
- There is ample opportunity to support much of the planned future campus growth with existing parking spaces. Based on best available assumptions, no new parking supply may be needed until the later stages of Phase 2 of campus development. By full build-out, it is estimated that a total of 1,020 parking spaces be constructed.
- Existing traffic volumes on TX-201 are very low. There is available vehicle capacity on TX-201 and TX-195 to support all future campus growth.
- Today, the only points of access to campus are on TX-195. The primary eastern entrance has incomplete sidewalks, a narrow crosswalk on only one leg of the intersection, no pedestrian-scale lighting, and no refuge area for pedestrians.
- Safety on campus-adjacent roadways is a growing concern. Since 2016, crashes on TX-201 and TX-195 near A&M-Central Texas campus have become more frequent and more severe.
- Most trips in the region, both commute and non-commute, are either drive-alone or multi-passenger personal vehicle trips, with limited bicycle and transit use.
- Today, none of the existing transit services in the region serve A&M-Central Texas campus. As campus grows and new land uses are added, there may be opportunities to create a direct transit or shuttle connection between campus to Fort Hood or other destinations in the Killeen/Temple area.
- Bicycle and pedestrian connections to campus are very limited. As the region grows, bicycle and pedestrian connectivity to other neighborhoods near campus will require significant new infrastructure investments.
- The pedestrian network on campus is strong with ample shade, landscaping, and wide paths that make biking and walking pleasant and safe. These facilities support an existing and future “park-once” campus.



Future Parking Demand and Recommended Supply by Phase

Recommendations

As the mix of uses on campus evolves, travel patterns to and from A&M-Central Texas campus will change. Nonetheless, driving and parking will likely continue to be the primary mode of access to campus. Balancing the parking supply with future demand will be key—building too little parking will limit growth and create frustration for campus visitors, but building too much will create excess costs, consume excess land and natural resources, and over-incentivize driving. A phased parking strategy, supported by periodic parking data collection to monitor use and guide planning decisions, should be used to maximize the utility of existing spaces and support future growth without over-building parking.

A right-sized and cost-efficient parking system—combined with a well-connected pedestrian-friendly campus plan and long-term investments in carpooling, biking, and shuttle services—will support A&M-Central Texas's long-term vision as a dynamic center for academic excellence combined with innovation and community growth.

Parking

1. Leverage existing parking supply to support initial phases of expansion.

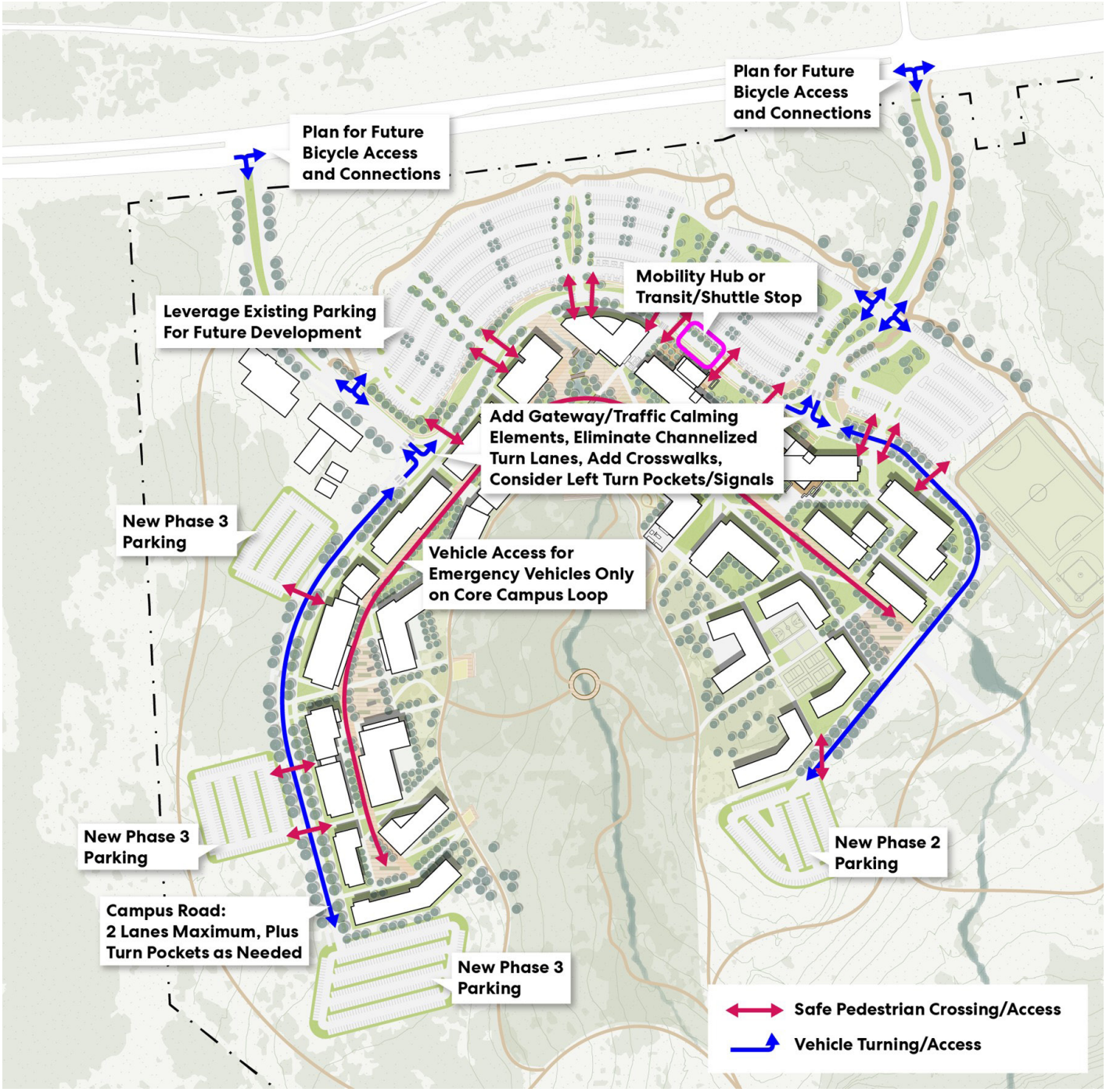
The existing campus parking supply, which includes over 1,500 spaces, was built to accommodate long-term growth and is dramatically underutilized today. At the busiest times, fewer than 20% of spaces are in use—leaving more than 1,200 spaces empty and available. The drawing to the right summarizes the estimated parking supply and demand forecasts by project phase.

- With effective parking management, existing spaces will likely support all campus uses through most of the Phase 2 development, with one new facility of approximately 200 spaces recommended near the end of Phase 2.
- Phase 3 expansion will require approximately 820 additional spaces, which are recommended to be spread across three new facilities along the western edge of the site. At full build-out, approximately 1,020 total new parking spaces are recommended to support future growth.
- Monitor parking demand over time through periodic manual counts or new parking technology systems. Update projections over time to ensure future build is right-sized to development phasing and affiliate travel behavior.

2. Manage parking with permits and/or pricing to better distribute demand.

The Plan envisions a walkable, pedestrian-friendly campus that leverages parking lots on the periphery and minimizes vehicles in the campus core—A&M-Central Texas should expand the existing parking permit system and leverage it to support this vision. An expanded parking permit system should:

- Continue to avoid reserving individual spaces for most users. As described in other recommendations, reserving some of the most convenient spaces within each parking lot for priority users—such as carpool users or shared rides—helps reward and incentivize those uses. As new types of affiliates begin commuting to and from campus, such as employees at the Research Park, A&M-Central Texas should avoid reserving specific spaces for those users. Maintaining a flexible permit system that embraces a shared parking approach within each facility will maximize the utility of the parking supply.
- Support a park-once environment. A permit system that strategically prioritizes access to parking facilities for specific affiliate groups can help ensure campus-goers do not drive short distances between on-campus destinations. For example, a resident-specific parking pass could ensure that students who live on campus can park close to home while also ensuring that those same students do not drive their vehicle the short distance to another campus lot to get to class.
- Require purchase of a parking permit for all new Research Park employees.
- Use tiered pricing to distribute demand across campus parking facilities and ensures that an available space is always within convenient walking distance from all campus destinations. While this system does maximize shared parking opportunities, it also creates the potential for users to have difficulty finding a space close enough to the front door of their destination to be practical.
- As campus grows, a tiered permit system that helps manage demand in specific facilities will maximize the usefulness of all spaces and ensure that the parking experience is user-friendly for everyone. For example, Lot C, D, and/or E may require a lower permit rate to incentivize their use and distribute demand evenly.
- Leverage pricing to manage demand and align with



Parking and Mobility Recommendations

management costs. In the near-term, A&M-Central Texas should consider reversing the current system from "opt-out" to "opt-in," which will prompt campus-goers to more actively consider their choices about how to get to campus. More flexible permit structures such as weekly or monthly permits can also help meet the unique needs of more types of affiliates.

- The price of a permit should reflect the full cost of managing the parking system, including enforcement costs, administrative costs, and facility maintenance costs. As campus grows and other travel options (such as shuttles, carpooling, and bicycling) become available, the parking permit pricing structure can also be used to incentivize campus-goers to consider other travel options.

3. Provide dedicated, conveniently located spaces for carpool/vanpool users, and support shared rides with incentives.

A&M-Central Texas should designate a portion of spaces within each parking lot as carpool/vanpool spaces. These spaces should be close to campus buildings to incentivize and reward shared rides, which reduce parking demand and help build relationships between students. Initially, A&M-Central Texas allocate about 1% of total supply (2-5 spaces per lot) for carpool and vanpool users, and adjust this supply as needed based on use. Carpooling should also be supported and incentivized by:

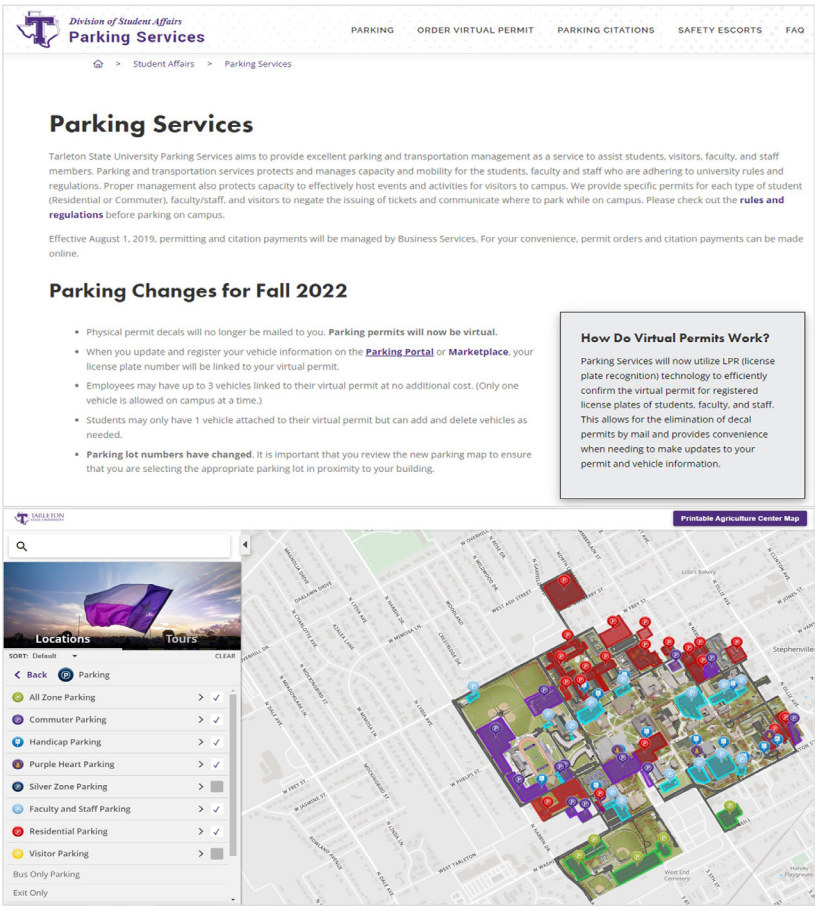
- Providing ride matching services that help students, faculty, residents, and office workers find other campus-goers with similar commute patterns. These services could be administered manually by A&M-Central Texas through a spreadsheet-based or bulletin board-style system or through a digital ride-matching service such as RideAmigos or Liftango (discussed in greater detail below).
- Leveraging key points of contact with affiliates, such as during the parking permitting process, to inform people about carpooling opportunities and encourage them to opt into the program.
- Incorporating discounts or other financial incentives into any parking pricing system, such as offering reduced or free rates for carpool users.

4. Invest in state-of-practice parking technology, wayfinding, and enforcement systems.

As A&M-Central Texas grows and new types of uses are incorporated the campus, parking management will become more complex. As needed, A&M-Central Texas should invest in the necessary tools and support systems to maintain healthy and efficient parking operations. These tools and systems should include:

- An online permit management system that is compatible with License Plate Recognition (LPR) enforcement. Such a platform will help establish a "virtual" permit system that is user- and management-friendly.
- An LPR-equipped enforcement vehicle. While upfront costs for this technology are high, LPR would significantly reduce labor costs, improve compliance with regulations, and allow for automated occupancy data collection.
- Updated parking information and wayfinding tools that provide user-friendly information and direct motorists to available parking. Wayfinding options include static, directional, informational per lot, arrival/entry, and digital message signs. Digital signage would allow for continually updated real-time information, be integrated across facilities, and facilitate distribution to websites and mobile apps. All signs and wayfinding tools should be branded and marketed in coordination with the overall campus branding system.

University Parking Wayfinding and Technology Systems



Virtual Permit System

Tarleton State University transitioned to a virtual permit system in Fall 2022, allowing affiliates to manage their accounts online. Parking staff no longer administer or enforce physical parking decals. The parking website also includes an interactive map with detailed information on parking regulations by facility.

Transit and Shared Rides

1. Explore a A&M-Central Texas rideshare matching program.

A carpool or vanpool matching platform to facilitate shared rides among affiliates can help reduce traffic volumes, make commutes more accessible, and reduce travel costs. Shared rides can be especially valuable for those travelling to and from lower density neighborhoods and/or from longer distances where public transit is not a convenient option. This service would be well-suited in the greater Killeen area, where daily travel patterns are polycentric, major nodes generate clusters of trips, and there are no "core" transit services available.

Numerous platforms exist, such as RideAmigos, that allow for carpool matching in a closed system so that A&M-Central Texas affiliates can identify a ride and/or passengers specific to campus and their travel schedule.

Ridehail companies, such as Lyft or Uber, also allow universities to provide subsidies through voucher codes for shared affiliate rides.

2. Establish an Emergency Ride Home (ERH) program.

A subsidized emergency ride home can help affiliates pay for a taxi/ridehail service if they do not drive alone to campus and need to leave suddenly or leave campus during late hours. Ridehail companies, such as Lyft or Uber, allow universities to provide subsidies through voucher codes for affiliate ERH rides.

3. Partner with Hill Country Transit District to provide direct transit service to A&M-Central Texas via the HOP.

The HOP currently provides transit service to the greater Killeen region via 10 fixed bus routes, one flex route, as well as paratransit and rural demand response. However, there is no direct transit to A&M-Central Texas.

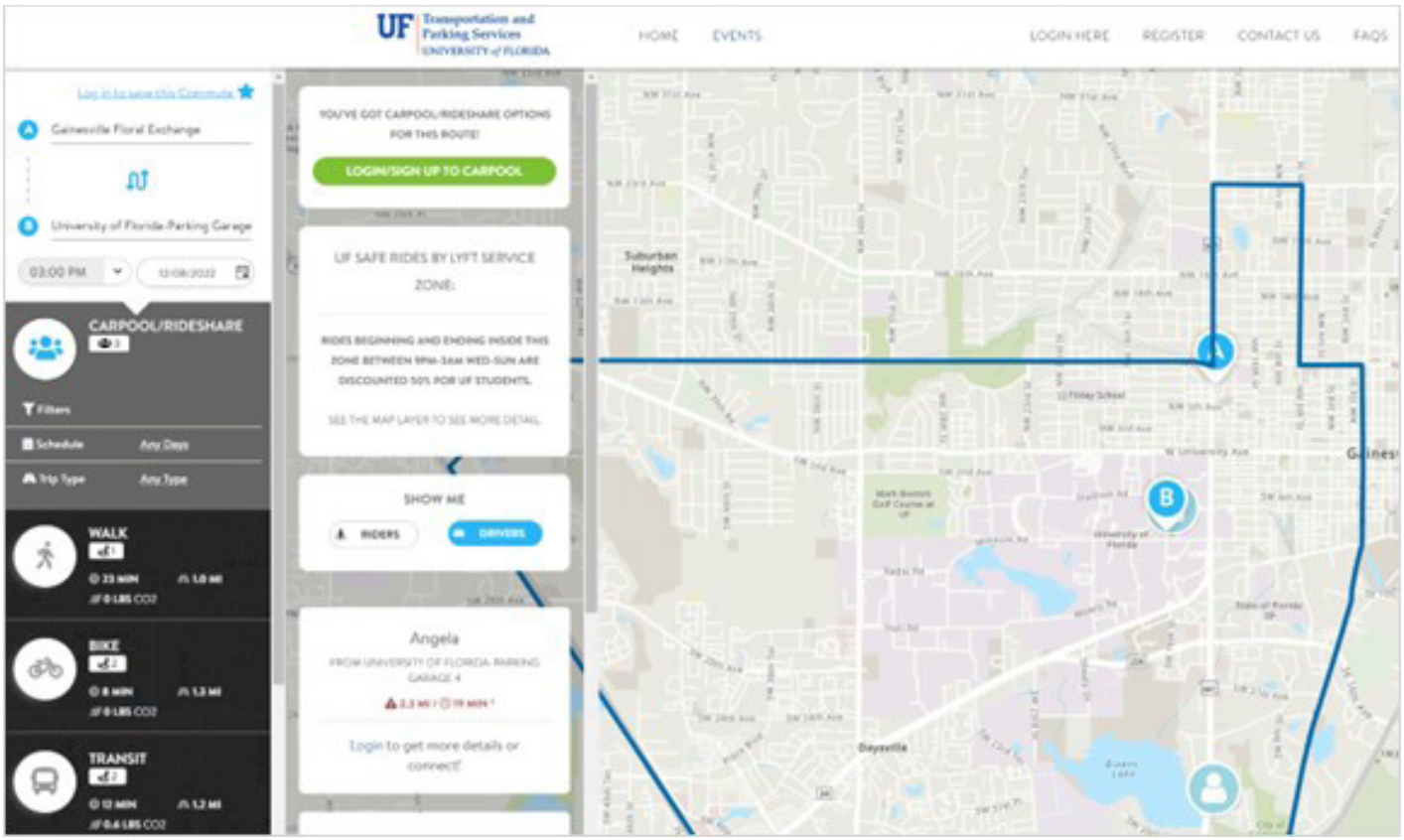
Direct transit service can help reduce traffic to campus and support equitable access for A&M-Central Texas affiliates who do not own or have access to a vehicle. As campus and the Research Park grows, transit service can also better connect A&M-Central Texas with Fort Hood, facilitating cross-campus collaboration and partnership. Key actions steps include:

- Identify priority service areas, such as those with high(er) density of A&M-Central Texas affiliate residences. Potential markets may be a direct shuttle between A&M-Central Texas and Fort Hood, local to Killeen and Temple, and/or south along the SH 195 corridor towards Georgetown and Round Rock.
- Conduct a transit survey with A&M-Central Texas affiliates to identify key markets and affiliates needs.

- If feasible, partner with The HOP to plan the service, including its routing (fixed-route vs. micro-transit), stops, span and frequency, and vehicle types.
- Create a transit hub on campus that includes rider amenities such as shelters, landscaping, seating, real-time transit information, bicycle parking, lighting, and signage. A transit hub that is a well-designed public space can help make waiting for buses or shuttles feel comfortable, safe, and enjoyable.
- As shown in Figure 19, a priority location for a mobility hub in the short-term would be in front of Warrior Hall. This location may require reconfiguration of Leadership Place to create space for a bus pull-out and waiting area, shelter, bike parking, and other shared mobility services.
- As needed, explore cost-sharing agreements or alternative service models, such as third-party contract services.

4. Evaluate a transit pass subsidy and/or program for A&M-Central Texas affiliates.

While The HOP does not provide direct service to A&M-Central Texas, affiliates, especially those without vehicles, may utilize the existing system for access to daily services across the region. The HOP standard fare is $1.00, but a variety of discount passes are available, including a monthly Student Pass (ages 13-19) for $25. A&M-Central Texas should partner with The HOP to extend this pass option and affordable access specifically to A&M-Central Texas students and affiliates. A pass program will be especially valuable if direct transit service comes to A&M-Central Texas.



Shared Rides

(Above) The University of Florida partnered with RideAmigos to provide a suite of transportation services for affiliates, including rideshare matching.

(Below) VIA Link provides ridesharing services for the University of Texas at San Antonio.

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Biking and Walking

1. Continue to partner with the City of Killeen and TxDOT to improve safe and direct access to campus. The A&M-Central Texas campus is in an area with limited development and proximate land uses. Some residential and commercial/retail exists along the TX-195 corridor to the south and east (2-3 miles away) and some residential development is located to west along Clear Creek Road (1-2 miles away). No sidewalks or bike lanes are available along the roadways that connect to A&M-Central Texas

As A&M-Central Texas grows and the surrounding area is developed, A&M-Central Texas should work with TxDOT and the City of Killeen to ensure that new and existing roadways maximize safety for all users. Roadways and intersections connecting to the campus should be designed to reduce vehicle speeds, provide for safe turning movements, accommodate safe crossings, and include sidewalks and bike lanes where feasible.

At the campus entrance intersections, improvements should include high-visibility crosswalks, pedestrian refuge islands, pedestrian-scale lighting, bulbouts and reduced turning radii, and improved wayfinding.

2. Maximize pedestrian and bicycle travel on campus and prioritize a park-once environment.

A&M-Central Texas should prioritize a walkable campus and park-once environment, ensuring that affiliates have convenient access to parking, but then circulate on campus without a vehicle. This approach will be crucial to minimizing internal vehicle trips and traffic as the campus grows and diversifies its land use mix and trip types.

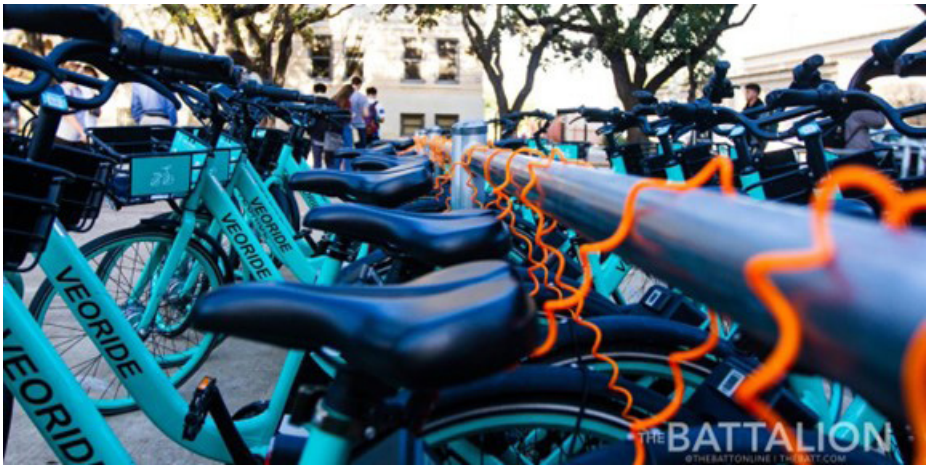
The campus core currently has a strong network of shared-use paths with ample shade and landscaping. However, as one moves out of the core, connections to the periphery and the parking lots can be improved to ensure safe and convenient movement. Key actions include:

- Implementation of extended and new pedestrian and bicycle paths within the campus core for shared bicycle and pedestrian use.
- Enhanced connections to and from the parking lots, including:
  - Sidewalks of 6-10’ along both sides of Leadership Place
  - High-visibility and raised crossings at intersections and mid-block crossings
  - Reduced crossing distances, smaller curb radii, and removal of vehicle slip lanes at major intersections along Leadership Place
  - Provision of pedestrian-scale lighting and trees

- Provision of active trip amenities, including bike parking, showers, and lockers

3. Consider a shared bike and scooter program.

As the campus grows and residential and offices uses are added, shared bikes and electric scooters may have strong appeal to affiliates to circulate on campus. Given the compact scale and flat topography of A&M-Central Texas, shared bike and scooter programs can also support the park-once approach and facilitate easy access to parking facilities. Multiple service models are available, including smart lock and free-floating or smart kiosk systems. Numerous vendors, such as Veo, BLOOM, and BCycle, work with universities and employers to operate campus bike share programs.



Shared Bike Program

BCycle provides bike sharing services at The University of Texas, San Antonio. Veo serves the Texas A&M campus.

Image Source: *The Express News (top) and Kaylee Cogbill (below)*

Campus Access

1. If needed to support long-term campus growth, evaluate new access points on the east side of campus at TX-195.

Today, access to campus is available by two access drives on the north side of campus. These existing access points are expected to provide sufficient roadway capacity to support all phases of proposed Research Park development, and no new vehicular access points are recommended on the west side of campus at this time.

In the future, as campus continues to grow and adjacent areas are considered for redevelopment, there may be a need for additional access points on the west side of TX-195. If a new access point is deemed necessary in the long term, the following principles should be integrated into access design:

- Prioritize safety for all users. Crashes on TX-195 are becoming more frequent and more severe, and they are most likely to occur at intersections. As campus grows and transportation patterns shift, the increased presence of new types of roadway users—such as pedestrians and bicyclists—will present even more safety concerns. A new campus access point to the west should include design features to mitigate vehicular speeds and promote safety for all users, including:
  - Installing gateway treatments at key entry and transition points (such as median islands)
  - Limiting the roadway to two travel lanes and slowing vehicle speeds on intersection approach (11-12' width per lane)
  - Designing the TX-195 intersection as an at-grade signalized intersection with single leg crosswalks at all approaches.
- Support multimodal access with bicycle and pedestrian infrastructure. Today, pedestrian and bicycle connections to campus are not available. A new access point should plan for non-vehicular users by providing safe, highly visible pedestrian and bicycle features, including sidewalks, that help provide safe multimodal access to and from campus.
- Mitigate the potential for cut-through traffic. The proposed Research Park Plan envisions a people-oriented walkable and bikeable campus network that limits vehicular speeds and access on core roadways. Creating a new access point to the west may create the potential for vehicles cutting through campus to get between TX-195 and TX-201. Traffic calming features, including speed humps, chicanes, curb extensions, and raised pedestrian crossings, can reduce vehicle speeds along any new access routes and preserve the walkable, bikeable internal campus network.

Example Traffic Calming Measures

Separated bike lanes, raised pedestrian crossings, chicanes, and curb extensions are all infrastructure treatments that can slow vehicle speeds, improve safety, and minimize cut-through traffic from any potential western access point.

6. Engineering Plans

Infrastructure Plans
Fire Lane Coverage
Water Line
Sanitary Sewer
Storm Sewer
Data Duct Bank
Electric Duct Bank
Sanitary Sewer Flows

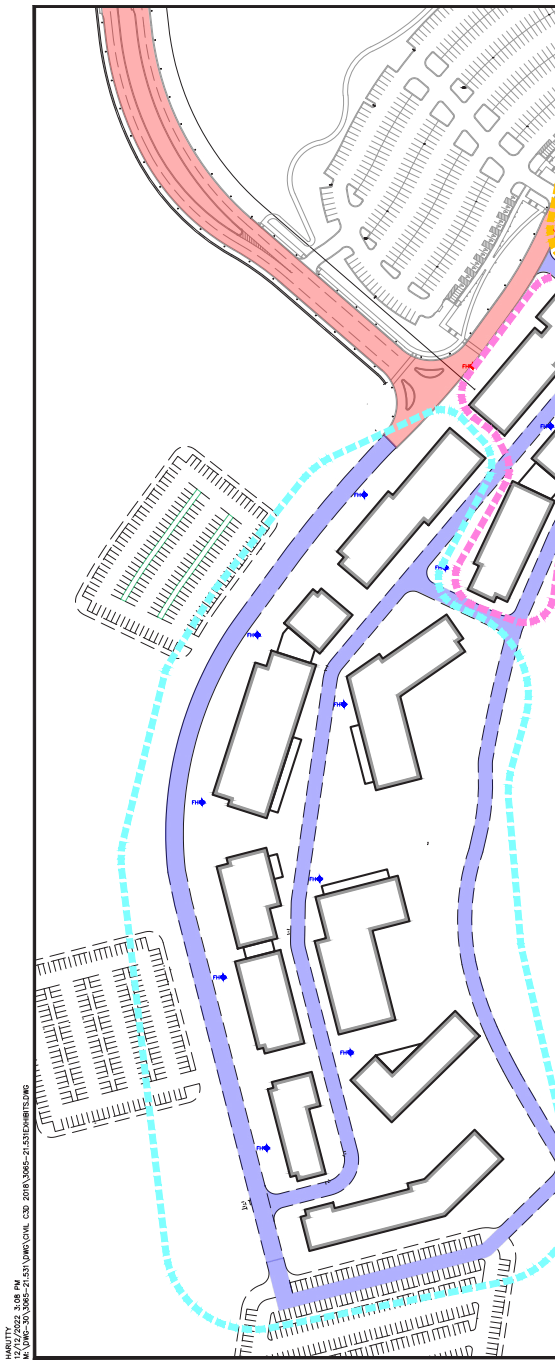
Construction Cost
Cost by Phase
Additional Information

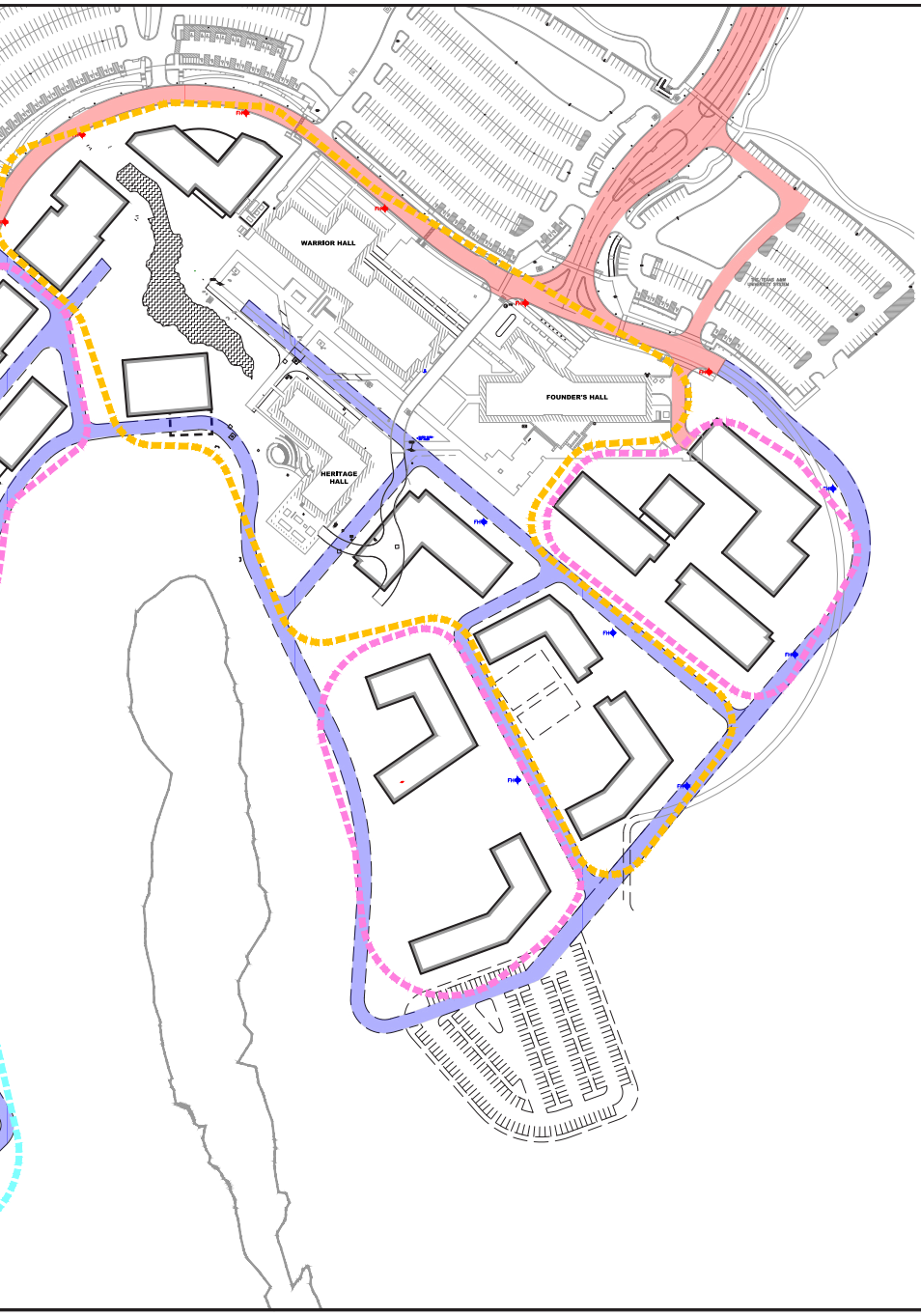
Development of the place housing Forge research park will require certain infrastructure to support various functions in the blended community. The following are the plans required to moved towards building out the community and costs which will be associated with these infrastructural needs at each phase.

Fire Lane Coverage

New fire lanes will be required throughout the project and the main street and prioritized pedestrian street shall serve as the primary fire lanes for the new buildings. In addition, a proposed multi-surface fire lane is proposed around the inner portion of the buildings that will follow a pedestrian trail route. It is anticipated this fire lane will be a combination of grass-pave, gravel-pave, and concrete to achieve a more natural trail look due to its proximity to the creek and the proposed pedestrian use. It is anticipated that new fire lanes will need to be provided within 150 feet to 200 feet of all exterior portions of buildings. In some areas, hammerhead fire lane conditions may be required to achieve the necessary fire coverage for a couple of buildings.

A conceptual fire lane layout is shown in the following exhibit.





N

0 50 100 200 300

GRAPHIC SCALE IN FEET

LEGEND

- PROPOSED FIRE LANE
- EXISTING FIRE LANE
- EXISTING BUILDING
- PROPOSED BUILDING
- PHASE ONE
- PHASE TWO
- PHASE THREE
- WATER FEATURE

NOTE:
FIRELANE LAYOUTS SHOWN ON THIS PLAN ARE CONCEPTUAL IN NATURE. A&E TEAM SHALL VERIFY DURING THE DESIGN OF EACH BUILDING/PROJECT PHASE THAT ADEQUATE FIRE LANE COVERAGE IS PROVIDED.

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TEXAS REGISTRATION NO. 135544
DATE: 12/12/2022

TX REG. ENGINEERING FIRM F-469
TX REG. SURVEYING FIRM LS-10008000

FIRE LANE COVERAGE

RESEARCH PARK MASTER PLAN

TEXAS A&M CENTRAL UNIVERSITY

DESIGN CONCEPTS

CITY OF KILLEEN, BELL COUNTY, TEXAS

DESIGN	DRAWN	DATE	SCALE	NOTES	FILE	NO.
JJL	HAR	NOV. 2022	1"=100'			EX 1

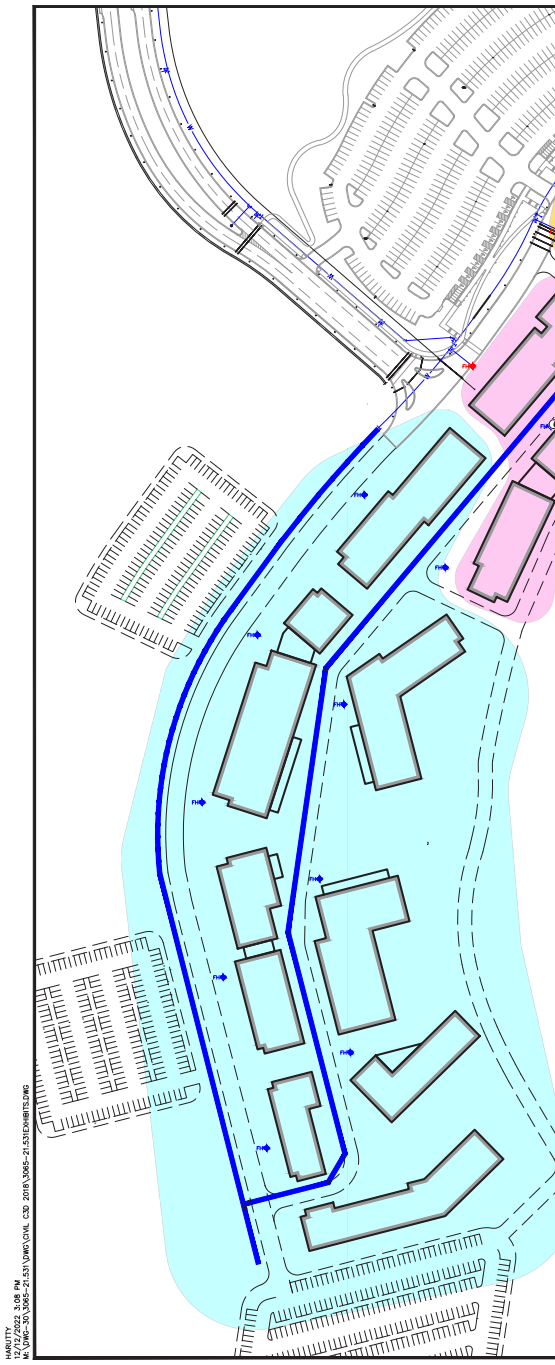
PK FILE: 3065-21.531

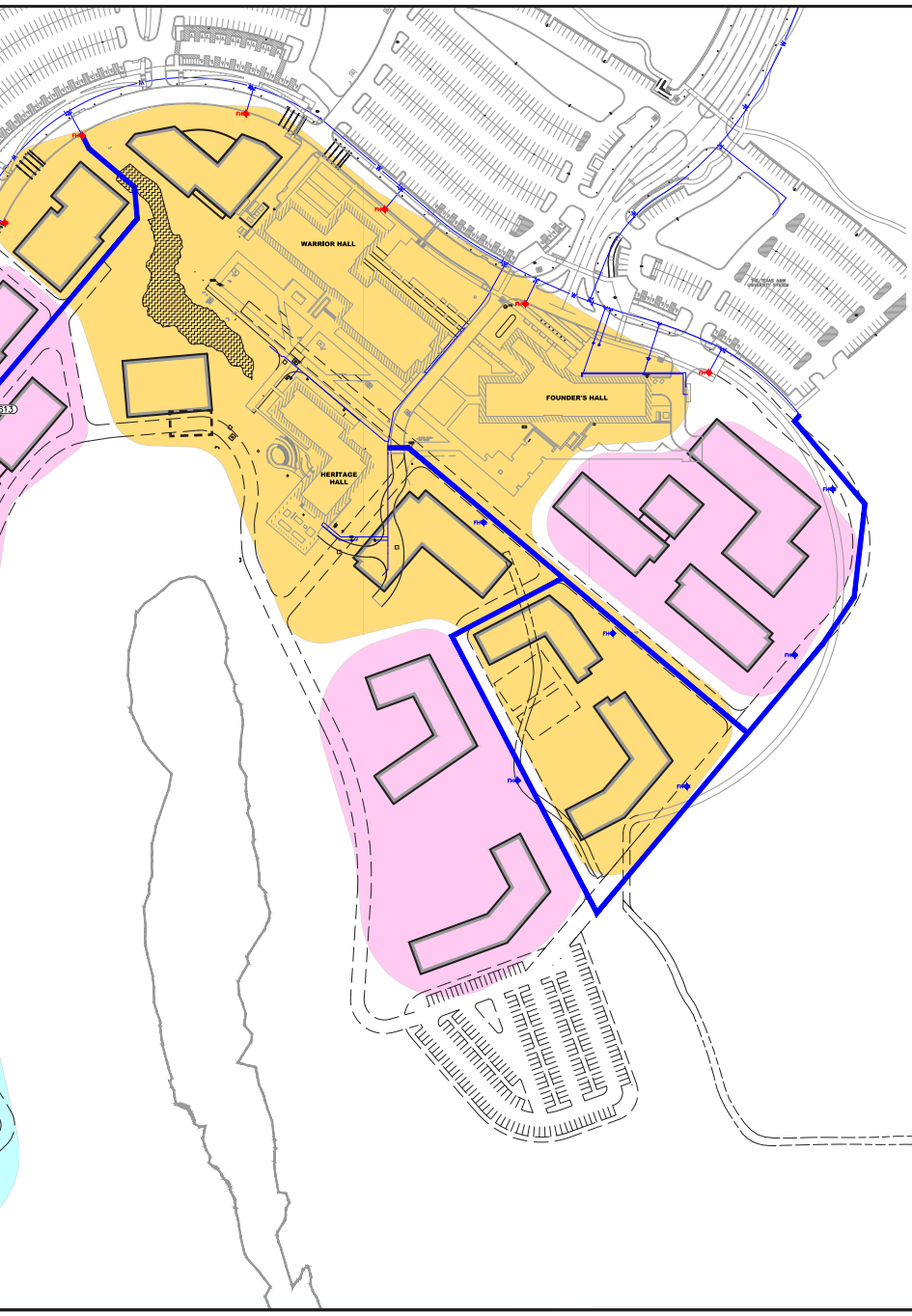
Water Line

Existing water service is provided by the City of Killeen. There is an existing 12” water loop that runs through the developed portion of campus today. This water loop enters the campus from Clear Creek Road on West Campus Drive and loops back out through East Campus Drive. With the addition of the new development as part of the research park project, it is recommended to add new water loops within the campus to provide the best water pressure and water quality conditions to all new buildings. As part of the research project, new 12” water mains will be looped on both the east and west sides of campus. The 12” water loops will utilize the main street and pedestrian prioritized street as corridors to serve the proposed building domestic and fire services.

As part of the fire coverage for the buildings, new fire hydrants will need to be installed along all fire lanes at approximately 500-foot intervals. Some dead-end fire mains may be required to serve fire hydrants along hammerhead fire lane conditions if adequate fire hydrant coverage can’t be provided along the main water corridors.

A conceptual water layout including proposed fire hydrant locations is shown in the following exhibit.





N

0 50 100 200 300

GRAPHIC SCALE IN FEET

LEGEND

- EXISTING WATER LINE
- PROPOSED WATER LINE
- EXISTING FIRE HYDRANT
- PROPOSED FIRE HYDRANT
- EXISTING BUILDING
- PROPOSED BUILDING
- PHASE ONE
- PHASE TWO
- PHASE THREE
- WATER FEATURE

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WATER LINE EXHIBIT

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JJL	HAR	NOV. 2022	1"=100'			EX 2

PK-3065-2K55\EXHIBITS\3065-EX2.DWG

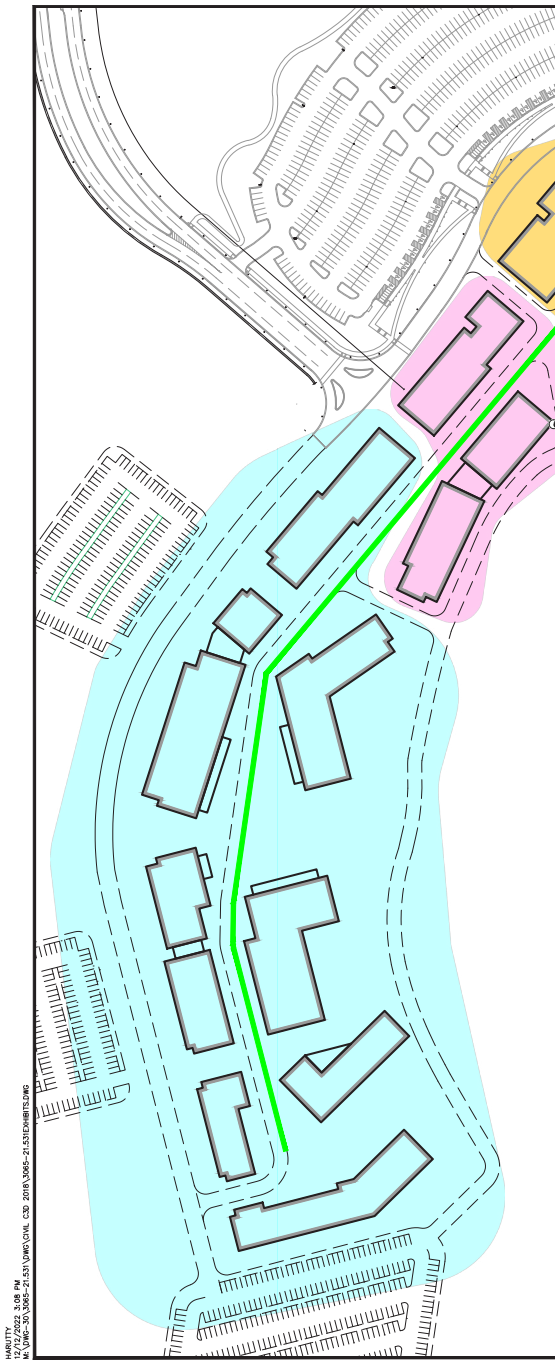
Sanitary Sewer

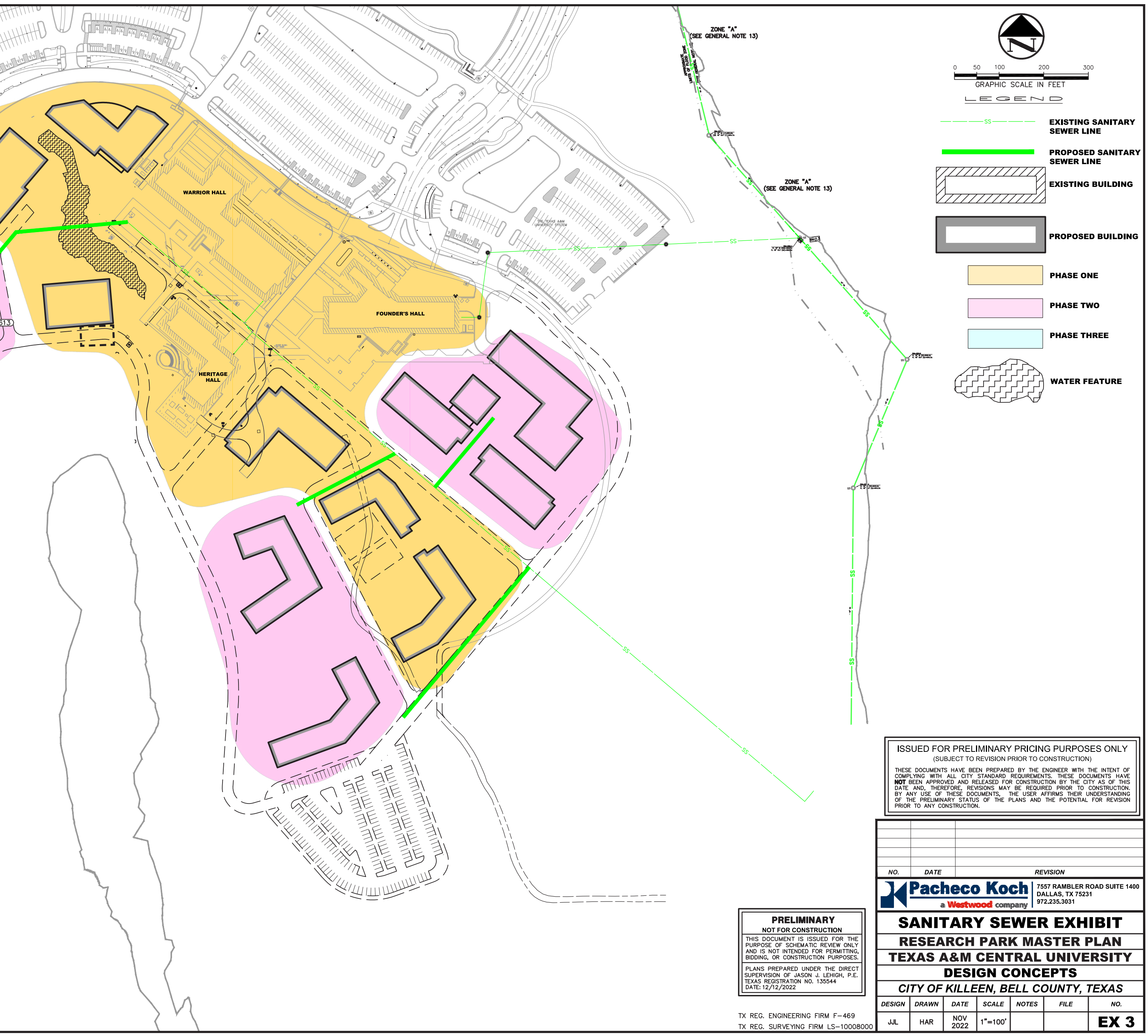
As part of the existing campus, sanitary sewer mains were installed with future campus growth in mind. The Warrior Hall project extended a sanitary sewer main to the southwest corner of the building to help serve future growth to the west on campus. As part of the research park project, the 12” sanitary sewer main will need to be extended to provide adequate service to the new buildings. The new extension should be located down the pedestrian prioritized street to provide adjacency to all new buildings.

The buildings located at the furthest southwest portion of campus will need to have shallow services to allow for the main to gravity flow to the existing sewer tie-in location. If shallow services are not feasible, an alternate route along the south limit of the research park project may be an option to get back to the public main on the eastern portion of campus.

The eastern portion of the research park plan is immediately adjacent to the existing 12” main that was installed as part of the Warrior Hall project. Due to this proximity, shorter sanitary sewer spines will serve the new buildings on this portion of the campus.

A conceptual sanitary sewer layout is shown in the following exhibit.





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SANITARY SEWER EXHIBIT
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DESIGN	DRAWN	DATE	SCALE	NOTES	FILE	NO.
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PK-3065-21_531

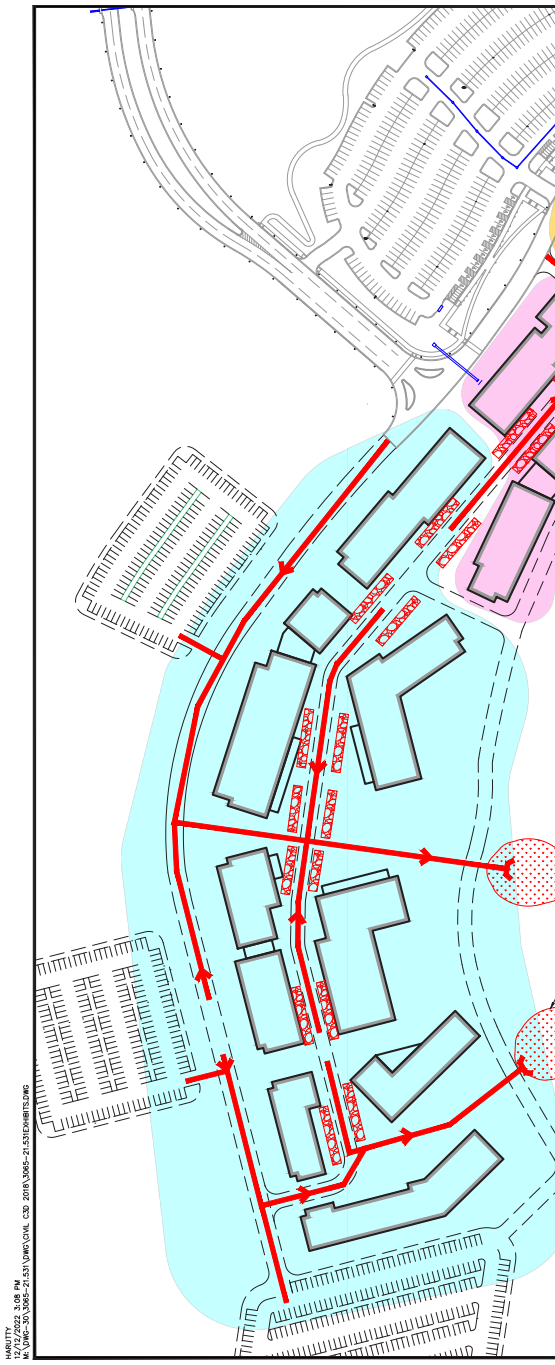
Storm Sewer

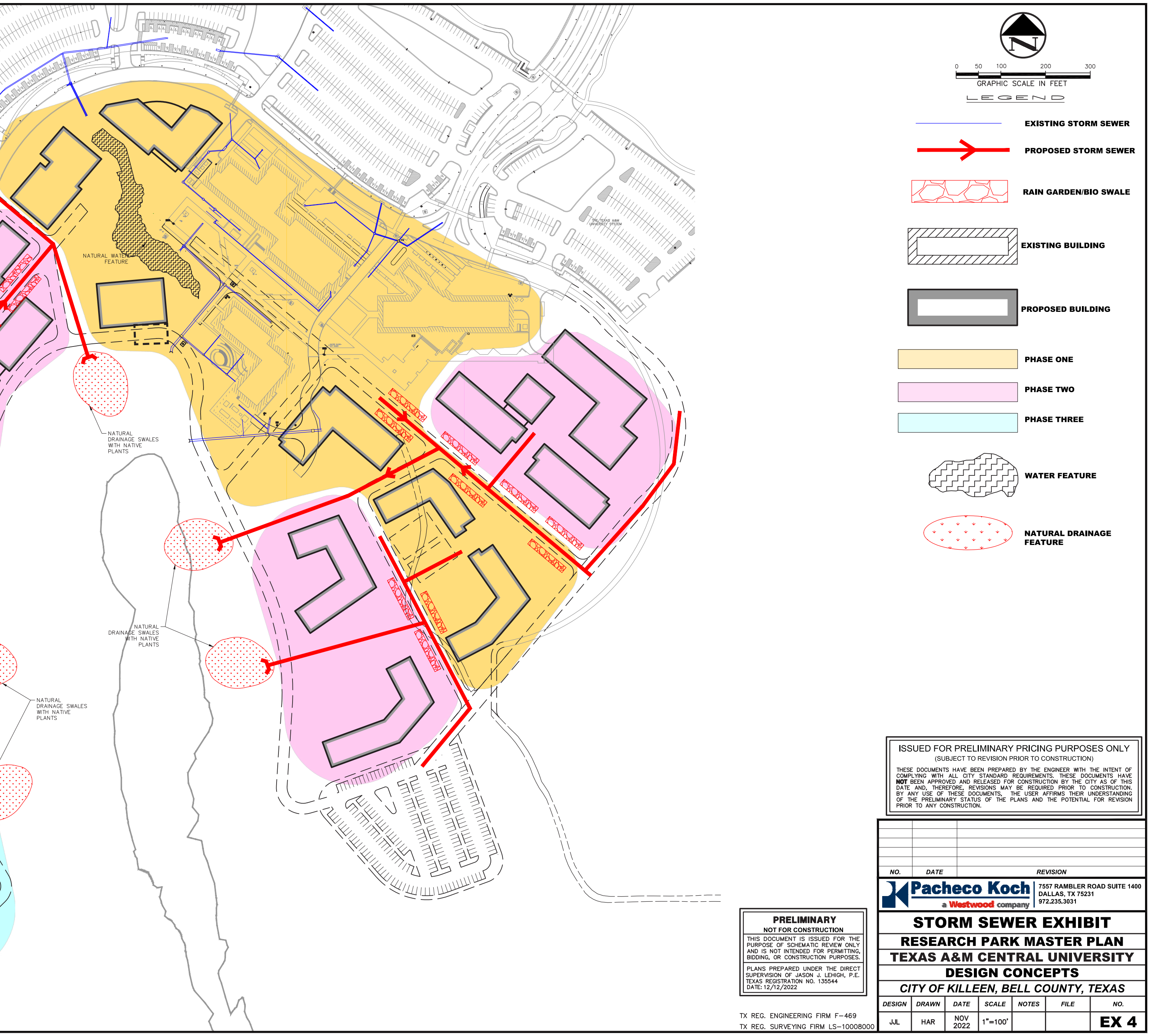
As part of the campus master plan, there was an emphasis on prioritizing strategies which reduce stormwater runoff quantity which included rainwater harvesting. It is recommended that as part of the research park, that prioritization remain a focal point in design. In addition, the Research Park project shall provide drainage swales that emulate natural ground conditions on-site and bioswales surrounding pedestrian corridors. The implementation of these features will help improve water quality from storm runoff.

The bioswales on site will generally be made up of native plants and vegetation with the possibility of improved soils such as sand that would allow for improved infiltration into the ground. Bioswales can be located along pedestrian pathways or in larger green spaces where surface flows into the bioswales permit. They can also be implemented in parking medians where curb cuts would allow for the water to drain through the curbs and into the systems. The bioswales will ultimately drain to atrium grates that will connect to the campus storm system.

A proposed water feature that will be similar to a dry creek will be a focal point at the center of the campus. Existing storm sewers serving the parking lots to the north and west shall be re-routed if feasible to discharge into the dry creek to improve water quality from the existing storm runoff. For general campus storm runoff, it is anticipated a series of underground storm sewer pipes will collect the majority of storm runoff and discharge into drainage channels with ground cover that emulates the natural ground conditions on-site. Rock rip-rap would also be required at discharge locations to minimize erosion possibilities from a concentrated discharge.

A conceptual storm sewer layout is shown in the following exhibit.

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0 50 100 200 300
GRAPHIC SCALE IN FEET
LEGEND
EXISTING STORM SEWER
PROPOSED STORM SEWER
RAIN GARDEN/BIO SWALE
EXISTING BUILDING
PROPOSED BUILDING
PHASE ONE
PHASE TWO
PHASE THREE
WATER FEATURE
NATURAL DRAINAGE FEATURE
NATURAL WATER FEATURE
NATURAL DRAINAGE SWALES WITH NATIVE PLANTS
NATURAL DRAINAGE SWALES WITH NATIVE PLANTS
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STORM SEWER EXHIBIT
RESEARCH PARK MASTER PLAN
TEXAS A&M CENTRAL UNIVERSITY
DESIGN CONCEPTS
CITY OF KILLEEN, BELL COUNTY, TEXAS
DESIGN JJL
DRAWN HAR
DATE NOV 2022
SCALE 1"=100'
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FILE
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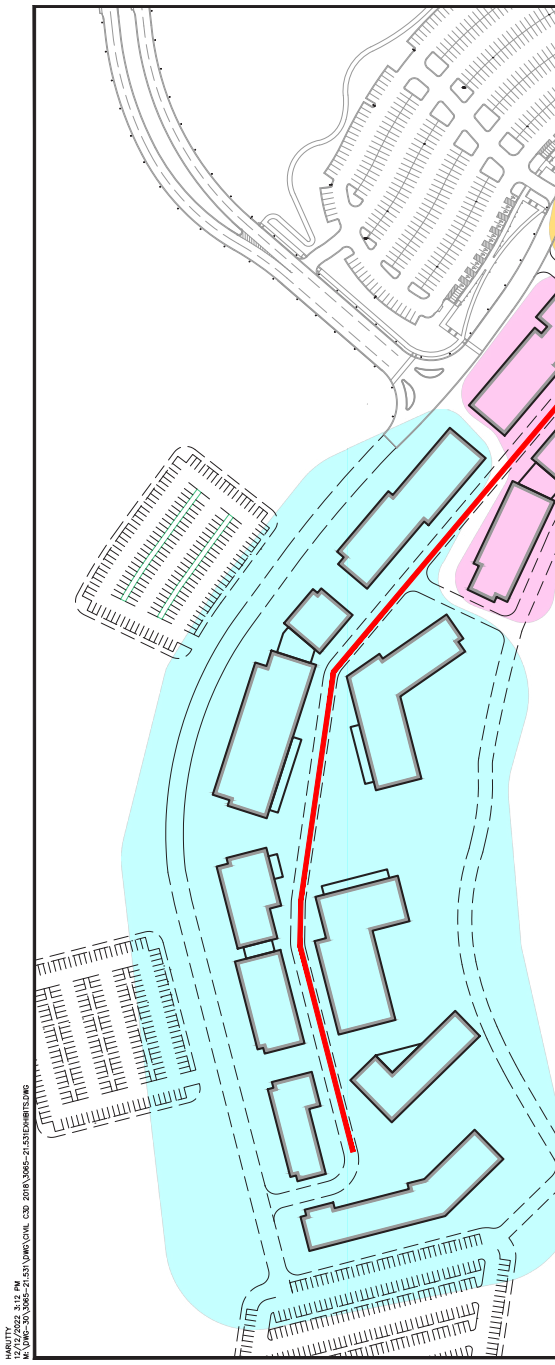
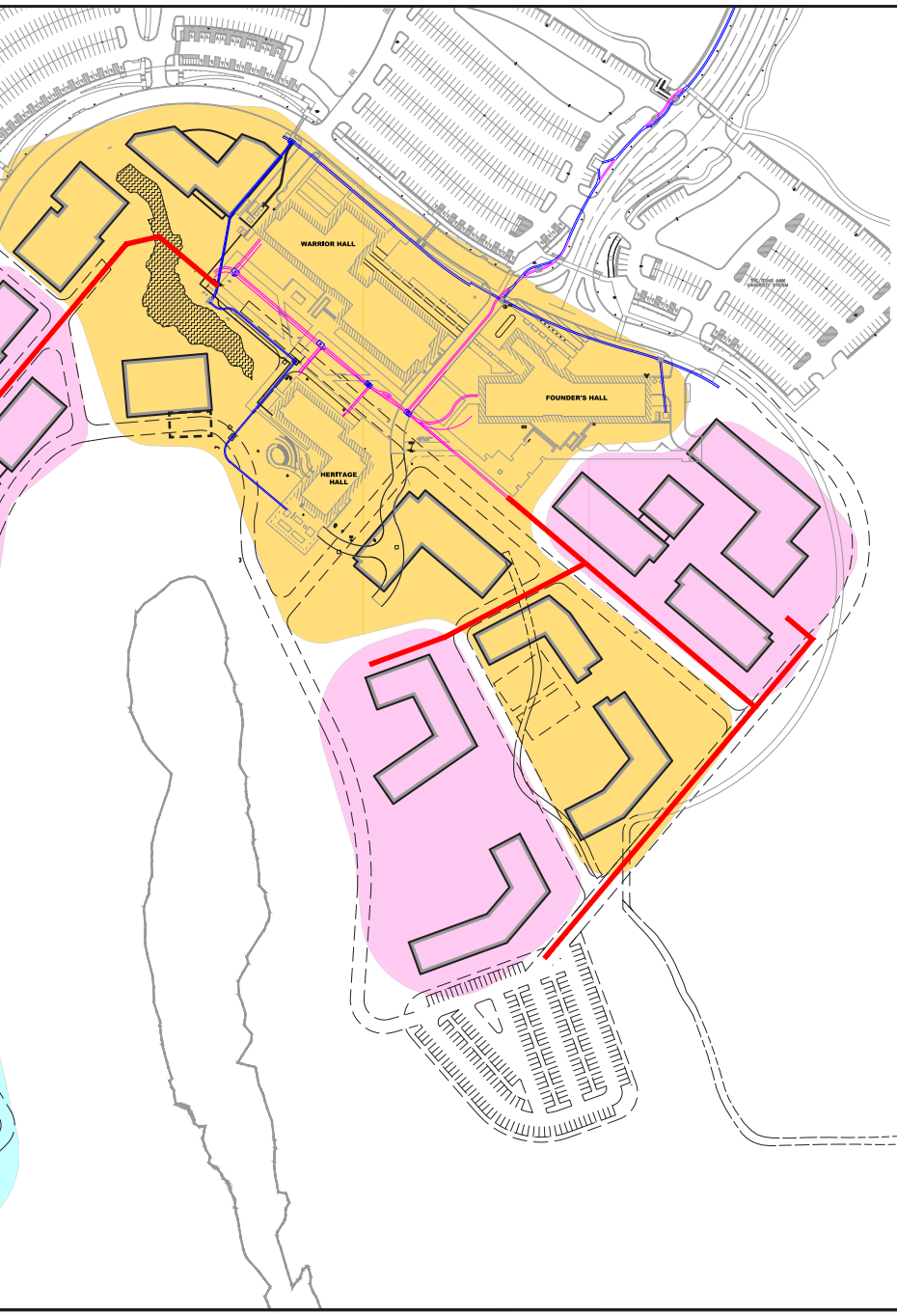
Data Duct Bank

Existing electric and data duct banks serve the three buildings on campus today. To continue service to the rest of the campus, an extension of the existing duct banks are proposed. These duct banks will run underneath the pedestrian mall to allow for shorter lateral services to each building. All electric duct banks on campus shall be concrete encased with redundant conduits to be used as spares for future expansion or maintenance. It is anticipated that the new buildings will be served from pad mounted transformers and switchgears on site; however, it is unknown how many will be required for the project at this time.

A conceptual electric and data duct bank layout is shown in the following exhibit and next spread .





N

0 50 100 200 300

GRAPHIC SCALE IN FEET

LEGEND

EXISTING DATA DUCT BANK

PROPOSED DATA DUCT BANK

EXISTING DATA/ELECTRIC DUCT BANK

EXISTING BUILDING

PROPOSED BUILDING

PHASE ONE

PHASE TWO

PHASE THREE

WATER FEATURE

ISSUED FOR PRELIMINARY PRICING PURPOSES ONLY

(SUBJECT TO REVISION PRIOR TO CONSTRUCTION)

THESE DOCUMENTS HAVE BEEN PREPARED BY THE ENGINEER WITH THE INTENT OF COMPLYING WITH ALL CITY STANDARD REQUIREMENTS. THESE DOCUMENTS HAVE NOT BEEN APPROVED AND RELEASED FOR CONSTRUCTION BY THE CITY AS OF THIS DATE AND, THEREFORE, REVISIONS MAY BE REQUIRED PRIOR TO CONSTRUCTION. BY ANY USE OF THESE DOCUMENTS, THE USER AFFIRMS THEIR UNDERSTANDING OF THE PRELIMINARY STATUS OF THE PLANS AND THE POTENTIAL FOR REVISION PRIOR TO ANY CONSTRUCTION.

NO.	DATE	REVISION

Pacheco Koch
a Westwood company
7557 RAMBLER ROAD SUITE 1400
DALLAS, TX 75231
972.235.3031

PRELIMINARY

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PLANS PREPARED UNDER THE DIRECT SUPERVISION OF JASON J. LEHIGH, P.E. TEXAS REGISTRATION NO. 135544 DATE: 12/12/2022

TX REG. ENGINEERING FIRM F-469

TX REG. SURVEYING FIRM LS-10008000

DATA DUCT BANK EXHIBIT

RESEARCH PARK MASTER PLAN

TEXAS A&M CENTRAL UNIVERSITY

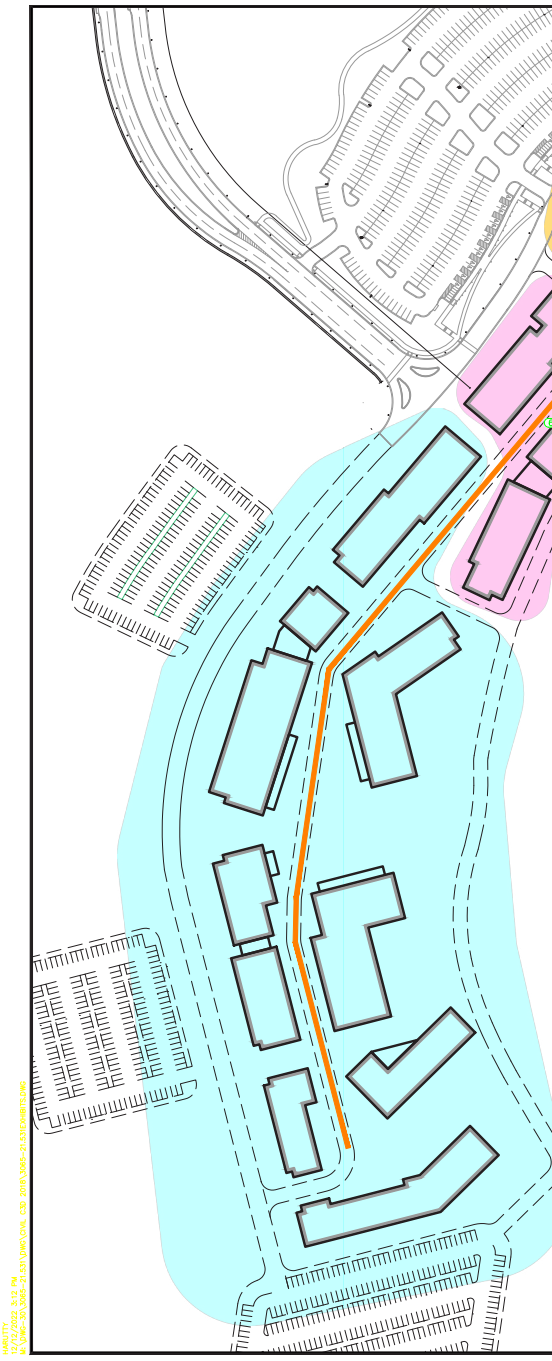
DESIGN CONCEPTS

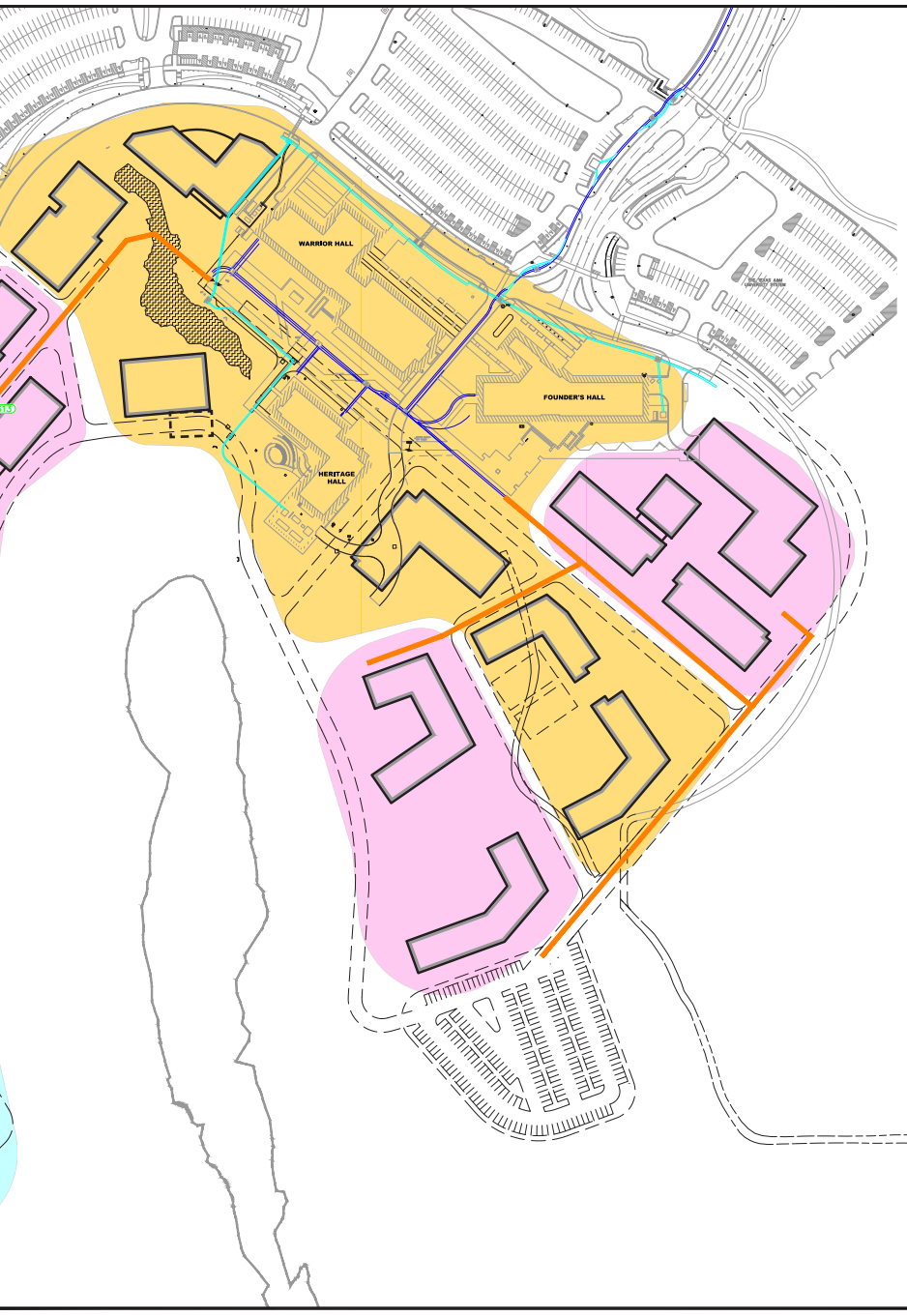
CITY OF KILLEEN, BELL COUNTY, TEXAS

DESIGN	DRAWN	DATE	SCALE	NOTES	FILE	NO.
JJL	HAR	NOV. 2022	1"=100'			EX 5

PK-3065-2K55\EXHIBITS\EX5.DWG

Electric Duct Bank





N

0 50 100 200 300

GRAPHIC SCALE IN FEET

LEGEND

EXISTING ELECTRIC DUCT BANK

PROPOSED ELECTRIC DUCT BANK

EXISTING ELECTRIC/DATA DUCT BANK

EXISTING BUILDING

PROPOSED BUILDING

PHASE ONE

PHASE TWO

PHASE THREE

WATER FEATURE

ISSUED FOR PRELIMINARY PRICING PURPOSES ONLY
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NO.	DATE	REVISION

Pacheco Koch
Westwood
7557 RAMBLER ROAD SUITE 1400
DALLAS, TX 75231
972.235.3031

ELECTRIC DUCT BANK EXHIBIT

RESEARCH PARK MASTER PLAN

TEXAS A&M CENTRAL UNIVERSITY

DESIGN CONCEPTS

CITY OF KILLEEN, BELL COUNTY, TEXAS

DESIGN	DRAWN	DATE	SCALE	NOTES	FILE	NO.
JJL	HAR	NOV 2022	1"=100'			EX 6

PRELIMINARY
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PLANS PREPARED UNDER THE DIRECT SUPERVISION OF JASON J. LEHIGH, P.E. TEXAS REGISTRATION NO. 135544
DATE: 12/12/2022

TX REG. ENGINEERING FIRM F-469
TX REG. SURVEYING FIRM LS-10008000

PK-3065-[illegible]

Sanitary Sewer Flows

Based on the new building square footages and residential units, the existing 12” sanitary sewer will have capacity for all proposed development. A sanitary sewer demand analysis is exhibited to the right.

Use	
Academic	
Academic/Research	
Industry	
Residential	
Academic/Research	
Industry	
Residential	
Academic/Research	
Industry	
Residential	

Note: Average Daily Demands are bas

Exhibit 7

Total Peak Daily Demand

	Quantity		Average Daily Demand		Average Daily Demand		Peaking Factor	Peak Daily Demand	
			gpd	*SF*	*gpd*	*GPM*		*gpd*	*GPM*
Existing	300,000	SF	20	per 400	15,000.00	10.42	4	60,000.00	41.67
							Total	**60,000.00**	**41.67**
Phase 1	230,000	SF	25	per 400	14,375.00	9.98	4	57,500.00	39.93
Phase 1	80,000	SF	25	per 400	5,000.00	3.47	4	20,000.00	13.89
Phase 1	150	Units	200	per Unit	30,000.00	20.83	4	120,000.00	83.33
							Total	**197,500.00**	**137.15**
Phase 2	245,000	SF	25	per 400	15,312.50	10.63	4	61,250.00	42.53
Phase 2	80,000	SF	25	per 400	5,000.00	3.47	4	20,000.00	13.89
Phase 2	160	Units	200	per Unit	32,000.00	22.22	4	128,000.00	88.89
							Total	**209,250.00**	**145.31**
Phase 3	375,000	SF	25	per 400	23,437.50	16.28	4	93,750.00	65.10
Phase 3	90,000	SF	25	per 400	5,625.00	3.91	4	22,500.00	15.63
Phase 3	225	Units	200	per Unit	45,000.00	31.25	4	180,000.00	125.00
							Total	**296,250.00**	**205.73**
							Overall Total	**763,000.00**	**529.86**

ed on TCEQ Design Guidelines. For Residential, 2 indivials per unit was assumed.

Construction Cost

PHASE 1

Item No.	Est. Quant.	Unit	Description	Unit Price	Total
Demolition & Erosion Control					
1	1	LS	Clearing and Grubbing	$85,000.00	$85,000.00
2	1	LS	Erosion Control / SWPPP	$85,000.00	$85,000.00
				Sub-Total (Section)	$170,000.00
Storm Sewer					
3	440	LF	18" RCP	$154.00	$67,760.00
4	340	LF	24" RCP	$182.00	$61,880.00
5	305	LF	36" RCP	$268.00	$81,740.00
6	365	LF	48" RCP	$425.00	$155,125.00
7	25	EA	Storm Inlets (Catch Basins, Curb Inlets, etc.)	$8,000.00	$200,000.00
8	2	EA	JUNCTION BOXES	$17,500.00	$35,000.00
9	3	EA	Headwalls	$12,500.00	$37,500.00
				Sub-Total (Section)	$639,005.00
Water & Sanitary Sewer					
10	1900	LF	12" Water	$195.00	$370,500.00
11	5	EA	Fire Hydrant w/ 6" Lateral	$10,000.00	$50,000.00
12	600	LF	6" Water (Building Services)	$125.00	$75,000.00
13	1050	LF	12" Sanitary Sewer	$135.00	$141,750.00
14	600	LF	8" Sanitary Sewer (Building Laterals)	$100.00	$60,000.00
15	5	EA	Manhole	$11,000.00	$55,000.00
16	3	EA	Connect to Existing Sanitary Sewer Line	$7,500.00	$22,500.00
				Sub-Total (Section)	$774,750.00
Power / Communications					
17	1350	LF	Concrete Encased Duct Bank	$1,000.00	$1,350,000.00
18	1350	LF	Concrete Encased Data/Fiber Duct Bank	$1,000.00	$1,350,000.00
				Sub-Total (Section)	$2,700,000.00
Pavement					
19	123250	SF	6" Reinforced Concrete Pavement (Fire Lanes)	$10.00	$1,232,500.00
				Sub-Total (Section)	$1,232,500.00
				Sub-Total	$5,516,255.00
				Contingency (20%)	$1,103,251.00
				PHASE 1 TOTAL	$6,619,506.00

PHASE 2

Item No.	Est. Quant.	Unit	Description	Unit Price	Total
Demolition & Erosion Control					
1	1	LS	Clearing and Grubbing	$85,000.00	$85,000.00
2	1	LS	Erosion Control / SWPPP	$85,000.00	$85,000.00
				Sub-Total (Section)	$170,000.00
Storm Sewer					
3	670	LF	18" RCP	$154.00	$103,180.00
4	1100	LF	24" RCP	$182.00	$200,200.00
5	470	LF	36" RCP	$268.00	$125,960.00
6	2000	LF	48" RCP	$425.00	$850,000.00
7	25	EA	Storm Inlets (Catch Basins, Curb Inlets, etc.)	$8,000.00	$200,000.00
8	3	EA	JUNCTION BOXES	$17,500.00	$52,500.00
9	0	EA	Headwalls	$12,500.00	$0.00
				Sub-Total (Section)	$1,531,840.00
Water & Sanitary Sewer					
10	2200	LF	12" Water	$195.00	$429,000.00
11	4	EA	Fire Hydrant w/ 6" Lateral	$10,000.00	$40,000.00
12	800	LF	6" Water (Building Services)	$125.00	$100,000.00
13	715	LF	12" Sanitary Sewer	$135.00	$96,525.00
14	800	LF	8" Sanitary Sewer (Building Laterals)	$100.00	$80,000.00
15	1	EA	Manhole	$11,000.00	$11,000.00
16	1	EA	Connect to Existing Sanitary Sewer Line	$7,500.00	$7,500.00
				Sub-Total (Section)	$764,025.00
Power / Communications					
17	1115	LF	Concrete Encased Duct Bank	$1,000.00	$1,115,000.00
18	1115	LF	Concrete Encased Data/Fiber Duct Bank	$1,000.00	$1,115,000.00
				Sub-Total (Section)	$2,230,000.00
Pavement					
19	97916	SF	5" Reinforced Concrete Pavement (Parking)	$10.00	$979,160.00
20	53600	SF	6" Reinforced Concrete Pavement (Fire Lanes)	$10.00	$536,000.00
				Sub-Total (Section)	$1,515,160.00
				Sub-Total	$6,211,025.00
				Contingency (20%)	$1,242,205.00
				PHASE 2 TOTAL	$7,453,230.00

PHASE 3

Item No.	Est. Quant.	Unit	Description	Unit Price	Total
Demolition & Erosion Control					
1	1	LS	Clearing and Grubbing	$85,000.00	$85,000.00
2	1	LS	Erosion Control / SWPPP	$85,000.00	$85,000.00
				Sub-Total (Section)	$170,000.00
Storm Sewer					
3	330	LF	18" RCP	$154.00	$50,820.00
4	2380	LF	24" RCP	$182.00	$433,160.00
5	210	LF	36" RCP	$268.00	$56,280.00
6	310	LF	48" RCP	$425.00	$131,750.00
7	50	EA	Storm Inlets (Catch Basins, Curb Inlets, etc.)	$8,000.00	$400,000.00
8	5	EA	JUNCTION BOXES	$17,500.00	$87,500.00
9	2	EA	Headwalls	$12,500.00	$25,000.00
				Sub-Total (Section)	$1,184,510.00
Water & Sanitary Sewer					
10	2350	LF	12" Water	$195.00	$458,250.00
11	6	EA	Fire Hydrant w/ 6" Lateral	$10,000.00	$60,000.00
12	800	LF	6" Water (Building Services)	$125.00	$100,000.00
13	1030	LF	12" Sanitary Sewer	$135.00	$139,050.00
14	800	LF	8" Sanitary Sewer (Building Laterals)	$100.00	$80,000.00
15	4	EA	Manhole	$11,000.00	$44,000.00
16	1	EA	Connect to Existing Sanitary Sewer Line	$7,500.00	$7,500.00
				Sub-Total (Section)	$888,800.00
Power / Communications					
17	1070	LF	Concrete Encased Duct Bank	$1,000.00	$1,070,000.00
18	1070	LF	Concrete Encased Data/Fiber Duct Bank	$1,000.00	$1,070,000.00
				Sub-Total (Section)	$2,140,000.00
Pavement					
19	288,575	SF	5" Reinforced Concrete Pavement (Parking)	$10.00	$2,885,750.00
20	66350	SF	6" Reinforced Concrete Pavement (Fire Lanes)	$10.00	$663,500.00
				Sub-Total (Section)	$3,549,250.00

Sub-Total	$7,932,560.00
Contingency (20%)	$1,586,512.00
PHASE 3 TOTAL	$9,519,072.00

TOTAL	$23,591,808.00

The quantities and prices shown hereon are an indication of the Engineer's opinion of probable construction costs associated with the referenced project and are NOT a guarantee of individual or total construction costs.

Jason J. Lehigh, PE.

Additional Information

Gas

As part of the master plan in 2010, it was investigated to determine if gas service on the campus is feasible. This study was re-visited as part of two recent Program of Requirements for other campus buildings ant it was determined that gas service is still not feasible for the campus. The closest gas service is approximately 2 miles from campus. No gas service is recommended for the project at this time.

Paving

The site paving design shall be in accordance with the recommendations in a Geotechnical Report prepared by others. Without the benefit of said study, it is anticipated that similar pavement sections to those specified on other campus projects will be used. They are as follows:

- 4” thick, 3000 PSI (5-sack mix) reinforced concrete pavement for sidewalks.
- 5” thick, 3600 PSI (6-sack mix) reinforced concrete pavement for vehicular parking areas.
- 6” thick, 3600 PSI (6-sack mix) reinforced concrete pavement for drive lanes and fire lanes.
- 7” thick, 3600 PSI (6-sack mix) reinforced concrete pavement dumpster pads and equipment areas.

It is anticipated that all vehicular pavement subgrades shall be lime stabilized (approx. 8% hydrated lime dry unit weight).

Perkins&Will

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