

City of San José Public Streetlight Design Guide



June 2016



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1 Background and Purpose

In December 2008, the San José City Council adopted Resolution No. 74739 revising City Policy 4-2: Public Streetlights, to advance its Green Vision streetlight goal. The revised policy allows the City to take advantage of broad spectrum (white) street lighting technologies, such as light emitting diode (LED), plasma and induction (a type of fluorescent) lights. These advanced technologies are more energy-efficient and longer-lasting than the streetlight technology stipulated in the previous policy: specifically low- and high-pressure sodium (also known as high intensity discharge or HID). The policy also permits the City to dim its streetlights in the late evening hours when reduced pedestrian and vehicular traffic justify lower light levels.

The Council conditioned implementation of the new public streetlight policy on the adoption of a public streetlight design guide. This *Public Streetlight Design Guide* comprises three separate sections:

- The “Public Streetlight Replacement Design Guide” establishes design guidelines for replacing existing public streetlights and outlines the application of effective luminance factors (ELF) which modifies the luminance to account for increased visibility under white light.
- The “Public Streetlight Installation Design Guide” establishes design guidelines for improving or installing new public streetlights in the City and outlines the application of effective luminance factors (ELF) which modifies the luminance to account for increased visibility under white light.
- The “Adaptive Street Lighting Design Guide” establishes design guidelines for dimming public streetlights when reduced pedestrian and vehicular traffic justify lower light levels.

The Public Streetlight Design Guide makes use of state-of-the-art lighting science and internationally and nationally recognized street lighting design practices to maintain or improve the quality of lighting on the City’s streets; reduce energy consumption; and protect astronomical research at the Lick Observatory.

The Public Streetlight Design Guide relies on roadway lighting design guidelines issued by the Illuminating Engineering Society of North America (IES) and the International Commission on Illumination (abbreviated as CIE from its French title).

The IES is considered the nation’s technical authority on illumination. The independent, member-based professional organization synthesizes research, investigations, and discussions to develop lighting design recommendations intended to promote good lighting practice. The IES publishes nearly 100 varied technical publications that include recommended practices for a variety of specific lighting applications such as office, sports, roadway lighting, outdoor lighting, and lighting for healthcare facilities. Its members are largely based in the United States, Canada and Mexico.

The CIE is an international, independent authority on illumination. Its member countries span the globe. Like the IES, the CIE provides an international forum for the discussion of all matters relating to the science, technology and art in the fields of light and lighting. It also publishes standards, reports and other publications concerned with the science, technology and art of lighting.

All three sections of the Public Streetlight Design Guide reference IES's *American National Standard Practice for Roadway Lighting*, (Recommended Practice 8 Reaffirmed in 2005, RP-8-05). RP-8 is the nationally recognized industry recommendation for roadway lighting.

Between 1991 and 2011, San José used the 1964 version of RP-8 to determine the appropriate wattage, spacing and height for public streetlights installed in the City. In February 2011, the City approved by Resolution 75733, which indicated that the *Public Streetlight Design Guide*, relies on RP-8-05 for the installation of new streetlights. While updates to RP-8 have been taken into consideration, the Guide continues to rely on RP-8-05 as a basis for new lighting design.

For several decades the lighting community has discussed the need to revise photometric practice to recognize that the color of light has a significant effect on vision, particularly peripheral vision, in outdoor, low-light conditions (called 'mesopic' vision). CIE's *Recommended System of Mesopic Photometry*, which was adopted by the international lighting standards body in 2010, summarizes the scientific basis for the recommended system and provides guidelines for its use and application. In 2012, the IES published Technical Memorandum 12 Spectral Effects of Lighting on Visual Performance at Mesopic Lighting Levels. The result: a low-pressure (yellow light) or high-pressure (orange-pink light) sodium streetlight can be replaced with a broad spectrum (white) streetlight that emits less light for equal or better visibility. Both the "Public Streetlight Replacement Guide" and "Public Streetlight Installation Guide" employ TM-12's recommended system of mesopic photometry on streets where the speed limit is 25 miles per hour or less.

The City's Adaptive Street Lighting Design Guide also references CIE's report on this subject: *Lighting of Roads for Motor and Pedestrian Traffic* (CIE 115:2010). This report, which was issued initially in 1995 and updated in 2010, provides a structured model for dimming lights depending upon variables such as traffic volume or weather conditions. The Federal Highway Administration (FHWA) has published *Design Criteria for Adaptive Roadway Lighting*^A which adds threshold values for the parameters outlined in CIE 115:2010. Within the FHWA report, traffic volume is considered low when the hourly traffic is reduced by 50 percent.

All three design guides were also informed by a streetlight demonstration and study organized by the City and led by its consultant, Clanton & Associates, which was held in March 2010. The study systematically compared the performance of different streetlight technologies—LPS, HPS, induction and LED—at full brightness and dimmed approximately by half. A survey ascertained the public's response to those lights. A small target visibility study determined how well people could detect objects under the lights at different lighting levels. The latter research was led by Dr. Ron Gibbons, a lighting and visibility expert, Director of the Center for Infrastructure Based Safety Systems, Virginia Polytechnic Institute and State University (Virginia Tech). The study helped establish the parameters for when, where and how much the City may dim its lights.

^ADesign Criteria for Adaptive Lighting: <https://www.fhwa.dot.gov/publications/research/safety/14051/14051.pdf>

Special conditions will require special considerations of deviations from the guide.

2 General Technical Information

IES RP-8 is intended to provide guidance for designing new continuous lighting systems for roadways and streets; however, local agencies are not required to adopt IES recommended practices. This Guide relies on, and takes precedence over, RP-8-05. Definitions of additions, clarifications, and changes to RP-8-05 are described within this guide. The information provided here is applicable to all three of the City's Design Guides. This Guide uses RP-8-05 calculation methods and values to compare existing and proposed replacements.

Additional guidance for the Greater Downtown is being considered to update the San Jose Downtown Street and Pedestrian Lighting Master Plan.

2.1 Backlight, Uplight, Glare Rating System

Previously, IES vertical cutoff distribution classifications (e.g. Full Cutoff, Non-Cutoff) were based on a maximum percentage of lumens above 80 degrees and did not distinguish between backlight and forward light. Based on the luminaire classification system (LCS) infrastructure included in TM-15-11, the BUG (Backlight-Uplight-Glare) rating system was issued. The BUG systems provides a numerical rating of a luminaire based on the photometric distribution as tested by the manufacturer. The BUG rating system was proposed due to its availability to evaluate luminaire distributions in the context of the impact of light emitted in the various solid angles of the LCS as they apply to light trespass, skyglow and glare issues, and was intended to replace the IES vertical cutoff classification system.

BUG ratings cannot be directly compared to the previously used cutoff classifications as the cutoff classifications are determined from intensities (candela) of the light source above 80 degrees, rather than luminaire lumens. The three components of BUG ratings are illustrated in Figure 2-1.

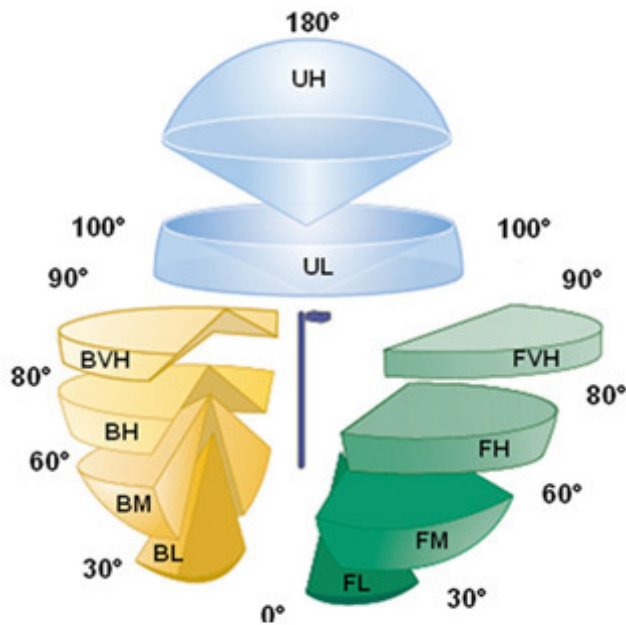


Figure 2-1: Components of BUG Rating System

Table 2-1: BUG Rating Zones.

Zone	Description
UH	Uplight High
UL	Uplight Low
BVH	Backlight Very High
BH	Backlight High
BM	Backlight Medium
BL	Backlight Low
FVH	Forward Light Very High
FH	Forward Light High
FM	Forward Light Medium
FL	Forward Light Low

Backlight creates light trespass on adjacent sites. The B rating takes into account the amount of backlight in the low (BL), medium (BM), high (BH) and very high (BVH) zones, which are in the direction of the luminaire opposite from the area intended to be lighted.

Uplight causes artificial sky glow. Lower uplight (UL) causes the most sky glow and negatively affects professional and academic astronomy. Upper uplight (UH) not reflected off a surface is

mostly energy waste. The U rating defines the amount of light emitted into the upper hemisphere with greater concern for the light at or near the horizontal angles (UL).

Glare can be annoying or visually disabling. The G rating takes into account the amount of frontlight in the high (FH) and very high (FVH) zones and the amount of back light in the high (BH) and very high (BVH) zones.

A higher BUG rating means that more light is emitted in the higher solid angles and the allowable rating increases with higher lighting zones. This guide does not provide BUG limitations. The City will specify BUG rating requirements for particular installations.

2.2 Color Temperature

The range of LED color temperatures is required to be 3000K to 4300K, and is based on study of visibility and preference. In the *Advanced Street Lighting Technologies Assessment Project for the City of San José (2010)*, it was found that while higher color temperature LEDs are more efficient, subjectively, participants generally preferred lower color temperature LEDs. There are also concerns from the astronomy community about the presence of blue wavelengths in higher color temperature light sources.

2.3 Luminance and Effective Luminance Factors (ELF)

There are three different types of visual responses; photopic (day vision), scotopic (night vision), and mesopic (combination of night and day vision). IES TM-12 *Spectral Effects of Lighting on Visual Performance at Mesopic Light Levels* provides a calculation method for evaluating the effectiveness of light sources for the mesopic visual range as a factor of the photopic luminance (Effective Luminance Factor or ELF). ELF is calculated using two values: the S/P ratio and the photopic luminance. ELFs may only be used on streets with a speed limit of 25 miles per hour or less. Calculation results within 10% of the goal for luminance are considered to meet the goal. Luminance goals take precedence over uniformity and veiling luminance.

2.3.1. S/P Ratio

The S/P ratio is a ratio of scotopic-to-photopic luminous flux of a light source. It is a ratio specifically applied to the value of luminance. S/P ratios are provided by the manufacturer of the luminaire or by an independent laboratory test. The following table shows the S/P ratios used for the replacement calculations:

Table 2-2. S/P Ratios Used for Replacement Calculations.

Luminaire	S/P Ratio
Low Pressure Sodium	0.25 ^B
High Pressure Sodium	0.6 ^C
4000K LED	1.56 ^D

S/P ratios less than one have a negative adjustment for white light effectiveness, meaning that the given photopic luminance will be effectively reduced under mesopic conditions. Conversely, S/P ratios greater than one have a positive adjustment for white light effectiveness, meaning the given photopic luminance will be effectively increased. The photopic luminance value is calculated based upon specific orientation and geometry of the street, motorist and lighting system. Refer to TM-12 for additional information.

2.3.2. Calculation of Mesopic Luminance

The photopic luminance value is determined using lighting calculation software. The units are candela per square meter. Once the S/P ratio for the source is known and the average photopic luminance is calculated, Annex A in TM-12 can be used to determine the ELF. In cases where the S/P ratio or the average photopic luminance value falls between values listed in the table, a single or double interpolation may be necessary. The ELF is applied to the average photopic luminance value to determine the average mesopic luminance.

2.4 Street Classifications

While the Envision San Jose General Plan 2040^{E,F,G&H} outlines several street topologies, for the purposes of engineering and design applications the Director of Transportation defines and maintains the City's Functional Classification Diagram of roadways (e.g., Local, Collector, Arterial, Expressway, and Freeway). Street typologies are shown in the General Plan 5, Transportation Network Diagrams. These functional Classifications and Street Typologies support the Street Classification definitions as follows:

^B Outdoor Lighting: Visual Efficacy Vol 6, Issue 2, January 2009 LRC Mark S. Rea, Jean Paul Freyssinier p. 6

^C CIE 191:2010 Recommended System for Mesopic Photometry Based on Visual Performance p. 17

^D City of San Jose Public Streetlight Design Guide, 2011 p. 12

^E Transportation Network Diagram: <http://www.sanjoseca.gov/DocumentCenter/View/7457>

^F General Plan Information: <http://www.sanjoseca.gov/index.aspx?NID=1736>

^G Functional Class Diagram: <http://www.sanjoseca.gov/index.aspx?NID=1882>

^H General Plan: <http://www.sanjoseca.gov/DocumentCenter/Home/View/474>

Freeway:

These facilities are designated solely for traffic movement of automobiles, trucks, and express transit buses. Freeways provide no access to abutting properties and are designed to separate all conflicting movements through the use of grade-separated interchanges. Bicycles and pedestrians are prohibited, or accommodated on separate parallel facilities. Freeways are maintained and operated by Caltrans.

Expressway:

These facilities provide limited access to abutting land uses and are designed primarily for traffic movement by serving high volume and high-speed regional traffic including automobiles, trucks, and express transit buses. Expressways are maintained by and operated by the Santa Clara County Roads and Airports Department.

Major:

A minor or major arterial street which accommodates four to six travel lanes. Major streets may have either (or both) a landscaped median, and on street parking.

Collector:

A neighborhood street or major collector street which accommodates two to four travel lanes. Collectors will not have a landscaped median but may have on street parking.

Local:

A residential or minor street facility which accommodates two travel lanes. Local streets will not have a landscaped median. On street parking will be available on residential streets.

Table 2-3 provides guidance for the determination of the IES road and street classification. Where conflicting information is given for a particular street, the following shall be considered in decreasing order of precedence: the functional class, street typology, and legacy references with exceptions noted.

Table 2-3: Roadway and Street Classification Guide.

IES Classification	Functional Class	General Plan Typology	Legacy Reference Information ^{Note 2}
Freeway (A & B)	Freeway	Freeway	State of California
Expressway	Expressway ^{Note 1}	Expressway	County of Santa Clara
Major	Major Arterial, Minor Arterial, Major Collector	Grand Boulevard, Main Street City Connector, Local Connector	7,500 to 50,000+ ADT, 35+ MPH, 106 to 130 ft ROW,
Collector	Major Collector, Neighborhood Collector, (Minor Collector-FHWA), Residential	Local Connector, 2 Lane City Connector	2,000 to 16,000 ADT, 60 to 90 ft ROW 30 to 45 MPH
Local	Local, Residential	Residential	Up to 2,000 ADT Up to 30 MPH 52 to 60 ROW

Notes for Table 2-3:

1. Expressways with bicycle or pedestrian access, frequent access streets, or frequent grade intersections may be considered Major.
2. Legacy reference information may be used in accordance with Table 2-3 to determine the street classification on streets without sufficient definition, or where such information indicates a higher class. Legacy reference information is in order of precedence: average daily traffic volume (ADT), speed limit in miles per hour (MPH), and Right-Of-Way (ROW).

2.5 Pedestrian Activity Level Classifications

The following are basic pedestrian classification definitions.

High:

Areas with significant numbers (over 100 pedestrians an hour) of pedestrians expected to be on the sidewalks or crossing the streets during darkness. Examples are downtown retail areas, near theaters, concert halls, stadiums, and transit terminals.

Medium:

Areas where less numbers (10 to 100 pedestrians an hour) of pedestrians utilize the streets at night. Typical are downtown office areas, blocks with libraries, apartments, neighborhood shopping, industrial, parks, and streets with transit lines.

Low:

Areas with very low volumes (10 or fewer pedestrians per hour) of night pedestrian usage. A low pedestrian classification can occur in any street classification but may be typified by suburban streets with single family dwellings, very low density residential developments, and rural or semi-rural areas.

IES pedestrian volumes represent the total number of pedestrians walking in both directions in a typical block or 660 feet section. Pedestrian counts and traffic studies take precedence over other references. There are two options for determining pedestrian counts:

1. Take one hour of pedestrian counts during the first hour of darkness on some selected days to establish the estimated average pedestrian traffic count. One or two representative blocks, or a single block of unusual characteristics can be counted, perhaps at a different hour, such as discharge from a major event.
2. Factor 2 hour (4-6PM) pedestrian counts crossing at intersections by 0.5 (to account for a one hour time period) and divide the count based upon the intersecting streets.
 - a. Matching street classes: Divide the count equally between the two streets.
 - b. Major/Local street: Allocate 80 percent of the total count to the major street and 20 percent to the local street.
 - c. Major/Collector: Allocate 60 percent of the total count to the major street and 40 percent to the collector street.
 - d. Collector/Local street: Allocate 60 percent of the total count to the collector street and 40 percent to the local street.

The General Plan outlines several land use designations¹. On-Street Primary Bicycle Facility is a General Plan Typology that may influence the pedestrian area classification. Table 2-4 may also be used as a reference when pedestrian counts are not available.

¹ Land Use Map: <http://www.sanjoseca.gov/index.aspx?nid=2086>

Table 2-4: Pedestrian Conflict Level Guide.

IES Classification	General Plan 2020	Land Use Designations ^{Note 5}
Low	A	Agriculture - Density: up to 1 DU/20 AC; minimum 20 acre parcels (1 to 2.5 stories)
	LH	Lower hillside - Density: up to 1 DU/5 AC (match existing land-use pattern) FAR up to 0.35 (1 to 2.5 stories)
	OH ^{Note 1}	Open hillside - Density: up to 1 DU/20 AC (1 to 2.5 stories)
	OSPH ^{Note 1, 2, & 3}	Open space, parklands and habitat - Density: N/A
	PROS	Private recreation and open space - Density: N/A
	RN	Residential neighborhood - Density: typically 8 DU/AC (match existing neighborhood character); FAR up to 0.7 (1 to 2.5 stories)
	RR ^{Note 1}	Rural residential - Density: 2 DU/AC (match existing land-use pattern); FAR up to 0.35 (1 to 2.5 stories)
Medium	CIC	Combined industrial/commercial - Density: FAR up to 12.0 (1 to 24 stories)
	HI	Heavy industrial - Density: FAR up to 15 (1 to 3 stories)
	IP ^{Note 1}	Industrial park - Density: FAR up to 10 (2 to 15 stories)
	LI	Light industrial - Density: FAR up to 1.5 (1 to 3 stories)
	MUC	Mixed-use commercial - Density: up to 50 DU/AC FAR 0.5 to 3.0 (1 to 6 stories)
	MUN	Mixed-use neighborhood - Density: up to 30 DU/AC 0.25 to 2.0 (1 to 3.5 stories)
	NCC	Neighborhood community commercial - Density: FAR up to 2.0 (1 to 4 stories)
	PQP ^{Note 2 & 3}	Public quasi-public - Density: FAR N/A
	RC	Regional commercial - Density: FAR up to 12.0 (1 to 25 stories)
	TEC ^{Note 4}	Transit employment center - Density: FAR up to 12.0 (4 to 25 stories)
	TR ^{Note 4}	Transit residential - Density: 50–250 DU/AC; FAR 2.0 to 12.0 (5 to 25 stories)
	UR ^{Note 2}	Urban residential - Density: 30 to 95 DU/AC; 1.0 to 4.0. (3 to 12 stories)
	UV ^{Note 4}	Urban village - Density: up to 250 DU/AC; FAR up to 10.0
High	CD	Commercial Downtown - Density: FAR up to 15.0 (3 to 30 stories)
	DT	Downtown - Density: up to 350 DU/AR: FAR up to 15 (3 to 30 stories)

Notes for Table 2-4:

1. Communication Hill goals may apply as defined by policy exception.
2. Low pedestrian classification where there is not access to site. Schools for example often have large fenced frontages that only have maintenance access from the street.

3. High pedestrian classification with maximum build per the General Plan.
4. Other sources may contribute to determining the pedestrian class including event centers, pedestrian generators, and trails.
5. Refer to the General Plan for descriptions (FAR is floor area ratio, DU/AC is dwelling unit per acre).

2.6 Other Definitions

Roadway:

Freeways, expressways, limited access roadways, and roads on which pedestrians, cyclists, and parked vehicles are generally not present. The limits of the road extend from the edge of oil or curb to the edge of oil, curb, or barrier. Performance goals for roadway lighting applies to the limits of the travel lanes only – shoulders are not included.

Street:

Arterial, collector, and residential streets where pedestrians and cyclists are generally present. The limits of the street extend from the face of curb on one side of the street to the face of curb on the other side of the street. Performance goals for street lighting applies to the limits of the travel lanes only – shoulders, bike lanes, and on street parking are not included.

Intersection:

The traffic conflict area in which two or more streets join or cross at the same grade. Intersection limits are defined by the outside edge of pedestrian crosswalks, see Figure 2-2. If there are no pedestrian crosswalks, then the intersection is defined by the extension of the existing stop bars across the whole street. If there are no stop bars, then the intersection is defined by the radius return of each intersection leg. Intersection limits may also include the area encompassing channelized areas in which traffic is directed into definite paths by islands with raised curbing, see Figure 2-3. Performance goals for intersection lighting applies to the intersection limits.

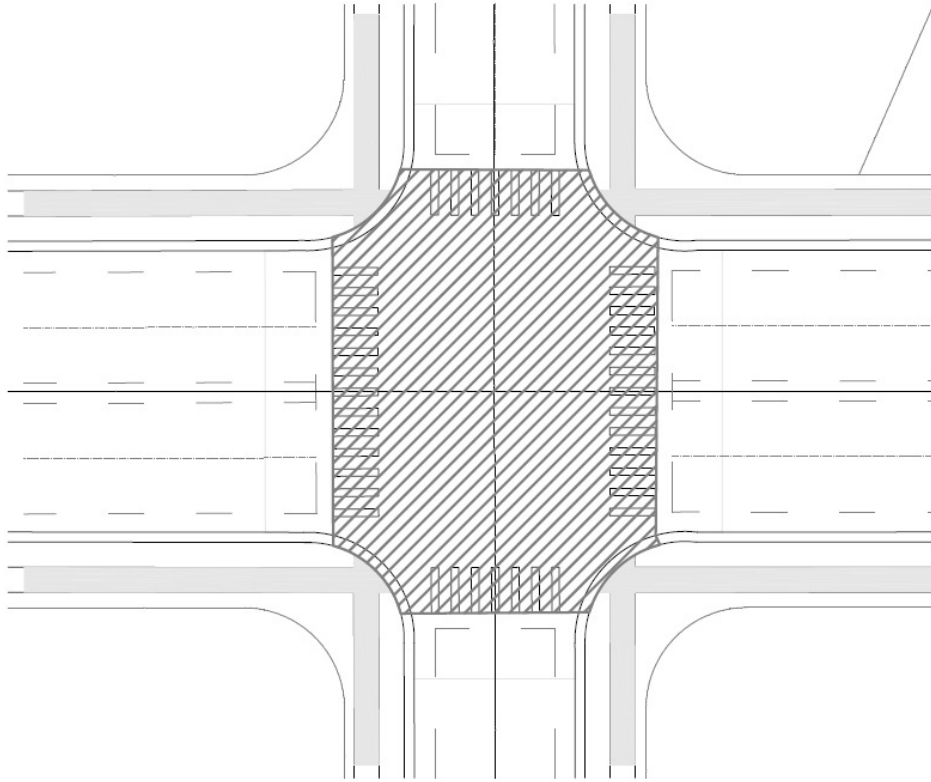


Figure 2-2: Example of Intersection Calculation Grid.

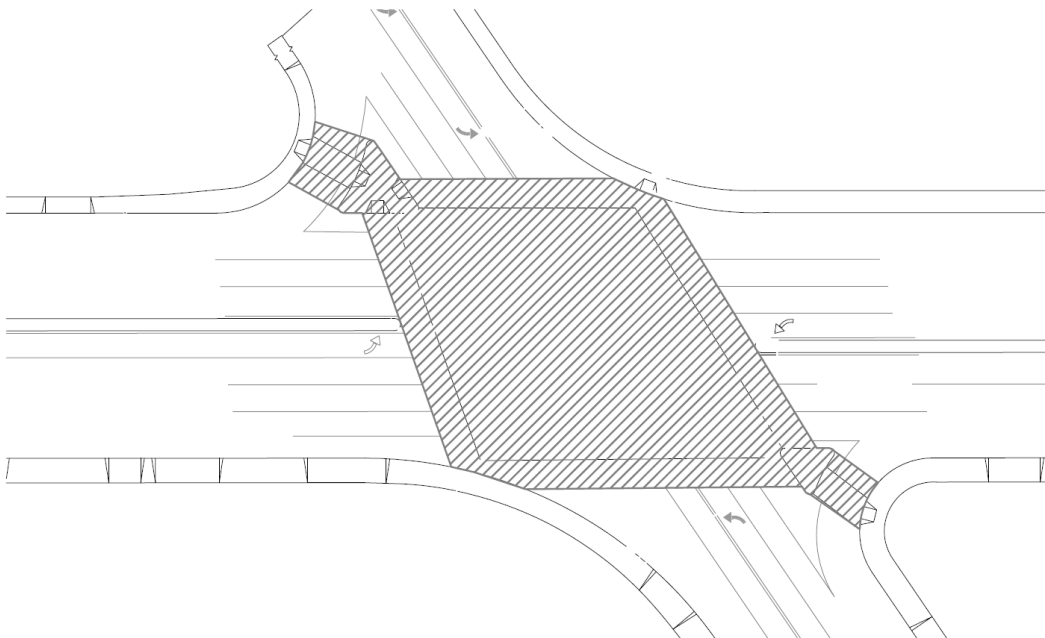


Figure 2-3: Example of Pork Chop Intersection Calculation Grid.

2.7 Uniformity

Uniformity (maximum to minimum or average to minimum) goals exist for both the illuminance and luminance performance methods for new installations. Refer to the Appendix for documentation which supports the following goal on uniformity (maximum to minimum or average to minimum) new installations.

1. A uniformity ratio (maximum to minimum) goal of 8 is to be used for street classifications that do not have a higher goal, such as minor street with low pedestrian conflict area which has uniformity ratio (maximum to minimum) goal value of 10. Maximum uniformity ratio (maximum to minimum) takes precedence over average uniformity (average to minimum) because the value can be field verified.
2. Calculation results within 10% of the goal for maximum uniformity ratio are considered to meet the goal.

2.8 Veiling Luminance

Veiling luminance is a luminance that is superimposed on the retinal image which reduces its contrast. It is this veiling effect produced by bright sources or areas in the visual field that results in decreased visual performance and visibility. The veiling luminance ratio goals outlined in Table 3 in RP-8-05 is the maximum veiling luminance divided by the average luminance. Goals for this value range between 0.3 and 0.4. Uniformity goals take precedence over veiling luminance ratio goals. Calculation results within 10% of the goal for Veiling Luminance are considered to meet the goal.

2.9 Light Loss Factors

Table 2-5 outlines the light loss factors recommended for all lighting calculations.

Table 2-5: Light Loss Factors.

	Luminaire Dirt Depreciation	Luminaire Lumen Depreciation	Total Light Loss Factor
LED	0.9	0.85	0.765
HPS	0.9	0.9	0.81
LPS	0.9	0.85 (0.7 for 180W)	0.765 (0.63 for 180W)

2.10 Concept of Adaptive Lighting

The IES (RP-8-05), the International Commission on Illumination's (CIE) *Lighting of Roads for Motor and Pedestrian Traffic* (115:2010), and the Federal Highway Administration *Guidelines for the Implementation of Reduced Lighting on Roadways* (FHWA HRT-14-050) provide for adaptive lighting. The IES provides a more conservative approach than the CIE on the degree to which it recommends lights be adapted. The maximum adaptive level using RP-8-05 is 50 percent of full light output when the pedestrian conflict level changes from high to low. The maximum adaptive level using CIE 115 is 50 percent of full light output when the traffic volume changes from very high to very low. There are several other parameters within CIE 115 for which the adaptive level is calculated. The maximum adaptive level using FHWA HRT-14-050 is 66 percent of full light output when the traffic volume changes from high to low. Hourly traffic volume is considered low when it has reduced to 50 percent of the high value (page 12).

IES allows for adaptive lighting and varying luminance goals for streets based on the level of pedestrian conflict. The IES states that the level of pedestrian conflict is closely related to the abutting land use and defines three levels of conflict: high, medium, and low. When lighting goals are selected, the worst case of pedestrian conflict is chosen to adequately light the roadway. However, this level is also time dependent and may be high at one point in the night and low at another. RP-8-05 describes all of the pedestrian conflict levels and implies the use of adaptive standards.

CIE takes a more detailed approach by defining all of the parameters that contribute to the need for lighting on a street. These include: speed, traffic volume, traffic composition, presence of medians, intersection density, presence of parked vehicles, ambient luminance, and visual guidance. This approach allows for a more detailed tailoring of the lighting goals to individual stretches of street. It also recognizes that some of these parameters are static (speed, median, intersection density) and some are conditional (traffic volume, traffic composition). How these conditional parameters vary between peak use of the road and a reduced level of activity define the required luminance goals for each time period.

FHWA takes the CIE parameters and adds selection criteria.

2.11 Bike Lanes

The IES does not currently have lighting goals established for bike lanes that are adjacent to the traffic lanes. Per IES RP-8-05 Figure A4, bike lanes are not included in the street calculation area. Bike lanes will continue to be excluded from the calculation area until the IES generates specific lighting goals for bike lanes.

3 Public Streetlight Replacement Design Guide

3.1 Purpose

The purpose of this section of the *Public Streetlight Design Guide* is to provide a methodology for replacing existing high intensity discharge (HID) streetlights with broad spectrum light streetlights, such as LED technology. This guide should only be used for the replacement of public streetlights. It is not required or economically feasible for local agencies to update all of their streetlight to meet changing IES lighting recommendations. Instead, the goal of this replacement guide is to maintain equivalent lighting levels for a given stretch of road when luminaires are replaced.

The goal for streetlight replacements is to replace in-kind; they are not designed to increase the existing lighting levels on the streets, but to provide comparable visibility for the stretch of street illuminated by the existing lights.

A broad spectrum replacement light is considered 'equivalent' to the existing HID light if a lighting system using the light can deliver similar performance to the existing system using luminance goals (within 10%).

3.2 Streets with Consistent Wattage of Luminaire

Table 3-1 provides LED replacement equivalents based upon lumen output range and maximum wattage for the following existing conditions:

- Continuously lighted streets and roads
- Non-continuously lighted streets and roads
- Curved streets greater than a 600 meter radius (3.281 feet per meter)
- Streets with a grade of less than 6 percent
- Intersections
- Mid-block crosswalk

Replacing the existing lighting with the designated LED lumen output packages and maximum wattages will deliver an equivalent luminance.

Table 3-1: Replacement Guide for Existing Luminaires.

Street Classification	Existing Luminaire Type	Speed Limit 25mph and less		Speed Limit Greater than 25 mph	
		Replacement Lumen Output Range (LED)	Maximum Replacement Wattage (LED)	Replacement Lumen Output Range (LED)	Maximum Replacement Wattage (LED)
Local	55W LPS	2300-2600	26	2900-3200	35
	90W LPS	3900-4200	45	4300-4600	48
	135W LPS	5700-6000	65	7100-7400	79
	70W HPS	3900-4200	45	3900-4200	45
	100W HPS	3900-4200	45	5700-6000	65
Collector	55W LPS	2300-2600	26	2900-3200	35
	90W LPS	3900-4200	45	4300-4600	48
	135W LPS	5700-6000	65	7100-7400	79
	180W LPS	8600-8900	96	11,000-11,300	122
	100W HPS	4300-4600	48	5700-6000	65
	150W HPS	8600-8900	96	9700-10000	110
Major	90W LPS	3900-4200	45	4300-4600	48
	135W LPS	7100-7400	79	8600-8900	96
	180W LPS	9700-10,000	110	11,000-11,300	122
	150W HPS	8600-8900	96	9700-10,000	110
	250W HPS	13,300-13,600	148	16,400-16,700	182

Notes to Table 3-1:

1. Replacements require Type II (local streets only) or Type III distributions.
2. The minimum efficacy requirement for all replacements is 85 lumens per watt.
3. This table accommodates mounting heights between 31-35 feet.
4. Lumen output is the initial output of the luminaire, rather than the maintained output.
5. Table 3-1 does not apply to downtown lighting applications.
6. Freeway, expressway and other areas maintained by others are not included.

3.3 Streets with Inconsistent Wattage of Luminaires

Table 3-1 does not apply to streets with inconsistent wattage of luminaires, or streets where the luminaires are mounted at a height outside of the 31-35 foot range.

The following lighting analysis needs to be done to determine the required replacement luminaire for streets with inconsistent wattage of luminaires, or luminaires mounted outside of the range:

1. Calculate existing luminance for the stretch of roadway.
2. If the existing luminaires for the stretch of roadway exceed the IES recommended luminance for that street classification and pedestrian conflict level, then the RP-8-05 luminance value becomes the target light level for the street.
3. Propose a replacement luminaire. A single luminaire is recommended for replacement to avoid several different luminaire types along a single roadway.
4. Calculate photopic average to two significant digits. Apply effective luminance factor (ELF), if speed limit is 25 miles per hour or less.
5. Perform additional analysis to ensure that the replacement(s) is within 10% of the existing average luminance. Selection of an acceptable replacement is a process that may require several iterations.
6. Prepare a summary of results including a comparison to the goals.

3.3.1. Streets with Inconsistent Wattage Replacement on Straight Street Example

A major arterial street has a curb to curb width of 82 feet, with two lanes of travel in each direction. There is no bike lane, on street parking, or shoulder. The street classification is Major with a Low pedestrian conflict level. The speed limit is greater than 25 miles per hour. ELFs are not applicable.

Along the stretch of road, there are three existing wattages of luminaires:

- 90W LPS (quantity of 3)
- 100W HPS (quantity of 3)
- 150W HPS (quantity of 4)

Following the steps from Section 3.3:

1. Calculate the existing luminance using AGI32. Apply applicable light loss factors for each type of existing wattage and type of luminaire.

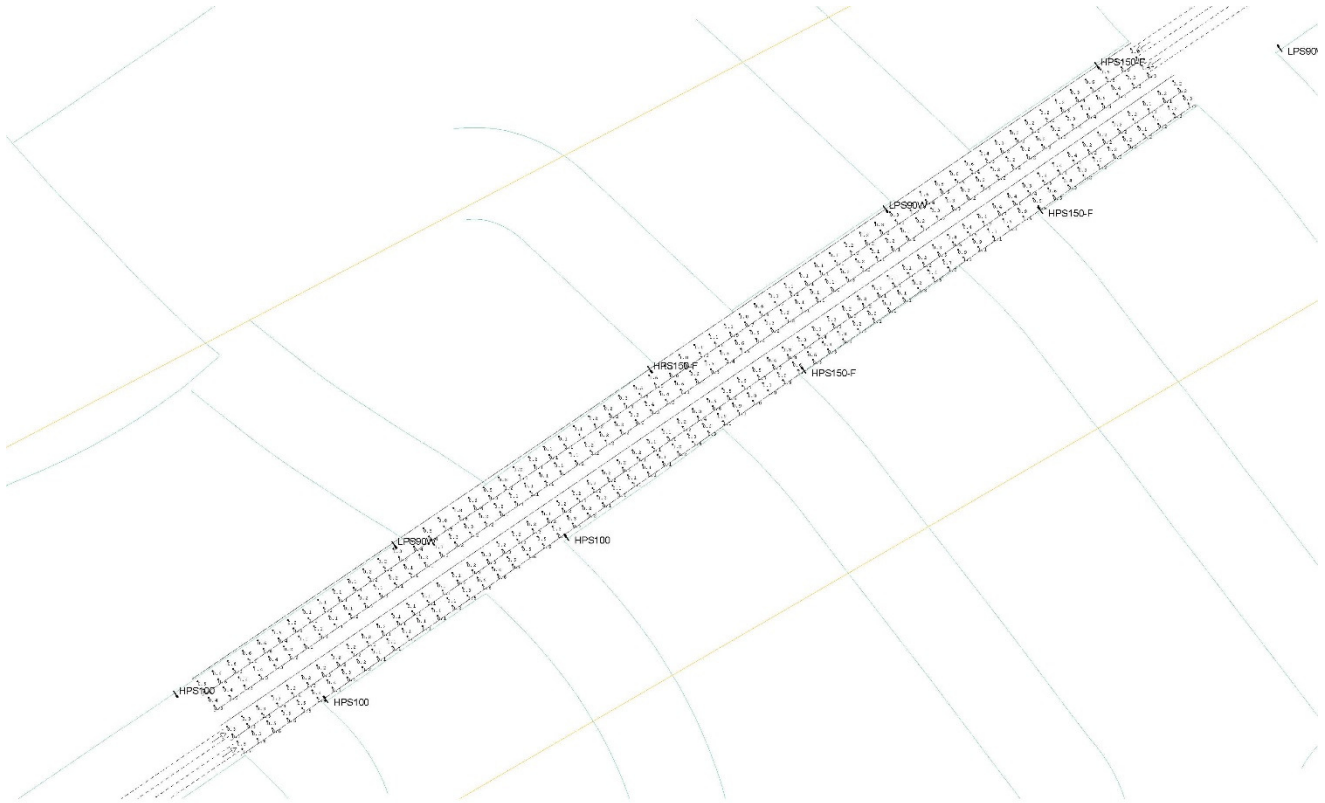


Figure 3-1: Existing Luminance Point by Point Calculation.

Table 3-2: Existing Luminance

	Westbound	Eastbound	Average
Existing photopic Luminance	0.36	0.35	0.35

2. Compare existing to RP-8-05 value.

Since the IES luminance goal is 0.6cd/m² which is higher than the existing luminance, the existing luminance is the target goal.

3. Propose a replacement luminaire.

An LED luminaire with 8066 initial lumens and 88Watts (system) is selected for replacement.

4. Calculate the photopic average of the replacement luminaire. ELF's are not applicable because the speed limit is higher than 25 miles per hour.

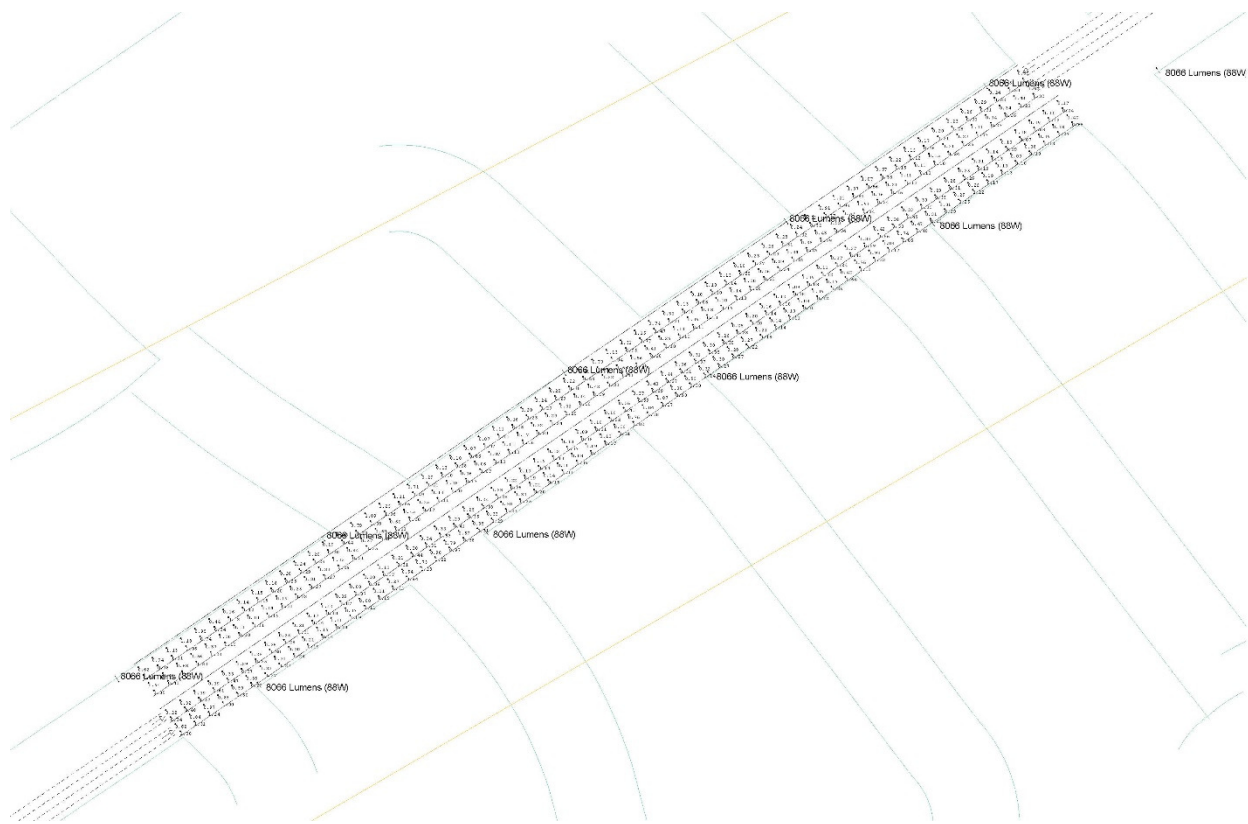


Figure 3-2: Proposed Luminescence Point by Point Calculation.

Table 3-3: Proposed Luminescence Values.

	Westbound	Eastbound	Average
Proposed replacement photopic Luminescence	0.36	0.36	0.36

5. Perform additional analysis.

Since the recommended replacement is within 10% of the existing luminescence, there is not a need to perform additional analyses. Had the selected type not been within 10%, additional iterations of selecting a luminaire and recalculating would be performed.

6. Prepare a summary of results in comparison to the goal.

3.4 Intersections

The same luminaires are to be used throughout the intersection. Designers are to consider the street classification of the intersecting roads, the speed limit, luminaires at the intersection, and use Table 3-1 to determine the applicable replacement luminaire for all luminaires at an intersection. The greater of the two recommended replacements from Table 3-1 should be used.

3.4.1. Intersection Replacement Example

A major arterial street, with a speed limit of 35 miles per hour, intersects with a collector street with a speed limit of 25 miles per hour. There are four existing luminaires at the intersection, all with a wattage of 135W LPS.

From Table 3-1, there are two different replacements:

1. Collector, 135W, speed limit 25 miles per hour or less
 - a. Lumen output range of 5700-6000 and maximum system wattage of 65W
2. Major, 135W, speed limit greater than 25 miles per hour
 - a. Lumen output range of 8600-8900 and maximum system wattage of 96W

The luminaire for replacement all of the lights at the intersection should have a lumen output of 8600-8900 and maximum system wattage of 96W.

4 Public Streetlight Installation Design Guide

4.1 Purpose

This section of the Guide is only to be used for improving or installing public streetlighting, either standalone, or on traffic signal installations and modifications affecting pole types or locations (excluding minor work by City maintenance staff).

4.2 General Guidance

For all new installations, lighting design shall follow the values set forth in the 2005 version of the Illuminating Engineering Society of North America's (IES) *American National Standard Practice for Roadway Lighting* (RP-8-05).

4.3 Lighting Design Process

Performing a lighting design for new installations of streetlights is an iterative process. This occurs because the lighting design is altered (spacing, arrangement, mounting height) until the target goals for the specific street in question is met. Most efficiently, a simulated model is created to perform the luminance (straight streets) or illuminance (intersection and non-straight streets) calculations while allowing easy modification of the streetlight parameters. Once the target luminance is achieved, the ELF can be applied to the photopic average luminance, if the speed limit is 25 miles per hour or less.

4.3.1. New Installations on Continuous Straight Streets

The design process for improving or installing streetlights should follow the outlined process below.

1. Determine the design parameters of the new street, including: median width, luminaire setback, curb to curb width of the street, number of lanes in each direction, bike lane width, presence of on street parking, width of shoulder, street classification, and level of pedestrian conflict for both street and cross street. If also determining the lighting for an intersection, determine the street classification of the intersecting street.
2. Determine the goals that are to be achieved based upon the street classification and level of pedestrian conflict from Section 2.4 Street Classifications and Section 2.5 Pedestrian Conflict Classification. Note that this guide may permit a higher maximum uniformity ratio than is listed in RP-8-05.
3. Develop a model of the street with the design parameters in lighting calculation simulation software such as AGI32. Calculate photopic average to two significant digits. Apply effective luminance factor (ELF), if speed limit is 25 miles per hour or less.
4. Define luminaires that may be used in the calculation model. Apply light loss factors for maintained conditions (lamp lumen depreciation, luminaire dirt depreciation, etc.). Set the mounting height and arm length that will be used for the installation.
5. Use software such as AGI32 Roadway Optimizer to start preliminary design. For streets that do not have a median, use the 'Configure' tool to adjust to the 'Entire Roadway' for 'Single Roadways with Two Way Traffic.'
6. Set up a luminance calculation grid for one cycle of luminaires in the area of travelled way. The travelled way is the number of vehicle lanes for the majority of the length of the

roadway. Bike lanes, on street parking, and shoulder are not included in the travelled way. If irregular spacing is to be used, then the designer should consider extending the calculation area to include the whole street segment. Note that the veiling luminance ratio will exceed the goal within intersection areas because the observer's view will be impacted from the lights within the intersection. In this case, calculate the veiling luminance from only one side of the street where the observer's view is not impacted by the intersection.

7. Begin placing luminaires on the portion of the straight continuous lighted street. Evaluate the outcomes of varying street light arrangements (staggered, opposite, or, single sided) to achieve an appropriate spacing. Although the luminance calculation grid includes only one cycle of luminaires (or stretch of street), include additional luminaires in each direction in the model as long as the luminaires have significant contribution.
8. Integrate lighting locations and revise lighting model in correspondence to other improvements, e.g. clearance from driveways (10ft commercial and 5ft residential), fire hydrants (5ft), trees (20ft), and utilities (State General Order, 95 & 128). Place lights near property lines wherever practical and avoid locations in front of doorways, windows, and lines of egress.
9. Use TM-12 to calculate the ELFs based on the S/P ratio and the photopic luminance, if the speed limit is 25 miles per hour or less.
10. If the calculated luminance meets average luminance, maximum uniformity ratio, and maximum veiling luminance ratio goals (within 10%), then the luminaire is a viable option. Average luminance and maximum uniformity ratio (maximum to minimum) takes precedence over average uniformity ratio (average to minimum) and maximum veiling luminance.
11. If necessary, adjust the luminaire spacing and/or wattage and repeat until the values (average luminance, uniformity ratio, and veiling luminance ratio) meet the goals.

4.3.2. Intersections

The design process for improving or installing streetlights and installing or modifying traffic signals should follow the outlined process below.

1. Determine the goals that are to be achieved based upon the street classification and level of pedestrian conflict from Section 2.4 Street Classifications and Section 2.5 Pedestrian Conflict Classification.
2. Begin placing luminaires on top of the signals in accordance with RP-8-05 Figure D3 (d).
3. Perform illuminance calculations using proposed luminaires. Because the unit is illuminance, ELFs cannot be applied.
4. Compare the illuminance goals determined in Step 1 to the calculated illuminance in Step 3. If the calculated illuminance is far above or below the design target, adjust the luminaire wattage, add additional luminaires on the traffic signal poles or add additional street light poles and repeat until the value of the calculated illuminance meets the goals (within 10%). Calculate the light level on intersecting streets. If an intersecting street is illuminated higher than the intersection light level goal, then the intersection

illumination value should be increased to the sum of the light level of the intersecting streets.

5. Integrate lighting locations and revise lighting model in correspondence to other improvements, e.g. clearance from driveways (10ft commercial and 5ft residential), fire hydrants (5ft), trees (20ft), and utilities (State General Order, 95 & 128). Place lights near property lines wherever practical and avoid locations in front of doorways, windows, and lines of egress.
6. If the calculated illuminance and uniformity meets the goals (within 10%), then the luminaire arrangement is a viable option for that particular intersection.

4.4 Atypical Street Sections

Throughout the City there will be atypical street sections that will require special consideration to design the lighting.

4.4.1. Horizontal Curves

Streets that have a radius of 600 meters^J or less (measured from the center point to curb face) can be calculated using the horizontal illuminance goals for straight streets. Streets that have a radius greater than 600 meters (rounded to the nearest 100 meters) should be designed using luminance goals. If the calculation places the observer off of the road, then consider using illuminance goals for the street. ELF's cannot be applied to illuminance calculations.

Additional design guidance is provided below:

- Sharper radius curves (less than 600 meters, rounded to the nearest 100 meters) warrant closer spacing of luminaires in order to provide higher pavement illuminance. Refer to Figure D2 in RP-8-05.
- Provide ample lighting on vehicles, road curbs and berms, and guard rails.
- Poles should be located behind guard rails or other natural barriers.
- Place poles on inside of curve where feasible; there is some evidence that poles are more likely to be involved in accidents if placed on outside of curves.
- Aim luminaires with mast arm at 90 degrees to tangent of the curve.

4.4.2. Slopes

Streets that have a six percent grade or greater can be calculated using the horizontal illuminance goals for straight streets. Streets that have a grade less than six percent should be designed using luminance goals. ELF's cannot be applied to illuminance calculations.

Additional design guidance is provided below:

- Steeper grades (six percent or greater) warrant closer spacing of luminaires in order to provide higher pavement illuminance. Refer to Figure D2 in RP-8-05.
- Orient the luminaire and mast arm so that the luminaire is perpendicular to the street centerline and level (no tilt).

^J 3.821 feet per meter

- Roll the luminaire so that the light pattern from the luminaire is symmetric on the street; i.e. the cross slope of the luminaire (which is normally level) is parallel to the slope of the street.

4.4.3. Single Sided Luminaire Arrangement

Where luminaires are proposed on one side of the street only, the luminance goals from RP-8-05 shall be applied individually to both the near side and to the far side of the street and then averaged together. ELFs may be applied if the speed limit is 25 miles per hour or less.

4.5 Historic Districts/Areas

Historic Districts/Areas^k have special guidelines as indicated in the Ornamental Streetlights Council memorandum approved 12-18-01 and included in this Guide as Appendix 6.3. Refer to the Planning webpage for additional Historic Districts/Areas (see link below).

4.6 Communication Hill Area

The Communication Hill Area has requirements as indicated in Council Resolution 71808 approved 11-04-03 and included in this Guide as Appendix 6.4.

4.7 New Installation Design Example

The following example includes how to design and select the luminaires for two dissimilar street classifications as well as the intersection of the two streets.

Following the steps from Section 5.3.1:

1. Determine the design parameters of the street.

A local street has a curb to curb width of 36 feet, with one lane of travel and seven feet of shoulder in each direction. The street classification is local with a low pedestrian conflict level. The speed limit is 25 miles per hour. The local street intersects with a major street with a curb to curb width of 81 feet, with two lanes of travel in each direction, a 14 feet median, a six feet bike lane in each direction, and a four foot shoulder on one side of the street with a seven foot shoulder on the other side of the street. There is no on street parking. The street classification is major with a medium pedestrian conflict level. Approaching the intersection, the major street has a 60 feet taper and two left turn lanes in lieu of a median.

The luminaire will be mounted at 31.75 feet on the street and 35 feet at the intersection. Each luminaire will have an arm length of 8 feet. The setback of each pole is 2.25 feet. The luminaires will be arranged in a staggered arrangement.

2. Determine applicable goals from RP-8-05 and exceptions within this guide.

^k Historic Districts/Areas: <http://www.sanjoseca.gov/index.aspx?nid=2174>

Table 4-1. Design Goals from RP-8-05 Table 3.

	Straight Street			
	Average Luminance	Average Uniformity Ratio L_{avg}/L_{min}	Max Uniformity Ratio L_{max}/L_{min}	Max Veiling Luminance Ratio LV LV_{max}/L_{avg}
Local, low	0.3	6.0	10.0	0.4
Major, medium	0.9	3.0	8.0	0.3

Table 4-2. Design Goals from RP-8-05 Table 9.

	Intersection	
	Average Illuminance	E_{avg}/E_{min}
Major/local, medium	2.0	3.0

3. Develop a model.

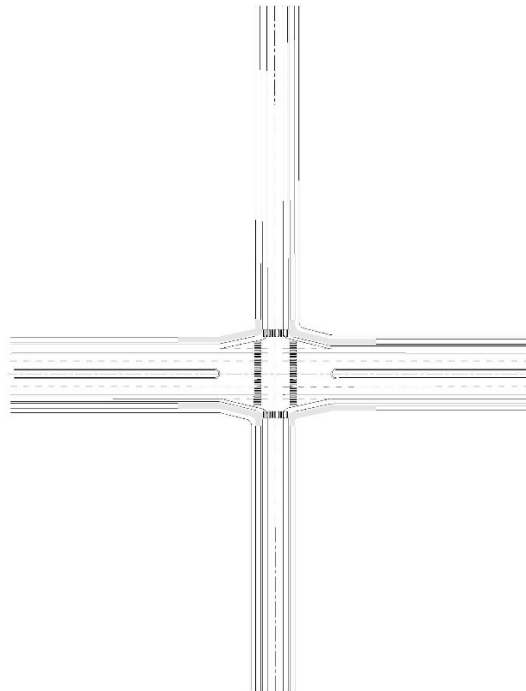


Figure 4-1. Example Drawing of Two Intersecting Streets.

4. Define luminaires.

Several luminaires of varying lumen outputs were defined in AGI32. Each luminaire was assigned the applicable light loss factor and arm length. In lieu of an accepted manufacturer's list, designers are to use professional experience to estimate the initial set of defined luminaires.

5. Use AGI32 Roadway Optimizer to select starting conditions.

Roadway Optimizer was used to establish a preliminary spacing to be used in the model for both the local street and the major street. Set the setback value accordingly. The Configure tool is used since the local street does not have a median.

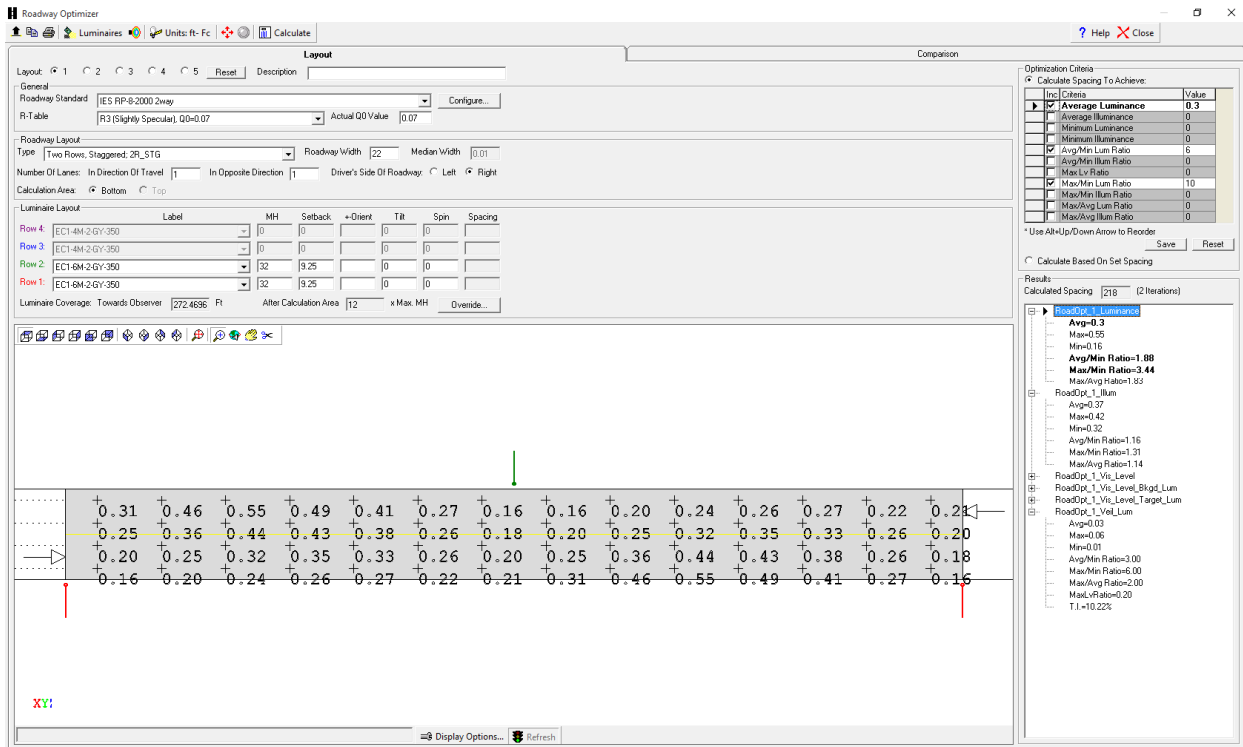


Figure 4-2. Roadway Optimizer for Local Street.

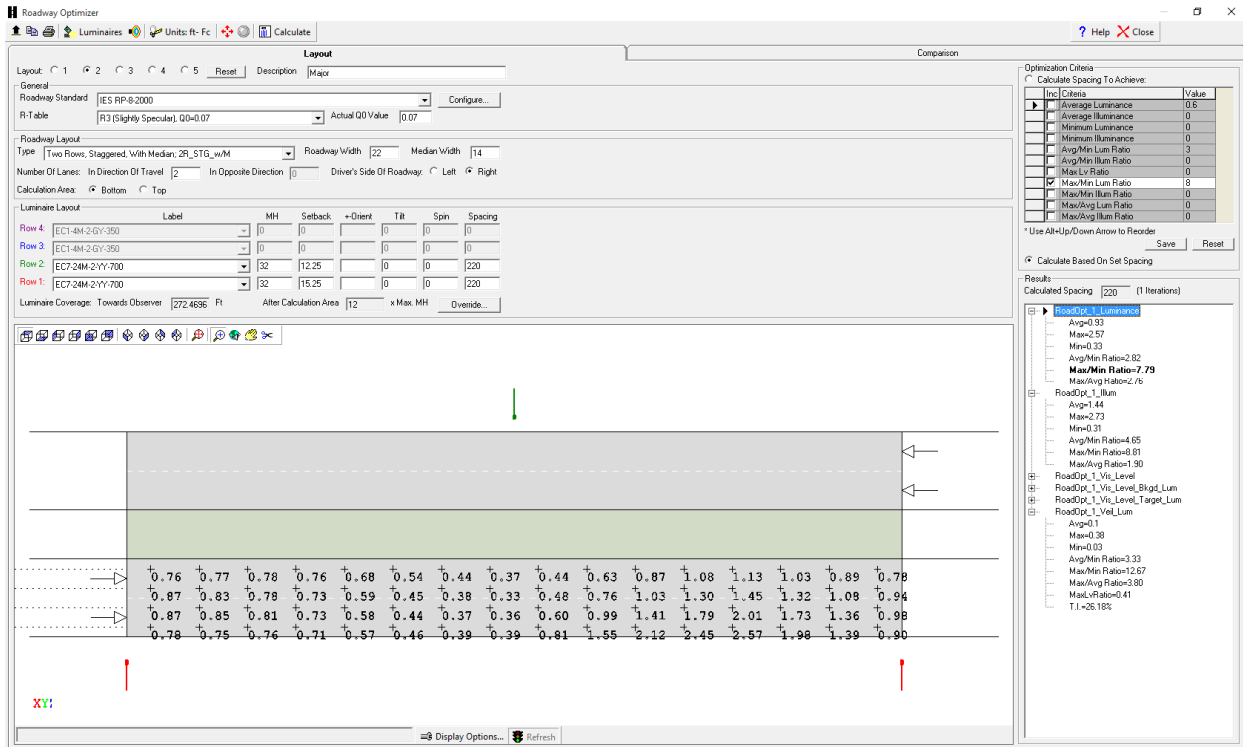


Figure 4-3. Roadway Optimizer for Major Street.

The following luminaire spacings were found with the corresponding lumen output to achieve the performance goals:

Local Street: 218 spacing (staggered) with selected luminaire

Major Street: 220 spacing (staggered) with selected luminaire

6. Set up calculation grid.

Three calculation grids are required: Intersection, local street, and major street. The calculation grids for the streets should be a luminance calculation. The intersection calculation should be an illuminance calculation.

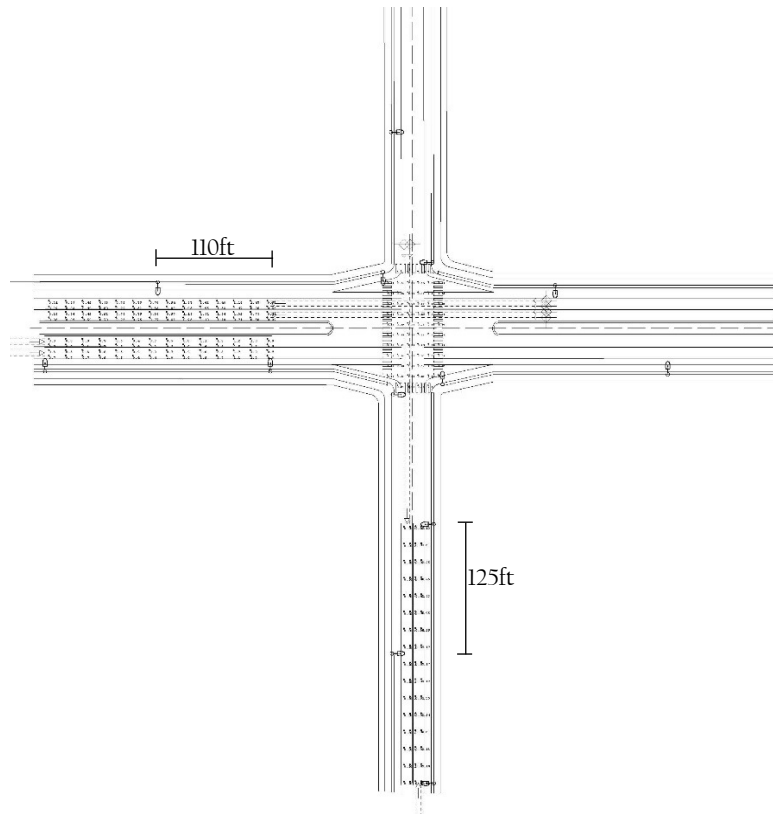


Figure 4-4. Example Calculation Grid.

7. Place luminaires in desired arrangement.

Luminaires are placed according to the findings from Roadway Optimizer. The greater lumen output is used at the intersection to illuminate the higher street classification. The lower lumen output is used at the intersection to illuminate the lower street classification.

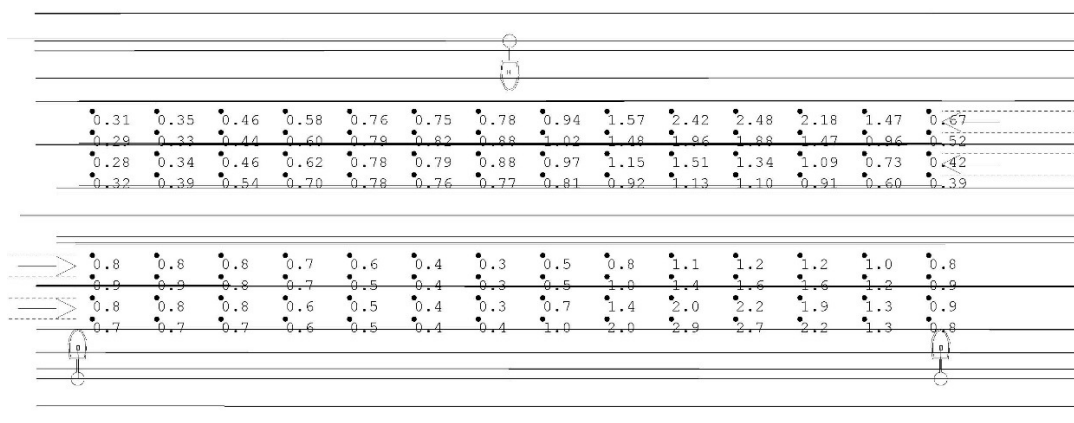


Figure 4-5. Major Street Point by Point Calculation.

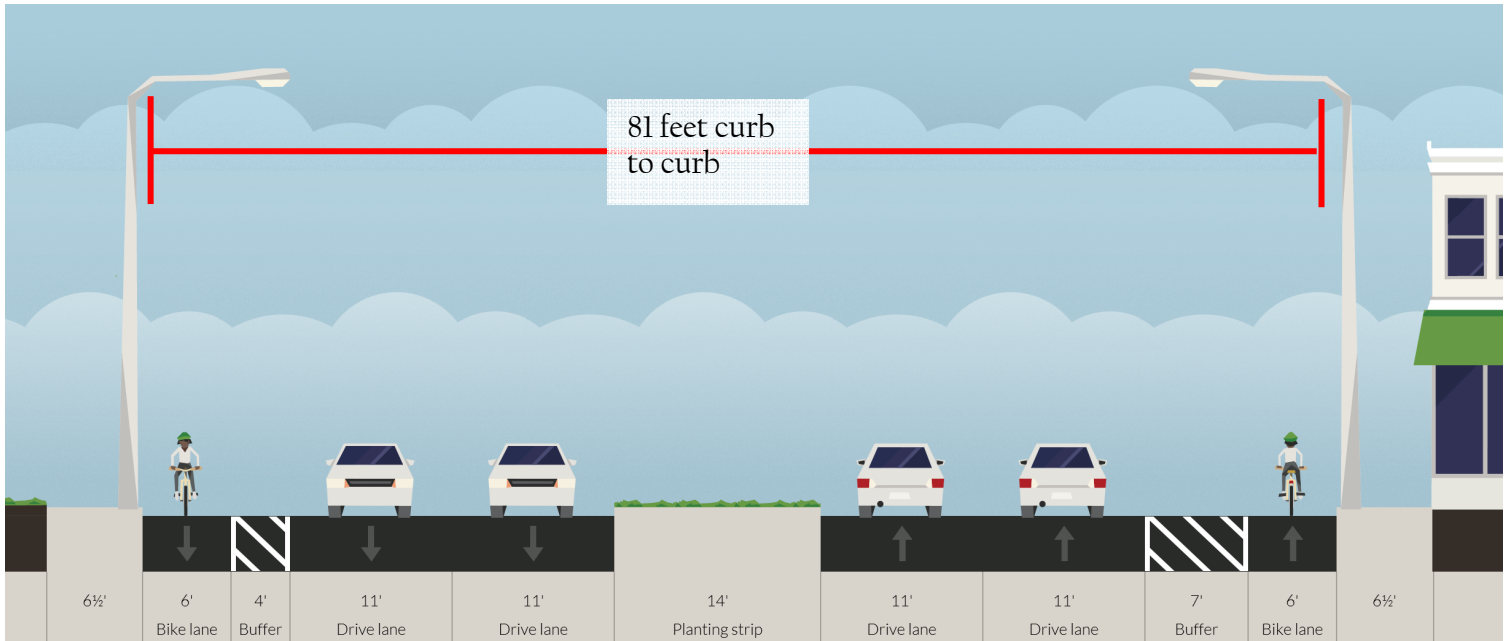


Figure 4-6. Major Street Cross Section.

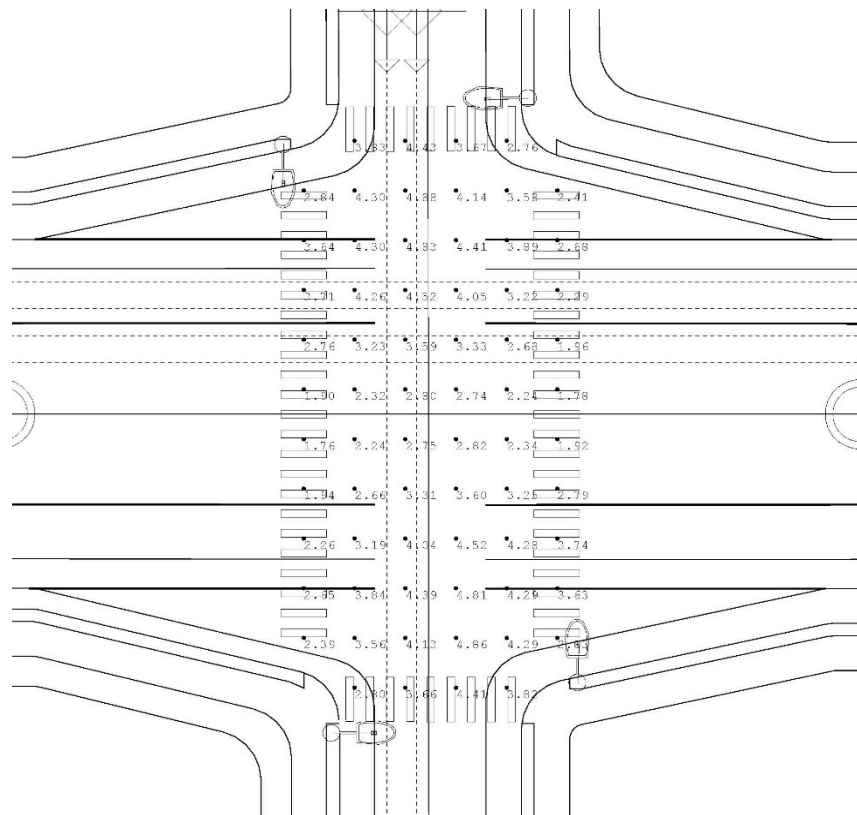


Figure 4-7. Intersection Point by Point Calculation.

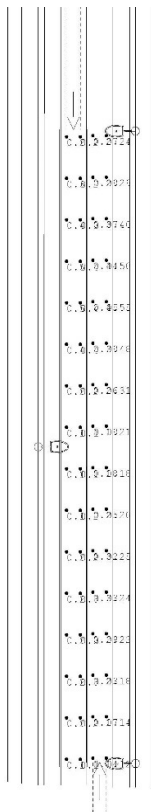


Figure 4-8. Local Street Point by Point Calculation.

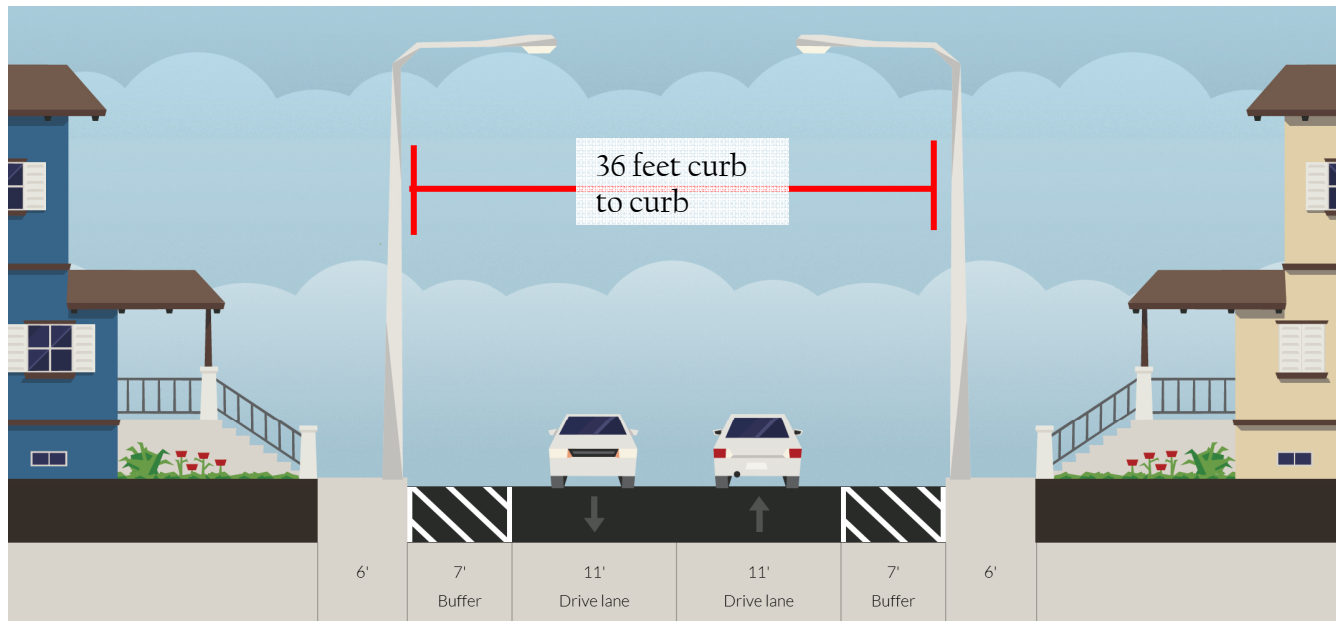


Figure 4-9. Local Street Cross Section.

8. Integrate lighting locations and revise lighting model in correspondence to other improvements, e.g. clearance from driveways (10ft commercial and 5ft residential), fire hydrants (5ft), trees (20ft), and utilities (State General Order, 95 & 128). Place lights

near property lines wherever practical and avoid locations in front of doorways, windows, and lines of egress.

No modification to street lights is necessary based upon this example.

9. Apply ELFs.

Since the local street has a speed limit of 25 miles per hour, ELFs may apply. Use TM-12 and the S/P ratio to determine the ELF. Apply the ELF to the average luminance value. Note that the veiling luminance ratio will exceed the goal because the observer's view will be impacted from the lights within the intersection. In this case, calculate the veiling luminance from only one side of the street where the observer's view is not impacted by the intersection.

Table 4-3. Local Street Mesopic Luminance Results with Updated Luminaire.

	Average Luminance	Average Uniformity Ratio L_{avg}/L_{min}	Max Uniformity Ratio L_{max}/L_{min}	Max Veiling Luminance Ratio LV LV_{max}/L_{avg}
Photopic	0.26	2.6	5.5	0.38
Mesopic	0.29	2.6	5.4	0.34

10. Compare results to design goals.

Table 4-4. Local Street Comparison to Design Goals.

	Average Luminance	Average Uniformity Ratio L_{avg}/L_{min}	Max Uniformity Ratio L_{max}/L_{min}	Max Veiling Luminance Ratio LV LV_{max}/L_{avg}
Goals	0.3	6.0	10.0	0.4
Design	0.29	2.6	5.4	0.34

Since the average luminance, veiling luminance ratio, and the max uniformity ratio are met (the precedent criteria), the proposed luminaire is appropriate for this design.

LED luminaire with 2888 lumens and 28 system watts.

Table 4-5. Major Street Comparison to Design Goals.

	Average Luminance	Average Uniformity Ratio L_{avg}/L_{min}	Max Uniformity Ratio L_{max}/L_{min}	Max Veiling Luminance Ratio LV LV_{max}/L_{avg}
Goals	0.9	3.0	8.0	0.3
Design	0.94	3.2	3.1	0.21

Note that the veiling luminance ratio will exceed the goal because the observer's view will be impacted from the lights within the intersection. In this case, calculate the veiling luminance from only one side of the street where the observer's view is not impacted by the intersection.

Since the average luminance, veiling luminance ratio, and the max uniformity ratio are met (the precedent goal), the proposed luminaire is appropriate for this design.

LED luminaire with 20,000 lumens and 220 system watts.

Table 4-6. Major/Local Intersection Comparison to Design Goal.

	Average Illuminance	E_{avg}/E_{min}
Goal	2.0	3.0
Design	1.9	1.9

The illuminance level of the intersecting streets needs to be checked to determine if the intersection goal needs to be adjusted.

Based upon the lighting model (Figures 4-5, 4-7, and 4-8) completed in AGI32 (not the results in Roadway Optimizer), the illuminance on the local street is 0.33 footcandles and the illuminance on the major street is 1.46 footcandles. Since the illuminance of each of the intersecting streets does not exceed the illuminance goal of 2.0 footcandles, the intersection goal does not need to be adjusted.

Because the average illuminance and the average uniformity ratio goals are met (within 10%), the proposed luminaire is appropriate for this design.

- II. Adjust, if necessary.

No further adjustments are necessary.

5 Adaptive Street Lighting Design Guide

5.1 Purpose

Roadway lighting is typically designed for peak traffic conditions that may exist on a given stretch of street. These conditions include traffic volume, the presence of pedestrians, and ambient luminance. Advances in lighting control technology now allow public agencies to modify luminaire light output to match the environmental conditions likely present at a particular time. This is called adaptive lighting. Adaptive lighting not only reduces energy consumption of the street lighting system, but also minimizes light pollution.

The purpose of this section of the *Public Streetlight Design Guide* is to provide guidance on how to adapt street lighting on City streets. This scheduled adaptive lighting approach is drawn from the Illuminating Engineering Society of North America's (IES) *American National Standard Practice for Roadway Lighting (RP-8-2014)*. Refer to Sections 1 and 5.4 for additional information on adaptive lighting practices.

5.2 Application of Adaptive Lighting

Scheduled adaptive lighting may be applied for both new installations and existing streetlights. Adaptive lighting levels are consistent with the same street classification and pedestrian conflict levels, with the schedule adjusted to accommodate the change in weekend traffic.

5.2.1 Hourly Traffic Analysis

The City of San Jose collected hourly traffic volume for a sample of street classifications. The purpose of this analysis was to identify periods of time through the night when hourly traffic volumes reduce to 10 percent of peak traffic volume.

These streets include a sampling across the three street classifications as well as the three pedestrian conflict classifications. The weekly data was parsed into weekend and weekday data. Weekends include the 48 hour period beginning on Friday at 9PM and concluding at 8:59PM on Sunday. Weekdays include the five day period beginning on Sunday at 9PM and concluding on Friday at 8:59PM.

5.3 Adaptive Lighting Levels

For all street classifications, regardless of pedestrian conflict classification, the following table outlines the adaptive lighting levels that may be used within the City. The lights shall return to 100 percent of designed lumen output at normal operation during all other times.

Table 5-1. Adaptive Lighting Schedule.

	Adaptive Level (percent of designed lumen output at normal operation)	Start	End
Weekday	50%	12:00AM (midnight)	5:00AM
Weekend	50%	1:00AM	6:00AM

Schedule may be adjusted to accommodate specific needs, i.e. special events.

6 Appendices

- 6.1 Supporting Information on Uniformity
- 6.2 Lighting and Security
- 6.3 Historic Districts/Sites: Ornamental Streetlights Memorandum
- 6.4 Communication Hill Area: Council Resolution 71808 and Council Memo for Special Streetlighting standards for the Communication Hill Planned Community

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Appendix 6.1
Supporting Information on Uniformity

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6.1 Supporting information on Uniformity

There are several studies that have evaluated uniformity as it relates to roadway visibility. Based upon the findings of these research studies, the City of San José has adopted its uniformity performance requirements in Section 2.7.

6.1.1. Clanton & Associates, Inc.

In 2012, Clanton & Associates and Virginia Tech Transportation Institute (VTTI) conducted a street lighting visibility study in Seattle's Ballard neighborhood along 15th Avenue NW, between NW 65th Street and NW 80th Street. Clanton divided the fifteen-block stretch into six evaluation test areas with approximately one test area per two blocks.

Over the course of two evenings, three groups of participants evaluated the entire test site at three different lighting levels: 100 percent of full light output, 50 percent of full light output, and 25 percent of full light output. VTTI conducted the user field test to measure detection distance between the vehicle and the target.

Regarding uniformity, the research study found:

- The user field test data findings demonstrate that less uniformity trends toward greater detection distance. The importance of uniformity in target detection constitutes another aspect to consider. The 4100K luminaire exhibited the highest illuminance uniformity ratio, indicating the most non-uniform appearance; it also showed the highest visual performance.

6.1.2. Federal Highway Administration

The Federal Highway Administration (FHWA) is currently conducting a research study for the Strategic Initiative for the Evaluation of Reduced Lighting on Roadways. This study aims to conduct a review of the crash and safety benefits associated with implementing adaptive lighting technologies.

At the Illuminating Engineering Society of North America (IESNA) Street and Area Lighting Conference (SALC) in 2013, the principal investigator, Dr. Ron Gibbons, with Virginia Tech Transportation Institute, presented some preliminary findings of the study.

The findings include:

- Increasing non-uniformity (increase in uniformity ratio) actually decreases crash rate.

6.1.3. Pittsburg LED Streetlight Research Project¹²

¹² <http://www.cmu.edu/rci/documents/led-updated-web-report.pdf>

In 2011, the City of Pittsburgh reached out to the Remarking Cities Institute to evaluate the impacts of replacing the City's entire inventory of streetlights to LED luminaires. The study also performed a thorough review of LED streetlights.

The study provided the following conclusions to the City:

- Lighting standards and many lighting regulations require uniformity of illuminance between poles in a misguided attempt to replicate daylight conditions and improve visibility. However, the focus on uniformity in street lighting in general reduces visual acuity by eliminating contrast and increasing glare by requiring light sources to be affixed higher up on the pole to shed light evenly across its lightshed. For example, oncoming headlights are more visible against a black background than a grey one. This contrast provided by uneven light patterns creates greater awareness of the oncoming vehicle. This is supported by public visual preference studies in which overlapping ovals are preferred over a uniform lighting pattern.
- A more uniform LED street lighting installation results in higher glare, more energy use, and a poor human preference response.
- Safety officials generally prefer uniform light along the street, believing that uniform light eliminates shadows and adds to the clarity. As a result, most lighting codes are written with uniformity objectives. However, as reported elsewhere in the study, the human eye requires shadows in order to perceive shapes and depth.
- Uniformity of street lighting is not producing good results for visual acuity and clarity, particularly for older persons.

6.1.4. Illuminating Engineering Society of North America

In response to the research that has been conducted on the subject of uniformity for roadway lighting, the IES is developing a research request for proposal (RFP) to gain a greater understanding of the issue.

Appendix 6.2

Lighting and Security

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6.2 Lighting and Security

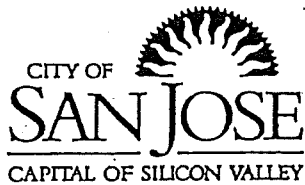
It is a common assumption, from a pedestrian's point of view, that more light increases the perception of security. A literature review by Heschong Mahone Group found that there is no link between lighting and crime or that any link is too subtle or complex to have been evident in the studies undertaken to date.¹³

¹³ Outdoor Lighting and Security: Literature Review:
http://www.calmac.org/publications/Outdoor_Lighting_and_Security_White_Paper_CALMAC_version.pdf

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Appendix 6.3
Historic Districts/Sites:
Ornamental Streetlights Memorandum

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Memorandum

TO: HONORABLE MAYOR AND
CITY COUNCIL

FROM: Rajeev Batra
Joseph Horwedel

SUBJECT: ORNAMENTAL STREET
LIGHTS

DATE: 11-29-01

Approved

Date

12.3.01

COUNCIL DISTRICT: Citywide
SNI AREA: N/A

RECOMMENDATION

Direct staff to utilize ornamental fixtures when installing street light systems in Historic Districts and Conservation Areas in the manner consistent with this memorandum.

Legal: Exempt.

BACKGROUND

The Department of Public Works receives street light requests for locations throughout the City from residents, City Council, and other agencies on an ongoing basis. These requests are prioritized by staff annually in accordance with the Street Light Installation Priority Criteria (see Attachment 1) approved by the City Council on November 1, 1994.

In recent years, staff has received a number of requests for the installation of ornamental street lights. Due to the limited funds available for street light installation, the normal practice has been to install only the most cost efficient lighting. This standard street light system is most often wired overhead and may include mounting of fixtures on wood utility poles where practicable. The purpose of the street light request program has been to provide street lighting that meets the standards for new developments at the least cost by using standard street light systems.

Many of the residents who have requested ornamental street lights have done so in the context of sensitivity to historic neighborhoods. They believe that it is inappropriate to install contemporary fixtures in neighborhoods that have a historic designation.

Public Works staff researched the issue of historic designation with the City Planning Department and their Historic Preservation Officer. Planning Department staff provided information on Historic Districts and Conservation Areas in San José. There are 5 existing Historic Districts in San José and 3 Conservation Areas. They are listed below and shown in Attachment 2:

HISTORIC DISTRICTS

- Hensley District (City Landmark District and National Register Historic District)
- Downtown Commercial Historic District (National Register Historic District)

- St. James Square (City Landmark District and National Register Historic District)
- Alviso (National Register Historic District and State Point of Historical Interest)
- River Street (City Landmark District)

CONSERVATION AREAS

- Hanchett and Hester Park
- Naglee Park
- Palm Haven

There is a specific process that is required to achieve Historic District status. It involves conducting a survey and historical study of the area, and requires action by the Landmarks Commission, the Planning Commission and adoption of the Historic District by City Council. The Conservation Area designation involves a less rigorous process. Property owners in Historic Districts must obtain an Historic Preservation permit, reviewed by the Historic Landmarks Commission, prior to any exterior modifications. In Conservation Areas, property owners are required to obtain a Single Family House Permit for significant remodeling proposals.

It should be noted that staff has received requests for the installation of ornamental fixtures in areas that do not fall into the Historic District or Conservation Area designation. Staff, in response to community interest, has looked at the possibility of implementing a process that would allow neighborhoods to pay the incremental cost between standard street lights and ornamental street lights. This proposal was presented at a community meeting but was not supported by the residents in attendance. Staff can continue to explore this option if Council so directs.

ANALYSIS

In looking at Historic Districts and Conservation Areas, it is apparent that lighting is an important visual component of a neighborhood. The use of modern lighting fixtures may not be appropriate for areas of historic significance and it is not consistent with a City policy of preserving the look and feel of our historic neighborhoods.

Planning, Building and Code Enforcement staff recommend that new lighting installations on residential streets in Historic Districts and Conservation Areas use ornamental fixtures. In order to best maintain the historic look and feel of such neighborhoods, staff recommends that illumination levels be consistent with the original illumination levels that existed in similar era neighborhoods throughout the City. This level of illumination would be appropriate for all typical neighborhood activities on such residential streets, although the illumination level generally would be less than what would be installed in the construction of a new neighborhood street lighting system. As well as maintaining the historic nature of the neighborhood, the recommended illumination level would reduce the incremental cost of installing ornamental rather than standard street lights.

Public Works staff recommends that arterial and collector streets in Historic Districts and Conservation areas utilize a street light system that mixes the use of standard and ornamental fixtures similar to the street lighting recently installed on The Alameda. A mixed lighting design allows more flexibility and economy in achieving appropriate illumination levels for these higher

volume streets. The majority of the fixtures on these arterial and collector streets would be ornamental and the visual effect would still maintain a historic feel.

Public Works staff also recommends the installation of standard street lights at intersections in Historic Districts and Conservation Areas. Standard lights are the most appropriate lighting at intersections because they provide more consistent and brighter illumination of the intersection. Moreover, the visual impact of standard light fixtures is less noticeable at these locations.

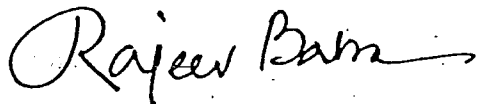
There is a cost difference between a standard street lighting installation and the cost to install ornamental fixtures in the manner being proposed by staff. Attachment 3 shows a cost comparison for a typical residential street. As shown in Attachment 3 the cost to install ornamental lighting is slightly more than twice as much as a standard installation. Staff believes that its recommendation best balances the desire to maintain the historic atmosphere of certain neighborhoods with appropriate illumination levels and cost.

It is anticipated that the funding for the ornamental lighting will need to compete with other Citywide street lighting needs. The backlog of unfunded street light requests has been estimated to total \$34 million when utilizing standard street lighting systems. Establishing a policy of installing ornamental fixtures in Historic Districts and Conservation Areas could increase the unfunded street light requests backlog costs by \$320,000. The potential increase in costs to provide ornamental rather than standard lights to meet all the unfunded lighting needs in Historic Districts and Conservation areas could amount to as much as \$2 million. For FY 2000-01, the funding allocation to address street light requests citywide is \$1.8 million.

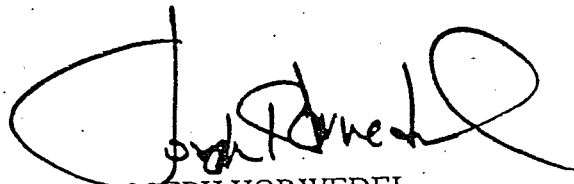
It is apparent that the existing and anticipated street light funding levels are insufficient to meet the current level of lighting requests. It will therefore not be possible to immediately install ornamental lights in all the designated Historic Districts and Conservation Areas. The intent would be to install ornamental fixtures over a period of time and within the limits on available funding.

PUBLIC OUTREACH

Not applicable



RAJEEV BATRA
Acting Director, Public Works Department



JOSEPH HORWEDEL
Acting Director, Planning, Building
and Code Enforcement

BK:dfc

ATTACHMENT 1
STREET LIGHT INSTALLATION PRIORITY CRITERIA
APPROVED BY CITY COUNCIL NOVEMBER 1, 1994

1. What percentage of the existing light is consistent with the Street Lighting Standards for New Development? (Greater priority assigned for lower percentages.)
2. At the requested location, are there commercial, residential, institutional, or mass transit station generators of nighttime pedestrian traffic that regularly cause a number of pedestrians to walk alongside, within or across the traveled way?
3. Within 300 feet of either side of the requested location, how many accidents occurred in the last three years at night?
4. Is the requested location at a public street intersection?
5. Is the requested street or road an arterial? Collector? Local/Residential? etc...?
6. Is the requested location a bicycle route or otherwise designated as a bicycle facility on the City's bicycle master plan?
7. Evaluator may increase the priority for additional factors that would merit the installation of street lights (e.g. Is the location in a Project Blossom area?).
8. Does the requestor reference neighborhood security at their location as reasons for street lighting improvements?
9. Is the area in a low to moderate income area (to be used as a tie breaker between requests with the same priority).
10. Has the street designation been changed due to development or regional projects and will street lights improve traffic conditions after a sudden increase in traffic volume?

Revised by Transportation & Development Committee on 10/13/94.

HANCHETT AND HESTER PARK



HANCHETT AND HESTER PARK CONSERVATION AREA

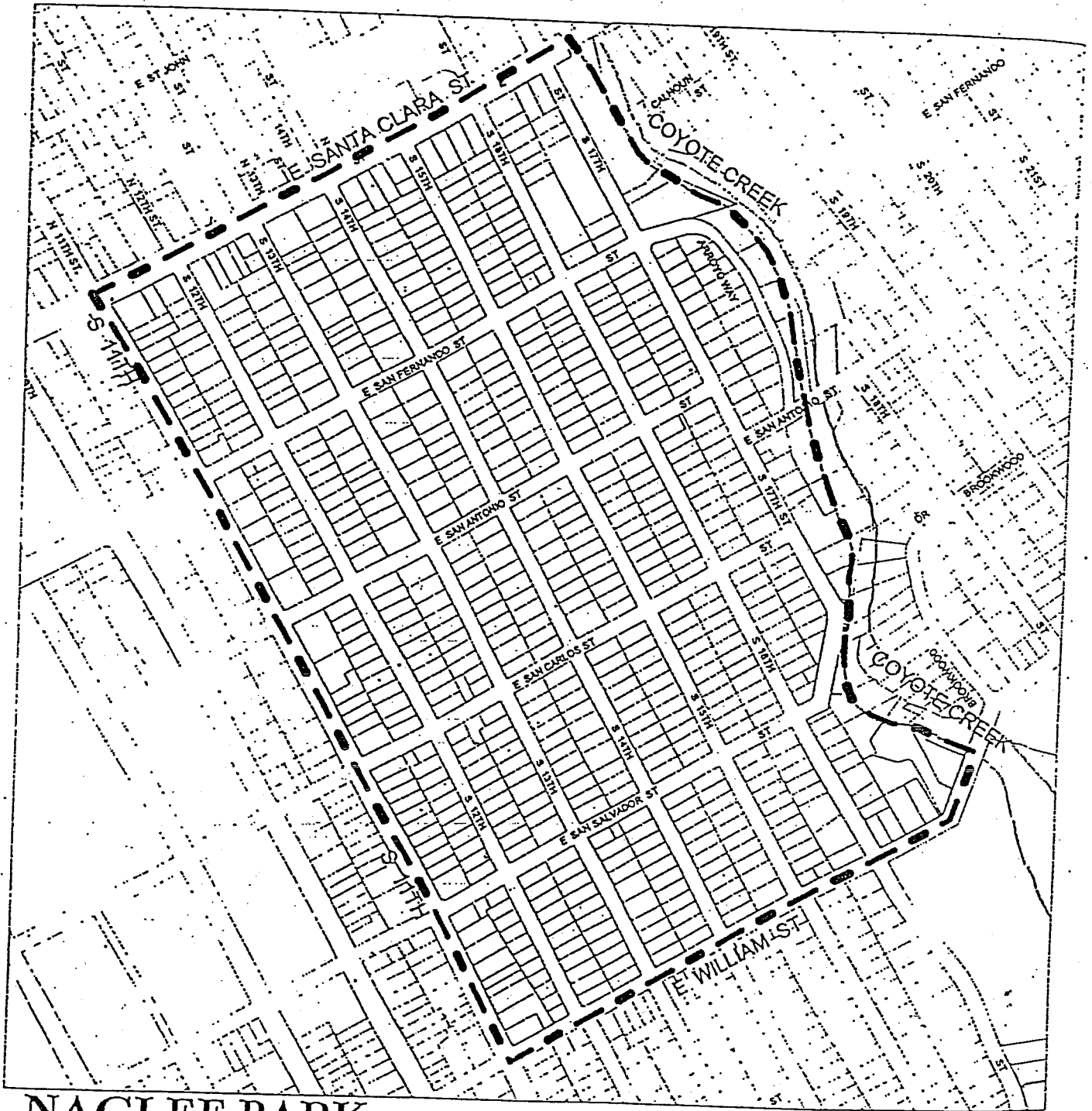


NORTH

Scale: 1"=450'



ATTACHMENT 2 NAGLEE PARK



**NAGLEE PARK
CONSERVATION
DISTRICT**



Scale: 1"=500'



ATTACHMENT 2 PALM HAVEN CONSERVATION AREA



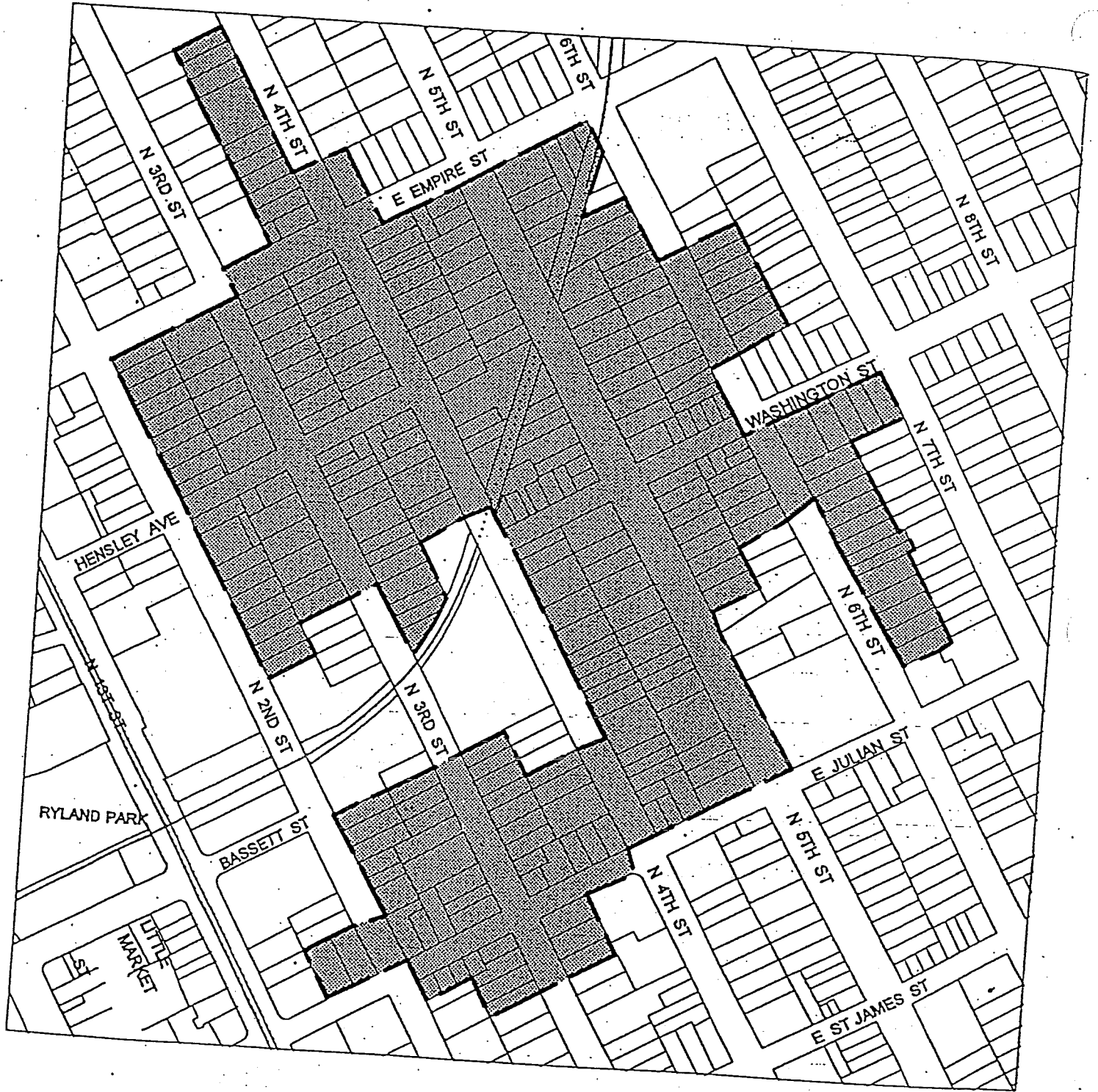
**PALM HAVEN
CONSERVATION
AREA**



Scale: 1"=500'



ATTACHMENT 2
HENSLEY HISTORIC DISTRICT



**CITY HISTORIC DISTRICT
AND LISTED ON THE
NATIONAL REGISTER
OF HISTORIC PLACES**

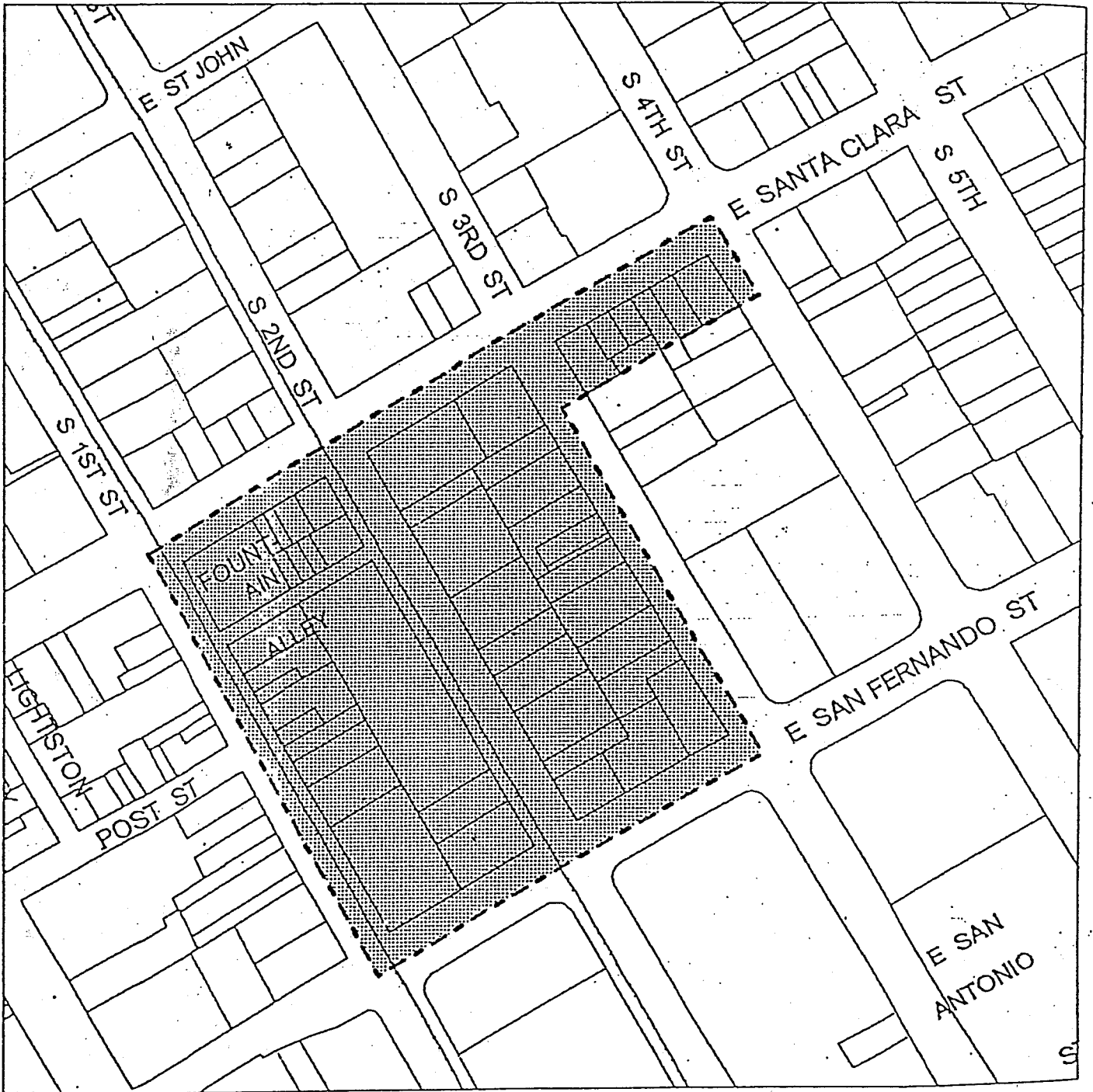


NORTH

Scale: 1"=350'



ATTACHMENT 2
SAN JOSE DOWNTOWN COMMERCIAL
HISTORIC DISTRICT



LISTED ON THE
NATIONAL REGISTER OF
HISTORIC PLACES

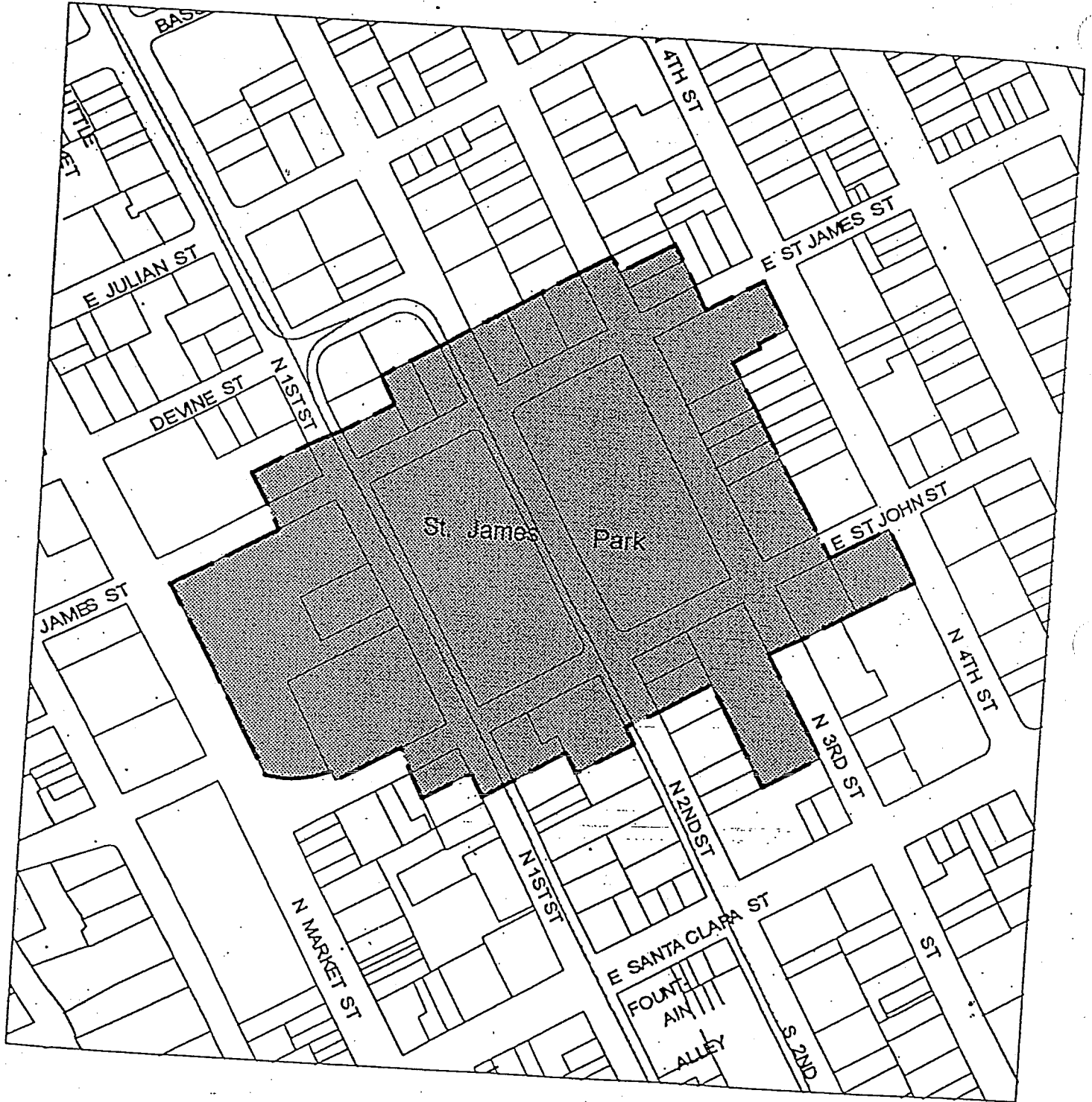


NORTH

Scale: 1"=250'



ATTACHMENT 2 ST JAMES SQUARE HISTORIC DISTRICT



**CITY HISTORIC DISTRICT
AND LISTED ON THE
NATIONAL REGISTER
OF HISTORIC PLACES**

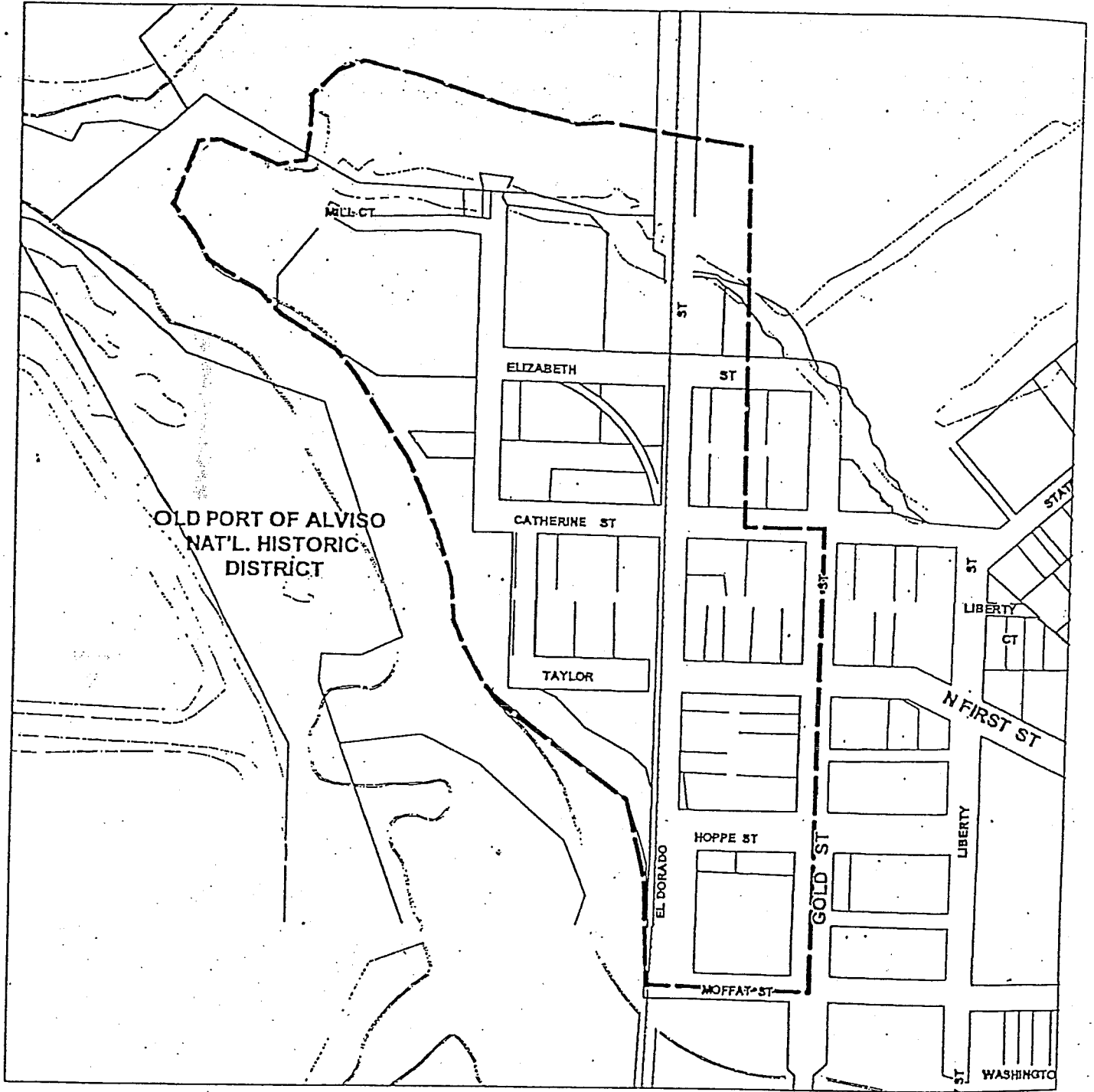


NORTH

Scale: 1"=300'



ATTACHMENT 2 ALVISO HISTORIC DISTRICT



**STATE POINT OF
HISTORICAL INTEREST**



NORTH

Scale: 1"=450'



ATTACHMENT 2

RIVER STREET HISTORIC DISTRICT



CITY HISTORIC DISTRICT
AND LISTED ON THE
NATIONAL REGISTER
OF HISTORIC PLACES

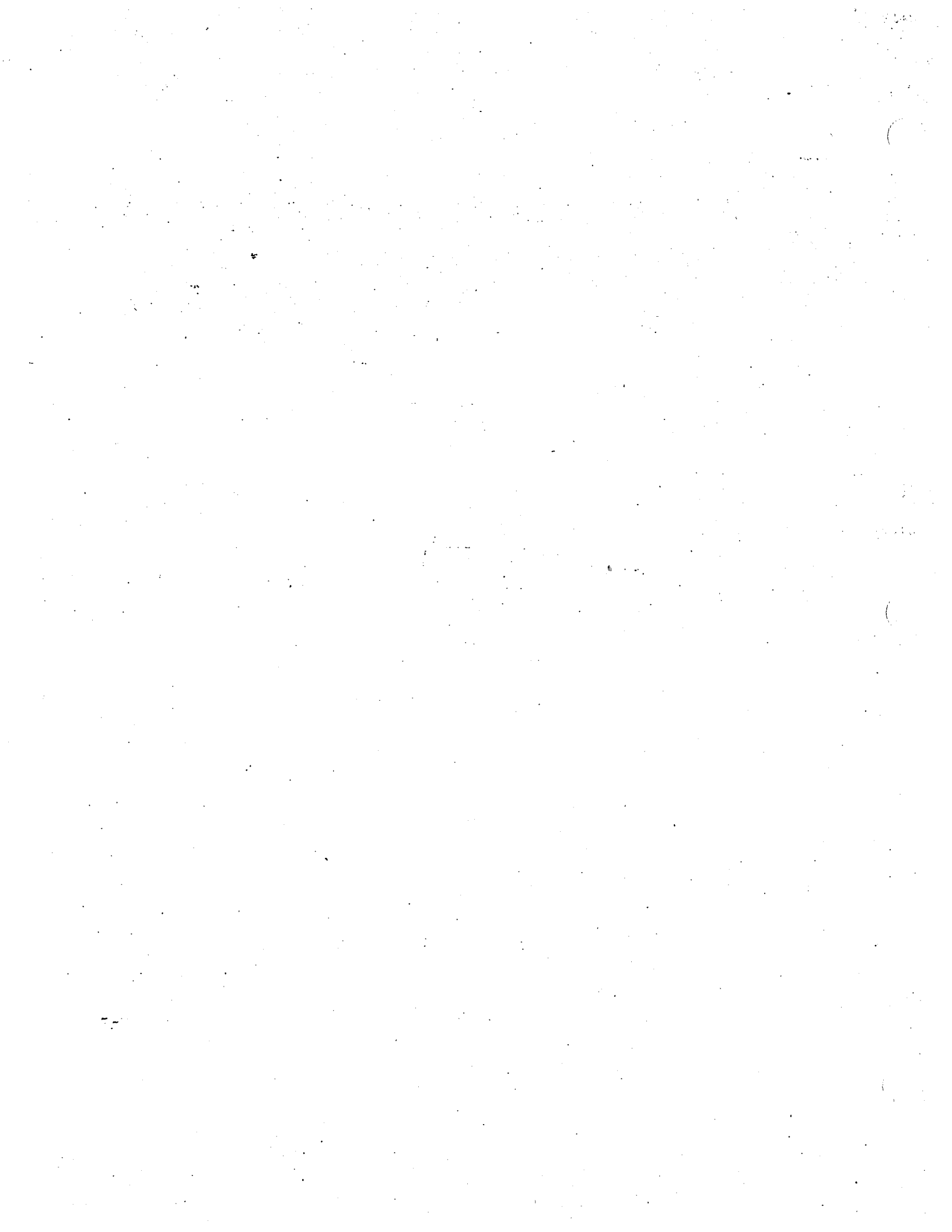


ATTACHMENT 3

COMPARISON OF ORNAMENTAL TO STANDARD STREET LIGHTS (TYPICAL STREET - 600 FT LONG)

	ORNAMENTAL STREET LIGHTS	STANDARD STREET LIGHTS
CONSTRUCTION ESTIMATE	\$23,500.00	\$10,600.00
35% E&I	\$8,225.00	\$3,710.00
10% CONTINGENCY	\$2,350.00	\$1,060.00
TOTAL ESTIMATE	\$34,075.00	\$15,370.00
NUMBER OF STREET LIGHTS	2	2
ESTIMATE PER STREET LIGHT	\$17,037.50	\$7,685.00

Note: The construction estimate for ornamental street lights includes \$9,000 additional cost for underground wiring and \$3,500 for the ornamental poles and luminaires.



Appendix 6.4

Communication Hill Area:

Council Resolution 71808 and Council Memo for Special Streetlighting
standards for the Communication Hill Planned Community

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RESOLUTION NO. 71808

A RESOLUTION OF THE COUNCIL OF THE CITY OF SAN JOSE AMENDING RESOLUTION NO. 63396 TO MODIFY THE DESIGN STANDARDS FOR PUBLIC STREET LIGHTING FOR NEW DEVELOPMENT WITHIN THE COMMUNICATIONS HILL SPECIFIC PLAN AREA

WHEREAS, on December 10, 1991, the City Council adopted Resolution No. 63396 setting forth Design Standards for the Installation of Public Street Lighting for New Development; and

WHEREAS, the Council now desires to amend Resolution No. 63396 to modify the Design Standards for the Installation of Public Street Lighting for New Development within the Communications Hill Specific Plan Area in order to avoid light pollution from such new development in the surrounding Santa Clara Valley.

NOW, THEREFORE, BE IT RESOLVED BY THE COUNCIL OF THE CITY OF SAN JOSE:

SECTION 1. Section 2 of Resolution No. 63396 is hereby amended in its entirety to read as follows:

Section 2. Except as provided for in Sections 3 and 6, the initial design of streetlighting for all public streets in new developments shall meet or exceed the standards of the "American Standard Practice for Roadway Lighting" as published by the Illuminating Engineering Society, reprinted from the February 1964 issue of Illuminating Engineering, which are incorporated herein by reference, and are on file in the Office of the City Clerk.

SECTION 2. Section 6 is hereby added to Resolution No. 63396 to read as follows:

Section 6. The Communications Hill Specific Plan Area, as delineated in the Specific Plan adopted on April 7, 1992, shall conform to the standards established in Section 2 herein except that:

(a) On all local public streets, including both cul-de-sac and through streets, the average lighting level shall be 0.4 foot-candles with a uniformity ratio of 6:1;

(b) On Communications Hill Boulevard, approximately 500 feet from Hillsdale and Curtner Avenues respectively, the average lighting level shall be 1.2 foot-candles with a uniformity ratio of 3:1;

(c) With the exception of the portion of Communications Hill Boulevard described in Subsection (b) above, on Communications Hill Boulevard the average lighting level shall be 0.9 foot-candle with a uniformity ratio of 3:1;

(d) At intersections of local public streets, including T and cross intersections, the average lighting level shall be 0.6 foot-candles, and the minimum lighting level at any point shall not be less than 0.15 foot-candles; and,

(e) At intersections of local public streets with Communications Hill Boulevard the average lighting level shall be 1.3 foot-candles, and the minimum lighting level at any point shall not be less than 0.3 foot-candles.

SECTION 3. Except as expressly modified by this Resolution, the provisions of Resolution No. 63396 shall remain unmodified and in full force and effect.

ADOPTED this 4th day of November, 2003, by the following vote:

AYES: CAMPOS, CHAVEZ, CHIRCO, CORTESE, DANDO,
GREGORY, LeZOTTE, REED, YEAGER; GONZALES

NOES: NONE

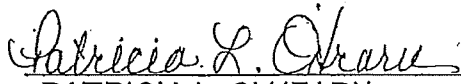
ABSENT: WILLIAMS

DISQUALIFIED: NONE

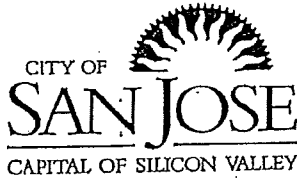


RON GONZALES
Mayor

ATTEST:



PATRICIA L. O' HEARN
City Clerk



Memorandum

TO: HONORABLE MAYOR AND
CITY COUNCIL

FROM: Katy Allen

SUBJECT: SEE BELOW

DATE: 10-15-03

Approved

Date

10/23/03

Council District: 7

**SUBJECT: SPECIAL STREETLIGHTING STANDARDS FOR THE
COMMUNICATIONS HILL PLANNED COMMUNITY**

RECOMMENDATION

Adoption of a resolution amending Resolution No. 63396 adopted on December 10, 1991, which sets streetlighting standards for new development, to provide for special streetlighting design standards for the Communications Hill Planned Community.
CEQA: Resolution Nos. 63624 and 70194, PP03-09-306.

BACKGROUND

Communications Hill is one of the most visually prominent features in Santa Clara Valley. The largely undeveloped slopes of Communications Hill itself total about 500 acres and rise over 300 feet above the surrounding valley floor. Council adopted a Specific Plan for Communications Hill in April 1992. The objective of the Communications Hill Planned Community is to provide a comprehensive planning framework for development of a unified, high-density, pedestrian-oriented, urban community with a mix of uses on and around Communications Hill. The Communications Hill Planned Community has also been incorporated in the 2020 General Plan. Attachment A shows a map of the Planned Community.

ANALYSIS

One of the key elements identified by the Communications Hill Specific Plan is "walkable streets". As stated in the Specific Plan, "Streets are walkable if their widths, traffic volumes, landscaping, parking arrangements, lighting and sidewalk design serve walkers and if the buildings that enfront streets give them life and vitality." Streetlighting plays an integral part in the design of "walkable streets".

To implement the vision of the Specific Plan and create comfortable pedestrian-oriented streets, continuous streetlighting will be installed on all public streets. To add character to the streets, the Planned Development Permit for the hilltop development further requires that pedestrian-scale ornamental electroliers be installed on all public streets except the main collector Communications Hill Boulevard. A unique ornamental fixture was evaluated and selected by the City for use in this development. Attachment B shows an image of the selected fixture. Maintenance of these unique fixtures is included in the community facilities district which has been established for this planned community.

The City of San Jose's current streetlighting design standard for subdivisions in Resolution 63396 is not well suited for the intended hilltop development. The current resolution references the American Standard Practice for Roadway Lighting published by the Illuminating Engineering Society (IES) in 1964 as the streetlighting design standard for subdivisions. Due to the Hill's uniqueness and prominence in the valley, an excessive number of streetlights will produce significant light pollution at night and create undesirable visual effects from dusk to dawn when viewed from the valley floor.

A study was conducted by Alliance Engineering Consultants under City direction with funding from developers of the Communications Hill site in search of a more suitable lighting standard for this development. The study included a survey of the current practices of various cities in their hillside/hilltop developments, and an analysis of streetlighting practices recommended by the Illuminating Engineering Society (IES). A summary of the study is attached to this memo for Council's information. (See Attachment C)

Based on the findings of the study and recognizing the objective of creating pedestrian-oriented streets, a modified streetlighting standard is proposed for the streets in the hilltop development (see Attachment D). The proposed streetlighting standard deviates from the City's adopted standards in that a slightly lower lighting level is recommended for the local streets and intersections in the hilltop development. However, it is at the high end of the range of the streetlighting levels employed by the cities surveyed.

The proposed streetlighting level reduces the number of required electroliers to be installed, therefore reducing light pollution at night and minimizing the undesirable visual effects. It is expected that the high-density dwelling structures will also provide a significant amount of ambient light onto the streets during nighttime hours with high pedestrian traffic. Combined with the output from the pedestrian-scale streetlights, this will create a well-lit and comfortable walking environment.

PUBLIC OUTREACH

The study and recommendation were coordinated with the developers and landowners of Communications Hill.

COORDINATION

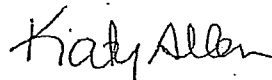
This memorandum, lighting study, and proposed resolution amending Resolution No. 63396 have been coordinated with the City Attorney's Office, the Department of Planning, Building and Code Enforcement, and the Department of Transportation, as well as the Communications Hill landowners and developers.

COST IMPLICATIONS

This recommendation results in no added cost to the City.

CEQA

Resolution Nos. 63624 and 70194, PP03-09-306.



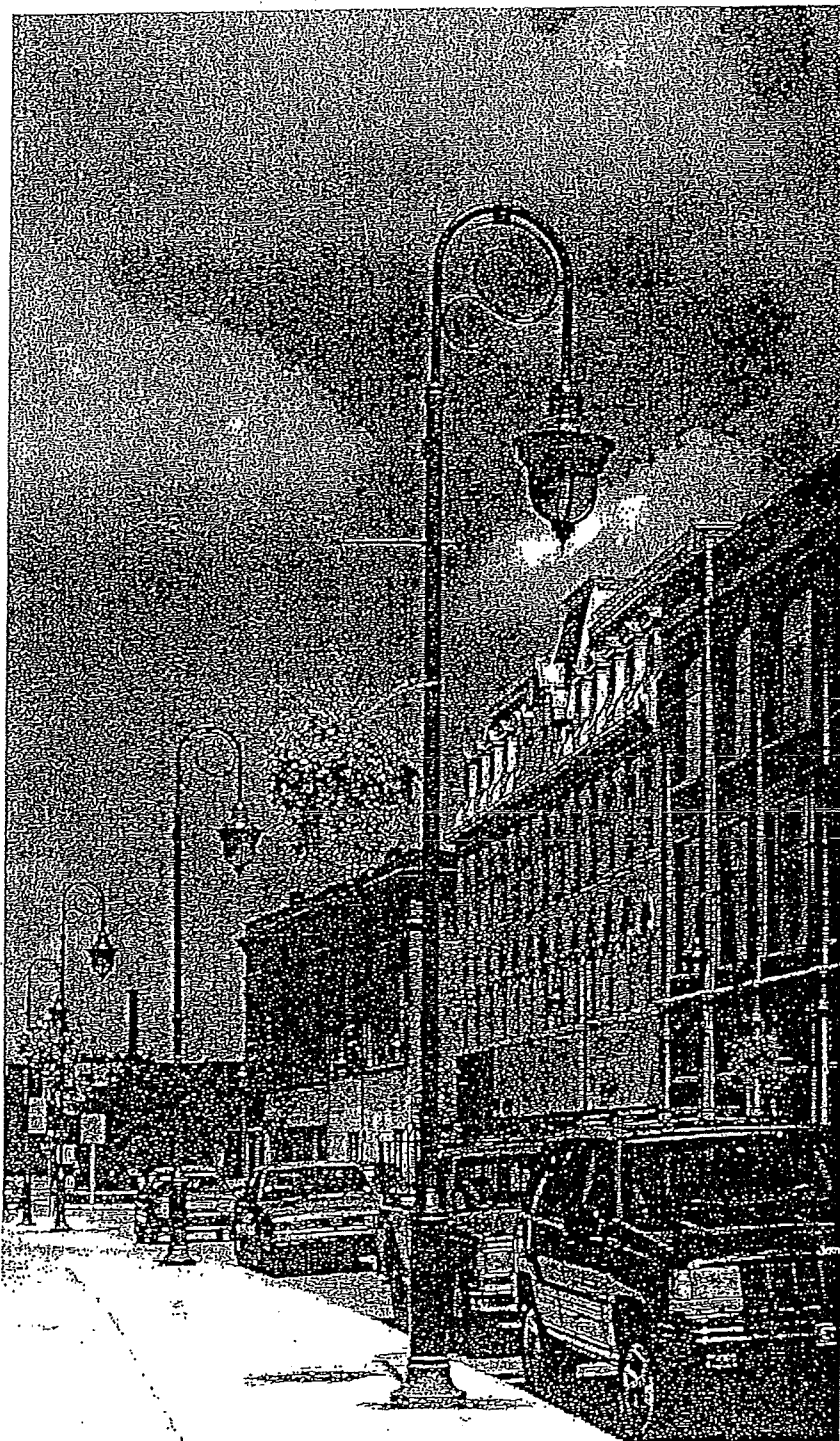
KATY ALLEN
Director, Public Works Department

HF:MA:dcs
Attachments

- Attachment A - Communications Hill Planned Community Vicinity Map
- Attachment B - Special Ornamental Electrolier for Public Streets in Communications Hill Planned Development
- Attachment C - Communications Hill Planned Community Streetlighting Study Executive Summary
- Attachment D - Special Streetlighting Standards for Public Streets in the Hilltop Development of Communications Hill Planned Community

ATTACHMENT B

SPECIAL ORNAMENTAL ELECTROLIER
FOR PUBLIC STREETS
IN COMMUNICATIONS HILL PLANNED COMMUNITY



ATTACHMENT C

COMMUNICATIONS HILL PLANNED COMMUNITY STREETLIGHTING STUDY EXECUTIVE SUMMARY

INTRODUCTION

The General Plan and Specific Plan for Communications Hill Community identified a vision to create a hillside neighborhood similar in ambiance to that of Telegraph Hill in San Francisco, which provides for pedestrian-oriented urban streets and minimizes the potential adverse impacts of the Communications Hill area development on the immediate surrounding neighborhood. Streetlighting plays an important role in the creation of a comfortable walking environment on the streets: To add charm and character to the streets, the Planned Development Permit for the hilltop developments further requires that pedestrian-scale ornamental electroliers be installed on all public streets except the main collector Communications Hill Boulevard.

Analysis and conceptual design indicated that the City's current adopted streetlighting standard is not well suited for this development site because, due to the Hill's uniqueness and prominence in the valley, an excessive number of streetlights will produce significant light pollution at night and create undesirable visual effects from dusk to dawn when viewed from the valley floor. Therefore, it is preferable and desirable for special streetlighting standards suitable for this unique hillside community to be established for development in harmony with the General Plan and Specific Plan.

A study was performed to determine what streetlighting levels should be used on streets of Communications Hill Planned Community. The study includes a survey of streetlighting requirements for hillside developments in various cities, and an analysis of recent streetlighting standard practices recommended by the Illuminating Engineering Society.

DEFINITION OF TERMS

Technical definitions can be found in the Illuminating Engineering Society Handbook. In simple terms:

Lumen is a basic unit of measure for the amount of light on a surface area.

Foot-candle is a unit of measure for the intensity of light on a surface area, expressed as lumens per square-foot. One foot-candle is equivalent to the intensity of light seen one foot away from a lit candle.

Uniformity ratio is a method of expressing the evenness of illumination distributed on a surface, generally it is a ratio of the average to the minimum foot-candle values on a surface area.

SURVEY FINDINGS

A survey was conducted to determine the streetlighting requirements for various hillside communities. Twelve (12) cities and agencies including the cities of San Francisco, Sausalito, and Berkeley, were surveyed. The intent of the survey was to investigate streetlighting standards used by other cities and agencies in similar development settings. The survey included questions about streetlighting requirements for hillside developments, approved streetlighting standards, and any exceptions granted. The survey results and supplementary information from the other cities and agencies are tabulated in Exhibit II of the study report.

The cities and agencies surveyed use a wide variety of streetlighting standards for hillside areas. It was found that special case standards or guidelines are often used in hillside areas. The average streetlighting level requirements range from not requiring any lighting to 0.4 foot-candles. Most cities also allow implementation of different type of lighting fixtures to be used on hillside communities.

STANDARD PRACTICES SUMMARY

The City of San Jose Municipal Code incorporates by reference the American Standard Practice for Roadway Lighting published by the Illuminating Engineering Society (IES) in 1964 as the streetlighting design standard for subdivisions. This Standard Practice coarsely defines area usage into three classifications based on the level of pedestrian traffic at nighttime as: "downtown", "intermediate", "outlying and rural". The area usage at Communications Hill as described in the Specific Plan does not fit exactly into any one of these defined classifications. However, the expected pedestrian traffic volume may be interpreted as that described under "intermediate", and the recommended average streetlighting level for the "intermediate" local streets is 0.6 foot-candles with a 3:1 uniformity ratio. Whereas the recommended average streetlighting level for typical low-density residential local streets is 0.2 foot-candles with a 6:1 uniformity ratio.

The latest version of American National Standard Practice for Roadway Lighting was published in 2000 by the IES. This latest version abandoned the area classification used in the earlier versions. Instead it directly defines three pedestrian conflict levels based on the pedestrian traffic volume: High, Intermediate, and Low. The local streets in the intended development in Communications Hill fall in the "intermediate" pedestrian conflict level; and the recommended average streetlighting level is 0.7 foot-candles with a 6:1 uniformity ratio. Whereas a typical residential local street would fall in the "low" pedestrian conflict level with a recommended average streetlighting level at 0.4 foot-candles with a 6:1 uniformity ratio.

In general both the 1964 Standard Practice and the 2000 Standard Practice recommend that the average lighting level at street intersections to be the sum of that of the two intersecting streets with a 3:1 uniformity ratio. The 2000 Standard Practice also recommends that other traffic conflict areas be provided with illuminance values 50 percent higher than recommended for the street.

The City of San Jose has not adopted the latest IES Standard. However, the City has implemented several special lighting Standards that deviate from the 1964 IES Standards. The practice of deviating from IES Standard is not unusual for the City of San Jose and other cities since most cities consider IES Standard as general guidelines only.

ANALYSIS AND RECOMMENDATIONS

Preliminary analysis showed that in order to comply with the City's adopted streetlighting standard a large number of electroliers would have to be installed on the hilltop, which can produce considerable amount of light pollution at night, and create an undesirable "birthday cake" effect when viewed from the valley floor at night.

It is desirable to increase the spacing of the electroliers and reduce the number of units that will be installed in order to reduce the undesirable light pollution and visual impacts. This translates to a reduced lighting level on the streets from the streetlights. However, it is expected that the high-density housing structures will add a certain amount of ambient light during the hours of high nighttime pedestrian traffic on the streets, which will compensate for the reduced lighting levels from the proposed electroliers.

Alliance Engineering Consultants held several discussions with City staff, representatives of landowners and developers regarding the streetlighting for the streets in Communications Hill Planned Community. Pedestrian comfort on City streets, as well as aesthetics, style, and maintainability were considered; the survey and research findings were reviewed. As a result a special streetlighting standard is being proposed and now recommended for adoption by Council.

The proposed special streetlighting design standard is summarized as follows:

1. On local public streets, including both cul-de-sac and through streets, the average lighting level shall be 0.4 foot-candles with a uniformity ratio of 6:1.
2. On Communications Hill Boulevard, approximately 500ft from Hillsdale and Curtner respectively, the average lighting level shall be 1.2 foot-candle with a uniformity ratio of 3:1.
3. On the rest of Communications Hill Boulevard the average lighting level shall be 0.9 foot-candle with a uniformity ratio of 3:1.
4. At intersections of local public streets, including T and cross intersections, the average lighting level shall be 0.6 foot-candles, and the minimum lighting level at any point shall not be less than 0.15 foot-candles.
5. At intersections of local public streets with Communications Hill Boulevard the average lighting level shall be 1.3 foot-candles, and the minimum lighting level at any point shall not be less than 0.3 foot-candles.

In general, the recommended streetlighting level for Communications Hill Boulevard is consistent with the City's currently adopted standards, and the recommended lighting levels for local public streets are slightly lower than the City's currently adopted standards, but are consistent with the current practices in hillside communities of the twelve cities surveyed. Attachment D also shows the recommended standards in tabulated form.

SPECIAL ORNAMENTAL ELECTROLIER

A special pedestrian-scale ornamental electrolier was selected and evaluated for use on the local streets in Communications Hill. The special ornamental pole and fixture was selected with the intent to integrate the overall appearance of the streets with the architectural style of the buildings lining the streets. The pole and fixture combination was evaluated for style, sturdiness of construction, and maintainability. Cost and availability issues were also taken into consideration.

The selected ornamental electrolier has a 16-foot steel pole, a curved aluminum bracket with a decorative element, and a globe type luminaire with 55-watt low-pressure sodium lamp. Attachment B shows an image of the ornamental electrolier.

ATTACHMENT D

SPECIAL STREETLIGHTING STANDARDS
FOR PUBLIC STREETS
IN THE HILLTOP DEVELOPMENT OF
COMMUNICATIONS HILL PLANNED COMMUNITY

The following streetlighting design standards shall apply in the hilltop development of Communications Hill Planned Community as designated in the General Plan. All public streets shall have continuous streetlighting designed to meet the specified levels and uniformity or better. The special ornamental electrolier shall be installed on all local public streets except the main collector Communications Hill Boulevard. The City's standard octaflute electrolier with the full cutoff "shoe box" luminaire shall be installed on Communications Hill Boulevard.

Street Lighting Level Recommendation			
No.	Street or Intersection	Average Horizontal Footcandles (and Uniformity Ratio)	Average Horizontal Footcandles at Intersection
1	Residential Cul-de-sac Streets	0.4 (6 to 1 Avg/Min)	N/A
2	Residential Through Streets	0.4 (6 to 1 Avg/Min)	N/A
3	Intersection of two Residential Streets (T Junction)	N/A	0.6 Average 0.15 Minimum
4	Intersection of two Residential Streets (Cross Junction)	N/A	0.5 Average 0.15 Minimum
5	Communications Hill Blvd. Approx. 500' from Hillsdale and Curtner, respectively	1.2 (3 to 1 Avg./Min)	
6	Communications Hill Blvd. (remaining section)	0.9 (3 to 1 Avg/Min)	N/A
7	Intersection of Communications Hill Blvd. & Residential Street	N/A	1.3 Average 0.3 Minimum