CITY OF SAN JOSE
CAPITAL OF SILICON VALLEY

Memorandum

TO: SMART CITIES AND SERVICE IMPROVEMENTS COMMITTEE

FROM: Jim Ortbal
Kip Harkness

SUBJECT: LED STREETLIGHTS CONVERSION UPDATE

DATE: May 29, 2018

Approved Date

RECOMMENDATION

1. Accept this report on LED Streetlight Conversion Strategy Update.
2. In consideration of the individual and relative value of the following objectives of an LED streetlight conversion project:
    a. speeding up the overall time of full conversion;
    b. reducing the cost of conversion and increasing the City's return on investment;
    c. establishing a Smart City foundation; and
    d. minimizing the number of trips to the streetlight poles;

    provide input to staff on options for converting the City's non-LED streetlights to LED streetlights, including the three options identified below:

    Option 1: Convert non-LED streetlights to LED streetlights with basic on/off lighting controls (without "smart" controllers) utilizing existing in-house crews and a reactive conversion approach (as the lamps burn out or the fixtures malfunction) over a seven-year period at an estimated project delivery cost of $16.5 million.

    Option 2: Convert non-LED streetlights to LED streetlights with basic on/off lighting controls (without "smart" controllers) utilizing a combination of existing in-house and contractual crews and a combined reactive (as the lamps burn out or the fixtures malfunction) and proactive zone-based conversion approach over a four-year period at an estimated project delivery cost of $17.6 million.

    Option 3: Convert the non-LED streetlights to "smart" LED streetlights and upgrade the existing LED streetlights with new "smart" controllers utilizing a combination of existing in-house and contractual crews and a proactive zone-based conversion approach over a four-year period at an estimated project delivery cost of $30.2 million.

3. Provide input as to whether staff should pursue up to $1 million in "gap" funding that would accelerate the timeframe for full conversion by up to one year by completing needed engineering, procurement, and other activities prior to securing full project funding.

BACKGROUND

There are approximately 64,400 active streetlights in the City of San Jose. The following table provides a breakdown of streetlights by type:

Streetlight Type	Number in City
Low Pressure Sodium (LPS)	29,600
High Pressure Sodium (HPS)	3,800
LED	26,000
Other (e.g. underpass, pedestrian overcrossing, and ornamentals)	5,000
Total Streetlights	**64,400**

A map showing the general location of streetlights already converted to LED, streetlights not yet converted to LED, and streetlights currently being converted to LED is provided in the Attachment.

Over the last six years, the City has converted approximately 26,000 streetlights to LED through various projects. Approximately 18,000 streetlights were converted as part of an Energy Solutions Company (ESCO) project and 8,000 streetlights were converted through several smaller projects utilizing City and grant funding sources (e.g. Traffic CIP, CDBG, Federal Recovery Act). Another 1,700 streetlights – 1,300 HPS streetlights in the Downtown and 400 LSP streetlights on major arterial streets – are being planned for conversion with Parking and Traffic CIP funding in 2018 and 2019. This will bring the total number of LED streetlights in the City to about 27,700 by the end of 2019, with approximately 36,700 streetlights still to be converted.

In August 2015, the City issued the Innovative LED Streetlight Replacement RFP to solicit proposals for converting the City's non-LED streetlights, which was estimated at that time to be just over 39,000 lights. On June 13, 2017, the City Council declared the proposal submitted by Siemens Corporation as the winning proposal and directed the City Manager to enter into negotiations with Siemens and its co-proposer, anyCOMM Holdings Corporation, for a pilot for up to one-year duration. On February 2, 2018, the City Manager terminated the negotiation process due to lack of progress despite seven months of good faith efforts by City staff.

Since the termination of negotiations with Siemens and anyCOMM, which effectively ended the Innovative Streetlight LED Replacement RFP process, staff from the Department of Transportation (DOT) and the City Manager's Office of Civic Innovation and Digital Strategy have been reviewing the latest information related to converting the remaining streetlights to LED. This information includes the following:

- Currently, there is no source of funding identified for future LED streetlight conversions. Possible funding options include a future general obligation bond measure for this and

other capital needs, conventional financing, and/or utilization of the City's General Fund or Traffic Capital Improvement Program.

- The City's 29,600 LPS lights remain one of the most energy-efficient types of streetlights available besides LED, making the benefits and return on investment for converting them to LED relatively less attractive.
- City Council Policy 4-2 – Public Streetlights and the City Council adopted Public Streetlight Design Guide call for the implementation of "adaptive lighting" to make use of advanced monitoring and control systems. The policy and design guide also establish the practice of dimming streetlights during late night and early morning hours to further reduce energy consumption and protect the sky from unnecessary light pollution. Unfortunately, the installation and implementation of LED streetlights with "smart" controllers increase the cost of conversion and further diminish the return on investment.
- Since the last conversion, the cost of LED fixtures has dropped by about 20% and the manufacturers rated life expectancy of the fixtures has increased from about 15 years to about 24 years and the number of lights needing to be converted has been reduced to approximately 36,700. The combination of these developments has positively impacted the capital cost of conversion and the return on investment.
- In late 2017, the City received notification that new orders for LPS replacement lamps and fixtures will not be accepted after July 2019, and the production of these products will cease in 2020. DOT might need to preorder and potentially purchase in advance any replacement lamps for lights that burn out and aren't planned for conversion to LED.
- The evolution of streetlight controls and their integration with future Smart City and Internet of Things (IoT) applications is accelerating with several promising products hitting the market. Conversely, the City's current streetlight control system, while cutting-edge at the time of adoption six years ago, is technically outdated and should not be expanded as part of new conversions. Consideration should also be given to upgrade the controllers in existing LED streetlights as part of a comprehensive conversion plan.
- Staff recently received notice that PG&E will be terminating its LED streetlight conversion rebate program at the end of 2018. No new applications will be accepted after December 31, 2018. The City had previously anticipated receiving approximately $1.5 million in rebates for the remaining non-LED streetlights.

Based on the above facts and latest developments in the LED and smart controller market, converting the remaining non-LED streetlights to LED is a complex decision. Staff has developed a framework for objectively evaluating various options against a set of common criteria to aid in choosing a preferred option and for informed decision-making.

The purpose of this memo, in consideration of the items described above and pending further information and analysis, is to provide various options for future LED streetlight conversion for the Committee's review and input.

ANALYSIS

Desired Objectives and Key Considerations for an LED Conversion Strategy

The following objectives for an LED conversion project were identified by staff and utilized as criteria for considering the pros and cons of various conversion options:

a. Speeding up the overall time of full conversion
b. Reducing the cost of conversion and increasing the City's return on investment
c. Establishing a Smart City foundation
d. Minimizing the number of trips to the streetlight poles

In the process of framing various conversion options and approaches, staff concluded that the type of controller to be installed on new and existing LED streetlights, and the sources of funding that might be used to pay for LED conversions, would have a significant impact on achieving the desired outcomes. The following provides additional information on these key considerations.

Type of Streetlight Controller to be Installed

An important decision must be made regarding the type of controller to be installed as non-LED streetlights are converted to LED. The City Council Policy 4-2 – Public Streetlights and the City Council adopted Public Streetlight Design Guide call for the implementation of "adaptive lighting" and dimming. To be consistent with the policy and design guide, the City would need to install "smart" controllers that enable centralized streetlight monitoring and control functions, like dimming. The only other option, which would require a deviation from the policy and design guide, is to install basic photocell controllers that simply turns the streetlight on and off as the sun rises and sets.

The benefits of having smart controllers are that the streetlights can be individually and collectively monitored and controlled via a central management system. Staff can receive real-time and historical reports regarding operating status (on, off or failed), light output and performance, and energy consumption data for billing purposes. Streetlights can also be programmed to turn on or off and increase or decrease (dim) lighting levels. Dimming during certain hours of the night supports the operations at Lick Observatory and further reduces energy consumption.

Smart streetlight controllers may also be a critical piece for future Smart City applications. The City has made significant progress in its journey to develop a city-wide IoT Strategy through a $200,000 Knight Foundation Grant. The IoT strategy identifies the streetlight infrastructure and smart controllers as a foundational piece for building out the IoT sensor ecosystem by providing a prominent means of connectivity and communication. There are many potential IoT and Smart City use cases that would improve effectiveness of City services in four specific areas – public

safety, mobility, facilities management, and environment. By increasing the deployment of sensors throughout the City, significant operational efficiencies are possible. Some examples include reduced water usage and energy consumption, improved traffic congestion management, better flood warning and emergency response, to name a few.

However, installing a smart controller on new LED streetlights significantly increases the cost of conversion by an estimated $5.5 million. Additionally, the upfront costs are not fully offset by the energy savings obtained through dimming, and smart controllers incur more cost for maintenance. It is also likely that the City may need to replace the smart controller units at the end of their useful life, which is currently estimated to be approximately 10 years. Installing smart controllers would also require additional time to procure (research current products and capabilities, prepare specifications, develop an RFP, manage a selection process that includes field testing, and select a product). Depending on the level of resources made available, such a procurement process would take between six and 18 months.

In addition to installing smart controllers on the 36,700 streetlights that would be converted to LED, there are approximately 26,000 existing LED streetlights that are equipped with the City's current smart controller product, and another 1,700 planned for conversion by the end of 2019. The City's current smart controller product, while cutting-edge at the time of adoption six years ago, is technically outdated and should not be expanded as part of new conversions. Having all LED streetlights with the latest smart controller technology would establish a common control and management system platform for all streetlights and allow for more efficient operations, maintenance, and Smart City applications. However, it would cost a total of $12.6 million ($5.5 for new LED streetlights and $7.1 for existing LED streetlights).

As stated above, the only other option is to install a basic photocell controller that simply turns the streetlight on or off as the sun rises and sets. This is certainly a viable option in that it would minimize the overall cost and speed up conversion, but would require that exceptions be made to the public streetlights policy and design guide, and it would require another visit to the streetlight pole for future smart controller installation.

Sources of Funding

Identifying an available source of funding to convert the City's non-LED streetlights to LED streetlights is a significant challenge. Unlike most other jurisdictions where annual cost savings from reduced energy consumption and maintenance needs can fully support a financing model (e.g. commercial paper, ESCO project, etc.) that funds a conversion project without any capital outlay, the cost savings that the City would achieve through new and more efficient streetlighting would require a dedicated source of funding for the duration of the project if financed. Thus, funding options are few given the demands on the potential funding sources within the City's budget.

Additionally, the concept of leveraging public-private partnership agreements with telecom companies interested in small cell deployment as part of an LED conversion scheme would not

likely result in many conversions. It's also apparent, based on recent discussions with several telecom companies, that agreeing on the value of converting streetlights to LED may be a difficult task.

The most likely source of funding for LED streetlight conversions is the General Fund or CIP (with or without financing) or a future general obligation bond measure. It is also not likely that without a new and dedicated funding alternative, such as a general obligation bond, the City would be able to include the installation of smart controllers as part of an LED conversation project.

Evaluation of the LED Streetlight Conversion Options

Staff identified three options for converting the City's non-LED streetlights to LED:

Option 1: Convert non-LED streetlights to LED streetlights with basic on/off lighting controls (without "smart" controllers) utilizing existing in-house crews and a reactive conversion approach (as the lamps burn out or the fixtures malfunction) over a seven-year period at an estimated project delivery cost of $16.5 million.

Option 2: Convert non-LED streetlights to LED streetlights with basic on/off lighting controls (without "smart" controllers) utilizing a combination of existing in-house and contractual crews and a combined reactive (as the lamps burn out or the fixtures malfunction) and proactive zone-based conversion approach over a four-year period at an estimated project delivery cost of $17.6 million.

Option 3: Convert the non-LED streetlights to "smart" LED streetlights and upgrade the existing LED streetlights with new "smart" controllers utilizing a combination of existing in-house and contractual crews and a proactive zone-based conversion approach over a four-year period at an estimated project delivery cost of $30.2 million.

The sections below provide an analysis of each option related to the project objectives.

a. Speeding Up the Overall Time of Full Conversion

There are several reasons why converting the City's non-LED streetlights to LED streetlights as soon as possible is an important objective. For many residents, having better lighting in their neighborhoods or having more energy-efficient streetlights with the City benefiting from reduced energy costs is important. For other residents, not spending City resources to repair obsolete LPS and HPS streetlights is important and relevant since the lamps and fixtures will not be manufactured after 2020.

Regardless of which option is implemented, the following steps are necessary to complete the project:

1. Identify and secure funding to initiate and deliver the project.

2. Perform planning, engineering, and needed streetlight fixture, controller, and construction labor procurement.
3. Perform conversions and, if smart controllers are installed, perform system configuration.

Under this normal project delivery process, project planning, engineering, procurement, and construction would occur after funding is identified and secured. In this case, the earliest that full project funding would likely be available is July 2019, assuming that funding is provided as part of the FY 2019-2020 budget process or through a November 2018 infrastructure bond measure. To mitigate this delay, and if desired by the Committee, staff would look to identify and secure approximately $1 million in "gap" funding that would accelerate the timeframe for full conversion by up to one year by completing needed engineering, procurement, and other activities prior to securing full project funding.

With the "gap" funding, the fastest way to convert the non-LED streetlights to LED streetlights would be to implement Option 2. This approach could complete full conversion by December 2022, assuming full project funding is secured by July 2019.

Since Option 2 does not include the installation of a smart controller, the planning, engineering, and procurement phase would be straightforward. Staff estimates it would take approximately six months to update LED fixture specifications, procure new LED fixtures, and procure additional construction labor in preparation for construction. Once full project funding is secured, construction would start. "Gap" funding would accelerate the speed of conversion for Option 2 by providing the funding necessary to perform needed planning, engineering, and procurement processes, and purchase new LED fixtures and initiate conversion activity prior to securing full project funding. The table below provides a comparison of the possible implementation timeframes between the Option 2 with and without "gap" funding.

Project Milestones for Option 2	**Completion Date**	
	<u>Without</u> "Gap" Funding	**<u>With</u> "Gap' Funding**
Start Planning, Engineering & Procurement	January 2019	July 2018
Secure Full Project Funding	July 2019	July 2019
Start Construction	July 2019	January 2019
Complete Construction	June 2023	December 2022

Option 3 in combination with "gap" funding would also result in a relatively fast path to full conversion. The main difference with Option 3 compared to Options 1 and 2 is that the planning, engineering, and procurement phase would be more complex and longer due to the need to prepare and implement a complex RFP process for the evaluation and procurement of new smart controllers. Given the number of new smart controllers on the market and the emergence of Smart City capabilities, researching, evaluating, and procuring the devices would take about one year and require additional resources to perform. Utilizing "gap" funding would

accelerate this work and reduce the timeframe for conversion by about one year and result in full conversion by July 2023. The table below provides a comparison of Option 3 with and without "gap" funding.

Project Milestones for Option 3	**Completion Date**	
	<u>Without</u> "Gap" Funding	**<u>With</u> "Gap' Funding**
Start Planning, Engineering & Procurement	July 2019	July 2018
Secure Full Project Funding	July 2019	July 2019
Start Construction	July 2020	July 2019
Complete Construction	July 2024	July 2023

b. <u>Reducing the Cost of Conversion and Increasing the City's Return on Investment</u>

The cost for converting the City's non-LED streetlights to LED streetlights varies depending on the type of controller installed, speed of conversion, and if financing is used to help pay for the cost of conversion. The total cost of each option is as follows:

Option 1: $16.5 million

Option 2: $17.6 million

Option 3: $30.2 million

The lowest cost option – Option 1 at total project delivery cost of $16.5 million – would not include smart controllers and would utilize a minimal number of conversion crews. Option 2 at a total project delivery cost of $17.6 million, which would add crews to speed up conversion, would require additional funding. Both options would provide a positive return on investment for the City in that cost savings are achieved over the life of the LED fixtures due to reduced energy consumption and maintenance. However, if the project is financed, the City would still need to commit funding to cover the difference between installation costs and energy cost savings during the duration of the conversion project.

As stated previously, the cost to install smart controllers on new and existing LED streetlights would be $12.6 million, for a total conversion cost of $30.2 million for Option 3. This option would not provide a return on investment over the life of the LED fixtures due to the high cost of the controllers and small increment of energy savings achieved through dimming alone.

All options would utilize existing in-house staff to perform some or all of the planning, engineering, and conversion work, therefore reducing the amount of new funding needed between $7.5 million and $3.8 million, depending on the duration and complexity of the project. Option 1, which would solely rely on in-house staff to deliver and take seven years to complete, would utilize $7.5 million in existing funding for in-house staff. Whereas Options 3 would

require additional staffing and contractual resources to deliver the project with smart controllers in 4 years, utilizing $3.8 million of existing funding.

The table below provides a summary of costs and funding needs for each option.

Cost Element	**Cost in $ Millions**		
	Option 1	**Option 2**	**Option 3**
Total Cost of Conversion Project	$16.5	$17.6	$30.2
Cost of Existing In-House Labor Already Budgeted	$7.5	$4.7	$3.8
Amount of New Funding Needed for Conversion *	$9.0	$12.9	$26.4

* Equals Total Cost of Conversion Project minus Cost of Existing In-House Labor Already Budgeted

As previously stated, the City's return on investment for converting non-LED streetlights to LED streetlights is less attractive than it is for other jurisdictions. This is due to the fact that the City's existing LPS streetlights are relatively energy efficient. Options 1 and 2 are the only options that would result in a positive return on investment due to energy savings over the 24-year life span of the LED fixtures. However, neither provide enough annual savings during the project delivery period to cover the cost of the project funding needed each year. The table below summarizes the energy savings, costs, and expected return on investment for each option.

Cost Element	**Cost in $ Millions**		
	Option 1	**Option 2**	**Option 3**
Energy Savings Over 24-Year Life of LED Fixtures	$18.3	$19.5	$20.4
Total Cost of Conversion Project	$16.5	$17.6	$30.2
24-Year Return on Investment *	$1.8	$1.9	($9.8)

* Equals Energy Savings Over 24-Year Life of LED Fixtures minus Total Cost of Conversion Project

Financing the project would increase the total cost of the project and require additional funding during the duration of the project for debt service and further diminish the return on investment. Total estimated debt service costs would be between $2.2 million for a $9.0 million, 12-year loan to pay for Option 1 and $6.4 million for a $26.4 million, 12-year loan for Option 3. Longer term loans could be available, but would also increase the total cost of debt service.

c. Establishing a Smart City Foundation

Option 3 with or without "gap" funding would provide the most value and a strong basis for realizing the San Jose Smart City Vision. Core to San Jose's Smart City journey is improving

existing services and creating completely new and innovative services by leveraging data generated by Internet of Things (IoT) sensors deployed where appropriate within the City.

Successful at-scale deployment of IoT sensors requires low cost and ubiquitous connectivity across the City. Connectivity is a foundational element of a Smart City. It is now cost effective to add communications technology to streetlamps at the same time as LED upgrades take place. This technology (smart controller) combines a connectivity layer along with lighting control and is designed specifically to connect city services and sensors, including streetlights. This connectivity enables the lights to be remotely monitored and controlled.

Moreover, additional sensors can be added to the lighting infrastructure, offering a cost effective way of creating a citywide IoT sensor network and enabling more efficient deployment of more smart services. By increasing the deployment of IoT sensors throughout the City with improved connectivity, the City can realize significant efficiencies in City operations such as water consumption savings, reduced energy consumption, improved traffic congestion management, and flood warning.

San Jose is presented with a significant opportunity to advance the Smart City Vision by installing smart controllers on every street light thereby creating a City-wide IoT connectivity platform.

Option 1 and 2 would utilize a basic photocell controller to provide the on/off functionality for the LED streetlight, and would need a temporary policy deviation from the City Council Policy 4-2 – Public Streetlights and the City Council adopted Public Streetlight Design Guide. As such Option 1 and 2 would not establish a Smart City Foundation.

d. Minimizing the Number of Trips to the Poles

One of the key recommendations of the Council Approved Broadband Policy is to gain operational efficiencies by minimizing the number of trips a crew makes to the streetlight pole for installing the LED luminaire and other devices, including smart controllers, small cells and various other IoT devices. Option 3, with or without "gap" funding, would best accomplish this objective by converting a non-LED streetlight fixture to an LED streetlight fixture while installing a smart controller at the same time. While Options 1 and 2 would reduce trips to a streetlight pole by converting the non-LED streetlights as they burnout or malfunction, additional trips to each streetlight pole would be required if the City decides to install smart controllers at some point.

Summary Comparison of Options

Staff is interested in understanding the Committee's perspectives on the individual and relative value of each option as they relate to the four desired project objectives. The table below provides summary comparison of the conversion options.

Desired Project Objectives	**Option 1**	**Option 2**	**Option 3**	**"gap" funding**
Speeding up the Overall Time of Conversion	○	◕	◑	●
Reducing the Cost of Conversion and Increasing the City's Return on Investment	●	◕	○	N/A
Establishing Smart City Foundation	○	○	●	N/A
Minimizing the Number of Trips to the Streetlight Poles	◔	◔	●	N/A

Rating Legend

○	◔	◑	◕	●
Least Impact		→		Greatest Impact

It should be noted that "Return on Investment" is electrical efficiency and does not include the anticipated return on investment from IoT.

Immediate Next Steps

Based on the input received from the Committee, additional analysis and coordination is immediately necessary to put forth an LED conversion plan, including the following:

1. Continue to evaluate options to convert the City's non-LED streetlights to LED streetlights.
2. Collaborate with the City Manager's Office and Finance to fully explore and vet various options to fully fund the project and provide "gap" funding, if desirable.
3. Develop a project work plan and schedule for implementation that encompasses all project phases.
4. Identify specific resources and establish needed budgets to implement the project.
5. Update the specifications and design guide for luminaires to include the most recent LED technology.

CONCLUSION

Converting the City's remaining non-LED streetlights to LED streetlights is a desirable and necessary project. Not only would it address the looming discontinuation of LPS streetlighting

products currently used by the City, it would improve lighting conditions in our neighborhoods and along the City's roadways, reduce the City's consumption of electricity, and could provide a foundation for future Smart City applications and benefits. Unfortunately, securing enough funding for the project is a difficult challenge for many reasons, and a variety of facts, information, and perspectives must be considered when selecting an approach for converting to LED streetlights. Staff is looking forward to engaging the Committee on June 7, 2018 to gain an understanding of the opinions, priorities, and direction of the Committee related to LED streetlight conversion.

/s/
JIM ORTBAL
Director of Transportation

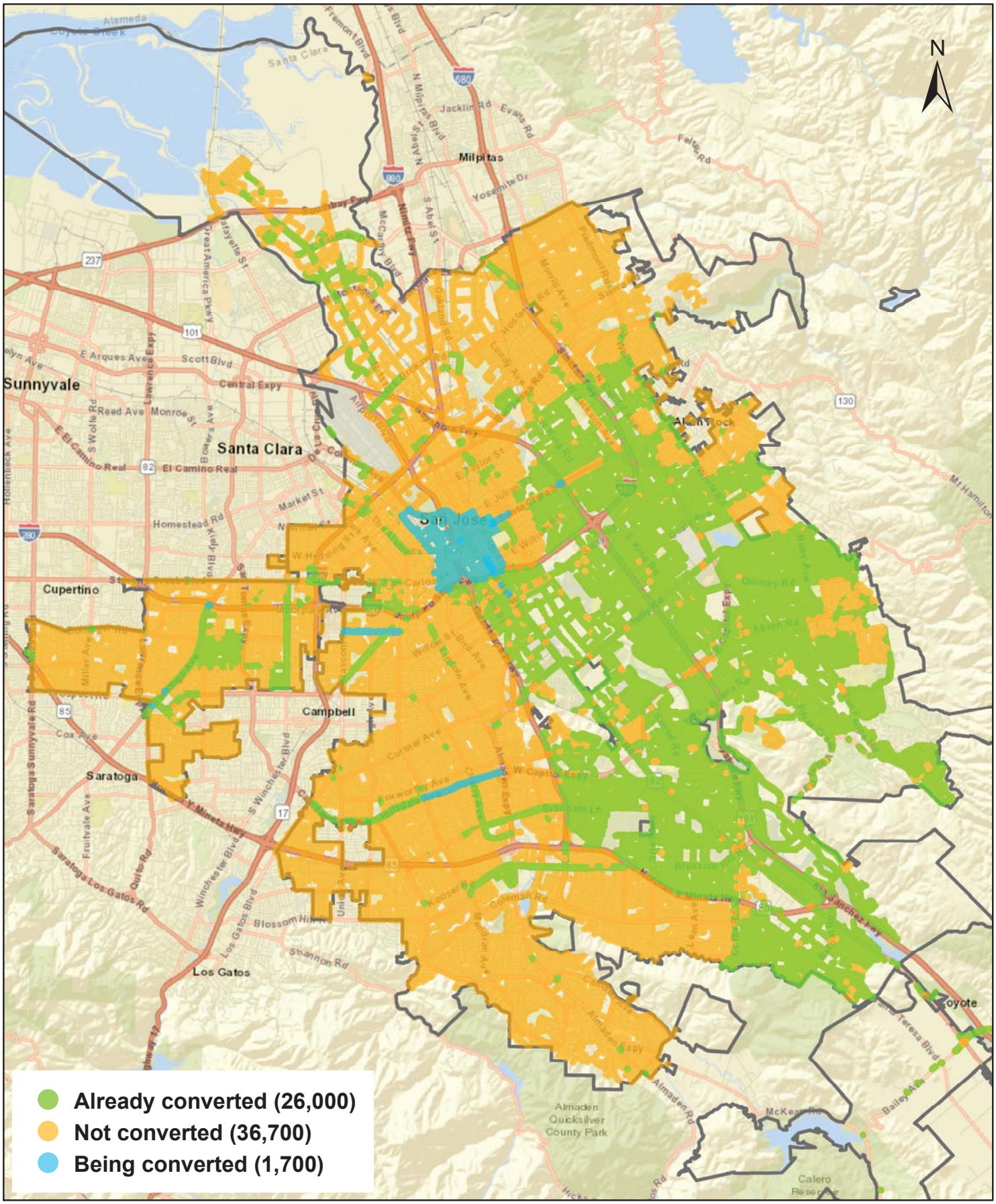
/s/
KIP HARKNESS
Deputy City Manager

For questions, contact Kevin O'Connor, Assistant Director of Transportation, at kevin.oconnor@sanjoseca.gov or by phone, at (408) 795-1835.

Attachment: Status of LED Conversion

ATTACHMENT

Status of LED Conversion



map date 5/29/18