6.0

Design Manual: Lighting

DESIGN MANUAL: LIGHTING

Lighting has been a crucial issue of concern to the Town and its citizens. In addition to improving the aesthetics of the streetscape, lighting fulfills the important function of illuminating roads and sidewalks, reducing the probability of traffic-related accidents and improving public safety. Concerns regarding safety in recent years have raised awareness of the importance of adequate lighting in Downtown Chapel Hill. The focus of this section of the Streetscape and Lighting Master Plan will be to assess the current lighting conditions and to offer a series of strategies for improving the quality and range of light cast onto the Town's streets and sidewalks.

Currently, the quality of lighting in Downtown Chapel Hill reveals areas for improvement. Based on an assessment by lighting consultant RMF Engineering, areas of inadequate sidewalk lighting are particularly pronounced along East and West Rosemary Streets but are also a problem along the 200 to 400 blocks of West Franklin Street. The comprehensive lighting assessment is based on standards set by the Illuminating Engineering Society of North America (IESNA), which outlines recommended illuminance values for roadways and pedestrian ways. A detailed explanation of these requirements is included in the subsequent pages in this section.

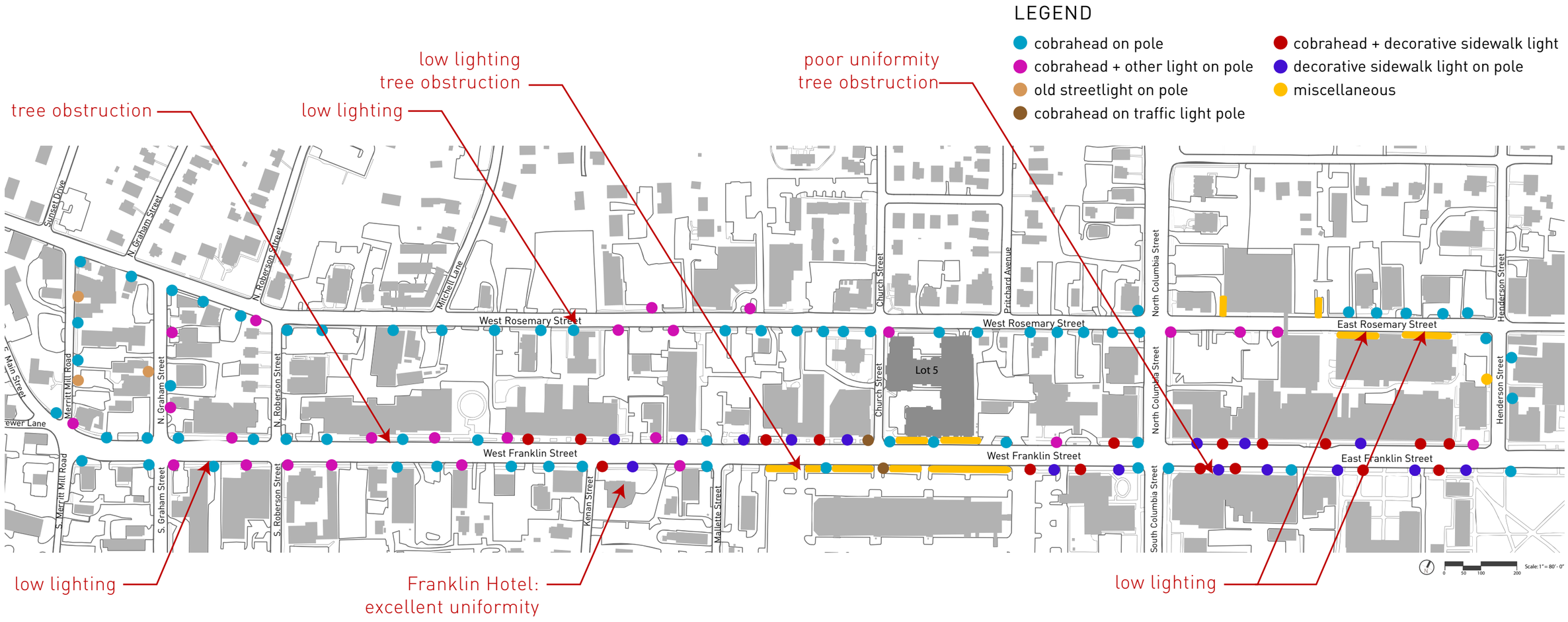
street lighting
RMF's examination of the current lighting specifications and pole spacing for street lights indicates that the currently installed 30' poles are adequate to meet or exceed NCDOT requirements. However, this is based on the assumption that the street lights are operating at their full output. As fixtures age, their light output decreases considerably. It is recommended that the Town of Chapel Hill work with Duke Energy to identify which lamps have reached the end of their rated life and develop a phasing strategy for all of the Downtown fixtures over a 20-year period based on the rated lifespan of each lamp.

fixtures
Existing street poles are comprised of a variety of materials, from pressure treated wood to galvanized steel. Particularly along Rosemary Street, poles that are in declining condition should be replaced with durable new poles that match the existing standard. Refer to the Appendix for street pole specifications. A movement towards a consistent material selection for poles and fixtures, as well as spacing, is encouraged in order to maintain design continuity.

sidewalk illumination
Light readings taken along both Franklin and Rosemary Streets reveal areas of low lighting in many parts of Downtown. A major issue is the utilization of mercury vapor (MV) lamps, which towards the end of their rated life will have a light output of as little as 10% of their rated output. Recommended alternatives to MV fixtures include metal halide (MH) fixtures, which cast a brighter, whiter light and are more energy efficient, and LED fixtures, which are the most energy efficient but carry the highest initial cost. The specifics of RMF's recommendations for pedestrian fixtures will be outlined in the following pages.

light obstructions
The placement and maintenance of street trees influences the quantity of light that is cast onto the sidewalk. The proposed lighting plan places new light poles in areas that will minimize conflict with existing and proposed street tree plantings. However, proper maintenance and pruning of the trees will have significant impact in terms of improving lighting conditions. In addition, commercial retail awnings often extend into the sidewalk space while blocking light from reaching the sidewalk surface. This concern will need to be addressed more fully between the Town and its commercial tenants.

EXISTING LIGHTING CONDITIONS



The diagram above, based on an initial lighting assessment, shows the lack of consistency in type of fixture installed across Downtown Chapel Hill. Areas of inadequate lighting are located primarily on East and West Rosemary Streets and West Franklin Street. The proposed lighting plan (on the following page) considers the existing conditions as well as cost and proposes utilizing existing pole locations to minimize additional expense while installing new fixtures where needed.

EXISTING LIGHTS IN DOWNTOWN CHAPEL HILL

Downtown Chapel Hill currently utilizes a variety of lighting types and fixtures. Below are descriptions of the most commonly installed light fixtures in Downtown. The fixture style and pole types used throughout Downtown are somewhat inconsistent, however, over time, the Town will move towards a consistent standard in terms of fixture style. Lighting upgrades have been completed in the 100-block of North Columbia Street, as well as the first blocks of East and West Franklin Streets. On the following pages, a strategy will be determined that maximizes the potential of the Town's existing configuration.

175W Mercury Vapor Pedestrian Light

Characteristics:

- casts a yellowish-green to bluish glow
- all existing pedestrian lights (including the more recently installed Lumec Domus fixtures) carry 175W mercury vapor (MV) lamps.
- MV lamps are less energy efficient than metal halide (MH) lamps but need to be replaced half as often as MH lamps

Issues:

- many MV lamps in Downtown Chapel Hill are nearing the end of their rated life, at which they are casting as little as 10% of their maximum output
- the current light output of existing pedestrian lamps is inadequate in many areas and does not meet IESNA standards

175W Mercury Vapor Decorative Light

Characteristics:

- the newer decorative Lumec Domus fixtures have also been installed with 175W MV lamps
- the Lumec Domus fixtures may be installed indepently on 16' poles or attached to taller, 30' street light poles as pictured
- the newer fixtures have been installed on the 100-blocks of East and West Franklin Street and more sparsely in the rest of Downtown

Issues:

- low energy efficiency compared to comparable light fixtures (e.g., 100W or 175W metal halide) continues to be a concern

400W High Pressure Sodium Street Light

Characteristics:

- casts a yellowish to yellowish-orange light
- all existing street lights are 400W high pressure sodium (HPS) fixtures
- an assessment by the lighting consultant RMF Engineering indicates that the current street lighting meets IESNA standards for roadway illumination

Issues:

- the cobra head street lights in some areas have been installed on aging wooden utility poles, particularly along West Rosemary Street
- recommended long-term upgrades include replacing these wooden utility poles with metal poles, for sustainability and visual continuity (see Appendix for specifications)

EVALUATING LIGHTING PERFORMANCE

Lighting Assessment Procedures:

In evaluating the existing lighting conditions, the lighting engineer carried out the following tasks:

- conducted computerized lighting calculations based on current placement and selection of light fixtures
  - light output was based on manufacturer's specifications for expected performance when newly installed
  - the light output numbers do not account for the age or actual condition of each of the fixtures but represents the maximum light potential of the existing lighting configuration when newly installed
- recorded light readings at night to determine the actual light output along the street and sidewalks within the Downtown District
- mapped visual observations at night to be compared with computerized lighting calculations. these observations included notes on obstruction from vegetation or retail awnings, as well as inconsistency in light output and quality

Defining Streetscape Lighting Standards:

The lighting analysis took into account standards set forth by both the North Carolina Department of Transportation (NCDOT) and the Illuminating Engineering Society of North America (IESNA), which provides national recommendations for light output levels for vehicular and pedestrian ways.

Preliminary Findings

The lighting consultant's conclusions and recommendations, which will be explained in greater detail on the following pages, can be summarized as follows:

- **pedestrian lighting**
  existing pedestrian lighting (at 16' height) is not adequate to meet or exceed IESNA standards, for the following reasons:
  - outdated light fixtures - the existing mercury vapor (MV) fixtures are not as bright or energy efficient as contemporary options
  - declining lamps - many of the fixtures have lamps that have exceeded their rated life of 24,000 hours and are producing as little as 10 percent of their maximum light output
  - insufficient number of light poles - gaps exist along the sidewalk where additional light fixtures are needed
  - visual obstructions - low-hanging tree branches and wide storefront awnings can prevent light from reaching the sidewalk surface

- **street lighting**
  the lighting consultant has concluded that the current street lighting configuration is adequate to meet or exceed NCDOT and IESNA standards; therefore, the focus of RMF's lighting recommendations will be on improving pedestrian lighting conditions

Existing Conditions Analysis: Photometric Rendering

The image above was one of a series of simluations of existing conditions produced by the lighting consultant's computerized lighting calculations. The analysis found areas of low lighting produced by the existing configuration of 175W mercury vapor (MV) fixtures. This analysis did not include factors such as age and condition of existing street poles and visual obstructions such as vegetation.

UNDERSTANDING PHOTOMETRIC ANALYSIS

Units of Measurement

This section will refer to various measures of light output, which are defined below:
- **lumen** - a meausre of the perceived power of light
- **foot candle** - a measure of light cast onto a surface. It can be defined as the illuminance on a 1-square foot surface of which there is a uniformly distributed flux of one lumen

Illuminating Engineering Socity of North America (IESNA) standards

Recommended illuminance values for a commercial collector roadway with a mixed (diffuse and specular) asphalt road surface:
- 1.2 horizontal foot-candles on the road surface
- 1 vertical foot-candle at 4.9' above the walking surface (this is based on facial recognition capability at eye level for pedestrian safety)
- average to minimum design uniformity of 4:1

Recommendations for high pedestrian conflict walkways with adequate separation between walkways and streets but continuous conflict such as intersections and driveways:
- 1.0 horizontal foot-candles on the walking surface
- 0.5 vertical foot-candle at 5.9' above the walking surface
- average to minimum design uniformity at 4:1

The recommendations will be applied to both Franklin and Rosemary Streets.

Interpreting Photometrics

The photometric plan on the following page illustrates the light output of both existing and proposed light fixtures. Each light fixture is represented with a series of irregularly shaped rings radiating outward from the fixture. Each of these rings, depending on its line weight, represents an intensity of light output, measured by foot-candles.

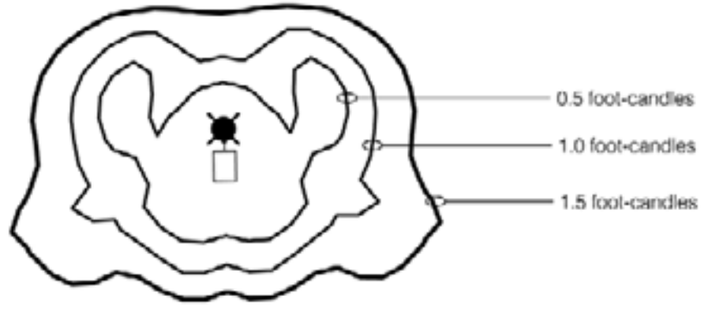
The outermost ring, also known as an iso-curve, indicates the periphery of the light fixture's measurable output, 0.5 foot-candles. In order to maintain the minimum 1.0 foot-candles needed on walking surfaces, the outer iso-curve of the light fixture should overlap with that of the adjacent fixture in order to provide a combined light output of 1.0 foot-candles.

Meeting Lighting Recommendations

The lighting engineer was given the imperative to work with the existing light fixture locations where streetscape improvements have been completed, while adding additional light poles where needed to meet IESNA lighting recommendations. While the utmost effort was made to completely remove gaps in lighting or low-level lighting areas, the limitations of the existing spacing, as well as location of driveways and curb cuts, may result in lighting that is not as consistent as would be achieved if an entirely new pole layout was created, without regard to the existing configuration. Where the number and spacing of existing poles may serve as a detriment to lighting improvements, particularly on Rosemary Street, the configuration of existing poles may be reconsidered as sections of sidewalk are redeveloped.

It has been the conclusion of RMF that the best means of meeting or exceeding IESNA lighting recommendations is to improve the light output of both existing and new fixtures. The existing fixtures are designed to utilize brighter, more energy efficient fixtures than have been installed under contract with Duke Energy. Given the limitations imposed by Duke Energy, RMF has generated the best possible strategy. Fixture and wattage options are explained in greater detail on the following pages.

Diagram: Interpreting Iso-Curves



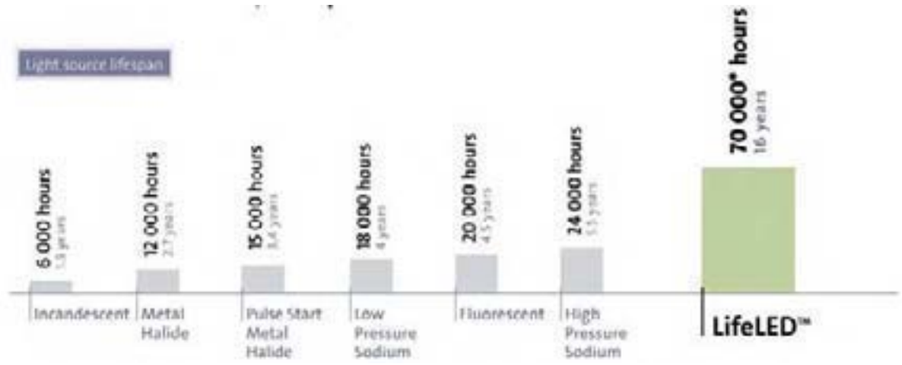
A typical iso-curve drawing is shown above. The rectangle represents a 30' street light, while the darkened circle represents a pedestrian height fixture (16') attached to the same pole. The irregular rings radiating outward represent measures of light output.

Lumec LifeLED Retrofit Kit

Close-up Image of LED Light

The images above are provided by the lighting manufacturer Lumec for its LifeLED retrofit LED light package. The LifeLED system would allow the Town to continue to use its existing Lumec Domus fixtures while replacing the lamps with the new LED technology.

Lumec LifeLED: Lifespan Comparison



The LED lights would last more than five times as long as a comparable metal halide (MH) lamp. While installing LED lights carries a high initial cost, over time, this option presents savings by reducing energy usage and requiring infrequent replacement compared to MH fixtures.

LIGHTING FIXTURE OPTIONS

- Existing Light Fixture: 175W Mercury Vapor (MV)

  Performance
  - Mercury vapor fixtures are generally considered outdated, as they are less energy efficient than most options available today

  Cost Considerations
  - Duke Energy currently supplies only metal halide (MH) and high pressure sodium (HPS) fixtures, but will continue to replace the 175W MV lamps for the Town for the life of the fixtures.

  Recommendation
  - the lighting consultant's assessment indicates that the current lighting configuration is **inadequate to meet IESNA recommendations**

- **Duke Energy Approved Upgrade: 100W Metal Halide (MH)**

  Performance
  - light output from each fixture would increase by approximately 10 percent

  Cost Considerations
  - this option requires replacing the ballasts in each of the existing light fixtures, as they are currently configured to support 175W MH or 175W MV lamps only

  Recommendation
  - the lighting consultant supports this option where significantly increasing lighting levels on sidewalks is not a primary concern
  - Duke Energy readily supplies 100W MH lamps, making this the most convenient option for the Town

- Duke Energy Pilot Study: 250W Metal Halide (MH)

  Performance
  - light output from each fixture would increase more than twofold

  Cost Considerations
  - the 250W MH option carries the highest operating cost of the options listed

  Recommendation
  - Duke Energy is considering a 12-light pilot project to test the 250W MH fixtures
  - the lighting consultant considers the 250W light output too high for pedestrian use, potentially resulting in over-illumination and unnecessary energy costs

- RMF Recommendation 1: 175W Metal Halide (MH) - unapproved by Duke Energy (for reference only)

  Performance
  - light output from each fixture would increase by approximately 40 percent

  Cost Considerations
  - there is no need to replace the ballasts, as the existing light fixtures already support 175W MH lamps

  Recommendation
  - the lighting consultant considers this option ideal if increasing lighting levels on sidewalks is a priority
  - Duke Energy does not currently stock 175W MH lamps and indicates it will not carry them in the future

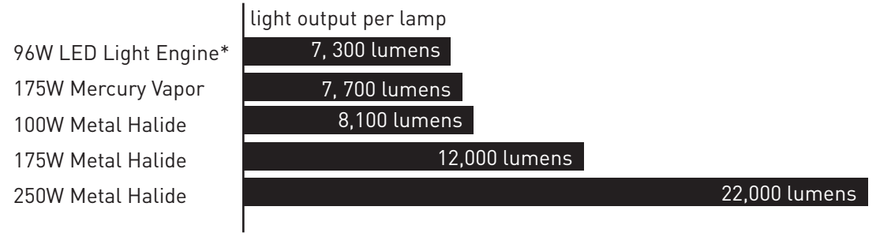
- RMF Recommendation 2: 96W LED retrofit - unapproved by Duke Energy (for reference only)

  Performance
  - the existing Lumec Domus fixtures can be retrofitted to utilize LED lamps
  - light output would increase by approximately 40 percent and is more energy efficient than MH or MV

  Cost Considerations
  - the required retrofit LED Light Engine (LLE) system has the largest initial expense but has the lowest operating cost

  Recommendation
  - the high initial investment may be cost prohibitive for the Town
  - the energy savings and lower operating cost may make this a viable option in the future if energy efficiency becomes a priority, outweighing initial cost

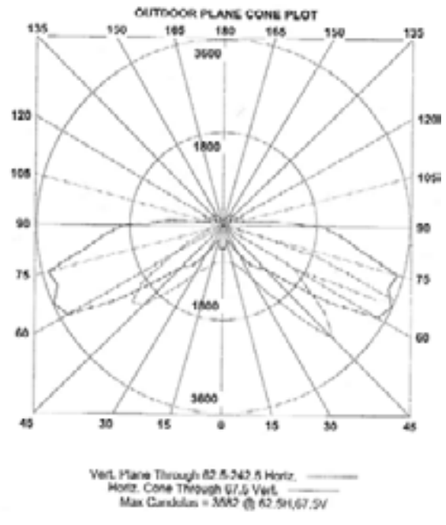
LIGHTING PERFORMANCE COMPARISON



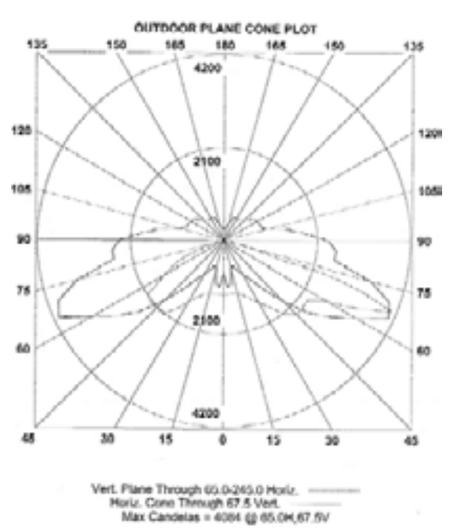
* Though the LED system produces fewer lumens, the manufacturer has presented material indicating an improvement in lighting levels over the 175W MV. This is due to the greater efficiency of the LED system at casting light from the fixture onto the sidewalk.

PHOTOMETRIC DATA

100W Metal Halide (MH) fixture



175W Metal Halide (MH) fixture



Photometric data provided by the manufacturer shows that the 175W MH fixture produces significantly higher light output than the 100W MH fixture across the same distance. Higher wattages, such as the 250W MH fixture, will produce even greater light output across the same distance.

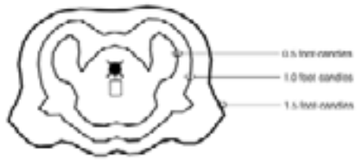
The lighting consultant's recommendations are based on a combination of these projected photometrics, along with existing and proposed pole spacing. The goal is to develop a plan that will ensure that the sidewalk lighting meets or exceeds IESNA standards while considering energy efficiency and long-term costs.

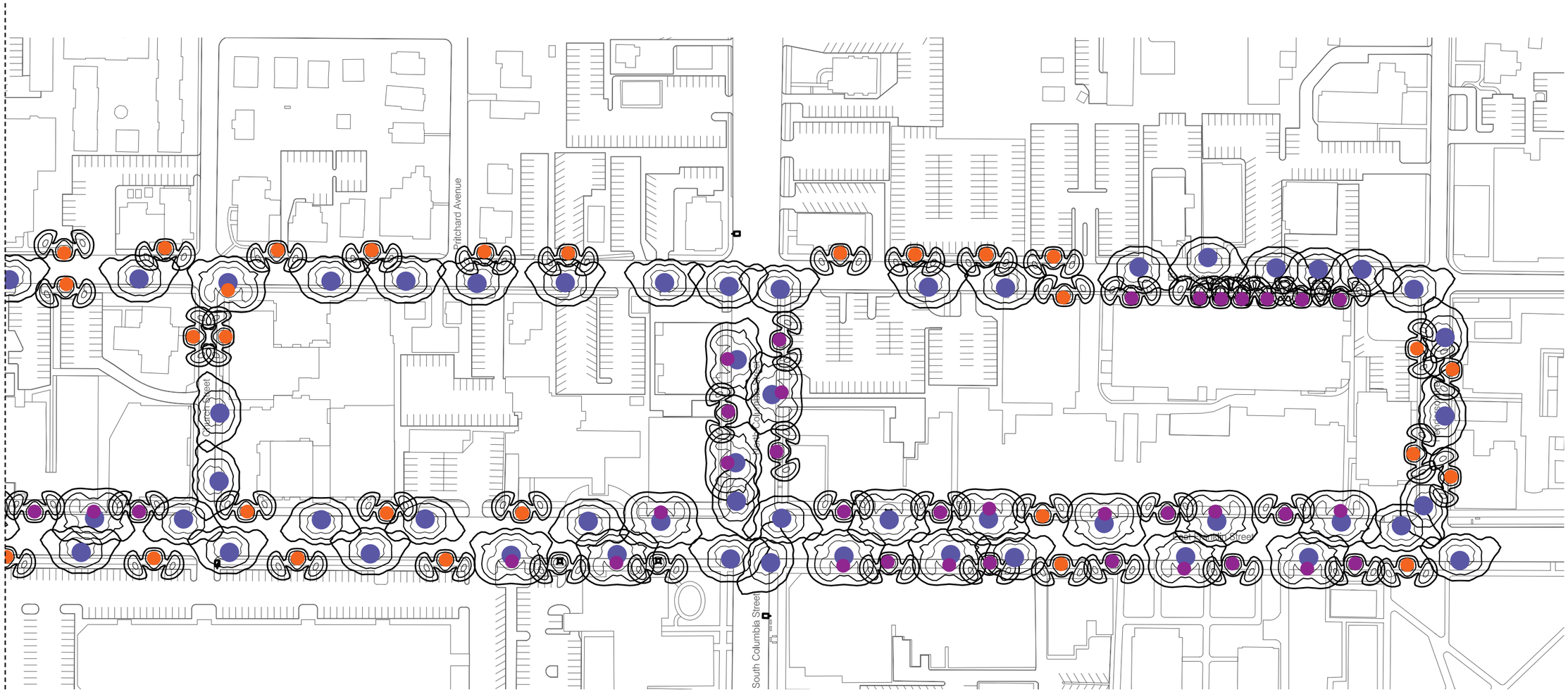

Sunset
North Graham Street
North Roberson Street
Mitchell Lane
West Franklin Street
South Graham Street
South Roberson Street
Basnight Lane
Kenan Street
Mallette Street

plan left

LEGEND

- Existing Street Light (30' height)
- Existing Pedestrian Light (16' height)
- Proposed Pedestrian Light (16' height)





plan right

The above plan was generated using light output data for 100W metal halide fixtures. A detailed description of metal halide lighting is included on the following page.

The plan maintains existing light pole locations while adding new poles and fixtures where current lighting conditions are inadequate. This includes attaching new pedestrian light fixtures to existing street light poles and installing new 16' poles with pedestrian fixtures. The Town will continue to install the decorative Lumec Domus fixture, which has become the streetscape standard.

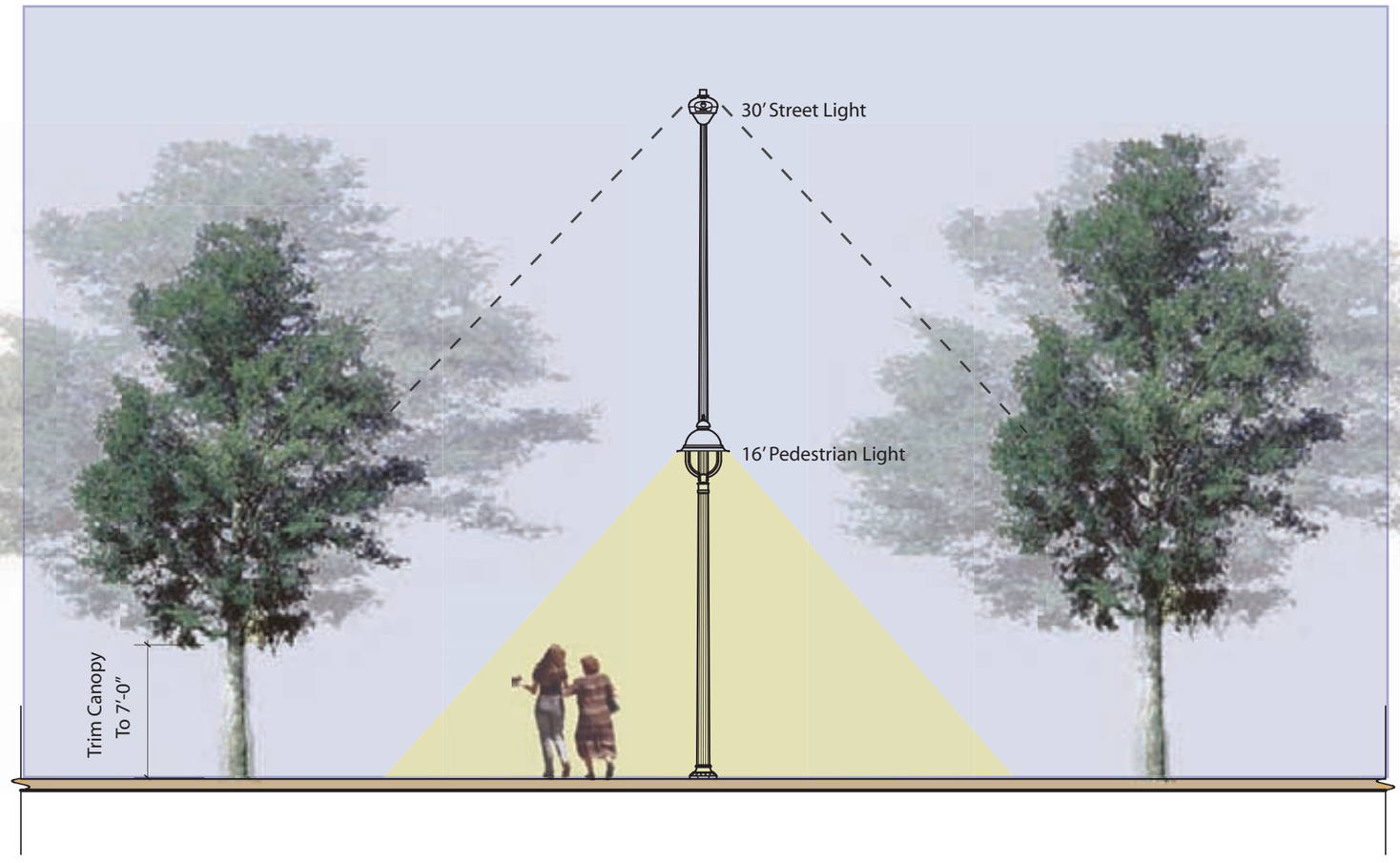
POTENTIAL LIGHT OBSTRUCTIONS

street tree plantings
In addition to the condition of the light fixture, one of the most important factors in illumination of the sidewalk is potential conflict with trees. When trees are not properly pruned, they can shield light from reaching the sidewalk. Trees should be selected for their habit such that they are compatible with the spatial requirements of the light fixture. In addition, with time trees should be pruned to ensure that branches do not fall in the path of the light, while maintaining the maximum amount of tree canopy possible.

retail awnings
Several retail awnings currently protrude over the sidewalk and therefore partially block light from reaching the sidewalk. The Town may find it necessary in the future to enact an ordinance that mitigates this problem. At this time, the lighting consultant does not recommend taking specific action regarding this issue, as it may result in greater challenges in terms of enactment and enforcement than may be beneficial to the Town.

supplemental lighting
The lighting consultant does not recommend relying on retail businesses to estabilsh supplemental lighting to bring the illumination levels in compliance with IESNA standards, as the retailer would likely have the right to remove the lighting without notice or fail to maintain the lighting system in proper operating condition. The responsibility for illuminating the sidewalk should be primarily with the Town, with any additional lighting contributing to levels above and beyond IESNA requirements.

Relationship Between Pedestrian Lighting and Street Trees



Notes:

1. All new street trees shall be planted at a minimum of 3" caliper and limbed up to avoid visual obstructions for pedestrians.
2. Refer to page 56 for maintenance and care of trees.

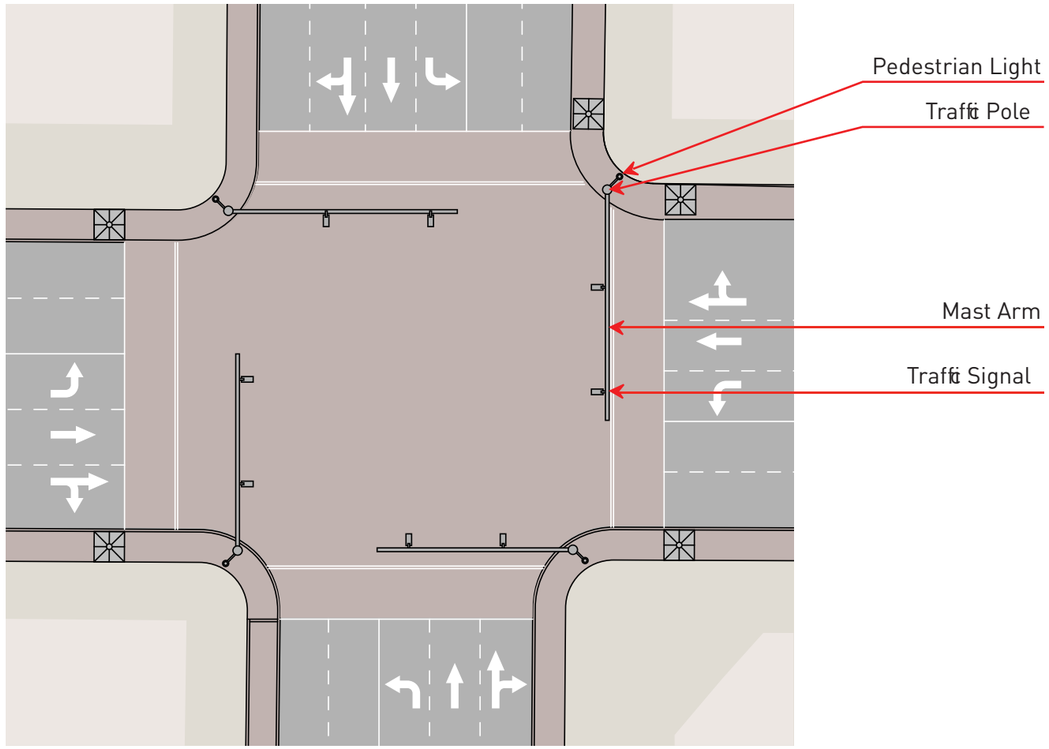
TRAFFIC LIGHTS

Existing Condition

Existing traffic poles are either wood poles with guy wires or metal strain poles without guy wires. Most traffic lights are cable-supported, though in some areas where streetscape improvements have been implemented, mast arm traffic lights have been installed. The Master Plan recommends phasing out the use of cable-supported traffic lights and replacing them with mast arm traffic signal poles.

Design Strategy

Mast arms should be installed at each corner of the intersection along with a pedestrian light attachment. Traffic signal poles that include pedestrian push buttons should be located within the sidewalk area. No pole should be located within any portion of the sidewalk ramp or interfere with pedestrian access.



The diagram above illustrates a typical traffic signal pole installation, with a mast arm pole at each corner. Each pole also has a pedestrian light attached.

The majority of traffic signals in Downtown Chapel Hill are cable-supported. Above is an example of cable-supported traffic lights at the intersection of Rosemary and Church Streets.

Recently improved areas, such as the intersection of Franklin and Church Streets shown above, include mast arm traffic lights. These will continue to be the standard when installing new traffic lights or replacing traffic lights as needed.