Traffic Signal Strategic Plan and Investment Framework

Final Report

NJTPA NORTH JERSEY TRANSPORTATION PLANNING AUTHORITY
Defining the Vision. Shaping the Future.

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Executive Summary

Traffic signal programs across the North Jersey Transportation Planning Authority (NJTPA) region vary significantly in ownership, funding, staffing, maintenance practices, technical capabilities, and available data. Despite these differences, agencies throughout the region face many of the same challenges: aging infrastructure, limited funding, inconsistent asset information, staffing constraints, fragmented responsibilities, and difficulty advancing smaller-scale signal improvements through traditional funding programs. These issues affect daily operations, long-term maintenance, and the ability of local agencies to plan for future traffic signal needs.

Traffic signals play a critical role in the regional transportation system. They influence safety, mobility, accessibility, freight movement, transit operations, emergency response, and the movement of people and goods through local, county, and regional corridors. However, many traffic signal systems are managed with limited resources and incomplete information. Without reliable inventories, consistent evaluation methods, and comparable data, agencies have limited ability to identify needs, justify funding requests, or prioritize investments across jurisdictions. The Traffic Signal Strategic Plan and Investment Framework was developed to address those challenges and provide a common basis for future decision-making.

National and state practices reviewed for the Framework point to several elements that are common among effective traffic signal programs. These include accurate asset inventories, performance-based decision-making, lifecycle-based asset management, documented maintenance practices, and coordination among agencies. These practices are especially important in the NJTPA region, where traffic signal responsibilities are distributed among counties, municipalities, the New Jersey Department of Transportation (NJDOT), the Port Authority of New York and New Jersey (PANYNJ), and other agencies.

Validation of the regional traffic signal inventory was one of the most important outcomes of the Framework. More than 7,300 NJTPA records were compared against nearly 7,900 records maintained by counties, municipalities, NJDOT, PANYNJ, and other signal owners throughout the region. This effort identified duplicate records, location discrepancies, missing information, and other data issues while establishing a substantially improved regional inventory and Geographic Information System (GIS)-based database. The improved inventory provides a stronger foundation for future planning, screening, asset management, data collection, and investment prioritization.

Three primary goals emerged through development of the Framework: Safety, Mobility & Efficiency, and State of Good Repair. Safety addresses the need to reduce crashes, manage risk, and improve conditions for all users at signalized intersections. Mobility & Efficiency addresses congestion, travel reliability, multimodal operations, and the movement of people and goods. State of Good Repair addresses the need to maintain, modernize, and replace traffic signal infrastructure so that systems continue to operate reliably throughout their service life. Together, these goals provide a practical structure for evaluating traffic signal needs across the region.

Supporting these goals is a network screening methodology that evaluates traffic signal investment needs using more than one measure of performance. Rather than relying only on crashes,

congestion, or equipment age, the methodology considers safety, operational performance, and infrastructure condition together. This approach allows NJTPA and its partners to compare needs more consistently and identify locations where investments may provide the greatest benefit.

Implementation will require continued attention to data quality and data availability. NJTPA and its partners already maintain useful datasets related to safety, congestion, transportation modeling, demographic conditions, and traffic monitoring. However, important gaps remain in traffic operations data, asset condition information, maintenance history, signal performance, lifecycle costs, and multimodal activity. Addressing these gaps will strengthen future screening efforts and support more transparent and defensible investment decisions.

A centralized GIS-based traffic signal inventory should serve as the primary platform for organizing and maintaining the data needed to support the Framework. The inventory should be updated as signals are installed, modified, upgraded, or removed. Over time, additional information should be added, including equipment condition, maintenance history, lifecycle status, ownership, operational characteristics, and other asset management data. Maintaining current and reliable inventory information will be essential for future planning, funding requests, and investment prioritization.

Stakeholder input was central to the development of the Framework. Three Technical Advisory Committee (TAC) meetings, regional surveys, and Subject Matter Expert (SME) interviews provided insight into the issues most affecting traffic signal programs across the region. Participants consistently emphasized the need for better coordination among agencies, improved asset inventories, stronger data and documentation practices, sustainable funding mechanisms, and practical implementation strategies. Stakeholders also stressed that the Framework must remain flexible enough to account for differences in agency size, ownership structure, available resources, and local operating conditions.

Recommended next steps include maintaining and updating the regional traffic signal inventory, expanding asset condition and maintenance data, applying the screening methodology to support future investment decisions, improving data collection for traffic operations and multimodal activity, and continuing coordination with counties, municipalities, NJDOT, PANYNJ, and other partners. These actions will help NJTPA and its partners use the Framework as a practical tool for identifying needs, supporting funding requests, and improving the long-term performance of traffic signal systems across the region.

Traffic signal programs across the NJTPA region do not need a single operating model or one uniform approach. Agencies have different responsibilities, funding mechanisms, staffing levels, and technical capabilities. What is needed is a consistent process for identifying needs, maintaining reliable data, evaluating investment opportunities, and linking projects to clearly defined transportation objectives. The regional inventory, GIS database, goals framework, screening methodology, and data framework developed through this effort provide that process.

Successful implementation will depend on continued collaboration among NJTPA, counties, municipalities, NJDOT, PANYNJ, and other stakeholders. Maintaining the regional inventory, improving data quality, expanding asset management practices, and applying performance-based decision-making will help agencies move beyond reactive project delivery and toward a more

strategic approach to managing traffic signal infrastructure. As technologies, data sources, funding opportunities, and regional transportation priorities continue to change, the Framework can be updated and refined to support future investment decisions and improve traffic signal performance throughout the NJTPA region.

Task 1: State of the Practice

Task 1.1. National and State Practices (Literature Review & Alignment Identification)

Task 1.1 reviewed national, state, and regional guidance documents to identify practices that have proven effective for planning, operating, maintaining, and investing in traffic signal infrastructure. Although the documents originated from a variety of agencies and programs, a consistent theme emerged: agencies achieve the greatest success when traffic signals are managed as critical transportation assets with clearly defined objectives, measurable performance targets, and long-term investment strategies.

The review found that many leading agencies have shifted away from project-by-project decision making and instead rely on performance-based approaches that link traffic signal investments to broader transportation goals such as safety, mobility, reliability, accessibility, resilience, and state of good repair. These programs use objective data, performance measures, and asset condition information to guide maintenance, modernization, and capital improvements.

A second key finding was the importance of maintaining a comprehensive traffic signal inventory. Asset inventories serve as the foundation for asset management programs, allowing agencies to understand what infrastructure exists, assess condition and risk, track performance, and make informed decisions about maintenance and replacement needs. National guidance consistently recommends pairing this inventory with lifecycle planning, performance monitoring, and risk-based investment prioritization to maximize the value of limited funding resources.

The literature also highlighted the value of standardized practices. Consistent design guidance, operational procedures, maintenance processes, and performance measures help reduce variability across jurisdictions, improve interoperability, and support more reliable system performance. Several state programs reviewed as part of this effort have successfully implemented common standards while still allowing flexibility to address local conditions and priorities.

Many of the most mature traffic signal programs use Traffic Signal Management Plans (TSMPs) or similar strategic frameworks to establish service expectations, define performance objectives, coordinate design and maintenance activities, and guide future investments. These plans provide a structure for moving beyond reactive maintenance toward a more organized and proactive approach to managing traffic signal infrastructure.

The review also identified regional coordination as a critical factor in successful traffic signal programs. Examples from Pennsylvania and other states demonstrate the benefits of centralized asset management systems, shared maintenance resources, corridor-based planning, and formal coordination mechanisms that improve consistency across agency boundaries while supporting local ownership and decision making.

When compared with conditions in the NJTPA region, the literature revealed several opportunities to strengthen current practices. Traffic signal ownership and maintenance responsibilities are

distributed across numerous agencies, resulting in variations in equipment, standards, maintenance approaches, and investment priorities. As a result, opportunities exist to improve consistency, strengthen coordination, establish common performance measures, and support more strategic investment decisions.

Overall, the literature review concluded that the NJTPA Traffic Signal Strategic Plan and Investment Framework should be grounded in asset management principles, performance-based decision making, lifecycle planning, and regional coordination. These practices provide a foundation for improving safety, mobility, reliability, and long-term stewardship of traffic signal infrastructure throughout the NJTPA region.

Task 1.2. Regional Planning Integration

Task 1.2 focused on understanding how traffic signal investments can support the transportation goals already established across the NJTPA region. The review included NJTPA's core planning documents, county transportation plans, municipal circulation elements, Vision Zero action plans, corridor studies, and other subregional planning efforts. While these documents vary in scope and purpose, they consistently identify transportation priorities that can be advanced through effective traffic signal planning, operations, and management.

The review found strong alignment between regional goals and the role traffic signals play in the transportation system. Safety, accessibility, mobility, reliability, environmental stewardship, economic development, and maintaining infrastructure in a state of good repair were recurring themes throughout virtually every plan reviewed. These goals closely mirror NJTPA's Long Range Transportation Plan and reinforce the importance of traffic signals as operational tools that influence how people and goods move throughout the region.

NJTPA's core planning documents establish the policy foundation for future signal investments. The Long Range Transportation Plan emphasizes safety, access to opportunity, system efficiency, resiliency, land use coordination, infrastructure preservation, and economic growth. The Congestion Management Process focuses on improving accessibility and mobility while supporting multimodal travel and transportation system management strategies. Air quality planning documents identify opportunities to reduce vehicle emissions through operational improvements, including signal optimization and Intelligent Transportation Systems (ITS). Project prioritization criteria reinforce these same themes by evaluating investments based on safety, environmental benefits, system performance, economic impacts, land use considerations, and state of good repair.

The county and municipal plans reviewed for this task generally build upon these same priorities. Many plans emphasize improving safety for all users, reducing congestion, supporting transit, improving conditions for pedestrians and bicyclists, incorporating emerging technologies, maintaining infrastructure, and strengthening connections between transportation and land use decisions. Although the terminology differs from plan to plan, there is substantial consistency in the outcomes agencies are seeking to achieve.

Several local planning efforts also demonstrate how transportation goals can be translated into measurable actions. Plans such as Jersey City's Circulation Element, Somerset County Transportation Plan, Hudson County Vision Zero Action Plan, and the Middlesex County Traffic Signal

Master Plan establish clear goals, define implementation strategies, identify responsible agencies, and track progress through performance measures and monitoring programs. These examples provide practical models for linking regional transportation goals to future traffic signal investments and operational improvements.

A second major finding was the importance of coordination. Traffic signal ownership, operation, and maintenance responsibilities are distributed among numerous state, county, municipal, and private entities throughout the NJTPA region. As a result, successful implementation of future investments will depend on collaboration among agencies, consistent planning processes, and shared understanding of regional priorities. Coordination was identified as a recurring theme in both regional and subregional plans.

The review also highlighted opportunities to further strengthen regional decision-making. While most plans clearly define goals and priorities, the methods used to evaluate projects and measure outcomes are not always consistent across jurisdictions. Establishing common performance measures, documenting decision-making processes, and incorporating more data-driven evaluation methods would improve transparency and help ensure that future traffic signal investments are aligned with both local needs and regional objectives.

Overall, Task 1.2 confirmed that traffic signal investments can advance many of the transportation priorities shared across the NJTPA region. The findings provide a framework for connecting future signal investments to established regional goals and ensuring that project selection, funding decisions, and implementation strategies support the broader transportation vision of the region.

Task 1.3. State of the Practice Local Traffic Signals in NJTPA Region

Task 1.3 examined how traffic signals are funded, planned, operated, maintained, and managed across the NJTPA region. Information was collected through a survey of counties, municipalities, transportation agencies, and other stakeholders to better understand current practices and identify common challenges affecting local traffic signal programs.

The survey confirmed that there is no single approach to traffic signal management within the region. Responsibilities for signal ownership, maintenance, operations, and planning vary widely among jurisdictions. Some agencies maintain large, centralized programs with dedicated staff, formal maintenance procedures, and advanced management tools, while others rely on a combination of local budgets, consultants, and on-call contractors to keep systems operating.

The largest agencies, including NJDOT, PANYNJ, Bergen County, Middlesex County, Newark, and Jersey City, generally have the staff, infrastructure, and resources needed to actively manage their signal systems. These agencies tend to have established maintenance programs, centralized monitoring capabilities, and more sophisticated tools for managing signal assets. In contrast, many smaller jurisdictions focus on day-to-day operational needs and have limited resources available for long-range planning, data management, and system optimization.

One of the most consistent findings was the lack of comprehensive asset management practices across much of the region. While several agencies maintain inventories of their signal equipment,

the information tracked is often limited to basic details such as location and installation date. Data that supports long-term investment planning, including equipment condition, expected service life, replacement costs, and maintenance history, is often unavailable or not maintained in a consistent manner. As a result, many agencies have limited ability to forecast future needs or support data-driven funding requests.

The survey also highlighted a largely reactive approach to traffic signal operations. Signal timing updates are commonly initiated in response to complaints, development activity, crashes, or requests from police departments and elected officials. Routine performance monitoring and proactive signal retiming programs were far less common. Several agencies indicated that staffing and funding limitations make it difficult to regularly evaluate system performance or update timing plans.

Funding challenges were reported by agencies of all sizes. Most maintenance and operational activities are funded through local budgets, while capital improvements often depend on state, regional, or federal grants. Agencies frequently cited long grant timelines, administrative requirements, matching fund obligations, and competition for limited funding as obstacles to implementing improvements. Several respondents also noted that funding opportunities are generally more available for design and construction than for ongoing maintenance, operations, or signal timing programs.

Technology deployment across the region generally reflects available resources. Larger agencies have implemented advanced traffic management systems, adaptive signal control, centralized monitoring platforms, and more comprehensive asset management tools. These capabilities are far less common among smaller agencies, many of which continue to rely on conventional signal systems and manual processes.

Despite differences in organization, funding, and system size, several common needs emerged from the survey. Agencies expressed interest in improving access to funding, expanding technical support resources, strengthening asset management practices, and establishing more consistent approaches to traffic signal operations and maintenance. Respondents also identified opportunities to enhance pedestrian, bicycle, transit, and emergency vehicle accommodations through operational improvements and updated design practices.

Overall, the survey showed that traffic signal programs across the NJTPA region operate with varying levels of staff, funding, and technical capability. While some agencies have developed mature and data-driven programs, others continue to face resource constraints that limit their ability to proactively manage and improve their systems. These findings helped identify the gaps, challenges, and opportunities that will inform development of the Traffic Signal Strategic Plan and Investment Framework.

Task 2: Local Traffic Signal Data Validation

The regional traffic signal inventory was reviewed and validated against data provided by signal owners throughout the region to establish a more reliable baseline for future planning and investment decisions.

The validation effort brought together information from three primary sources: NJTPA's traffic signal inventory, signal inventory data provided by counties and agencies, and NJDOT Straight Line Diagram data. Because the datasets had been developed independently and used different formats, naming conventions, and levels of detail, the first step involved organizing the information into a common structure that could be reviewed and compared consistently.

Data was received from 17 jurisdictions and subregions, including all NJTPA counties, Jersey City, Newark, NJDOT, and PANYNJ. The NJTPA inventory contained more than 7,300 signal records, while the data supplied by the signal owners included nearly 7,900 records. The comparison process identified duplicate records, location discrepancies, naming inconsistencies, and signals that appeared in one dataset but not another.

A combination of coordinate-based matching and intersection name matching was used to compare the datasets. Geographic coordinates provided the most reliable method for identifying common records, while intersection names were used to evaluate locations where coordinates were unavailable or inconsistent. Records that could not be matched automatically were reviewed manually to determine whether they represented legitimate traffic signals, duplicate records, or missing inventory information.

The review found that the vast majority of the NJTPA inventory could be verified through comparison with local agency data and NJDOT records. Most discrepancies were the result of differences in how agencies maintain their inventories rather than fundamental issues with the underlying data. The process also identified locations that existed in local inventories but were missing from the regional inventory, along with records that require additional confirmation from the responsible agency.

An important outcome of the task was the development of a regionwide GIS database that brings together NJTPA's inventory and the inventories maintained by individual signal owners. The database allows users to review matched and unmatched records, track data quality issues, and maintain a consistent inventory structure moving forward. Supporting documentation was also developed to establish common data definitions and inventory management procedures.

The validation effort highlighted a broader challenge across the region: traffic signal inventory practices vary significantly among agencies. Some jurisdictions maintain detailed GIS-based inventories that support planning and asset management activities, while others rely on spreadsheets or more limited recordkeeping systems. As a result, inventory completeness and data quality are not consistent across all subregions.

Overall, Task 2 resulted in a substantially improved traffic signal inventory and established a process for maintaining that information over time. The validated database provides a stronger foundation for identifying future investment needs, supporting regional planning efforts, and evaluating traffic

signal infrastructure across the NJTPA region. The task also identified records that require additional review by individual agencies, creating a path toward continued refinement of the inventory as new information becomes available.

Task 3: Goals and Outcome of a Traffic Signal Strategic Investment Framework

A comprehensive review of regional and subregional transportation goals was conducted to inform the development of the NJTPA Traffic Signal Strategic Plan and Investment Framework. This effort focused on aligning the framework with the goals established in the NJTPA Long Range Transportation Plan (LRTP) and with priorities identified across subregions.

The LRTP establishes a set of overarching objectives centered on accessibility, safety, system performance, resilience, sustainability, infrastructure preservation, and economic competitiveness. Building on this foundation, coordination with NJTPA staff and the Technical Advisory Committee (TAC), along with a review of subregional planning documents, resulted in the identification of three primary, consensus-driven goals for the Traffic Signal Investment Framework: Safety, Mobility & Efficiency, and State of Good Repair. The following Table outlines these goals and their associated outcomes and alignment with existing LRTP goals.

Table 1 – Goal Categories and Associated Outcomes

Traffic Signal Investment Framework Goals		
Goal Category	**Traffic Signal Program Goal** (Outcome)	LRTP Goals Alignment
Safety	Reduce crashes, mitigate risks, and promote safety for all users/modes at signalized intersections.	*2, 3, 5*
Mobility & Efficiency	Balance serving the needs of all users of the traffic signal system (pedestrians, bicycles, vehicles, transit, freight, and emergency responders) through a multi-modal context-sensitive approach that minimizes congestion, enhances efficiency, and facilitates access, accessibility, connectivity, and opportunity.	*1, 2, 3, 5, 7*
State of Good Repair	Provide good basic service and quality customer service through traffic signal operational consistency with minimal interruptions and adaptation to changing external factors/environmental conditions throughout its lifecycle in a cost-effective, strategic, reliable, resilient, standardized and systematic manner.	*3, 4, 6, 7*

These goals collectively advance multiple LRTP priorities and provide a clear, unified direction for traffic signal investments across the region. Detailed documentation of the goal development process, supporting analysis, and alignment with regional and subregional plans is provided in Appendix I.

Task 4: Screening and Identification of Needed Data

A structured network screening methodology was developed to support the identification and prioritization of traffic signal improvement needs across the NJTPA region. The methodology is aligned with the framework goals of Safety, Mobility & Efficiency, and State of Good Repair and establishes a consistent process for evaluating traffic signal needs across multiple jurisdictions. Rather than relying on a single measure, the framework considers infrastructure condition, operational performance, and transportation outcomes together to provide a more complete understanding of where investments may be warranted.

The screening framework incorporates industry-standard analytical practices, existing regional data resources, and targeted supplemental data collection. The approach was designed to build upon planning tools, performance measures, and transportation datasets already used by NJTPA and its partners while also identifying additional data that would strengthen future evaluations. This creates a scalable screening process that can be applied consistently across the region and refined as additional data becomes available. Detailed methodologies, data sources, and supporting information are provided in Appendix J.

Task 4.1. Screening Approach

The network screening methodology applies a goal-based evaluation structure in which each framework goal is assessed using a defined set of analytical techniques:

Task 4.1.1. Safety

The safety component of the framework emphasizes the identification of high-risk locations through application of the United States Department of Transportation (U. S. DOT) Safe System Approach. Screening incorporates crash analysis, near-miss evaluation, speed assessments, and Highway Safety Manual methodologies to identify locations with elevated safety concerns. Additional considerations include pedestrian activity, school crossings, roadway characteristics, and other multimodal safety factors that may influence intersection performance and risk.

Task 4.1.2. Mobility & Efficiency

The mobility and efficiency component evaluates how effectively signalized intersections support the movement of people and goods throughout the transportation network. Screening considers congestion, delay, volume-to-capacity relationships, travel patterns, and multimodal activity, including transit, freight, pedestrian, bicycle, and micromobility travel. Land use and demographic characteristics are also considered to provide context for how intersections function within the surrounding community and transportation system

Task 4.1.3. State of Good Repair

The state of good repair component assesses the condition and performance of existing traffic signal infrastructure using asset management principles. Screening incorporates lifecycle considerations, equipment age and condition, reliability metrics, maintenance practices, resiliency, and system standardization. This portion of the framework builds on the inventory and validation activities

completed under Task 2 and recognizes that infrastructure condition is a critical consideration when establishing long-term investment priorities.

This approach provides a balanced assessment of candidate locations by considering both transportation performance and infrastructure needs. By evaluating safety, operational performance, and asset condition together, the methodology establishes a consistent basis for future screening, prioritization, and investment decisions throughout the NJTPA region.

Task 4.2. Data Framework

The screening methodology is supported by a data framework that brings together information from a variety of regional, state, local, and third-party sources. The review found that many of the datasets needed to evaluate traffic signal performance already exist, but they are often maintained by different agencies, collected for different purposes, and stored in different formats. The framework was developed to organize these data sources into a consistent structure that can support future screening, prioritization, performance monitoring, and investment decisions across the NJTPA region.

Available data sources include NJTPA performance dashboards, safety and congestion reports, transportation models, demographic datasets, roadway inventories, and existing traffic monitoring programs. Collectively, these resources provide much of the information needed to evaluate traffic signal needs through the lenses of safety, mobility and efficiency, and state of good repair. The framework also incorporates information developed through earlier project tasks, including the regional traffic signal inventory and validation effort completed under Task 2.

While a substantial amount of data is already available, the review identified several areas where additional information would improve future analyses. Recommended supplemental data include:

- Traffic operations data such as traffic volumes, speeds, travel times, congestion measures, and intersection performance metrics.
- Crash records, safety screening results, and near-miss reporting data to support more detailed safety evaluations.
- Multimodal activity data, including pedestrian, bicycle, transit, freight, and micromobility usage.
- Demographic, environmental justice, and land use information to provide context for investment decisions and better understand how intersections serve surrounding communities.
- Traffic signal asset information, including ownership, condition, equipment age, lifecycle status, maintenance history, replacement costs, and as-built documentation.

The framework also recognizes the growing role of emerging and non-traditional data sources. Probe vehicle data, connected vehicle data, geo-sourced mapping information, and third-party mobility datasets can provide insight into travel patterns and system performance that may not be available through traditional traffic monitoring programs alone. These data sources offer opportunities to enhance future screening efforts and support more detailed operational analyses.

Task 4.2.1. Data Cost Estimates

To better understand the feasibility of obtaining supplemental data, cost estimates were developed for several recommended datasets and data collection activities. Quotes were obtained from data providers to establish order-of-magnitude costs associated with acquiring regional traffic, mobility, and operational data. In addition, an Excel-based planning tool was developed to allow NJTPA to evaluate potential costs by subregion and better understand how data acquisition strategies may vary across the region. The cost estimates are included in Appendices L and M.

The review also evaluated the effort required to collect traffic signal asset information that is not currently available in a consistent format. Costs associated with field verification, inventory development, and condition assessments were estimated based on the expected level of effort at each intersection. These costs can vary significantly depending on the quality of existing records, the availability of as-built documentation, and the condition of the infrastructure maintained by individual agencies.

Task 4.2.2. Data Management and Integration

Long-term implementation of the framework relies on maintaining a centralized traffic signal inventory and GIS-based data platform. Building on the inventory developed under Task 2, the framework recommends integrating core data elements into a common database that can support screening, analysis, mapping, reporting, and investment planning across multiple jurisdictions. A centralized approach improves consistency, reduces duplication of effort, and allows information from different agencies and sources to be reviewed within a common structure.

The framework is intended to support ongoing updates as new data becomes available. Traffic, safety, and multimodal datasets should be refreshed periodically to maintain the relevance of the screening results, while infrastructure-related information should be updated as equipment is replaced, upgraded, or inspected. Establishing consistent data management practices and update procedures will help ensure that the database remains a useful tool for future planning, performance monitoring, and investment decisions.

By establishing a common set of data elements and a scalable database structure, the framework provides NJTPA with a foundation for managing information that is currently dispersed across multiple agencies and systems. The result is a more consistent and sustainable approach to evaluating traffic signal needs throughout the region and supporting future investment decisions.

Task 5: Stakeholder Engagement and Technical Advisory Committee (TAC) Coordination

Stakeholder engagement was an important component of the Traffic Signal Strategic Plan and Investment Framework and provided opportunities for NJTPA staff, subregional partners, traffic signal owners, and technical professionals to guide the development of the framework. Through Technical Advisory Committee (TAC) meetings, stakeholder surveys, and Subject Matter Expert (SME) interviews, the project team gathered input on existing practices, regional needs, data availability, investment priorities, and implementation considerations.

The TAC served as a forum for reviewing project findings, discussing technical issues, and obtaining feedback on key project deliverables. Representatives from NJTPA, counties, municipalities, NJDOT, and other transportation agencies participated, helping ensure that the framework reflects the diverse operational, planning, and funding conditions that exist across the region.

Three TAC meetings were conducted during development of the Framework. The first meeting introduced the project objectives, scope, and approach, and presented initial findings from the national and state practices review and regional planning integration effort. The second meeting focused on framework goals, stakeholder survey findings, traffic signal inventory validation, and preliminary screening concepts. The third meeting presented the completed screening methodology, data framework, and draft recommendations, with discussion focused on implementation considerations and future use of the Framework.

The second TAC meeting presented the results of the traffic signal inventory validation effort and demonstrated the development of the project's GIS database. Discussion focused on the proposed screening methodology, data needs, and approaches for evaluating traffic signal investments through the lenses of safety, mobility and efficiency, and state of good repair. Feedback received during this meeting was used to refine the framework and ensure that it reflected both regional planning objectives and practical implementation considerations.

In addition to the TAC meetings, interviews were conducted with subject matter experts representing a range of technical disciplines related to traffic signal planning, operations, maintenance, technology, funding, and asset management. Interview materials were developed specifically for each discussion and included interview questions, discussion topics, and supporting background information tailored to the expertise of the participants. These discussions provided valuable insight into current challenges, emerging technologies, data availability, organizational responsibilities, and opportunities for improving traffic signal investment decision-making.

Input received through the TAC meetings, stakeholder surveys, and SME interviews helped shape the framework's goals, screening methodology, data framework, and implementation recommendations. Common themes included the need for improved asset inventories, more consistent data collection practices, stronger coordination among agencies, sustainable funding mechanisms, and greater emphasis on proactive management of traffic signal infrastructure.

The stakeholder engagement process provided practical, real-world perspectives that complemented the technical analyses completed throughout the Framework. The resulting recommendations reflect not only industry best practices and regional planning objectives, but also the experiences and priorities of the agencies responsible for owning, operating, and maintaining traffic signal systems across the NJTPA region.

5.1. Technical Advisory Committee (TAC) Meetings

A Technical Advisory Committee (TAC) was established to provide technical guidance throughout development of the Traffic Signal Strategic Plan and Investment Framework. The TAC included representatives from NJTPA, NJDOT, counties, municipalities, transportation agencies, and other stakeholders involved in the planning, operation, maintenance, and management of traffic signal systems within the region. The committee served as a forum for reviewing project findings, discussing technical issues, and providing feedback on key project deliverables as they were developed. A complete list of TAC members is provided in Appendix P.

Three TAC meetings were conducted during development of the Framework. The meetings provided input on existing traffic signal practices, framework goals, inventory validation, screening methodology, data needs, and implementation strategies. Feedback gathered through the TAC process directly informed development of the Framework recommendations. Meeting agendas, presentation materials, summaries, and supporting documentation are included in Appendix N.

5.2. Subject Matter Expert Technical Interviews

In addition to the Technical Advisory Committee meetings, the project team conducted a series of targeted Subject Matter Expert (SME) interviews to gain a deeper understanding of the issues affecting traffic signal planning, operations, maintenance, funding, and asset management throughout the NJTPA region. The interviews were intended to supplement the broader stakeholder engagement process by capturing detailed perspectives from practitioners directly responsible for managing traffic signal programs and implementing transportation improvements. Up to eight SME interviews were identified as part of the project approach and were conducted with representatives from counties, municipalities, NJDOT, Federal Highway Administration (FHWA), and other transportation stakeholders.

The interviews were structured as technical discussions rather than formal presentations. Questions were tailored to each participant's area of expertise and focused on topics such as signal ownership and maintenance responsibilities, funding sources and project delivery, asset management practices, operational challenges, technology deployment, data availability, staffing resources, and opportunities to improve regional coordination. The information gathered through these discussions provided practical insight into the day-to-day realities of managing traffic signal infrastructure and helped validate findings identified through the TAC meetings, surveys, and technical analyses.

A consistent theme throughout the interviews was the significant variation in how traffic signal programs are organized and managed across the region. Responsibilities for ownership, operation, maintenance, and capital improvements differ considerably by jurisdiction. Some counties and municipalities maintain traffic signals directly, while others rely on municipal ownership agreements,

shared maintenance arrangements, or consultant support. Several participants noted that fragmented ownership structures can complicate decision-making, create inconsistencies in maintenance practices, and make implementation of a uniform regional approach difficult.

Funding emerged as one of the most frequently discussed challenges. Interview participants consistently noted that available funding often falls short of identified needs, particularly for ongoing maintenance, operations, and equipment replacement. While funding opportunities exist for larger capital projects, participants described difficulties pursuing smaller signal improvement projects through traditional state and federal programs. Agencies also cited increasing costs, matching fund requirements, administrative burdens, and lengthy project delivery processes as barriers to implementation. Several stakeholders noted that combining signal improvements with larger resurfacing or corridor improvement projects is often the most practical way to advance needed upgrades.

Staffing and resource limitations were also identified as significant concerns. Many agencies operate with limited personnel and must balance traffic signal responsibilities with broader engineering, planning, and maintenance functions. Participants noted that staffing shortages often result in reactive maintenance approaches, deferred upgrades, limited data collection, and reduced ability to pursue funding opportunities. The availability of staff with specialized traffic signal expertise was identified as an ongoing challenge, particularly for smaller jurisdictions.

The interviews also highlighted the need for improved asset management practices and more consistent data collection. While some agencies maintain signal inventories, maintenance logs, and asset databases, others have only limited information available regarding equipment age, condition, lifecycle status, and replacement needs. Participants emphasized that stronger inventory management and performance monitoring practices would support better long-term planning, more effective prioritization of improvements, and stronger justification for funding requests. The need for traffic signal management plans and formal asset management programs was raised frequently during discussions.

Technology and operations were another major topic of discussion. Stakeholders expressed interest in expanding the use of adaptive signal control, communications infrastructure, signal performance measures, connected vehicle technologies, and other advanced operational tools. However, participants also noted that technology deployments require sustained maintenance funding, staff training, communications infrastructure, and organizational capacity to be successful. As a result, many agencies continue to rely on conventional signal operations and struggle to maintain consistent timing, monitoring, and performance measurement programs.

Across nearly all interviews, stakeholders identified coordination as a recurring challenge. Traffic signal corridors frequently cross municipal boundaries, involve multiple owners, or require coordination among counties, municipalities, NJDOT, NJ TRANSIT, and other agencies. Participants noted that project delivery often becomes more difficult when responsibilities are unclear or when agencies operate under different maintenance practices, standards, and priorities. Improved communication, standardized processes, and stronger interagency partnerships were consistently identified as opportunities for improvement.

Several common themes emerged from the SME interviews and were incorporated into development of the Traffic Signal Strategic Plan and Investment Framework:

- Safety remains the primary driver for traffic signal investments and operational improvements.
- Funding limitations, staffing shortages, and administrative requirements continue to affect agencies of all sizes.
- Asset management practices and data availability vary significantly across jurisdictions.
- Stronger coordination among counties, municipalities, NJDOT, and other partners is needed to improve project delivery and system performance.
- Traffic signal management plans, performance measures, and consistent documentation practices would support more effective long-term planning and investment decisions.
- A regional framework should promote consistency while remaining flexible enough to accommodate differing local needs, governance structures, and resource levels.

The SME interviews provided valuable practitioner insight that complemented the technical analyses. The information gathered through these discussions helped validate project findings, identify implementation challenges, and ensure that the framework recommendations reflect the realities faced by agencies responsible for planning, operating, and maintaining traffic signal systems throughout the NJTPA region.

6. Conclusion

The Traffic Signal Strategic Plan and Investment Framework establishes a regional approach for evaluating traffic signal needs, prioritizing investments, and supporting long-term stewardship of traffic signal infrastructure throughout the NJTPA region. The Framework confirmed that agencies across the region face many of the same challenges, including aging infrastructure, funding constraints, inconsistent inventory information, staffing limitations, and fragmented ownership and maintenance responsibilities.

Safety, Mobility & Efficiency, and State of Good Repair emerged as the priorities that most consistently influenced traffic signal investment decisions throughout the region. Together, these priorities provide a common basis for evaluating needs and making investment decisions while recognizing that agencies have different responsibilities, resources, and operating environments.

The regional traffic signal inventory, GIS database, screening methodology, and data framework developed through this effort provide NJTPA and its partners with a consistent process for identifying needs, evaluating opportunities, and supporting future investment decisions. The Framework is intended to be implemented, refined, and expanded over time as data quality improves and regional needs evolve.

7. Recommended Next Steps

The Framework provides NJTPA and its partners with a common process for identifying traffic signal needs, evaluating potential improvements, and supporting future investment decisions. The inventory, data framework, and screening methodology developed through this effort are intended to serve as practical tools that can be updated and refined as conditions change.

In the near term, the focus should be on maintaining the regional traffic signal inventory and improving the quality of the supporting data. The validation effort demonstrated the value of having a regional inventory, but it also identified gaps and inconsistencies that will require ongoing attention. As agencies replace equipment, perform upgrades, or collect additional information, those changes should be incorporated into the database so that it remains current and useful for planning and investment decisions.

The Framework also highlighted the need for stronger asset management practices across the region. Some agencies have well-developed inventories and maintenance programs, while others rely on limited records and largely reactive approaches. Maintaining better information on equipment age, condition, maintenance history, and replacement needs will help agencies plan improvements more effectively and make better use of available funding.

As data quality improves, agencies should begin incorporating the screening methodology into planning and programming activities. The methodology provides a consistent way to consider safety, operational performance, and infrastructure condition when evaluating needs and establishing priorities. Over time, it can support project development, funding applications, corridor studies, and capital programming efforts.

The stakeholder outreach conducted as part of this effort also revealed opportunities for greater coordination among agencies. Many traffic signal challenges extend beyond individual intersections and, in some cases, beyond individual jurisdictions. Sharing information, coordinating projects, and pursuing corridor-based improvements where practical can improve efficiency and help address common operational and infrastructure needs.

Over the longer term, the Framework should be reviewed periodically and updated as new data, technologies, and funding opportunities emerge. The goal is not to create a static document, but to establish a process that agencies can continue to use as conditions evolve. Keeping the inventory current, expanding available data, and regularly applying the screening methodology will help ensure that future investments support regional priorities related to Safety, Mobility & Efficiency, and State of Good Repair.

By building on the inventory, data framework, and screening process developed through this effort, NJTPA and its partners will be better positioned to identify needs, prioritize improvements, and make more informed investment decisions across the region.

8. Appendices

Appendix A - Task 1.1 National and State Practices Review and Alignment Identification Report

UNDER SEPARATE COVER

Appendix B - Task 1.2: Regional Planning Integration Report

UNDER SEPARATE COVER

Appendix C - Task 1.3: State of the Practice Local Traffic Signals in NJTPA Region Report

UNDER SEPARATE COVER

Appendix D - Task 2: Local Traffic Signal Data Validation Memo

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Appendix E - Task 2: ArcGIS Database

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Appendix F - Task 2: GIS Maintenance Guidelines Memo

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Appendix G - Task 2: List of Data Discrepancies

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Appendix H - Task 2: Original Data Sets

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Appendix I - Task 3: Goals and Outcome of a Traffic Signal Strategic Plan and Investment Framework Report

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Appendix J - Task 4: Network Screening Methodology and Core Data Elements

Appendix K - Task 4: Data Comparison

Appendix L - Task 4: Regional Data Collection Cost Estimate

Appendix M - Flow Labs Luminus Proposal: Signal Performance Measures for NJTPA and its Member Agencies

Appendix N - Field Inspection Checklist

Appendix O - Middlesex County Signal Master Plan Field Inspection Checklist

Appendix P - Task 5: Subject Matter Expert/Technical Interview Summaries

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Appendix Q - Task 5: TAC Meetings Summaries

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