



South Campus Neighborhood Project

Street Lighting & Crime

REPORT

Prepared By

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Geography 411: Geospatial Analysis in GIS | Spring 2016

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Resilient Cities Initiative
Institute for Sustainable Development
California State University, Chico

The South Campus Neighborhood Project

The South Campus Neighborhood Project is an award-winning neighborhood improvement planning effort coordinated by the Resilient Cities Initiative at California State University, Chico and the Public Works-Engineering Division at the City of Chico, CA. The project is focused on the public rights-of-way in Chico, California's South Campus Neighborhood, a six by seven square-block area bound by 2nd Street to the North, 9th Street to the South, Orange Street to the West and Salem Street to the East. Immediately adjacent to both downtown Chico and the University, it is Chico's oldest residential neighborhood and was laid out by the town's founder, John Bidwell, in the 1860's.

The neighborhood today is densely populated with university students and is also home to a number of small businesses, restaurants, bars, churches, community organizations, a school, a fire station, a police station, a railway station and transit center. Given its location, population and mixed uses, the neighborhood faces a unique set of circumstances and challenges. This three-year project aims to assess existing conditions and to develop and refine neighborhood improvement concepts to address a range of identified issues. The neighborhood improvement planning process is focused on concepts for complete streets and public works that will enhance public health and safety, quality of life, sense of place and environmental sustainability.

➡ *More information can be found online at <http://scnpchico.com/>*

City of Chico Public Works-Engineering

The overall Mission, Vision and Goal of the City of Chico Public Works Department is to provide the best possible Quality of Life through our abilities to protect, plan, construct and maintain the physical assets of the City. This is achieved through teamwork, integrity, professionalism, innovation, respectful customer service, value to the citizens of Chico, accountability and stewardship of the City's infrastructure and public resources. We serve the public in a manner that supports the rich heritage of Chico, as well as progressing into future improvements desired by the community in a sustainable manner. We continue to look for new technology that assists in meeting these goals so that we can operate at the most efficient level and continue to be at the leading edge of modern standards.

Our Mission, Vision and Goals include ensuring public safety through detail oriented and strategic improvements to mitigate unsafe operation and use of our Public property; Providing safe, sustainable, integrated and efficient transportation systems to enhance the City of Chico's economy and livability for all modes of transportation; Efficiently and effectively providing a reliable, sustainable and cost effective sanitary sewer and storm water collection system for our residents and businesses in-line with our overall Mission and Vision. We are stewards of the natural environment and through responsible practices, we construct and maintain our natural environment to the highest of standards. We will continue to make the City of Chico a leader in sustainable and clean practices so that our residents can experience the quality of life that is desired for an infinite length of time.



The Resilient Cities Initiative

The Resilient Cities Initiative (RCI) is an interdisciplinary university-community partnership program established by the Institute for Sustainable Development at California State University, Chico in 2016. The RCI connects real-world community sustainability projects – identified and funded by partner agencies – with faculty expertise and student innovation from departments and disciplines across the University’s academic colleges. The RCI recruits partner agencies through a competitive selection process and matches projects with existing courses across the university’s curricula. Partner agencies are able to harness incredible momentum for their projects in large part because the partnership is realized on a bigger scale than more typical one-off university-community projects. Faculty are able to opt-in and augment their existing curriculum with real-world projects that have been identified, funded and supported by the leadership and staff of the partner agency – ultimately delivering their students’ work for consideration and implementation.

The RCI is a member of the Educational Partnerships for Innovation in Communities (EPIC) Network, a nationwide network of over 25 universities that have replicated the highly successful Sustainable City Year Model that was established at the University of Oregon in 2009. The model is based on university-community partnerships with a defined geographic and temporal scope, focused on advancing sustainability and the social good, leveraging the multidisciplinary knowledge and capacity of the university to ‘move the needle’ on pressing community issues. The RCI directly engages hundreds of CSU, Chico students each academic year, providing impactful opportunities for them to put theory to practice in their own community and region, connecting them with decision-makers in practitioners in their fields of study, and helping develop the next generation of workforce professionals and leaders.



Course Participants

Geography 411: Geospatial Analysis in GIS | Spring 2016 | Dr. Dean Fairbanks

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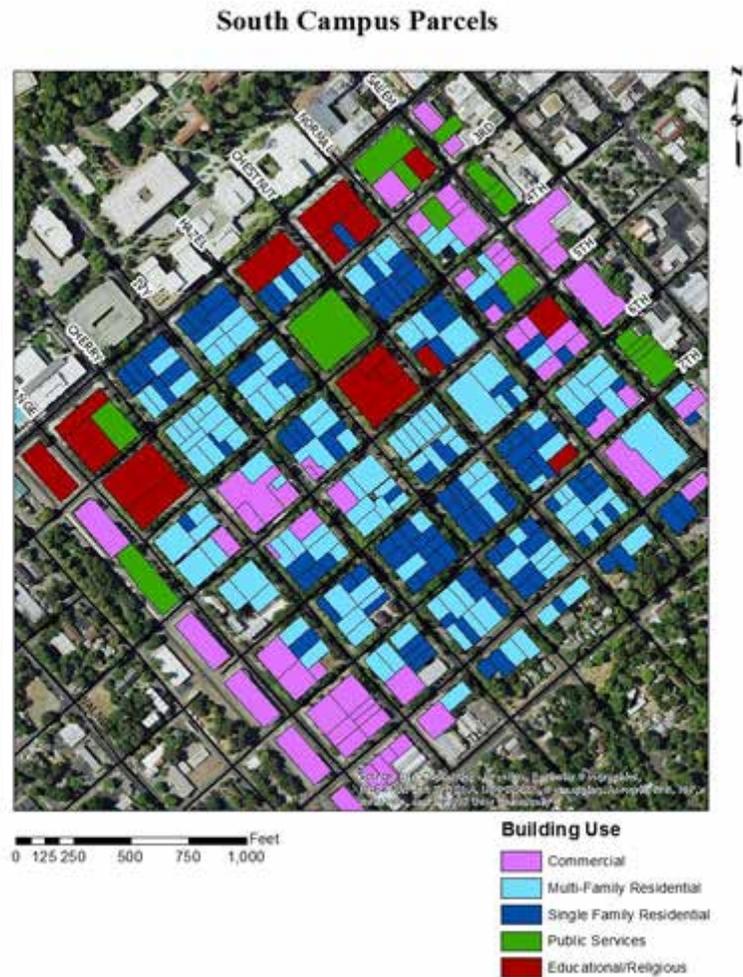


South Campus Lighting Report

Introduction

The South Campus Neighborhood (SCN) is one of Chico's most dynamic and varied neighborhoods, a place trapped between its historic nature and the influx of modern developments. The area's population of residents, composed overwhelmingly of students, sees a sudden explosion during the semesters of California State University of Chico (CSUC) and heightened levels of activity that accompany it. While Single and multi-family residential units dominate the thirty-six blocks that were surveyed (Figure 1),

representing more than 59% of buildings in the SCN area, clusters of commercial buildings exist most noticeably at the center (West 5th and Ivy Streets) as well as the southern end of Normal Ave and Cherry Street. Notre Dame Catholic School and the Newman Catholic Center are the most notable the parcels described as Religious and Educational buildings, as well as others including the Alumni and Parent Relations building, the University Police Station, and various campus parking structures. The rapid transition of parcel use in the SCN creates a living environment that is unique as a residential area in Chico. This brings with it challenges in the development, and maintenance of the SCN.



In recent years, growing levels of concern for safety and several of high profile accidents have captured the attention of the community. In response, an investigation of existing conditions was requested by the city council involving five areas of safety and service elements in the SCN. The areas of interest include crime statistics, emergency statistics, neighborhood general services, demographics, and traffic counts including vehicle, bicyclist, and pedestrian. CSUC instructors of relevant classes were contacted by Fletcher Alexander in hopes of integrating portions of this report into course work. Our class, Geospatial Analysis in GIS, was presented with the opportunity to contribute to the SCN Project as part of our final project. Our group selected to investigate the neighborhood general services component. By utilizing Geographic Information Systems (GIS) we hoped to identify trends and factors influencing safety in the South Campus Neighborhood.

Methods

Existing data on the SCN supplied by the city was compiled and organized by Geography and Planning instructor and faculty contributor Dr. Dean Fairbanks into a local campus geo-database that was utilized extensively. Following database establishment, we narrowed our investigation into the general services aspect. We identified the presence and quality of lighting in the SCN as one of the most critical and influential factors of safety.

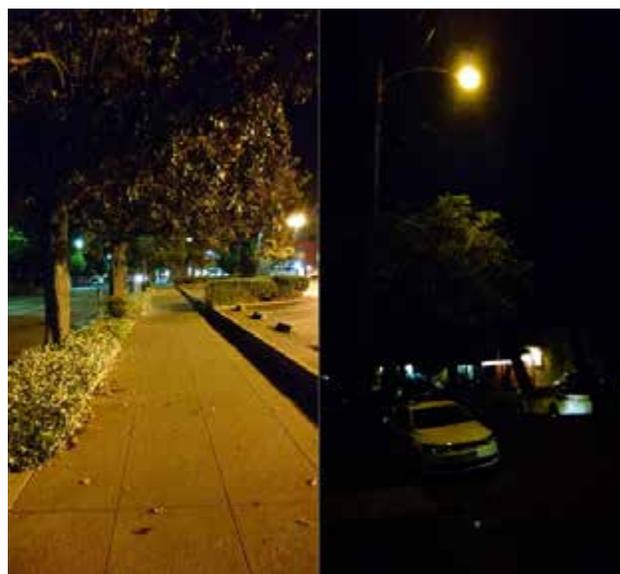
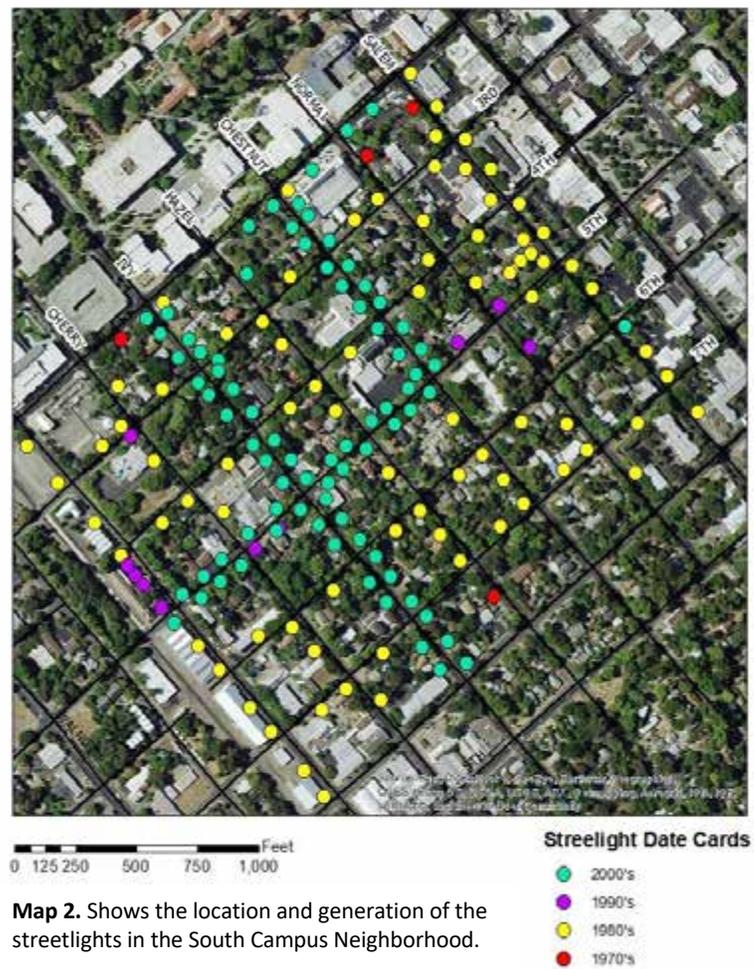


Figure 1. Lighting discrepancy in South Campus Area; 5th and Salem (left) 7th and Hazel (right)

During a walking evaluation we were stuck by the sporadic nature of lighting and the discrepancy in illumination that exists within a relatively small area (Figure 1). The primary source of light for the SCN came from a combination of city and PG&E owned streetlights installed in series between 1973 and 2007 (Map 2). You can easily identify what looks like a “4” in the center of the South Campus Neighborhood. This shows the extent of modern street light installation running along West 5th Street from Orange Street to Chestnut Street, extending the length of Ivy Street, and from West 2nd Street to West 5th Street and Chestnut Street.

South Campus Lighting, Current Streetlights



Map 2. Shows the location and generation of the streetlights in the South Campus Neighborhood.

The streets with the older streetlights in the SCN appear to be lacking in illumination and, compared to newer lights, the old models are noticeably dimmer (Figure 2). There is a significant structural difference between the series of streetlights installed during the 2007 South Campus Improvement Project and previous models. The newer streetlights have a corn design, with a double lamp that is attached to a standalone post. This positions the lamps below canopy levels maximizing street illumination (Figure 2).



Figure 2. Effect of lamp Positioning; Illuminance of retail mounted light (left) Acorn style streetlight (center) and Cobra style streetlight (right)

In contrast, the Cobra model of overhanging streetlights protruding from power line posts are often obstructed by the thick tree canopy present in many parts of the SCN. Additional inconsistencies include the spatial distribution of streetlights, which show a clustered trend with some blocks of the SCN having considerably less streetlights than others (Map 2). Many businesses and some residents have chosen to compound public lighting measures by installing private building lights presumably motivated by security and/or aesthetic reasons. The presence and magnitude of this type of secondary lighting seemed to be highly influenced by building use (Figure 2).

After identifying these variations and influences in lighting, it was determined that the construction of a street illuminance map of the SCN would provide the city council with significant and relevant data for its initial conditions report. A primary goal of this map would be to identify areas that are possibly under-lit in the SCN. This requires a definition of minimum lighting standards. Levels of recommended lighting vary drastically and are often based on arbitrary criteria. The most empirical recommendation found was from the National Optical Astronomy Observatory based on road type, pavement classification, and potential for pedestrian conflict (Table 1).

(Table 1.) Recommended Levels of Lighting: National Optical Astronomy Observatory. Recommended Light Levels (Illuminance) for Outdoor and Indoor Venues.

Road	Pedestrian Conflict	Pavement Classification		
		R1 (Lux)	R2&R3 (Lux)	R4 (Lux)
Major	High	12	17	15
	Medium	9	13	11
	Low	6	9	8
Collector	High	8	12	10
	Medium	6	9	8
	Low	4	6	5
Local	High	6	9	8
	Medium	5	7	6
	Low	3	4	4

The values are in the metric unit lux (lx) which are defined as lumen/m². Only the R1 pavement classification was considered to allow for the most lenient classification of lighting in the SCN. The medium level of lighting on major roads, 9.0 lx was set as the highest threshold of lighting. The minimal level suggested, 3.0 lx, was set as the threshold for lighting failure. Extensive field evaluations were used in conjunction with GIS analysis methods to create an illuminance map of the SCN.



Figure 3. Primary data collection instruments; the LX1330B Digital Light Meter (left) and GARMIN etrex 30 (right)

Lighting was manually collected from a 6x6 block area constricted at West 2nd and West 8th Streets as well as Orange and Salem Streets. The boundary at West 8th Street is one block short of the city’s initially defined boundary of the SCN at West 9th Street. This constriction of the SCN was due to safety concerns of surveyors collecting data on a highway, integrity of data due to lighting interference from heavy traffic, and budgetary decisions. The boundary at West 2nd Street was set in hopes of isolating SCN trends of lighting separate from

campus illumination. To record illumination in the SCN, two primary instruments were used: a LX1330B Digital Light Meter measured the magnitude lux at a point, and a GARMIN etrex 30 GPS Unit recorded the location of each measurement (Fig 3).



A field crew consisted of optimally three members with reflective vests, with each assigned to a light meter, GPS, or field notebook for computer input (Fig 4).

Best practices were developed to ensure that uniform measurements were taken between the field crews. A preliminary test was conducted to determine the scale

at which lighting is spatially correlated. If scale is not accurately determined, the sample rate risks being too coarse and analysis will fail to identify trends in phenomena. A graph was constructed using the results from the preliminary study to determine the distance at which lighting correlation became random and methods implemented to set distance between samples at an average of 12 feet (Figure 5).

Over 6 weeks of data collection, 2400 points of illuminance were taken in SCN and used to create the point layer that define all subsequent lighting analysis (Map 3). A kriging analysis was combined with a 60-foot buffer from the street centerlines to interpolate a continuous surface for lighting in the SCN (Map 4).

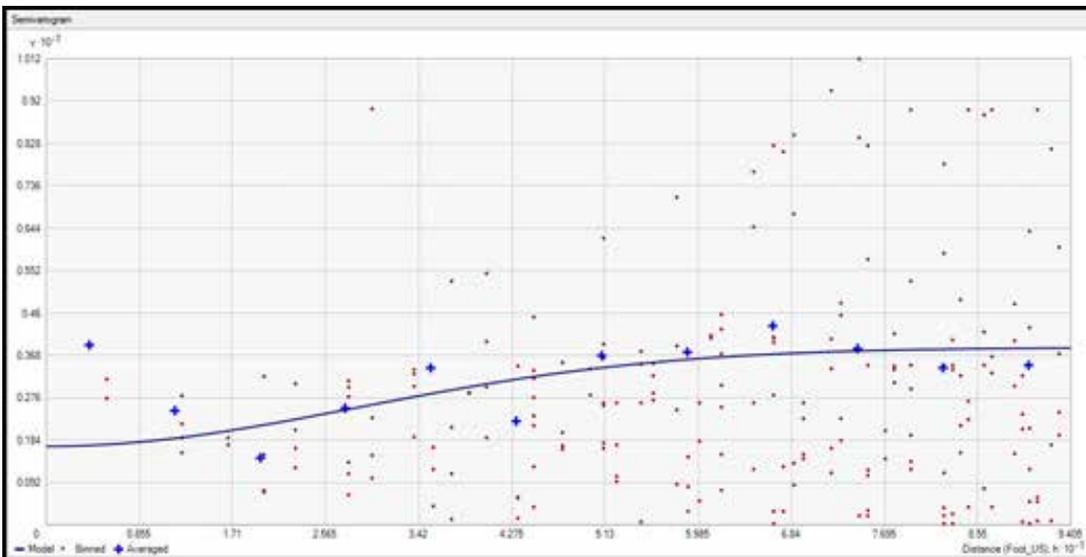
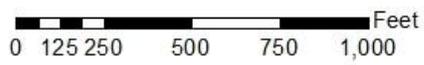


Figure 5. Semivariogram of lighting Spatial Autocorrelation

South Campus Field Data Points



Map 3. Points at which illuminance readings were taken throughout the extent of the South Campus Project

Results

Statistical analysis was used to summarize the general breakdown of lighting in the SCN (Table 2). Tests were also conducted to quantify mean illuminance surrounding buildings by use (Table 3). Results indicate that more than 49% of the street area in the SCN is underlit and falls below 3.0 lx. In particular, a trend of inadequate lighting is clearly visible in the resident-dominated southeast portion. In the building lighting analysis, residential blocks have roughly four less lx than all other building types, 3.2 lx for single family and 3.8 for multiple family buildings.

South Campus Lighting, Interpolation

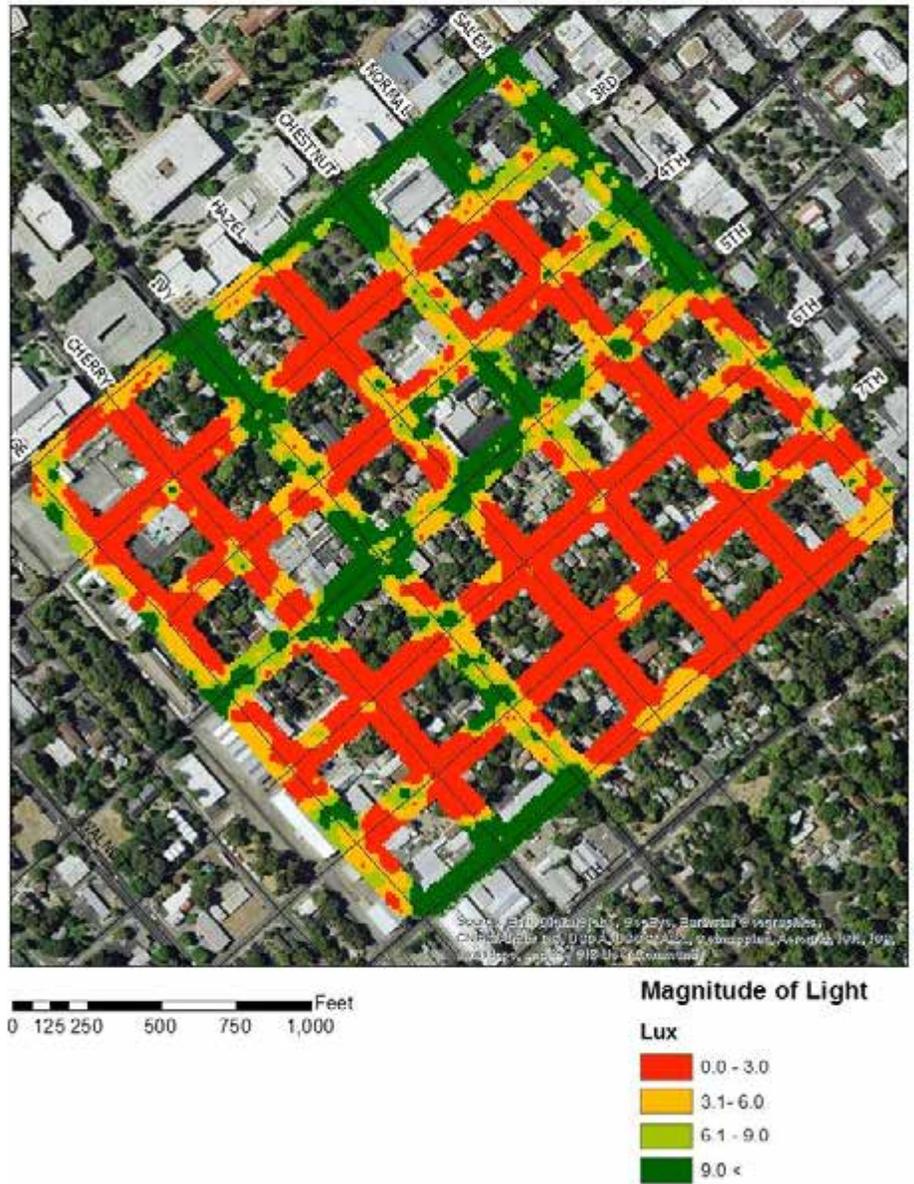


Table 2. Percentile breakdown of the South Campus Neighborhood based on classifications of recommend lighting created from the National Optical Astronomy Observatory’s Recommended Light Levels for Outdoor and Indoor Venues

South Campus Lighting Breakdown	
Lux	Percentage of Area
0 - 3	48.71%
3 - 6	22.65%
6 - 9	10.51%
> 9	18.14%

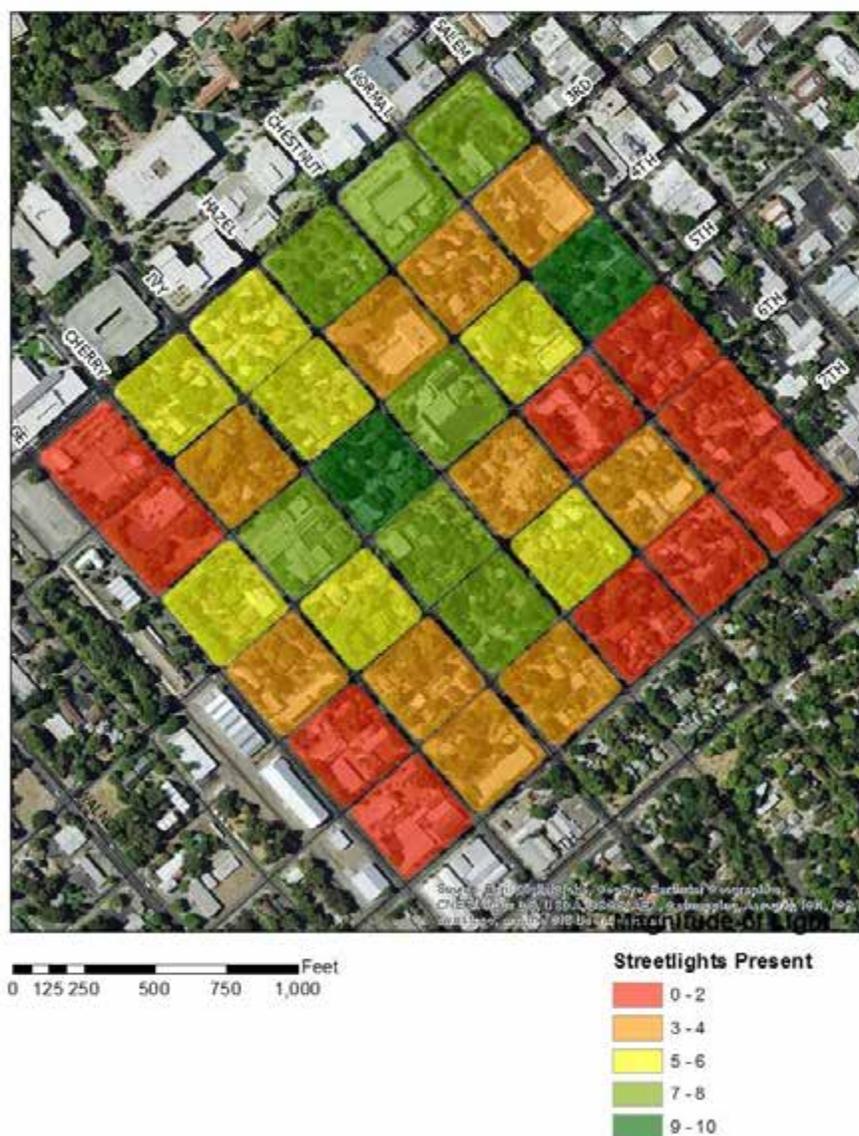
Table 3. Shows the average illuminance in a 50 ft buffer range from all buildings by parcel zoning category.

Influence of Parcel Type on Lighting		
<i>Parcel Use</i>	<i>% of Area</i>	<i>Mean Lux of Surrounding Area</i>
Public Services	7.56%	7.54
Educational/Religious	13.18%	8.8
Commercial	16.78%	8.3
Single Family Residential	22.44%	3.2
Multi-Family Residential	37.19%	3.9

Additionally, this area shows the lowest density of streetlight density in the SCN (Map 5). Just over 20% of the area is illuminated at or above the highest classification of recommended lighting of 9.0 lx. This area is concentrated around the education and retail buildings in the north and south corner of the SCN. Areas surrounding education-related buildings have a mean lux of 8.3 and retail area averaged 8.3 lx. The two streets which received the majority of the 2007 Acorn style streetlight installation also show significantly higher levels of lighting. The medium classifications of levels of lighting, 3-6 lx and 6-9 lx, represent the smallest portion of the SCN and primarily occur at the boundaries of areas between high levels of lighting and low levels of lighting. We believe that the under-lighting of the SCN is a pervasive issues that would

highly benefit from being addressed. Our hope is that the maps generated from this investigation will aid in the planning of future streetlight installation or the implantation of other lighting measures.

South Campus Lighting, Streetlight Desity by Block



Map 5. The distribution of streetlights (all types) in the South Campus Neighborhood

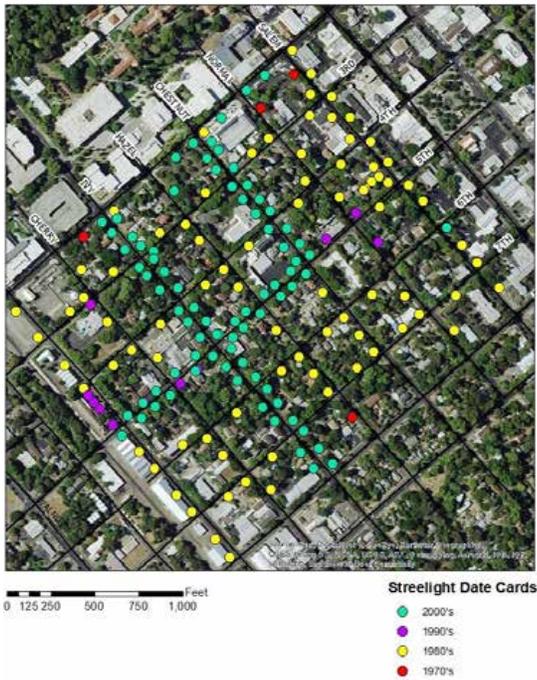


Executive Summary

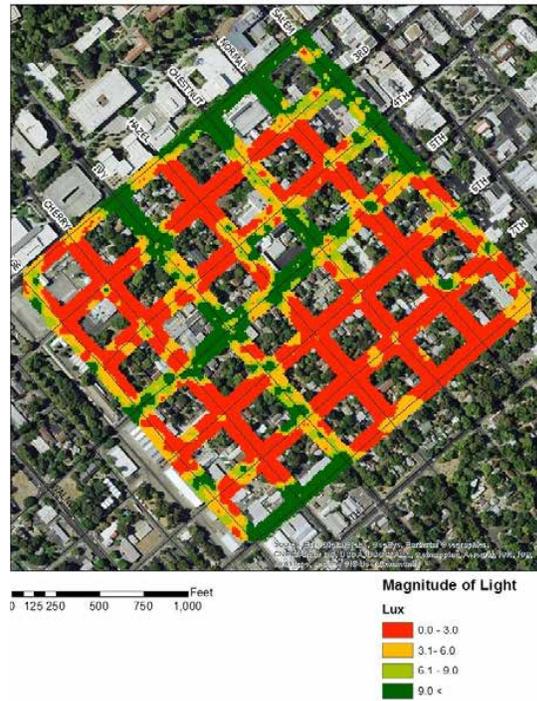
Map A. Shows the location and generation of the streetlights in the South Campus Neighborhood

Map B. Results of Kriging analysis from collected illuminance data in the South Campus Neighborhood. Lighting magnitude measured in Lux (lumens/m².)

South Campus Lighting, Current Streetlights



South Campus Lighting, Interpolation



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Table A. Percentile breakdown of the South Campus Neighborhood based on classifications of recommend lighting created from the National Optical Astronomy Observatory's [Recommended Light Levels for Outdoor and Indoor Venues](#)

Map C. Displays the buildings of the South Campus Neighborhood by their various zoning categories

South Campus Parcels

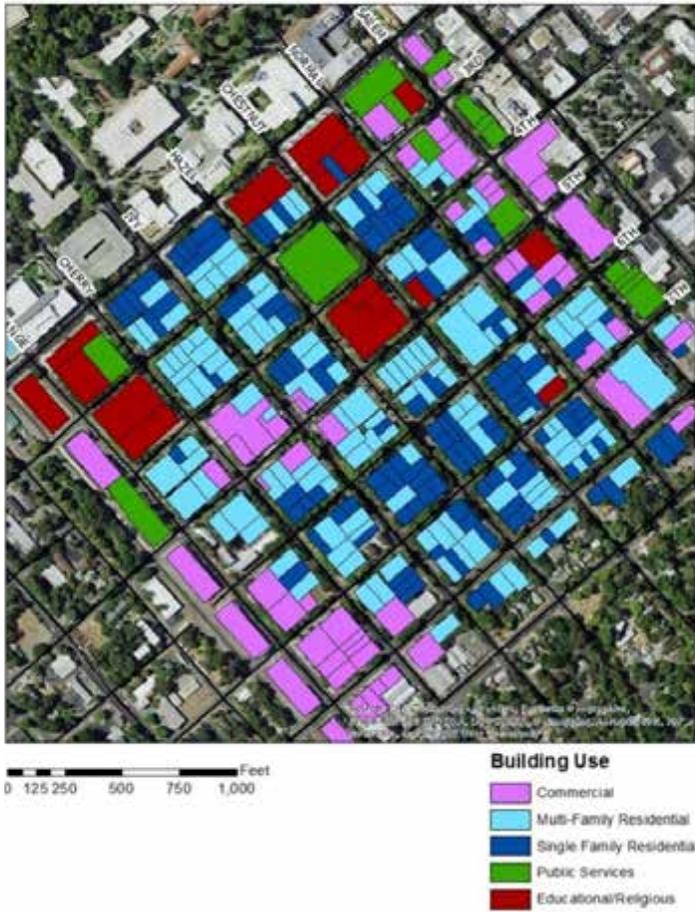


Table B. Shows the average illuminance in a 50 ft buffer range from all buildings by parcel zoning category.

Influence of Parcel Type on Lighting		
<i>Parcel Use</i>	<i>% of Area</i>	<i>Mean Lux of Surrounding Area</i>
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Retail	16.78%	8.3
Single Family Residential	22.44%	3.2
Multi-Family Residential	37.19%	3.9



Figure 2. Effect of lamp Positioning; Illuminance of retail mounted light (left) Acorn style streetlight (center) and Cobra style streetlight (right)

Lighting Analysis Conclusions

- I. Our analysis concludes that 49% of the South Campus Neighborhood falls below the minimal recommended value for lighting set by the National Optical Astronomy Observatory.
- II. A trend of inadequate lighting is clearly visible in the residential southeast quadrant of the South Campus Neighborhood.
 - a. Streets and sidewalks within 50 feet of housing parcels receive on average half the magnitude of lighting of all other types.
 - i. Commercial parcels often have significant private exterior lighting features that contribute light to surrounding area, visible in the north and south corners of the SCN.
 - b. The number of streetlights per block in the South Campus Neighborhood have a maximum of 10 and a minimum of 2, varying by a factor of 5.
 - c. Streetlights in the South Campus Neighborhood are one of two designs, Acorn or Cobra. Cobra streetlights hang down from existing utility fixtures while Acorn streetlights exist as standalone fixtures.
 - i. Cobra lights receive significantly higher levels of light obstruction from canopy in the South Campus Neighborhood. Acorn style lights avoid this because they are positioned lower.
 - ii. All series of streetlights installed before 2000 are the Cobra design. The series of Acorn-style streetlights were installed in 2007. This results in a much higher intensity of light coming from the modern Acorn lamps compared to the older Cobra ones.
 - iii. The installed Acorn street lights are highly clustered along West 5th Street, Chestnut Street, and Ivy Street. This correlates with the streets which have the highest levels of luminance in the South Campus Neighborhood.

- III. The areas with the lowest luminance in the South Campus Neighborhood are residential blocks with low streetlight density and exclusively Cobra style streetlights.
- IV. Compounding the issue of dim or outdated lamps, the South Campus Neighborhood suffers from low streetlight density and many of the streetlights are prone to canopy obstruction. These underlying issues must be considered when updating lighting infrastructure in the South Campus Neighborhood.

Recommendations for Future Actions

- To address areas of low streetlight density in the South Campus Neighborhood, we recommend that new streetlights be installed.
- Whenever possible, Acorn style lights would be most optimal for minimizing the obstruction of light from the tree canopy.
- We propose that a comprehensive plan be developed to implement regular replacement of lamps and maintenance of tree canopy in areas with only Cobra streetlights.
- Owners and landlords in the South Campus Neighborhood could be incentivized to provide exterior lighting fixtures of significant intensity.
- If nonexistent, city neighborhood lighting standards should be constructed with consideration of factors such as road conditions, speed limits, and traffic intensity.
- We propose that the monitoring of luminance in the South Campus Neighborhood continue in order to allow for efficacy to be tracked as improvements are made. This would allow for the development of neighborhood benchmarks and provide quantifiable feedback for the city.



South Campus Crime Report

Introduction

The South Campus Neighborhood (SCN) extends south from California State University of Chico from West 2nd Street to West 9th Street running east and west from Salem Street to Orange Street. Because of a high student population and several popular bars, a disproportionate amount of police resources are being utilized to address incidents of crime in this area. Between the years of 2011 and 2015 there have been 2,595 crimes reported to the Chico Police Department (CPD) in the SCN. Recently an existing conditions report (ECR) has been requested by the city council to aid in policy-making decisions. The following areas of safety and service elements were to be addressed in these reports; crime statistics, emergency statistics, neighborhood general services, demographics, and traffic counts including vehicle, bicyclist, and pedestrian. In collaboration with Project Manager Fletcher Alexander and Geography and PlanninDepartment Instructor Dr. Dean Fairbanks, our class was tasked with a final project that addresses one of these components. We elected to analyze crime statistics utilizing a Geographic Information System (GIS) in hopes of producing an end product which would give us two things: a fair and accurate representation of the intensity of crimes, and the general area(s) where they are being committed in the SCN.

Methods

Existing data on the SCN was compiled into a local campus geo-database by Dr. Fairbanks which served as default data for this and other SCN projects using the GIS. CPD provided five years of crime data (2011-2015) in an excel file that included addresses, dates, and call types of the specific incidents. An ESRI Online Geocoding Service was used to translate addresses into latitudinal and longitudinal coordinates. The file was then ready to be imported into the GIS software and analyzed for spatial densities and trends.

To examine the relationships of crime in the South Campus Neighborhood, we walked the SCN and identified the locations of commercial establishments. Next, to concentrate our focus, we removed the crime spots from the map that were not in our immediate study area. Finally, two fields were added to the attribute table to aggregate the crimes and to display the time of year (season) they occurred. There are eight crime categories: alcohol related, assaults, drug related, homicides, resisting arrest, sexually



related, thefts, and weapons. Within the attribute table, we summarized the group field to get a total count of crimes within each group and then exported it into excel to create a graph of the total crimes per group, per year (Figure 1). It was clear that assaults and thefts occur most often and would be the focus of this study.

We determined that a Kernel Density Analysis would provide the optimal results for analyzing trends in the SCN. We calculated the average street length in our study area. This helped us to determine a search radius of 342 feet for the Kernel Density Analysis. Using a cell size of 50 (2500 ft²) provided us an output that avoided spatial noise without losing trends due to coarseness. It also provides a smooth transition of the crime zones within this study as well as a fair and understandable representation of the data. Kernel Density Analysis allowed us to display our data in an understandable and comprehensive way for end users to utilize and apply to future neighborhood safety and improvement plans. Mapping Clusters were attempted but did not produce the end product we had hoped for. Lastly to provide a quantitative grounding for the densities all cells had their values multiplied by the area of an average block in the SCN. This resulted in a final product that not only can identify trends of high and low crime intensity but also returns a predictive value of crimes per block. In addition to the creation of maps for trend analysis, a fine scale density map was created as a way of identifying local hot spots. This gives us an idea of where the highest intensity of crimes occur on a more address-specific basis.



Results

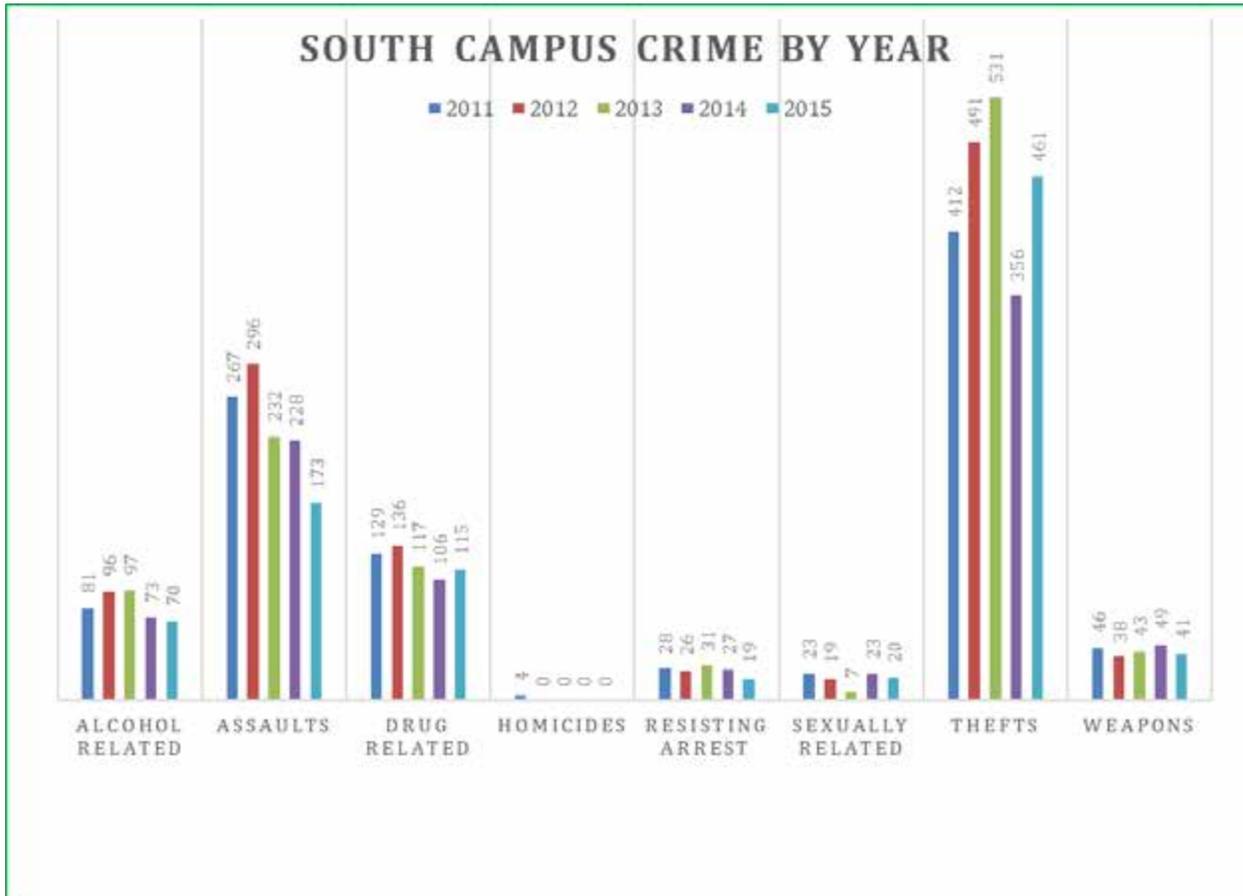
(Figure 1.) Listing of CPD Call Types associated with categories

Alcohol Related
Possible DUI
DUI crash
DUI with a minor
Bike DUI
DUI crash felony
Assaults
Stabbing
Assault with a deadly weapon
Assault/battery
Assault batter peace officer
Child abuser convicted of a violation
Battery between relatives or roommates
Drug Related
Possession of drugs
Possible drug activity
Overdose
Influence of drugs
Drugs for sale
Possession of syringe
Possess drug paraphernalia
Resisting Arrest
Resist a peace officer
Sexually Related
Sex/fondle/battery
Rape just occurred
Cold rape
Attempted rape

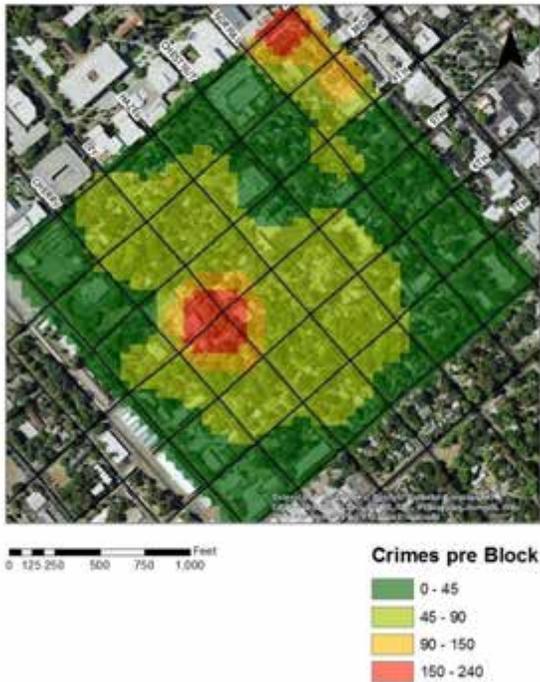
Thefts
Car Burglary
Theft/damage meters
Theft from vehicle
Strong arm robbery
Stolen vehicle
Stolen plate
Stolen bike
Residential burglary
Petty theft
Grand theft
Common Burglary
Burglary other
Armed robbery
Robbery just occurred
Home invasion Robbery
Safe Burglary
Possession of burglary tools
Weapons
Drawing, exhibiting, or using a firearm
Drawing, exhibiting, or using a knife
Firearm in public
Illegal weapon
Shots heard
Concealed weapon
Shots into residence
Shots seen
Drive by shooting
Shooting in progress
Switch Blade
Negligent discharge of firearm
Felony with firearm



Categorical breakdown of reported crimes in the SCN by nature of crime and year committed

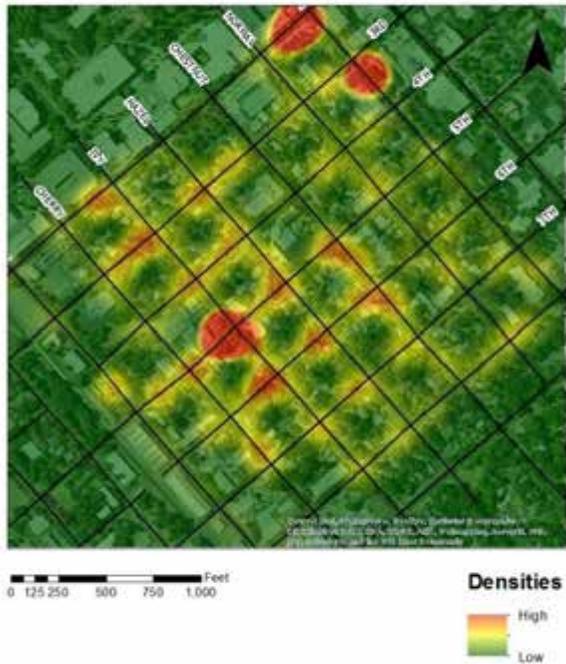


2011-2015 All Crime, Neighborhood Trends



As this indicates, thefts and assaults make up 76% of crimes in the SCN for all 5 years of data that was analyzed. The number of **assaults** for the last five years show a clear decline with **35.2%** less assaults occurring in 2015 compared to 2011. **Thefts** show a more sporadic trend, with an increase in 2015 after a significant drop in 2014, as well as a local maximum in 2013. **Thefts** represent the only category of crime that increased in the last five years with **11.9% more** incidents in 2015 than 2011. Drugs and alcohol-related calls represent the second highest percentage of crimes, but also shows a recent decrease. The number of **alcohol-related** crimes have decreased by **13.6%** over the last five years. **Drug-related** crimes show a similar steady decline with **10.9%** less occurring in 2015 than 2011. The remaining crimes, including resisting arrest, sexually-related, and weapons violations represent less than 1% of total calls in the area. **Resisting arrest** declined by **32.1%** in the last five years, **sexually-related** crimes have decreased by **13.0%**, and there have been **10.9%** less **weapons violations** in 2015 than 2011.

2011-2015 All Crime, Hot Spots

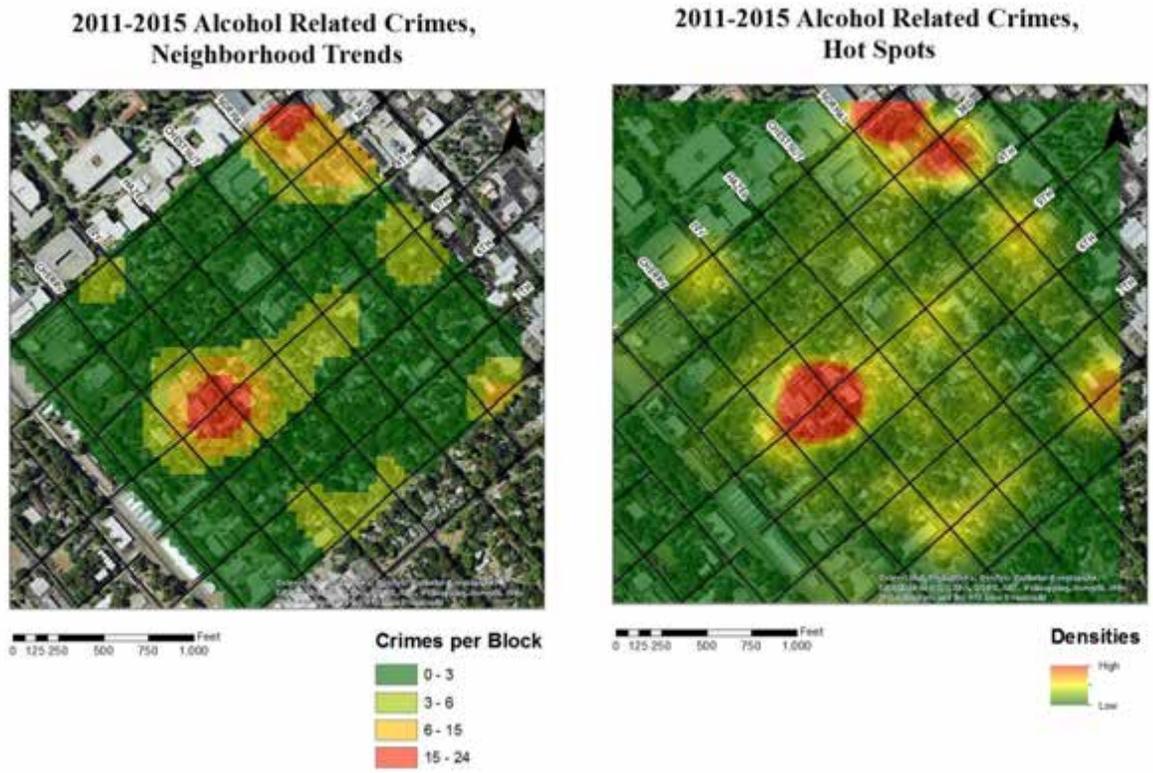


The critical zones (in red) have high levels of crime reaching up to 240 crimes per block from 2011-2015. The Hot Spot map indicates two major epicenters for crimes in the SCN that translate into critical zones of crime. One is located at West 5th and Ivy Streets between two popular bars, Franky's (south of intersection) and Riley's (southwest of intersection). The other center of critical crime density is located at West 2nd and Salem Streets surrounded by the popular bar Madison Bear Garden (west of intersection), local diner Mom's Café (east of intersection), and the B-line Transit Center (bordering West 2nd Street from Normal Ave to Salem Street).

The zones of elevated crime (in orange) closely encompass the critical zones and represent crime densities associated between 90 and 150 crimes per block. Near West 5th and Ivy Streets, these zones display a tightly fitted ripple shape indicating the influence that the critical zone has on it. It is primarily composed of businesses that serve patrons later than 12 AM and, therefore, are more prone to incidents of crime.

The Hot Spot map shows a third area of concentration, crime density, which shows that there is an elevated zone of crime located at West 3rd and Salem Streets. The zone seems to be centered around the downtown parking structure, bordering Hotel Diamond. The zones of moderate crime (represented in light green) represent crime densities between 45 and 90 crimes per block and represent one of the two levels of crime density that are made up of predominantly residential blocks. Most notably, Ivy and Hazel Streets are completely encompassed by this zone, as well as roughly half of Chestnut and Cherry Streets. These streets are well-known for Greek and other student living; they also represent some the best street lighting zones in the SCN. The Hot Spot map (above) indicates faint local increases in crime at all intersections

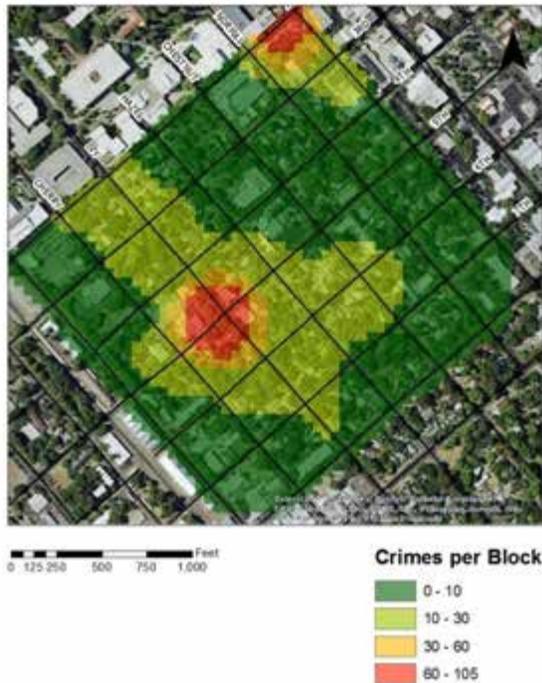
down Ivy and Hazel Streets. While the crime density is much lower, in comparison to the commercial areas, it is still high for a residential area. The dark green areas are associated with less than 45 crimes per block and are occupied by mostly residential, with some non-retail commercial buildings.



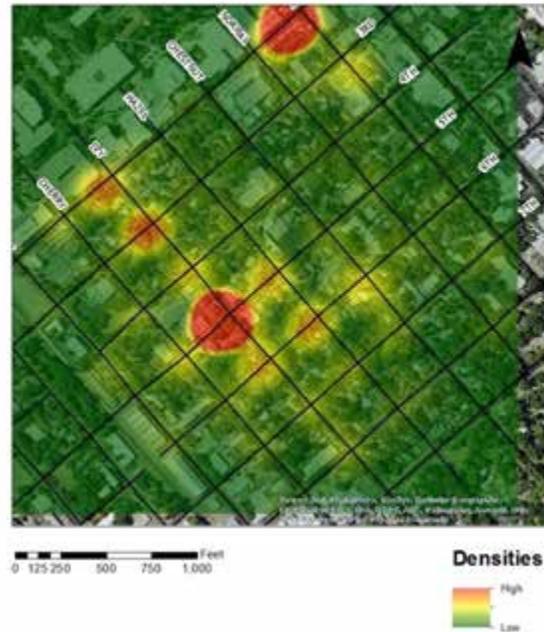
Alcohol related crimes between 2011 and 2015 (above) show many of the same trends discussed in the aggregated crimes maps. As expected, the Hot Spot map shows a much more distinct intensity surrounding the bars when other crimes are filtered out. Half a block extending from West 5th and Ivy Streets have densities between 15 and 24 alcohol related crimes per block. There is a similar hot spot near West 2nd and Salem Streets that reaches the same density. An elevated level of alcohol-related crimes seem to be occurring near the West 3rd Street parking structure, which reaches densities of 6-15 crimes per block. In addition, a small zone with densities of this magnitude is centered on West 8th Street and Normal Ave at the sports bar The Graduate (which closed in December of 2015). Most notably, the residential trends for alcohol-related crimes have the highest densities laterally along West 5th Street between Ivy Street and

Normal Ave. About halfway through Ivy street this density falls to 3-6 crimes per block. All other areas have baseline densities between 0-3 crimes per block.

2011-2015 Assaults, Neighborhood Trends

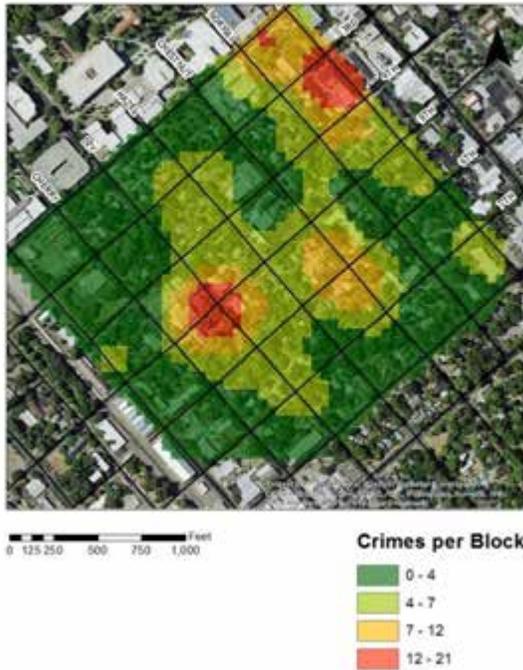


2011-2015 Assaults, Neighborhood Hot Spots

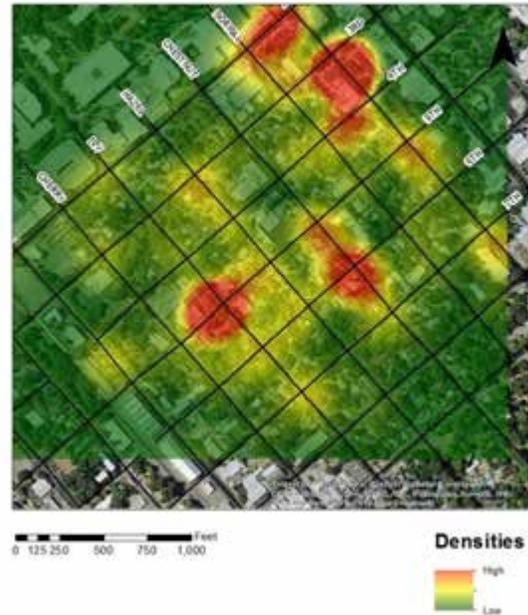


Assaults were the second most numerous crime in the SCN between 2011 and 2015 and have clear trends and hot spots (above) The neighborhood hot spots are again located directly over the two intersections with the highest concentration of bars in the SCN. Both areas surrounding West 5th and Ivy Streets, as well as West 2nd and Salem Streets, have densities of 60-105 crimes per block. Ivy Street shows the only other notable trend with elevated densities between 10 and 30 assaults occurring per block in the 5 years analyzed.

**2011-2015 Drug Related Crimes,
Neighborhood Trends**

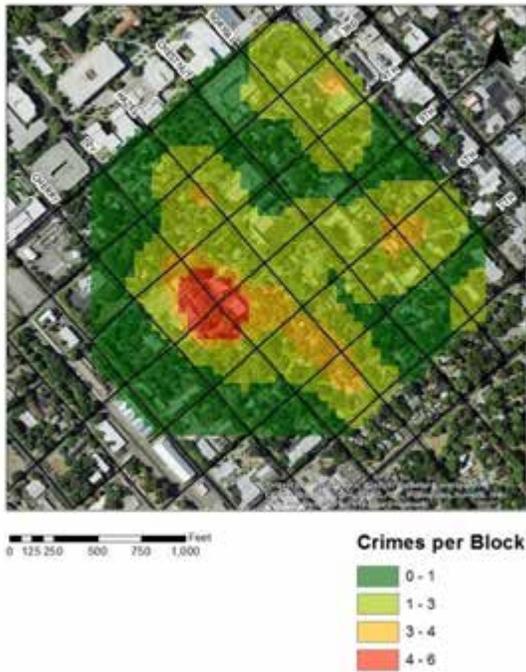


**2011-2015 Drug Related Crimes,
Neighborhood Hot Spots**

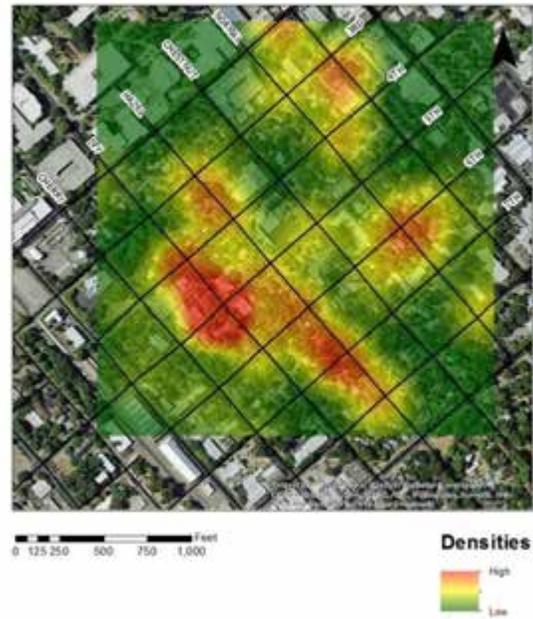


While only a small fraction of total crimes, the drug-related crimes in the SCN between 2011 and 2015 display a unique pattern. In contrast with the aggregated maps, a critical crime density zone exists directly over the West 3rd Street parking structure with another zone at West 5th and Ivy Streets. Between 12 and 21 drug-related crimes per block occur in the critical zones, and 7-12 in the elevated zones. A zone of elevated crime density is also seen on Chestnut Street from West 5th to West 7th Streets. The Hot Spot map (above) shows that a high density of drug-related crimes occur in the houses surrounding West 6th and Chestnut Streets including the Chestnut Arms apartment complex. All other areas show low densities of drug-related crimes ranging from 0-7 per block from 2011-2015.

2011-2015 Resisting Arrest, Neighborhood Trends

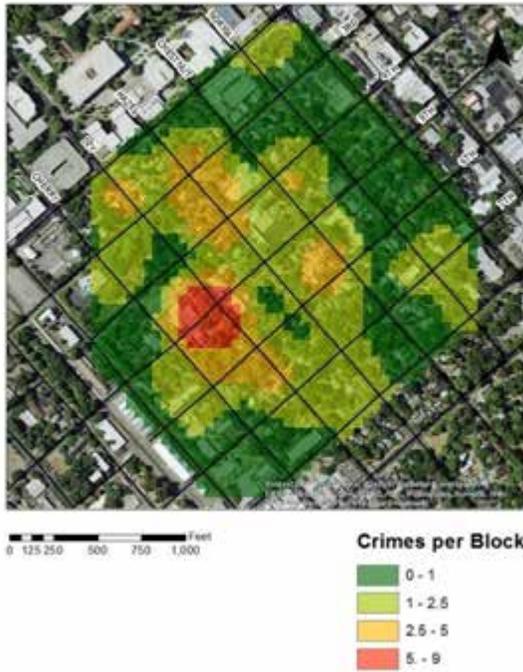


2011-2015 Resisting Arrest, Hot Spots

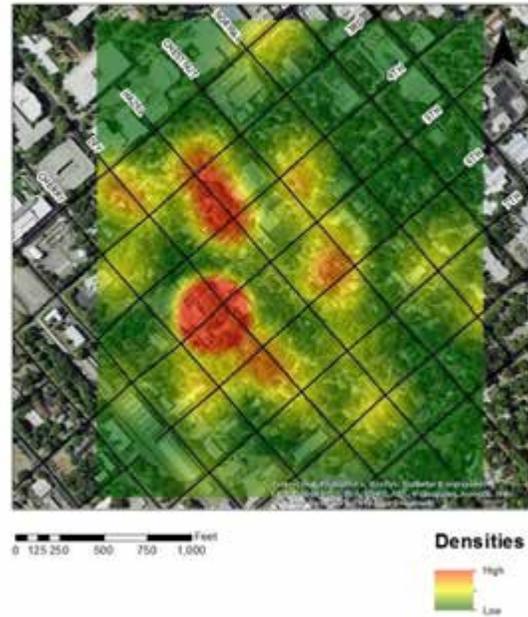


Resisting arrest is the second to least of all reported crime incidents in the SCN between 2011 and 2015 (above right) Even the critical zone represents only 4-6 crimes per block and is centered directly on West 5th and Ivy Streets with an elevated zone extending down to West 4th Street. The only other visible trend is elevated zones of 3-4 crimes per block occurring along Hazel Street in residential parts of the neighborhood. Similar to the drug-related crimes maps, a hot spot is shown at West 6th and Hazel Streets.

**2011-2015 Sexually Related Crimes,
Neighborhood Trends**

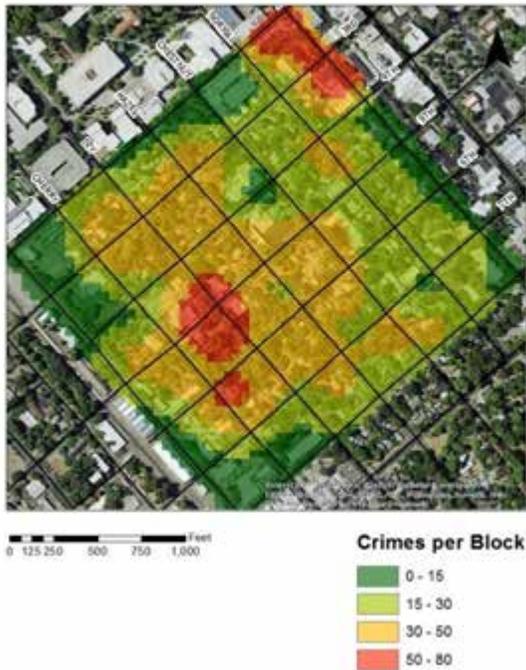


**2011-2015 Sexually Related Crimes,
Hot Spots**

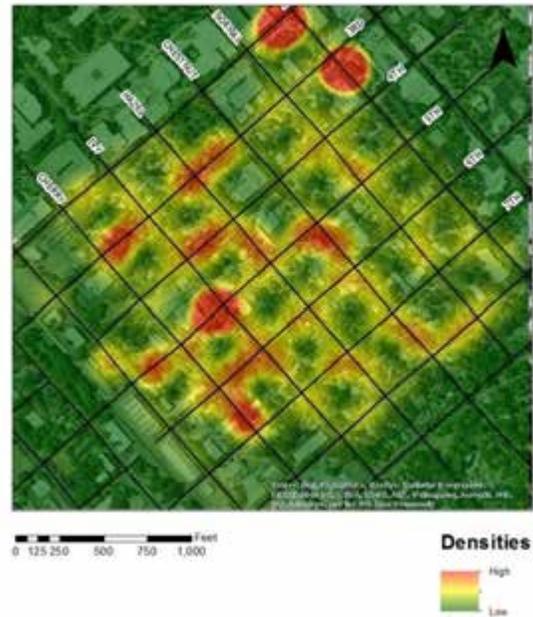


West 5th and Ivy Streets are the only critical zones of sexually-related crimes higher than 5 incidents per block between 2011-2015 in the SCN (above). Areas that fall between 2.5-5 crimes per block include a hot spot running from West 3rd to West 4th Streets on Hazel Street, a small zone east of West 6th and Chestnut Streets, and a pocket between West 2nd and West 3rd Streets on Ivy Street.

2011-2015 Thefts, Neighborhood Trends

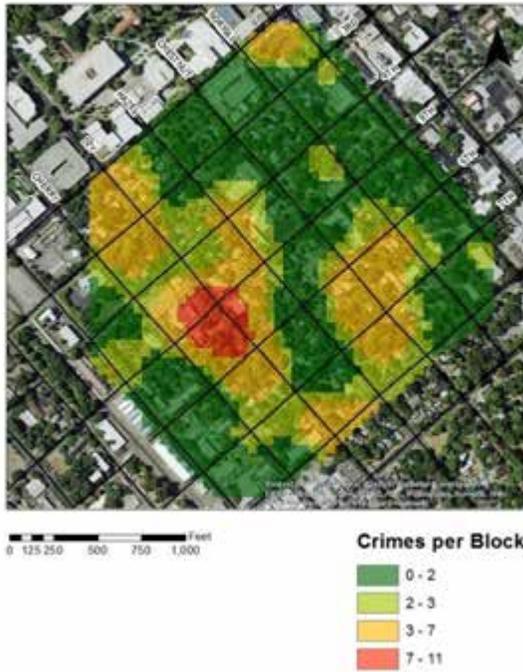


2011-2015 Thefts, Hot Spots

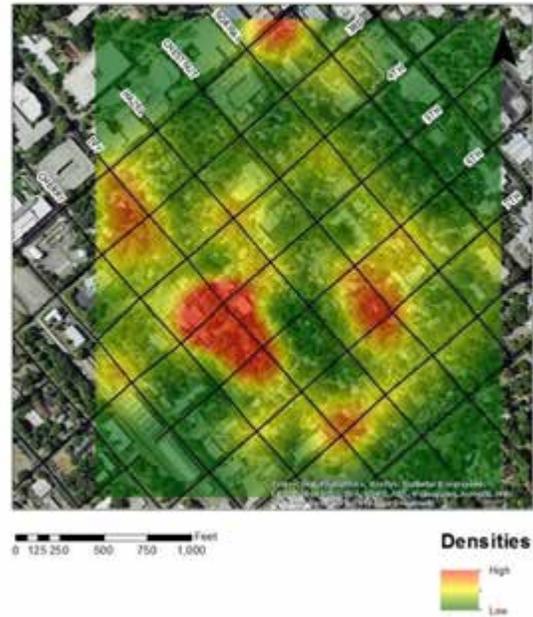


Thefts were the most numerous crime in the SCN between 2011-2015, and unlike assaults, it shows a rather dispersed pattern. Two distinct hot spots in the north part of the SCN are centered on the parking structure on West 3rd Street and the parking lot directly next to the B-line Public Transit Center. These two combine to result in a critical zone that represents 50-80 crimes per block. The types of theft in this area are mostly vehicular in nature and contribute largely to the elevated zone seen on the aggregated maps. There is also a critical zone at West 5th and Ivy Streets as well as a pocket at West 6th and Cherry Streets. Unlike the other categories of crime, most of the SCN is in the heightened zone of theft densities. Ranging from 30-50 crimes per block, it occupies most of the residential area in the SCN. Only edges of the SCN make up the baseline zones of 0-15 thefts per block.

**2011-2015 Weapons Violations,
Neighborhood Trends**



**2011-2015 Weapons Violations,
Hot Spots**



Weapons violations represent the least occurring crime in the SCN between 2011-2015. The one and only critical zone ranges between 7-11 weapons violations per block. Zones with an elevated level of 3-7 weapon violations per block are located near West 3rd and Ivy Streets, West 6th and Chestnut Streets, and West 2nd Street and Normal Ave. The rest of the SCN has densities below 3 weapons violations per block.

Conclusion

After our analysis, several things can be concluded. The eight categories can be placed into three tiers of crime for the SCN. Thefts and assaults are occurring with the greatest frequency in the SCN, followed by alcohol and drug-related crimes, and the remaining make up a small minority. All crimes in the SCN show a decline between 2011 and 2015, excluding theft. While the number of thefts that occurred in 2015 are greater than those in 2011 the number has decreased by 70 from the local peak during of 2013. Across eight categories and five years, there exists a zone of high crime rates around the establishments located at West 5th and Ivy Streets. Between Normal Ave and Salem Street, along West 2nd Street, another zone of high crime rates exists for all crimes except for those of resisting arrest and sexually-related crimes. The parking structure on West 3rd and Salem Streets has high instances of drug and alcohol-related crimes, as well as thefts. Chestnut, Hazel, and Ivy Streets are the three residential streets with the highest levels of crime in the SCN.



Executive Summary

Figure 1.

The frequency of crimes in the South Campus Neighborhood by category and by year.

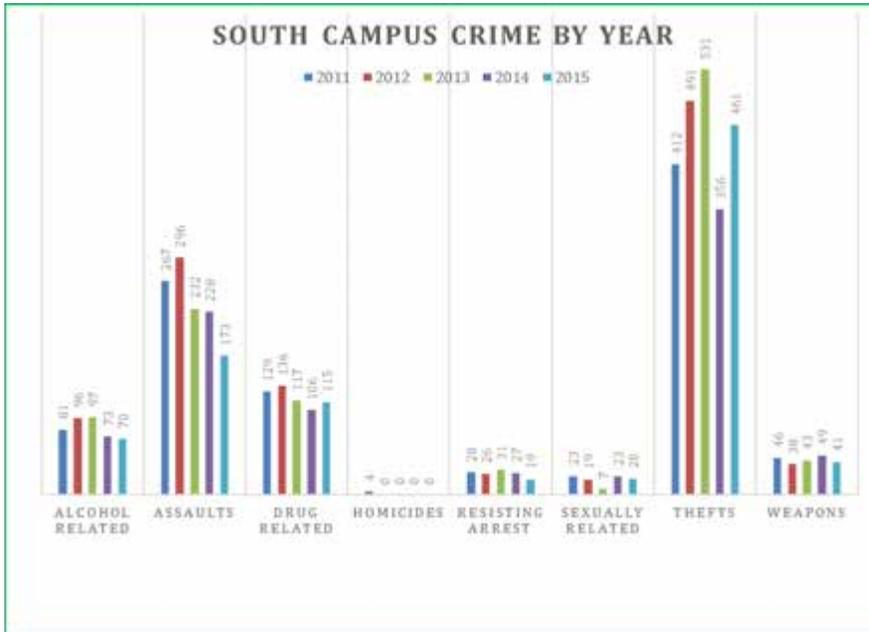
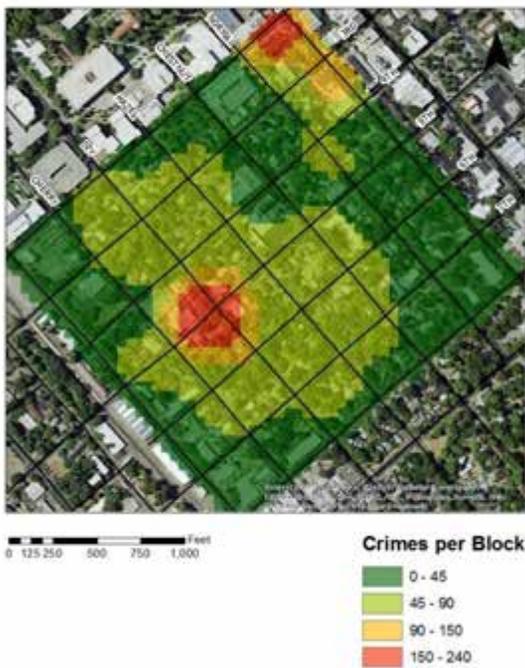


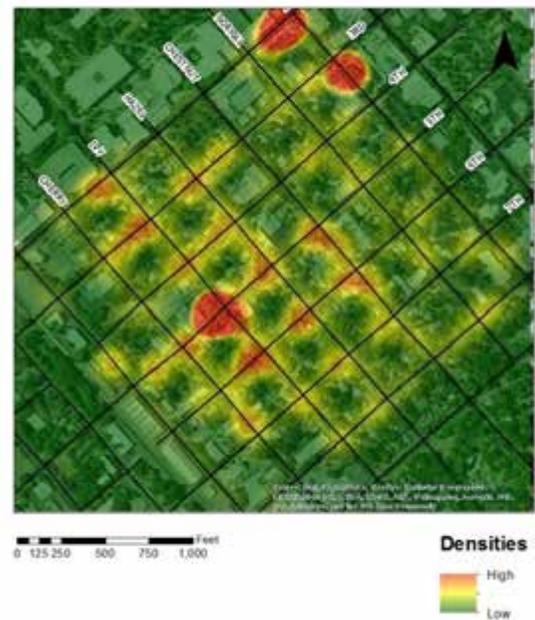
Table 1. The percentage of change in crimes from 2011 to 2015 in the South Campus Neighborhood, by category of crime.

Categories	% Change
Alcohol Related	-13.6
Assaults	-35.2
Drug Related	-10.9
Resisting Arrest	-32.1
Sexually Related	-13
Thefts	+ 11.9
Weapons	-10.9

2011-2015 All Crimes, Neighborhood Trends



2011-2015 All Crime, Hot Spots



Conclusions

- The eight constructed categories can be placed into three tiers of crime for the South Campus Neighborhood by frequency of occurrence.
 1. The most frequent: assaults and thefts.
 2. Common but not frequent: drug and alcohol-related crimes.
 3. The least frequent: weapons violations, sexually-related crimes, resisting arrest, and homicides.
- All categories show a decline between 2011 and 2015 excluding theft.
 - The number of thefts during 2015 decreased by 70 from the local maximum of 2013.
- Across all categories a zone of high crime rates exists around the establishments of West 5th and Ivy Streets.
- Between Normal Ave and Salem Street along West 2nd Street another zone of high crime rates exists for all crimes except resisting arrest and sexually-related crimes.
- Chestnut, Hazel, and Ivy Streets are the three residential streets with the highest levels of crime in the SCN.
- Near the parking structure on West 3rd and Salem Streets there are heightened levels of thefts, drug, and alcohol-related crimes.



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