



CITY OF LINCOLN

TRAFFIC MANAGEMENT MASTER PLAN

Preface

This is a Plan to improve the Traffic Management Systems in the City of Lincoln, NE. By the time you read this Plan, it is already outdated. Through the continuous, diligent work of dedicated staff, much of the data and work flow included in this document has already been further improved. Things impacting Traffic Engineering change quickly – weekly, daily, and minute by minute. Change is inevitable. Thus, much more the reason to take pause in the daily chaos and document resources necessary to sustain these important assets and functions. Assets and functions that help move all modes of traffic in the City of Lincoln.

In the past 24 months, our team has completed self-assessment and asset management inventory work. This has led to changes in how we do business, how we use technology, and what we know about our systems, staff, and processes. We are different. We are poised for the implementation of vast improvements City wide. With your support, in another 24 months we will again be fundamentally different. We will be better. The Citizens of Lincoln will reap the benefits. Travel will be safer and more efficient. With your support, we will move all modes of traffic as good or better than any agency in the nation.

- Lonnie Burklund, PE, PTOE
November, 2015

Executive Summary

The City of Lincoln strives to provide a transportation system that has superior operational and safety characteristics for our citizens and visitors to the Capitol City. Our transportation network has several components that must work together to provide this desired level of service, thus the continued planning, design, construction, and maintenance of these assets is vital. One such primary asset often at the forefront of public scrutiny is the City's traffic signal system. While this system has many parts that are visible to the daily commuters (poles, mast arms, red-yellow-green signals, etc.), there are several items that are not as visible. These include the complex system of central software, controller hardware, cabinets with electronic components, vehicle sensors, pedestrian detectors, cameras, and a maze of underground conduit for fiber optic communications. These crucial parts make up a portion of the overall Intelligent Transportation System (ITS) and work together in an effort to safely move all modes of traffic through City streets and intersections.

The Traffic Operations Division of the Public Works Department is responsible for the planning, design, operation, and maintenance of the City's 430-plus traffic signal system including over 150 miles of communications lines that support all city wide Departments and public facilities. While Traffic Operations staff conducts many other important functions, the content of this master plan is focused primarily on the traffic signal and ITS components, and the need to improve and enhance its infrastructure, operational function, staffing, and response.



Asset Management is a key component of any complex system. By vastly improving upon the data access, knowledge, and condition status of these systems in 2014-2015, Traffic Operations has revamped maintenance programs and workflow. More is known about the system components and communications network (both historical and new items) than ever before. Information sharing via web-based GIS tools, field techs logging work and system updates on mobile tablets, and efficiencies in troubleshooting via automated notifications – are all items that have improved with a focus on asset management.

With the enhancements of diligent asset management comes the benefit of real, accurate, self-assessment. The power of self-assessment with any system or program is learning about, and measuring performance. Often times this “look in the mirror” yields positive results and outcomes, and sometimes a closer examination can provide great opportunity for improvement. The goal of this Traffic Management Master Plan is to document both, and provide a path to overcome the challenges.

Many of the identified challenges with the existing system appear daunting. Change is needed. A refreshed focus into the operations of the traffic system by the Public Works Department is already occurring. With proper evaluation, planning, and phased implementation of improvements, significant benefits can be realized. With a focused plan, change is not intimidating, change is good.

Despite robust maintenance efforts, many system components are becoming outdated. Similar to transportation facilities across the nation, the challenge of replacing vital hardware has not kept pace with local needs. As described in later sections, the traffic signal rehabilitation program is in need of a boost. Additionally, software and operational requirements are not on par with modern changes in the industry. Agencies are deploying high-tech, IP-based systems that allow maximum flexibility in the proactive management of traffic. New technologies allow for enhanced monitoring, modified signal phasing, and improved traffic flow that the public demands.

The City's current central signal system software that communicates with all signalized intersections city wide to deploy signal timing information, has not been updated in over 16 years. It was implemented in 1999 and is no longer supported by the manufacturer, it is no longer supported by the vendor, and is no longer compatible with recent upgrades to the city wide computer operating systems. The software is not compatible with a newer platform than WindowsXP. Can you recall the computer you utilized in 1999, the software, the operating system, or what type of mobile phone you had?



Additionally, once prominent vehicle detection systems are declining – a primary reason for the majority of logged complaints and signal operational calls from the motoring public (daily/weekly). Aging hardware loops in the pavement are damaged from continuous environmental exposure, paving rehab needs, and degraded wiring within saw-cut pavement installations. Older model detection cameras (beyond 15 years old) are reaching end of life and do not include newer technology and robust components. Based upon recent data, over 30% of all detection city wide is faulty – making signal timing adjustments and safe operations even more challenging with limited staff and resources.

These are just a few of the issues that result in the need for a fresh approach, a revised and formal plan to improve traffic operations in the City of Lincoln. Continued transportation funding gaps, correct staffing allocation to adequately manage the system, and improved response to citizen needs are also apparent. The city continues to grow and expand – both in population and land area, resulting in additional intersections and traffic management issues for commuters.

To combat this less-than-favorable information, there is also GOOD NEWS! The City of Lincoln has done a fantastic job over recent years in expanding and leveraging its communications system infrastructure. Typically, for most agencies needing to do major system upgrades, the costs of new conduits and fiber can be the single largest cost (impediment) to funding improvements in the traffic system – often tens of millions of dollars alone. Traffic Operations has been working in concert with the Broadband Infrastructure initiatives to install, maintain and modernize dozens of miles of new fiber optic connections. Working cooperatively with private entities and installing infrastructure as part of CIP projects has resulted in an expansive and redundant communications network that is continuing to be well built out and geared towards the future! In short, the city can focus more of its traffic engineering resource needs on staff, software, and other hardware that will result in benefits to motorists.



In addition, a primary focus of needed upgrades to the system will allow for the implementation of new signal phasing, and new optimized signal timing plans on major arterials city wide. These signal optimization projects typically result in enormous benefit/cost ratios – minimum of 15:1 to 20:1 for improved corridors, and up to 40:1 when other minor improvements are included. Utilizing these performance metrics and the average cost of signal retiming projects at \$3,500 per intersection, it is quick to realize the public benefit for a system the size of Lincoln's:

(430 traffic signals x \$3.5K per intersection = cost of \$1.5M)

(At a B/C of 15:1; yields over \$22M in benefit)

Just a few of the benefits to the motoring public include:

- Reduced delays and stops
- Smooth commutes & less driver frustration
- Reduced emissions and pollutants
- Fuel savings
- Travel time savings for public, transit, and emergency vehicles
- Improved safety performance, reduced crashes
- Postpone or eliminate the need for costly road capacity construction



The Federal Highway Administration (FHWA) estimates that over 75% of all traffic signals can easily be improved through the updating of equipment and adjusting signal timing. This includes not only operational benefits, but overall enhanced safety amongst an agency's major arterials.

Furthermore, expenditures on technology driven components of the system upgrades also tend to provide a high return on investment for the greater population of the entire city when compared to

major capacity projects. Often times the cost of these lower hanging fruit improvements can vastly improve the performance of roadways beyond the “dirt, pipe, and concrete” infrastructure. As an example, utilizing present day construction costs – for the same amount of money we can either:

- Pave ¼ mile (3 blocks) of a new arterial roadway somewhere in the City of Lincoln

Or, we can....

- Implement new signal system software and controllers at ALL 430 traffic signals Citywide

For the cost of building another 3 blocks of urban arterial road, we could fix ALL vehicle detection Citywide with modern equipment – enhancing traffic flow, and eliminating citizen complaints regarding such. While there is much work to be done to modernize the system, there is documented value in enhancing capacity of current roadways, versus the high costs of additional lanes of paving and the follow up required maintenance of such.

The Traffic Management Master Plan identifies several areas for evaluation and proposed enhancements. A few of the primary system needs include:

- Advanced Traffic Management System (ATMS) hardware and software
- Location and functionality of the Public Works Operations Center (PWOC)
- Vehicle detection
- Signal phasing alternatives
- Signal optimization program
- ITS field devices - CCTV cams for system monitoring
- Arterial dynamic message signs (DMS)
- Communications systems
- Traveler information to the public
- Pedestrian and bicyclist safety
- Signal rehabilitation
- Traffic system management (staffing)
- Operations and maintenance activities



It is important to note that on an annual and on-going basis, subtle upgrades to the system are continually being implemented – either through CIP arterial roadway projects where signalized intersections are included within these limits, or as part of smaller project upgrades and stand-alone signal equipment replacement projects. There are also incidents (too frequently) each year that require emergency repairs due to equipment failures or vehicular crash damage at intersections – signal cabinets run over, poles hit etc. In these instances, new equipment that is consistent with the future (pending budget limitations) is deployed such that future needs at those intersections are being addressed ahead of time.

Other on-going maintenance work includes the replacement of signal bulbs (from incandescent to more energy-efficient LED bulbs), installation of countdown pedestrian signal indications, and improved push-button detectors. During annual cabinet maintenance activities, other components are upgraded as needed including signal conflict monitors and communications equipment. Many of these smaller interim projects help extend the life of intersection equipment.

The following list summarizes *key* recommendations identified in this master plan. Sections 4 and 5 of the master plan provide additional detail and cost/benefit information for these improvements that will alleviate public frustration and improve response to citizens.

ATMS Hardware and Software

- Procure and integrate a modern ATMS software to operate, monitor, manage, and maintain traffic signals and ITS field devices.
- Replace all existing traffic signal controllers with advanced traffic controller (ATC) protocol that are NTCIP compliant with appropriate local controller software in the field.
- Upgrade necessary traffic signal cabinets to TS2, Type I minimum standard that allows for compatibility with future detection needs and IP communications infrastructure.
- Implement operational hardware and software in the PWOC for management of the system.

Vehicle Detection and Signal Phasing

- Upgrade vehicle detection at existing faulty locations citywide with a mix of non-intrusive detectors (cameras and/or microwave radar) and preformed loops under pavement as needed.
- Continue annual replacement and conversion of mainline corridor detection to cameras for stop bar detection, and enable viewing of intersection approaches with the camera management software.



Signal Optimization Program

- Implement cyclical signal optimization program enabling primary arterials to be retimed every 3-5 years.
- Evaluate and install updated signal phasing hardware (Flashing Yellow Arrow) at all required protected/permitted left-turn locations.
- Develop City of Lincoln standard traffic signal optimization guidelines for internal and consultant staff use on signal timing projects.
- Continue deploying emergency vehicle preemption (EVP) systems per available funding in place with various public safety agencies.

- Coordinate with StarTran to facilitate evaluation of transit signal priority (TSP), bus rapid transit (BRT), or other transit projects as needed.

Intelligent Transportation System (ITS) Devices

- Deploy closed-circuit television (CCTV) cameras with pan-tilt-zoom (PTZ) capabilities across the city at the intersections of arterial roadways, as well as other locations as needed to monitor traffic performance and incidents.
- Deploy arterial DMS and trailblazer signs on primary routes for incident management, special events, congestion management, and travel time information.
- Deploy additional system sensors (microwave radar and Bluetooth/Wi-Fi) as needed for automated travel time collection and performance measurement.

Communications System

- Continue construction of the redundant, self-healing gigabit Ethernet fiber optic network.
- Implement wireless communications to signals not located on arterial roadways.
- Establish internet protocol (IP) based communications on the network to all devices.

Traveler and Public Information

- Install kiosks or other traffic-related information displays at City Hall or other high-activity areas to display important traffic/travel condition information for daily and event traffic.
- Explore software that integrates a future parking management and information system with the proposed central traffic signal management system software.
- Evaluate methods to quickly disseminate emergency traffic information via the City's website, social media, and other apps.

Pedestrian & Bicycle Safety

- Continue the evaluation of pedestrian signals at key crossing locations – implement rectangular rapid flashing beacons (RRFB).
- Implement necessary system detection for bicycle facilities (cycle tracks, bike lanes) to monitor efficiency and operations.
- Develop additional public information regarding ped/bike safety programs and planned facilities.

Traffic Signal Rehabilitation

- Program annual replacements of aging traffic signal infrastructure based on structure lifespan and on-going inspection results, and remove unwarranted signals.
- Look to implement roundabout intersection control at existing traffic signal locations as relevant for traffic and environmental conditions.
- Continue non-destructive testing of structures and signal pole inspection program.

Traffic System Management

- Program additional staff to provide one PWOC operator to monitor the traffic signal system and related devices from 6 am to 9 am and 3 pm to 6 pm, Monday through Friday, at a minimum.
- Program additional traffic engineering and technician staff to adequately manage the system.
- Continue to dedicate staff for evaluation of existing timing settings to ensure that they adhere to the latest Manual on Uniform Traffic Control Devices (MUTCD) and industry best practices.
- Optimize traffic signal coordination plans, at a minimum, every 3 to 5 years based on traffic volume and pattern fluctuations.
- Determine the feasibility and/or benefits of installing an adaptive or responsive system on corridors with closely-spaced signals and fluctuating, unpredictable traffic volumes.
- Develop, implement, monitor, and revise timing plans as necessary to accommodate special event traffic around major traffic-generating facilities.
- Staff adequately to respond to public inquiries with technical expertise in a timely fashion.

Maintenance

- Program additional staff positions to properly maintain the communications network and additional ITS devices deployed in the field.
- Continue to perform general traffic signal maintenance using internal maintenance staff, including fiber optic cable repairs.
- Continue to develop and implement a comprehensive and regular preventative maintenance program.
- Provide training for maintenance and operations staff to adequately maintain the traffic signal system.

By implementing the above recommendations, and continuing to proactively plan, fund, operate, and maintain a growing traffic management system, we will provide the citizens of Lincoln with a vastly improved travel experience. Many of the pieces are coming together. With additional support, the safe and efficient movement of all modes of traffic will result in sustainability of the transportation network and improved quality of life. The Public demands our program, and they deserve a better one. The future is bright. Are you ready?



**“Change is the law of life. And those who look only to
the past or present are certain to miss the future”**

- *John F. Kennedy*

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Traffic Engineering Team

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