PROFESSIONAL SERVICES AGREEMENT

This agreement ("Agreement") is made as of December 9, 2025, by and between the **City of Commerce**, a municipal corporation ("City") and Quality Engineering Solutions, Inc. (QES) ("Consultant"). City and Consultant are sometimes hereinafter individually referred to as a "Party" and collectively referred to as the "Parties."

R E C I T A L S

WHEREAS, City desires to utilize the services of Consultant as an independent contractor to provide Professional Services for the Pavement Management Program (PMP) Update as set forth in the Scope of Services attached hereto as **Exhibit A;** and

WHEREAS, Consultant represents that it is fully qualified to perform such consulting services by virtue of its experience and the training, education and expertise of its principals and employees.

NOW, THEREFORE, in consideration of performance by the parties of the covenants and conditions herein contained, the parties hereto agree as follows:

1.   Company's Scope of Services. The nature and scope of the specific services to be performed by Consultant are as described in **Exhibit A**.

2.   Term of Agreement. This Agreement shall commence on December 9, 2025, (the "Commencement Date") and shall remain and continue in effect until tasks described in **Exhibit A** are completed, but in no event later than December 31, 2026, unless sooner terminated pursuant to the provisions of this Agreement.

3.   Compensation.

A. City agrees to compensate Consultant for services under this Agreement in compliance with the schedule set forth in **Exhibit A**. Consultant shall submit proper monthly invoices in the form and manner specified by City. Each invoice shall include a monthly breakdown of all monthly services performed together with the hours spent on each service. Consultant shall maintain appropriate and necessary documentation supporting the monthly invoices detailing the type of service provided. It shall be available for review by the City at all reasonable times upon request.

B. Total payment to Consultant pursuant to this Agreement shall not exceed $173,977.

C. If at the request of the City, Consultant is required to incur out of pocket expenses (including but not limited to, out-of-town travel and lodging) which are above and beyond the ordinary expenses associated with performance of this Agreement, Consultant shall be entitled to reimbursement of such expenses. Consultant shall only be reimbursed for those expenses which: (I) appear on Consultant's monthly invoices;

(II) are accompanied by a copy of the City's written authorization for Consultant to incur such expenses; and (III) receipts documenting such expenses.

4.   General Terms and Conditions. The General Terms and Conditions set forth in **Exhibit B** are incorporated as part of this Agreement.   In the event of any inconsistency between the General Terms and Conditions and any other exhibit to this Agreement, the General Terms and Conditions shall control unless it is clear from the context that both parties intend the provisions of the other exhibit(s) to control.

5.   Addresses.

City of Commerce

City of Commerce
2535 Commerce Way
Commerce, CA 90040
Attn: Ernie Hernandez, City Manager

Quality Engineering Solutions, Inc. (QES)

Quality Engineering Solutions, Inc. (QES)
1025 N. Brand Boulevard, Suite 300
Glendale, California 91202
Attn: Kurt Keifer, Ph.D., P.E., Executive Vice President

6.   Exhibits.   All exhibits referred to in this Agreement are listed here and are incorporated and made part of this Agreement by this reference.

     Exhibit A – Scope of Services and Compensation Schedule
     Exhibit B – General Terms and Conditions

     SIGNATURES ON FOLLOWING PAGE

IN WITNESS WHEREOF, the parties have executed this Agreement as of the dates written below.

CITY

CITY OF COMMERCE

By: _____   _____
    Ivan Altamirano, Mayor   Date

CONSULTANT

Quality Engineering Solutions, Inc. (QES)

By: _____   11/19/2025
    Kurt Keifer, Ph.D., P.E.,   Date
    Executive Vice President

ATTEST:

By: _____   _____
    Melanie Park, Deputy City Clerk   Date

APPROVED AS TO FORM:

By: _____   _____
    Noel Tapia, City Attorney   Date

EXHIBIT A

SCOPE OF WORK

QES | Engineering Inspection

REQUEST FOR PROPOSAL

Commerce, CA Public Works Department
Professional Services for the Pavement Management Program (PMP) Update

Submitted by:
Quality Engineering Solutions, Inc.
1025 N. Brand Boulevard, Suite 300
Glendale, California 91202

Submitted to:
City of Commerce
ATTN: Shahid Abbas,
Public Works Director
2535 Commerce Way,
Commerce, CA 90040

September 3, 2025

September 3, 2025

City of Commerce
ATTN: Shahid Abbas, Public Works Director
2535 Commerce Way
Commerce, CA, 90040

Re: Proposal for Professional Services for the Pavement Management Program (PMP) Update

Dear Mr. Abbas:

Quality Engineering Solutions, Inc. (QES) is pleased to submit this proposal in response to the above-referenced request for proposal (RFP). QES is a minority, woman-owned business with an office at 1025 N Brand Blvd, Glendale, California 91202. Our primary contact, authorized representative, and Project Manager is Kurt Keifer, Ph.D., P.E. His phone number is (737) 900-6676 and his email is kkeifer@qespavements.com. Dr. Keifer is recognized nationally for his pavement engineering expertise, having over 25 years of experience in pavement testing, analysis, and management, and a deep working history with the United States Army Corps of Engineers (USACE), Department of Defense (DoD), and various institutions for higher education.

QES is currently in our 28th year in business and we have a track record of providing pavement inspection, engineering, and management services for agencies from California to Florida. Our vision statement is expressed in our name. We strive to provide solutions to challenges in the pavement and transportation field using the latest proven engineering technology, with a strong emphasis on the quality and timeliness of our work. QES understands the scope of services to be performed for this project and intends to execute the tasks within an established budget and timeline. This project includes the MicroPAVER implementation and field survey of 69.36 centerline miles of street infrastructure.

QES is offering a very experienced pavement management engineer, Mr. Douglas Frith, P.E., as a supplementary leader to the project as Deputy Project Manager. Mr. Frith has over 37 years of experience in pavement management and is a registered Professional Engineer in California. Furthermore, we have a designated Data Quality Manager who will ensure accurate and complete data is collected and reported, and all field surveyors are MTC and OCTA certified distress raters.

Should you have any questions, please do not hesitate to contact us. We look forward to doing business with the City of Commerce (the City). We acknowledge receipt of Addendum 1 dated August 19, 2025. This proposal is valid for one (1) year from the submission date.

Sincerely,

Kurt Keifer, Ph.D., P.E.
Project Manager | Executive Vice President

Table of Contents

Abbreviations List

Abbreviations List	
ASTM	American Society for Testing and Materials
B.S.	Bachelor of Science
CIS	Civil Infrastructure Solutions
DMI	Distance Measurement Instrument
DoD	Department of Defense
DQMP	Data Quality Management Plan
FHWA	Federal Highway Administration
FWD	Falling Weight Deflectometer
GIS	Geographic Information System
HWD	Heavy Weight Deflectometer
IRI	International Roughness Index
LCMS-2	Laser Crack Measuring System
M&R	Maintenance and Rehabilitation
M.S.	Master of Science
MTC	Metropolitan Transportation Commission
NCHRP	Cooperative Highway Research Program
NDT	Non-Destructive Testing
OCTA	Orange County Transportation Authority
PAVER	MicroPAVER
P.E.	Professional Engineer
PCC	Portland Cement Concrete
PCI	Pavement Condition Index
PMP	Pavement Management Program
PMS	Pavement Management System
P-TAP	Pavement Management Technical Assistance Program
QA	Quality Assurance
QC	Quality Control
QES	Quality Engineering Solutions, Inc.
QMP	Quality Management Plan
RFP	Request for Proposal
ROW	Right-of-Way
SY	Square Yards
The City	The City of Commerce, CA
TRB	Transportation Research Board
USACE	United States Army Corps of Engineers

Section I: Approach

Project Understanding

Based on our reading of the RFP along with the City's responses to questions during the pre-proposal meeting, the QES Team Leaders understand that the City is seeking proposals from experienced and qualified firms to provide a comprehensive pavement condition survey of the City's 69.36 centerline miles of streets. The functional classification breakdown of the City's streets is as follows:

Functional Classification	Mileage
Arterials	17.03
Collectors	4.42
Residentials	43.03
Alleys	4.88

In addition to the condition survey, the City intends to have the selected consultant implement the MicroPAVER pavement management system and, as discussed during the pre-proposal meeting, eventually migrate some or all of the City's historical StreetSaver data to MicroPAVER.

The QES Team is familiar and proficient with implementing both MicroPAVER and StreetSaver. In fact, our proposed project manager, Kurt Keifer, Ph.D., P.E., spent more than a decade with USACE developing the MicroPAVER system and an additional decade as a USACE contractor, where he further updated and improved the MicroPAVER software. Dr. Keifer has implemented MicroPAVER for more than 250 agencies in the United States and around the world.

Per the RFP, the last comprehensive update of the City's PMS was completed in December of 2022. The 2025 project goal is to revise the City's PMP report with current pavement conditions (i.e., surface, roughness, and structural conditions). The PMP report shall also identify the current maintenance and rehabilitation (M&R) needs of the street network. As part of multi-year, MicroPAVER-based funding analyses, existing M&R strategies shall be evaluated, and five- and ten-year analyses shall be performed to establish cost-effective priorities for pavement M&R activities.

Successful Project Approach

A successful project begins with strong project management and having a complete understanding of the client's needs. Our project manager has over 25 years of experience managing projects and will ensure the deliverables meet the goals and objectives of this project.

QES has developed a proven workflow for pavement management projects, illustrated in *Figure 1*. As noted, there are at least five steps to each project, 1) Project Initiation, 2) Production Data Collection, 3) Quality Assurance, 4) Data Analysis, and 5) Reporting. For the City's project, all five steps are recommended, culminating in multi-year management plans based on several budget scenarios.
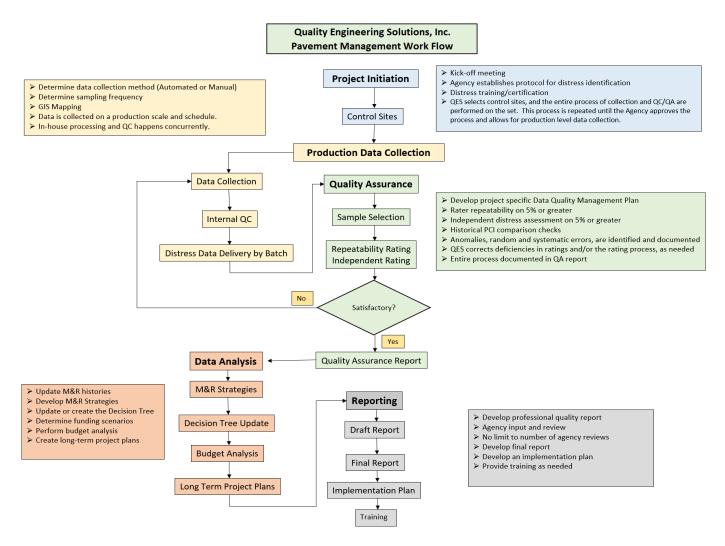

Quality Engineering Solutions, Inc. Pavement Management Work Flow

Project Initiation
Control Sites

➤ Kick-off meeting
➤ Agency establishes protocol for distress identification
➤ Distress training/certification
➤ QES selects control sites, and the entire process of collection and QC/QA are performed on the set. This process is repeated until the Agency approves the process and allows for production level data collection.

➤ Determine data collection method (Automated or Manual)
➤ Determine sampling frequency
➤ GIS Mapping
➤ Data is collected on a production scale and schedule.
➤ In-house processing and QC happens concurrently.

Production Data Collection

Data Collection
Internal QC
Distress Data Delivery by Batch

Quality Assurance
Sample Selection
Repeatability Rating Independent Rating

➤ Develop project specific Data Quality Management Plan
➤ Rater repeatability on 5% or greater
➤ Independent distress assessment on 5% or greater
➤ Historical PCI comparison checks
➤ Anomalies, random and systematic errors, are identified and documented
➤ QES corrects deficiencies in ratings and/or the rating process, as needed
➤ Entire process documented in QA report

No — Satisfactory? — Yes

Quality Assurance Report

Data Analysis
M&R Strategies
Decision Tree Update
Budget Analysis
Long Term Project Plans

➤ Update M&R histories
➤ Develop M&R Strategies
➤ Update or create the Decision Tree
➤ Determine funding scenarios
➤ Perform budget analysis
➤ Create long-term project plans

Reporting
Draft Report
Final Report
Implementation Plan
Training

➤ Develop professional quality report
➤ Agency input and review
➤ No limit to number of agency reviews
➤ Develop final report
➤ Develop an implementation plan
➤ Provide training as needed

Figure 1: QES Workflow for Pavement Management Projects

Task-Based Workplan

Task 1. Project Management and Coordination

QES assigns specialized roles to its team: the Project Manager acts as the main contact and manages all technical and contractual communications, a Deputy Project Manager provides oversight for the entire project team and ensures client satisfaction, a Project Engineer performs the technical evaluations utilizing MicroPAVER software, and a Data Quality Management Engineer oversees the quality of data collected, analyzed, and reported. Regular bi-weekly or monthly calls with the City's Project Manager are scheduled to keep the project on track. For this project, QES has designated Dr. Kurt Keifer, Mr. Doug Frith, Dr. Mona Nobakht, and Mr. Luis Ramirez as Project Manager, Deputy Project Manager, Project Engineer, and Data Quality Management Engineer, respectively.

A kick-off meeting will be organized and conducted within two weeks of receiving the notice to proceed to establish the most efficient communication channels and protocols, discuss the scope of work, budget, schedule, and project goals with the project stakeholders, including representatives from the City. Dr. Keifer, Mr. Frith, Dr. Nobakht, and Mr. Ramirez will attend the kick-off meeting, which we anticipate being a hybrid onsite/virtual meeting hosted by QES. During this meeting, a complete list of information available and/or needed will be developed, including the means and methods of transferring this information. QES has a SharePoint and Dropbox capable of transferring very large sizes of electronic information as needed. QES has an established and proven Data Quality Management Plan (DQMP) which will be provided at the kick-off meeting for City input. Additionally, QES maintains several MicroPAVER licenses.

We will review the 2022 PMP Update during project coordination. Preliminary work includes reviewing all M&R activities the City has conducted since the last update as well as streets and alleys reconstructed, overlaid, or slurry sealed since 2022. Corresponding updates to the database will be made before we begin Task 2.

We also have a written safety plan, and Mr. Ramirez is a member of the QES safety committee. Ongoing project management will be completed by Dr. Keifer, and bi-weekly virtual meetings will be routinely scheduled during the project to discuss project schedules, questions, and/or issues that may arise. QES utilizes Salesforce as our project tracking software and Foundation as our accounting software. Every staff hour is tracked on a weekly basis and project milestones are developed and tracked using Salesforce. If needed, Dr. Keifer and Mr. Frith have the authority to adjust schedules, priorities, and staffing to ensure this project is completed on time at a level that meets or exceeds your expectations.

Task 2. Automated Pavement Condition Survey

As pavement engineers, our team understands the need to have complete and accurate pavement condition data in MicroPAVER. A primary key to the success of this project is the collection of uniform, accurate, and complete pavement condition data, allowing meaningful budgetary decisions to be made. Items essential to the uniformity and accuracy of pavement distress condition ratings include:

- Clearly defined rating guidelines
- Standardized on-site rating processes
- Trained and experienced pavement rater teams

- Adequate rating time and conditions
- On-site quality control
- Overall quality assurance

Pavement Inventory Validation

To begin the project, we will review the City's existing street inventory list to ensure that street sections meet the following criteria:

- Lengths and widths are reasonable for maintenance or reconstruction efforts
- Pavement condition is similarly uniform through the section
- Section experiences the same general traffic loadings throughout
- Section is of the same pavement type and layer structure

During this process, we will review the street sections via Google Earth images to confirm the criteria listed above. We will develop a list of street sections which we believe should be modified to discuss with City staff prior to making any changes. This subtask will serve as the basis for data collection as well as the foundation for reporting the pavement conditions and developing the M&R list in the seven-year plan. QES has developed software that can quickly compare the inventory list to a GIS map. After running the software, each site will be checked for functional classification, surface type, length, width, and number of lanes. This is accomplished by comparing it to Google Earth images.
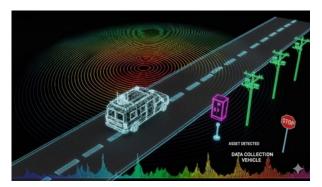

Figure 2: QES Data Collection Setup

When QES staff believe any of the current management sections should be modified, divided, or possibly combined with adjoining sections, Dr. Nobakht will coordinate with City staff for approval before any changes are made. At the conclusion of this effort, a section list and corresponding GIS map will be provided to the City for approval, prior to beginning the pavement condition ratings. The updated GIS map will be linked to the MicroPAVER software for enhanced reporting.

Pavement Surface Condition Survey

One of QES's greatest strengths lies in our ability to capture pavement condition data across the entire roadway width in a single pass, rather than being restricted to just one lane at a time. Older systems, such as LCMS-2, are limited in scope because they can only survey a single lane per run. This limitation not only increases collection time and costs but also produces fragmented datasets that make it harder to achieve a true understanding of network-wide conditions.

In contrast, the QES system can collect data for all lanes simultaneously while maintaining exceptional accuracy and resolution. This capability reduces field time and delivers significant cost savings to our clients. More importantly, it ensures that the resulting dataset provides a

complete and continuous picture of pavement conditions across the full roadway width, eliminating blind spots that other systems inherently miss.

What truly sets QES apart is the integration of our state-of-the-art sensors with proprietary AI-driven detection algorithms. Our team of Data Scientists led by Dr. Mostafa Nakhaei, developed – in collaboration with the US Army Corps of Engineers – the industry's first solution to capture and analyze pavement conditions from curb to curb with unparalleled precision. This means every crack and surface anomaly is identified and measured consistently, providing agencies with the confidence that their pavement management decisions are based on the most accurate and comprehensive data available. The following images showcase examples of our system's performance in the field:
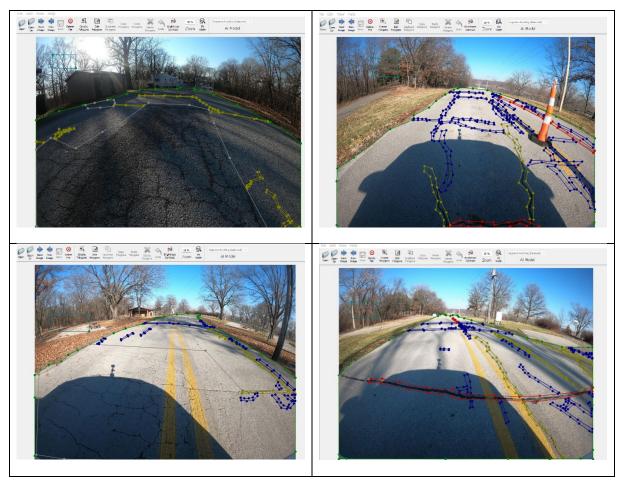

Figure 3: Example Rated Pavement Images

QES will complete the pavement condition ratings following ASTM D6433-23. All street sections will be surveyed in accordance with the most recent "Asphalt Surfaced Roads & Parking Lots PAVER Distress Identification Manual" and "Concrete Surfaced Roads & Parking Lots PAVER Distress Identification Manual" as published by the U.S. Army Corps of Engineers. Each defined street section will be divided into inspection units, with each inspection unit having an area of 2500 square feet (+/- 1000 square feet). For example, if a street section is 1000 feet long and 30 feet wide, then this street section will have 12 inspection units (1000x30/2500). We will survey 100% of the surface area using our sensors, perform quality control on 100% of the automated data collected, and conduct an engineering review of at least 10% of the inspection

units. In addition to distress types, severities, and quantities, the survey includes verification of road lengths, widths, surface types, and functional classification.

Note: The City's roadway network is primarily residential with some arterial and collector roads. The International Roughness Index (IRI) was developed for State DOT, higher-speed roadways with more uniform traffic flows. Residential and urban roadways have design features (i.e., drainage features, utilities, etc.) that skew IRI results and can result in inappropriate rehabilitation selection and/or prioritization. This being the case, MicroPAVER does not consider IRI in its maintenance and rehabilitation planning process. Consequently, we recommend that IRI data not be collected and used in the MicroPAVER analysis and reporting part of this project. Should the City require IRI values for select roadways, we can estimate those values from our data acquisition system, but we advise against using these values for planning purposes.

In addition to the automated condition rating, QES will assign its two most experienced MTC-certified distress raters, Mr. Matt Baker and Mr. Jason Clinton, to this project. They will serve as quality control reviewers, ensuring the highest level of data accuracy and reliability. We use an in-house developed tablet-based rating software for planning and field data collection, which has been proven to save time, reduce the overall cost, and enhance the accuracy of reported data. This tablet-based system aids in navigation and identification of inspection units (*Figure 4*), allows for distress data entry directly in the field, and provides GPS labeled photos (*Figure 5*). Our system also allows for calculation of the sample unit PCI value which can be a valuable check when comparing to the projected road condition. Data is uploaded nightly to the cloud and is available to the pavement management engineer and the quality management engineer.
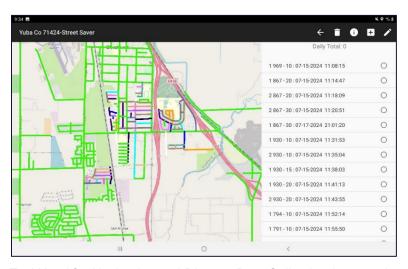

Figure 4: Mapping Tool Used for Navigation and Distress Data Collection (surveys have been completed on the green streets and surveys remain on the colored streets
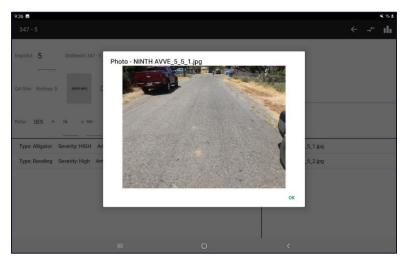
Figure 5: GPS Tagged Photo at Each Inspection Unit

Errors and inconsistencies in data collection occur when crews are rushed or are asked to complete the pavement distress ratings during inappropriate conditions, such as in rain, or when the pavement surface is wet, or even in poor lighting conditions. All inspections will be completed during daylight hours on clean, dry pavements.

The QES team is experienced in using data to create or integrate into GIS shapefiles. Mr. Clinton will work with City GIS staff and will produce exported MicroPAVER files that can be inserted into the City's GIS system. As noted, the GIS map serves as the basis for our data collection effort so there is minimal effort required to extract MicroPAVER condition data to be added as a layer onto the City's existing GIS maps. Our senor technology can capture a minimum of 40 miles of data a day and QES can deploy several vehicles at once to meet the deadlines if necessary.

Pavement Subsurface Condition Survey

QES will perform a network-level deflection survey across the City of Commerce using a Falling Weight Deflectometer (FWD). Traditionally, analyzing FWD data required coring or GPR testing to determine the Effective Structural Number (SNeff). While this approach is feasible at the project level, collecting pavement thickness data across an entire network is nearly impossible. To overcome this challenge, QES has developed a proprietary machine learning algorithm that calculates SNeff without requiring thickness as an input. This innovation makes QES one of the very few—if not the only—companies capable of accurately calculating SNeff at the network level.

QES will conduct one test every 500 feet or a minimum of one deflection tests per block/test section on all major streets (Arterials & Collectors). We will record sensor responses under standardized loading conditions and correct and normalize data for load (9000 kip) and temperature (68°F) to ensure consistency. Using

QES will compute and report key deflection parameters, including:

- Effective Structural Number (SNeff)

- Required Structural Number (SNreq)

- Temperature (used for accurate measurements)

- Surface Curvature Index (SCI8, SCI12, etc.) [optional]

- Maximum Normalized Deflection, D1 (normalized to 40 kN and temperature of 20°C) [optional]

- Normalized Deflections (normalized to 40 kN) [optional]

- Subgrade Resilient Modulus (MR) [optional]

- Effective Pavement Modulus (EP) [optional]

Our approach combines structural evaluation (FWD) with surface condition data (PCI, distresses) to give the City of Commerce a true, network-level picture of pavement performance. This ensures that capital improvement decisions are based on both functional and structural capacity, maximizing the return on investment for roadway maintenance and rehabilitation.

Task 3. PCI and IRI Calculation and Analysis

QES calculates both Pavement Condition Index (PCI) and International Roughness Index (IRI) using a combination of automated data collection and engineering review.

- PCI: QES collects full-width, high-resolution imagery of the pavement. Our AI tools automatically identify and classify all surface distresses by type, severity, and extent. Deduct values are then applied per ASTM D6433, and QC is performed by certified distress raters to ensure accuracy. This process produces reliable PCI scores for each inspection unit and the overall network.

- IRI *(Note: Note recommended for this project, as discussed in the previous section)*: Using advanced sensors, QES measures pavement profiles in the wheel paths. The data is processed through the ASTM quarter-car simulation model to calculate IRI values, representing ride quality.

Together, these methods allow QES to provide cities with a comprehensive pavement condition assessment, ensuring both objective ride quality metrics and detailed surface distress evaluations.

Task 4. Validation of Results

An area where we believe QES stands above other consultants is our commitment to collecting quality data, which is supported by our knowledge of distress variability, its effects on decisions, and how to measure and limit this variability. Since 1999, Mr. Frith and other QES staff have collaborated closely with the Virginia Department of Transportation (VDOT) to develop a DQMP and implement this plan on over 22,000 miles of pavement collected annually since 2005. We were the first company, in conjunction with VDOT staff, to develop a comprehensive DQMP, portions of which have been used to develop the FHWA requirements for state agencies in developing their own individual DQMPs, which was then adapted by MTC in developing their DQMP guidelines.

QES has established a proven DQMP which will be provided at the kick-off meeting. This plan has been accepted by the MTC. Highlights of the plan include:
- MTC rater certification

- Annual training and control site evaluations
- Independent quality assurance checks on 5% of the data, consisting of duplicate ratings on your roadways by an independent rater.
- Repeatability checks throughout the data collection effort
- Checks on the PCI value as compared to historical values.
- Completeness and reasonableness checks on 100% of the data

Field data is directly input into a tablet-based system while in the field, including all comments made by the evaluators. An example of the data collection application is shown in *Figure 6* below. As data is collected, the streets turn from red to green, ensuring that all data is collected.

Figure 6: Example of Data Collection Application System

Additional validation checks are conducted throughout the process to include independent reviews by Mr. Ramirez of the decision trees, and budget option reports. Final reports are reviewed by the quality engineer, the Project Manager and the Deputy Project Manager.

Task 5. PCC Evaluation

QES operates what is believed to be the first system capable of full-width, high-resolution pavement data collection, allowing for an evaluation process for Portland Cement Concrete (PCC) that is both simpler and more accurate than legacy systems like LCMS-2. Unlike older systems that only collect data in the travel lane, our curb-to-curb approach captures the entire pavement surface, ensuring that distresses outside the wheel paths are identified. This is particularly critical for PCC pavements, where conditions can vary dramatically from slab to slab and localized distresses—such as corner breaks, joint spalling, or faulting—can significantly impact pavement performance.

Our full-width data collection not only improves the detection of localized distresses but also ensures more accurate Pavement Condition Index (PCI) scoring, reducing the likelihood of underestimating deterioration or missing early signs of structural issues. The QES system automates the identification and classification of all visible distresses, while our certified engineers perform quality control to verify the automated results, following ASTM D6433 guidelines for visual assessment of concrete segments.

Jointed concrete pavements (JCP), constructed with Portland Cement Concrete (PCC), perform differently than asphalt concrete pavements. Thus, it is important that streets with JCP within the

layer structure are adequately identified. When JCP is the surface, this is easy, however many of the older JCP have likely been overlaid with asphalt concrete pavement which can be more of a challenge. There are several keys to look for when identifying composite pavements (JCP overlaid with asphalt concrete). The cracking is typically reflective cracking over the transverse and longitudinal cracks, which are exhibited as straight cracks. Additionally, the surface layer is typically above the surrounding features, due to the asphalt overlay. Other signs are faulting at the transverse cracks, corner slab reflective cracking and reflective longitudinal cracks. Furthermore, composite pavements can be readily identified with the deflection data. The JCP and composite pavements will need to have their own decision trees in MicroPAVER, which QES will develop.

For Continuously Reinforced Concrete Pavement (CRCP), we apply a proprietary QES procedure that ignores cracks narrower than the ASTM threshold, ensuring that intentional, designed cracks inherent to CRCP do not negatively influence the PCI score. This is a critical distinction because it prevents misclassification of healthy CRCP sections as deteriorated, a common limitation in older automated systems.

By combining full-width, high-resolution data capture, automated distress detection, and engineer-verified quality control, QES provides cities with the most complete and reliable assessment of PCC conditions available today. Our methodology not only meets industry standards but enhances them, giving the City confidence that pavement maintenance decisions will be based on accurate, actionable, and network-wide data—maximizing the effectiveness of capital improvement investments.

Task 6. GIS Integration and Mapping

QES will deliver a fully GIS-integrated pavement condition dataset to support the City of Commerce in managing its transportation assets efficiently. By combining full-width pavement surveys, deflection data, and automated distress detection with spatial mapping, the City will have a comprehensive, easily accessible, and actionable view of pavement performance across the network.

Approach

1. **Data Georeferencing**
   o All pavement survey data (PCI, IRI, distresses, structural indices, FWD results) will be georeferenced using GPS coordinates collected during field surveys.
   o Each inspection unit or pavement segment will be assigned a unique GIS identifier to maintain consistency across datasets.
2. **GIS Layer Creation**
   o QES will generate GIS layers for:
       ▪ Pavement Type (PCC, AC, AC over PCC)
       ▪ PCI scores (unit, section, network-level)
       ▪ IRI values
       ▪ Structural indices (SNeff, SNreq, LTE, SCI, etc.)
       ▪ Distress locations and severity
       ▪ Recommended maintenance or rehabilitation treatments
3. **Attribute Tables**
   o Each GIS feature will include a comprehensive attribute table with:
       ▪ Unique segment ID

- Pavement type and age
- PCI, IRI, and other condition indices
- Structural parameters from FWD (SNeff, SNreq, D0, D1, SCI, etc.)
- Distress type, severity, and extent
- Recommended treatment and priority

4. **Integration with City Systems**
   o All GIS layers will be fully compatible with the City's GIS platform and MicroPAVER asset management system.
   o QES can provide data in shapefile, GeoPackage, or other standard formats for easy import and integration.

5. **Visualization and Analysis Tools**
   o Color-coded maps to visualize:
     - Network-level PCI and IRI conditions
     - Pavement structural adequacy (SNeff vs SNreq)
     - Distress hotspots for targeted maintenance
   o Heatmaps and dashboards can be provided to help planners quickly identify critical areas and prioritize funding.

Limitations of MicroPAVER

QES recognizes the limitations of MicroPAVER that can sometimes make its final recommendations less practical for developing Capital Improvement Programs (CIP). Specifically, MicroPAVER cannot incorporate structural data collected via FWD into its decision-making process, nor can it directly utilize IRI information. Additionally, its decision trees lack the flexibility to account for more complex scenarios that may exist within a pavement network.

Therefore, in addition to Paver and GIS deliverables, QES proposes Smart Asset Management Solution (SAMS) web application as a complementary tool to help with a more comprehensive asset management solution. SAMS will be provided at no extra charge to the city for one year. We will deploy an optimized instance of the Smart Asset Management Solution (SAMS), providing the City with advanced maintenance and rehabilitation planning tools.

The primary objective of SAMS^{TM} is to deliver a user-friendly, GIS-centric pavement and asset management program that is agnostic to any underlying rating system. Whether the asset is pavement, sidewalks, traffic signs, or other infrastructure, SAMS^{TM} enables users to upload and manage all GIS layers in one location. The system's architecture is designed to ingest any data in any format, without the constraints typically found in commercial software. For example, pavement inspection data may be collected using ASTM D6433, ASTM E3303, or a combination of both; SAMS^{TM} can seamlessly import and analyze this data with no extra processing. This flexibility enables rapid assessment of current network health and facilitates data-driven, cost-effective maintenance and rehabilitation programs that maximize available resources while extending asset service life.
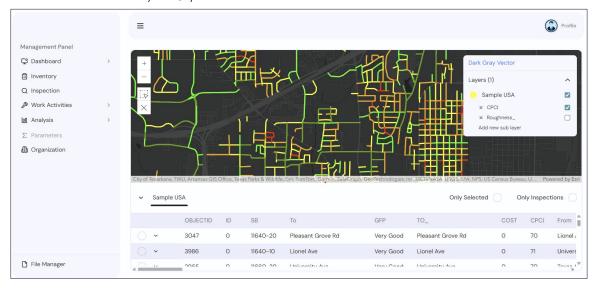
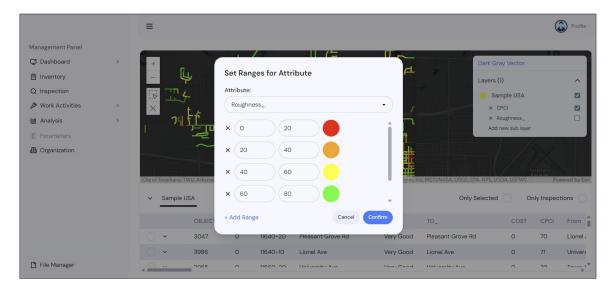## Key Differentiating Features of SAMS

- ***Flexible Inventory Based on ArcGIS Online API***

  SAMS allows users to import any GIS layer—not just pavement—or connect directly to ArcGIS Online to retrieve layers automatically. Inventory information is not pre-defined; instead, it is drawn from the user's existing GIS feature classes or shapefiles. Uploading a shapefile instantly creates a functional inventory. Image below is an example that
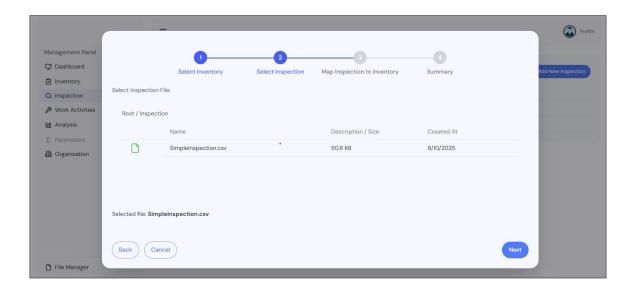
ArcGIS compatible dashboard where user defined colors based on Current PCI (CPCI). The user has the option to add different sublayers for color coding based on different attributes such as IRI, PSCI, etc.
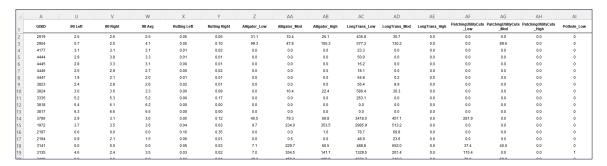
- *Agnostic Inspection Approach*
  Users can upload inspection data in any format, whether from a GIS layer or Excel spreadsheet, with any column structure. SAMS does not require predefined scoring systems (such as PCI or PSCI) and supports importing any condition scores or distress metrics chosen by the agency. Image below shows how users can import a csv file for their inspection, and this csv file can have any format (also attached below).

- **Customizable Decision Tree**
  Once data is uploaded, users can create a fully customizable decision tree based on their selected inputs. This flexibility allows agencies to apply conditions and treatment triggers unique to their needs.

- **Flexible Ranking System**
  Unlike most PMS programs that impose fixed priority lists, SAMS allows agencies to implement their own ranking criteria. For example, a city may prioritize roads in a downtown district or near hospitals more highly than local residential roads.

- **CIP Project Grouping**
  Unique to SAMS, this feature enables grouping of small, scattered segments into larger, more practical projects for inclusion in a Capital Improvement Program (CIP). This eliminates the inefficiency of executing isolated micro-projects and aligns the system's recommendations with real-world construction practices.

- **Image Viewing tool**
  SAMS™ have a powerful image viewing tool that allow agencies to investigate their data by click of a button.

Another powerful feature of SAMS™ is the analysis package. SAMS™ users can generate and assess multiple rehabilitation and maintenance scenarios by considering current budgetary constraints, network performance objectives, and long-term investment goals. These scenarios will allow agencies to compare trade-offs between cost, performance, and risk, enabling them to select a strategy that maximizes roadway condition improvements while staying within financial limitations. Example scenarios include:

- Annual funding required to maintain current pavement conditions.
- Annual funding required to maintain the current network backlog.
- Funding projections needed to achieve and sustain a target PCI over the next five years.
- Funding projections needed to achieve and sustain a target backlog over the next five years.
- Minimum funding level required to avoid falling below control PCI limit.
- Minimum funding level required to avoid falling below control backlog limit.
- Future network performance predictions, including the network average PCI and segment level PCI,
- Strategic rehabilitation recommendations for pavement treatments based on the current budget.

A Pavement Management Plan (PMP) can be developed through close collaboration among City stakeholders, key municipal staff, and QES pavement management experts. This collaborative process ensures that local knowledge and agency priorities are incorporated into the final SAMS™ PMS. The QES pavement engineer will work with the City to select and define the analysis parameters. These include:

- **Analysis Period** – Standard analysis period is 5 years.
- **Road Maintenance Budget** – A single annual value in $/year (may vary across years).
- **Rehabilitation Types and Unit Rates** – Costs provided in $/SY for each rehab type.
- **Completed Work** – Details of any work performed after the survey but before the analysis start date, including rehab type and date; data should be provided in a GIS-compatible format (shapefile, geodatabase, or list of Unique ID).

- **Planned Work** – Details of any work planned after the analysis start date (e.g., CIP or other future work), including rehab type and date; data should be provided in a GIS-compatible format (shapefile, geodatabase, or list of GISIDs).
- **Project Groupings** – Groupings based on proximity, functional class, pavement type, and similar conditions (e.g., PCI spread ≤20 and PCI <40).
- *If structural testing using the Falling Weight Deflectometer (FFWD) is involved: traffic data (AADT, %Trucks, and/or ESALs), provided in a GIS-compatible format (shapefile, geodatabase, or list of GISIDs). Default traffic count will be used if requested data is one of the specified formats.

Task 7. PMP Report

Dr. Nobakht will create StreetSaver PCI summary reports for the City in an Excel file and a GIS Shapefile format. The reports will detail the section PCI, the distribution of distress types and the overall City-wide average PCI. We will also include a description of the data quality management that occurred, with information on QA sites and repeatability sites. In order to produce an expected pavement condition report, QES staff will review the StreetSaver deterioration curves and ensure that the most appropriate models are used for each functional classification and roadway type. Once the StreetSaver PCI predictions are developed, QES will utilize a more manual process based on field notes and photos to identify sections will poor drainage conditions, excessive utility cuts, etc. in developing a seven-year performance plan. Dr. Nobakht will work closely with City staff defining functional classifications based on traffic volume and street type to optimize the performance predictions.

Dr. Nobakht will also work with the City to compile the historical M&R treatments into the StreetSaver database. Dr. Nobakht is experienced in identifying the proper treatment type to specify in StreetSaver to ensure the applied treatment is modelled correctly, resulting in accurate prediction of PCI values.

Mr. Frith and Dr. Nobakht will assist the City with the development of a policy for the application of the M&R treatments as defined in the decision tree to include budgetary considerations. It is important to understand that the PMS is a network-level evaluation, and the M&R treatments designated in the decision tree may or may not be the actual treatment utilized when the project level treatment selections are made. StreetSaver uses a decision tree to model the decision-making process that agencies follow to select an M&R strategy. The decision tree contains "branches" for each functional classification, surface type, and condition category. The QES project team will discuss the current M&R treatments used by the City and other potential processes that might not have been considered. Current costs for all selected M&R treatments will be included. The project team will add treatments with corresponding cost information to the database, which can be used in the development of a decision tree.

Finally, a priority listing of pavements in order of best to worst PCI will be produced and when combined with the updated decision trees, the priority projects will be identified based on a cost-benefit analysis of individual strategies using current condition, traffic volumes, funding levels and targets for backlog levels and future maintenance needs.

Our team is very experienced in the pavement maintenance field and have recently completed multiple research studies addressing the cost-benefit of various surface treatments, as well as developing construction and material specifications for recycling and reclamation methods. QES

will survey local contractors and other agencies in determining realistic unit cost data for each treatment.

At the conclusion of Task 5, Dr. Nobakht will develop management and financial plans using the historical and projected annual funding level over a period of seven years. A needs analysis will be completed, identifying all treatment needs regardless of budget. Treatments and costs will be summarized by segment and totaled for each year and over the entire analysis period. Additionally, budget and target driven scenarios will be developed for several conditions, to be determined by the City. Typical scenarios include:

- Estimated future budget based on current budget and historical trends
- Annual Budget amount required to maintain the current network wide average PCI
- Annual Budget amount needed to increase the network wide average PCI ratings to 70-75
- Annual Budget amount required to improve all streets to a minimum PCI level of 65

We will also conduct deferred maintenance analyses for each budget scenario. This involves assessing how the maintenance cost changes as a result of a backlog of M&R treatments that are postponed for a specific period of time.

The impact of budget scenarios on the pavement condition and the selection of street sections for treatments will be demonstrated through GIS maps and will be included in a PMP draft report which will be provided to the City. draft report will contain the following sections:

1. Title Page
2. Table of Contents
3. List of Tables
4. List of Figures
5. List of Appendices
6. Executive Summary
7. Statement of Study Objectives
8. Methodology of Study and Analysis
9. StreetSaver PCI Summary Report
10. PCI Distribution by Functional Classification
11. PCI Distribution by Percent Area of Network
12. Network PCI Comparison with Surrounding Agencies
13. Funding sources and needs to reach target PCI=s over the next 15 years
14. Five-Year Management and Financial Plans for current funding levels
15. Five-Year Management and Financial Plans for additional funding levels
16. Map of Inspected PCI by Section
17. Map of Proposed Treatment by Section
18. Pavement Management Practices
19. Recommendations
20. Quality Management Plan

The draft PMP report will be submitted to City personnel in electronic format for review. Mr. Frith and Dr. Nobakht will address all comments and corrections to the PMP report suggested by the City. Once addressed, QES will develop a full-color, professional quality final report to be delivered to the City. The electronic version will be provided through SharePoint or Dropbox. In addition, you will have access to the updated StreetSaver pavement management database online.

Dr. Nobakht will develop an executive summary in PowerPoint under the direction of City staff, which includes a brief background of the process required to generate a reliable PMP, a summary of the City's pavement network, PCI update, discussion on the development of the

decisions tree, a summary of the benefit/cost analysis, the proposed multi-year plan, and the implementation steps for the full program, showing when each street will receive treatments in the coming years. Dr. Nobakht or Dr. Keifer will be available to present the information to City personnel and/or elected officials.

Section II: Project Team

Firm Background

Quality Engineering Solutions, Inc. (QES) was started as a pavement consulting firm with the goal of providing high-quality services in the field of pavement engineering and has now been providing pavement engineering services for over 28 years. We have performed PMS implementation and update projects on a nationwide basis for cities, counties, airfields, and military facilities since 2000, using a variety of different pavement management systems and data collection methodologies. As pavement engineers, we specialize in pavement M&R recommendations, providing added value to our PMS services. Our Senior Pavement Engineers are leaders in pavement research efforts through the Transportation Research Board (TRB), the Federal Highway Administration (FHWA), the National Cooperative Highway Research Program (NCHRP), and various state agencies.

> QES: Forefront of pavement management since the inception of the concept in the 1980s.

QES has been committed to providing quality solutions to engineering projects since our founding in 1997. We are a pavement consulting firm that specializes in Pavement Engineering and Construction Inspection. We take pride in our emphasis on quality and our ability to provide practical, innovative solutions for a broad range of projects and clients. We have a team of knowledgeable and experienced staff to tackle any pavement engineering issue. QES is a minority, woman-owned business with offices in Glendale, CA, Reno NV, Seattle, WA, Austin, TX, Pittsburgh, PA, and Cochranton, PA. QES was purchased in 2021 by Ms. Lydia Kennard and operates as an S corporation with approximately 70 employees, including ten professional engineers. After 28 years in business, QES has been able to staff every project we have been awarded and has never defaulted on a project. We believe QES stands above other contractors in our commitment to collecting quality data, which is supported by our knowledge of distress variability, its effects on decisions, and how to measure and limit this variability.

Our engineering team is highly skilled in all aspects of pavement technology across different infrastructures, including airports and highways. With proven expertise in both flexible and rigid pavements and significant research experience with state highway agencies in multiple states, we are poised to deliver substantial value to the City of Commerce.

Team Organization

QES intends to collaborate with Dr. Mostafa Nakhaei of Civil Infrastructure Solutions (CIS) as our subcontractor to provide third-party data science-related consulting services for this project. This individual's brief professional summary can be found listed in this section below, and their resume is included in appendix A of this proposal. The project will be otherwise completed entirely by the QES team, which holds the necessary experience to successfully complete this project. Our experience has shown that a small, focused staff of expert personnel will provide cost-effective and timely services to the City.

All proposed staff members have the time needed to efficiently complete this project. Limiting the staff working on the project results in a more cohesive team, while ensuring all work is completed in a timely manner. Should any of these team members become unavailable, QES has three other experienced project managers, three additional experienced pavement

management engineers, and 12 pavement distress inspectors who can fulfill any staffing requirements.

As QES' proposed Project Manager, Dr. Kurt Keifer will manage and monitor operations, ensuring that our efforts exceed the expectations of the City, project deadlines are met, and the project is completed on time and within budget. Furthermore, we have a designated Data Quality Management Engineer, Mr. Luis Ramirez, who will ensure accurate and complete data is collected and reported. Actual field data collection will be completed by Mr. Jason Clinton and Mr. Matthew Baker, both of whom are pavement distress raters certified with MTC and OCTA.

Biographical summaries for our key staff personnel begin on the following page:

Kurt Keifer, Ph.D., P.E., Project Manager

Dr. Keifer will serve as the Project Manager and will be directly responsible for the analysis and reporting components of this project, including planning and conducting routine, bi-weekly project meetings with the City. Dr. Keifer is a nationally recognized pavement engineering expert with over 20 years of experience in pavement testing, analysis, and management. As project manager, he has successfully led largescale and high-profile pavement initiatives, including managing the largest annual pavement condition survey in the world for the Texas DOT – collecting 92,000 miles of pavement condition data in four months. During his time in his previous role at G&AI, Dr. Keifer directed a team of pavement engineers and technicians to deliver high-quality data, insights, and cost-effective recommendations to transportation agencies across the nation.

His robust pavement engineering background includes a decade with USACE's Construction Engineering Research Laboratory, where he served as Associate Program Manager for the MicroPAVER R&D team, updated the ASTM D6433 PCI standard, and helped pioneer the automated PCI method. As both a respected educator and leader, Dr. Keifer has taught more than 50 pavement management courses for institutions including the University of Illinois, Colorado State University, and the DoD, and has authored multiple publications in his field.

His proven expertise in project oversight, technical innovation, and close collaboration with stakeholders ensures consistent, successful delivery of complex pavement management projects. He has managed PMS implementations and updates and pavement condition surveys for hundreds of municipal, state, and DoD agencies in the United States and around the world.

Douglas Frith, P.E., Deputy Project Manager / Principal Engineer

As Deputy Project Manager, Mr. Frith will provide oversight, quality checks and ensure client satisfaction. As Vice President of Engineering for QES, he has the authority to assign or reassign project priorities, ensuring our work for the City of Commerce will exceed your expectations. Mr. Frith is a California registered Professional Engineer and holds an M.S. degree from the University of Idaho. He is currently in his 26th year as a QES team member and has 36 years of experience in pavement engineering. For eight years he served as the Project Manager for our Metropolitan Transportation Commission (MTC) P-TAP 14 through P-TAP 21 pavement management projects (34 cities).

Mona Nobakht, Ph.D., P.E., Pavement Management Engineer

Dr. Nobakht is a licensed Professional Engineer with over nine years of experience in both public and private sectors. She holds a Ph.D. degree in Civil Engineering from Texas A&M University. Her expertise spans pavement materials characterization, pavement design and evaluation, forensics, and management. Prior to joining QES, Dr. Nobakht served as a project manager at the Texas DOT, leading various pavement projects. Dr. Nobakht has successfully implemented Pavement Management Systems for several cities and counties in Texas. Since joining QES in 2023, Dr. Nobakht has participated in several distress data collection and pavement management projects, including the City of Seattle, WA; Yolo County, CA; Yuba County, CA; among others. On this project, Dr. Nobakht will oversee distress data collection quality and ensure complete and accurate information is loaded into your MicroPAVER database.

Dr. Nobakht will support this project at a high level, likely spending 50% of her time on average over the project duration. There will be weeks where 100% of her time will support this project, and other weeks where only minimal support is needed. In all cases, QES will ensure that Dr. Nobakht is available for this project when needed.

Carlos Cary, Ph.D., P.E., Project Engineer

Dr. Carlos Cary, Ph.D., P.E. specializes in pavement design and analysis and has 18 years of experience in geotechnical and pavement engineering. His expertise spans geotechnical engineering for pavement structures, unsaturated soil mechanics, pavement instrumentation, and full-scale accelerated testing. Dr. Cary also has extensive experience with conducting non-destructive evaluations and the characterization of pavement construction materials in both the field and in laboratory settings.

In addition to this experience, Dr. Cary has studied the environmental effects on pavement performance and, in fact, has authored more than 40 technical publications and reports, offering significant contributions to the advancement of pavement design and construction.

Luis Ramirez, P.E., Data Quality Management Engineer

Mr. Ramirez is a registered Professional Engineer in the State of Maryland. He has a M.Eng. degree from University of Pittsburgh and 12 years of experience with QES. Mr. Ramirez is experienced in design and analysis of pavement structures, pavement management, concrete forensics, concrete mixture design, pavement instrumentation, data acquisition systems, and in-field/lab testing of construction materials. He is skilled in cost analysis and project budgeting and experienced in elaboration of engineering and investigation reports. In the last three years, Mr. Ramirez has been responsible for the development of pavement management plans for six cities in the San Francisco, CA Bay Area. He will complete independent quality assurance reviews on the collected distress data in addition to performing in-house quality assurance review of each phase of the project.

Mr. Ramirez's level of involvement will be to serve as the Data Quality Management Engineer. During data collection, he will review the data on a daily basis and will complete an independent distress rating on a minimum of 5% of all inspection units rated. This will consist of approximately one full-time week while in the field and approximately two hours per day for the remaining data collection period. He will then spend an estimated 40 to 60 hours reviewing the entire collected data set. Finally, he will conduct an independent review of the PMP analysis and reports throughout the development of the PMP.

Matthew Baker, Field Distress Rater

Mr. Baker has seven years of pavement management experience with QES, primarily in the areas of pavement distress ratings and quality control. He holds a B.S. degree in Computer Science and Engineering from the University of Nevada, Reno. He is an MTC and OCTA certified pavement distress rater (MTC Certification #1147) and has conducted pavement surveys for more than a dozen agencies in California over the past four years, including Yolo County. He is currently providing quality assurance reviews on high-speed automated pavement distress data for the New Mexico DOT and the Virginia DOT.

Mr. Baker's level of involvement will be to serve as a key pavement distress rater which will require about 20 hours of preparation and planning during the first week of November. He will then work full-time for five weeks (two weeks in November, two weeks in December and one week in January) while completing the distress surveys.

Jason Clinton, Senior Technician / Distress Rater

Mr. Clinton has over 19 years of pavement technician experience with QES, primarily in the areas of pavement distress ratings and quality control. He has completed field distress ratings in Seattle WA, Yolo County, CA, Sonoma County, CA; the Cayman Islands; the City of Sacramento, CA; and 25 San Francisco Bay Area cities. In addition, he has completed

pavement distress evaluations from digital images on thousands of miles of military base, city, and state roadway pavements. Furthermore, Mr. Clinton is an MTC and OCTA Certified Pavement Distress Rater (MTC Certification #1145).

Mr. Clinton's level of involvement will be to serve as a key pavement distress rater, which will require about 20 hours of preparation and planning during the first week of November. He will then work full-time for four weeks (two weeks in November and two weeks in December) while completing the distress surveys. Post surveys, Mr. Clinton will assist Mr. Frith and Dr. Nobakht on an as-needed basis while completing the MicroPAVER and pavement management plan efforts.

Eric Miskow Staff Engineer

Mr. Eric Miskow joined the QES Pavements team in 2022 while working to complete his degree in Geological Engineering at the University of Nevada in Reno. He began his career as a part-time pavement distress rater, eventually transitioning into a full-time role following his graduation. He has conducted manual pavement distress ratings and supported digital image-based ratings, gaining valuable field and technical experience.

In addition to his fieldwork, Mr. Miskow has assisted senior engineering staff with processing and analyzing pavement distress QA data. His continuing expertise in pavement evaluation and his hands-on experience across several hundreds of miles of roadway assessments will position him as a skilled contributor to this pavement project.

Mostafa Nakhaei, Ph.D., Data Analysis Engineer (Civil Infrastructure Solutions)

Dr. Mostafa Nakhaei, Ph.D., is a Consulting Manager and Senior Pavement Engineer at CIS with more than 12 years of civil engineering experience. He has guided the development of Capital Improvement Programs for over 120 cities and counties across the United States, directing projects that together exceed $1 billion in value.

Dr. Nakhaei specializes in pavement engineering, with expertise spanning construction, management, structural design, laboratory testing, and FWD analysis. Holding a dual degree in Data Science, he has advanced the field by creating MASTIC and Back-MASTIC for layered elastic analysis and modulus back-calculation, as well as leading the development of ISA, a deep learning software for structural data analysis. He has also implemented pavement and asset management systems for numerous municipal agencies and is highly proficient in platforms such as SAMS, ESA, StreetLogix, AgileAssets, MicroPAVER, StreetSaver, Lucity, and Cartegraph

Project Organization Chart

Figure 7 on the next page illustrates the key personnel assigned to complete each task of this project and the QES team's reporting structure. QES assures the City of Commerce that the staff listed in this proposal have both the necessary professional qualifications and the time available to complete this project within the proposed schedule.

Personnel Resumes

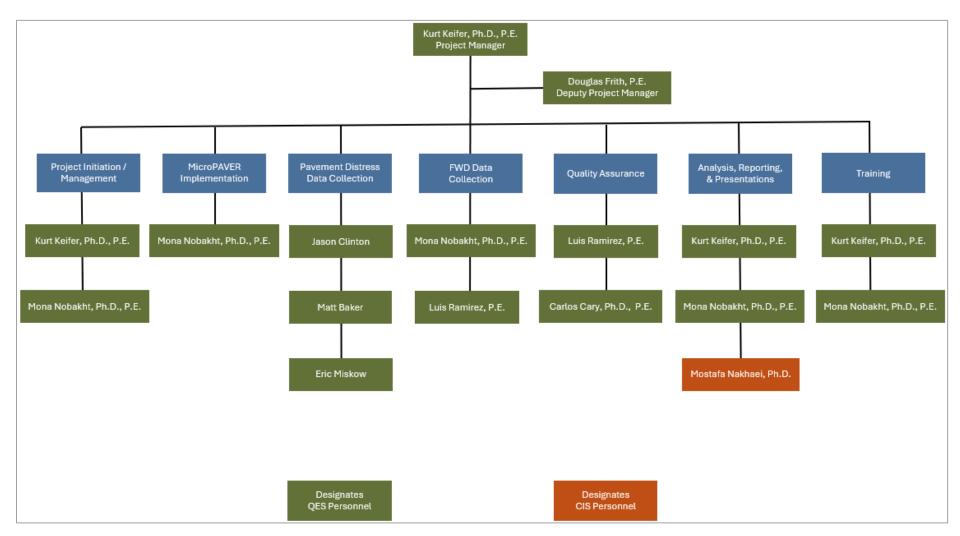Personnel resumes for all proposed project personnel can be found in Appendix A

Figure 7: Organizational Chart

Section III: Professional References

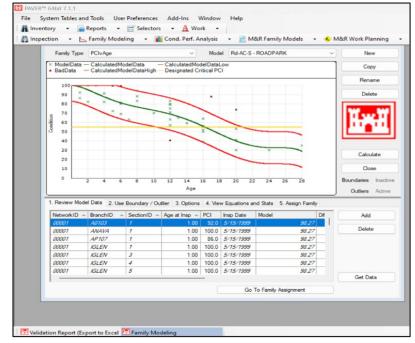## 2024 Pavement Conditions & Analysis Report, Bismarck, ND

Owner Agency & Contact Person Information

City of Bismarck, ND
Gabe Schell, P.E., City Engineer
City of Bismarck, ND
gschell@bismarcknd.gov
(701) 355-1507

Narrative of Services

In 2024, QES conducted a system-wide pavement condition evaluation and analysis for the City of Bismarck. The primary objective of this project was to collect, process, and analyze pavement condition data, update MicroPAVER pavement management databases, and develop multi-year maintenance and rehabilitation plans specific to local needs and budgets.

QES began this initiative by facilitating close collaboration with the City to establish a steering committee, which brought together representatives the City in addition to state and federal stakeholders. Once QES confirmed clear project goals, scope, schedule, deliverables, and communication protocols with the City, a project-specific Quality Management Plan (QMP) was developed to ensure that quality control and assurance measures were embedded in every phase of the work.

The QES project team reviewed and validated current and available GIS and pavement data, reconciling roadway attributes such as widths, surface types, functional classifications, and confirmed dates of previous construction activities. Updated inventories were integrated into MicroPAVER to establish accurate baseline databases for the City. QES then deployed its PathRunner Pavement Condition Survey System to collect high-resolution 2D and 3D pavement imagery, rutting and faulting measurements, right-of-way images, and International Roughness Index (IRI) values. This advanced approach provided a comprehensive, objective record of pavement conditions across the region.

Condition data was processed through a rigorous multi-step workflow. Automated software detected and classified cracking, while certified distress raters manually verified imagery to identify additional distresses and correct any misclassifications. Final PCI values were calculated and loaded into MicroPAVER following QMP protocols, ensuring accuracy and

consistency. A secondary verification phase reviewed historical construction data and deterioration rates to identify potential errors or anomalies, particularly where agency records were incomplete.

Upon data validation, the pavement management databases were customized to reflect realistic regional deterioration trends, effective preservation treatments, and rehabilitation strategies that were both locally appropriate and cost-effective. QES worked closely with the City's staff to incorporate practical treatment options, accurate unit costs, and realistic resurfacing and reconstruction cycles into MicroPAVER. Using these tools, QES developed a coordinated five- to ten-year pavement management program, which was delivered through GIS-based maps and budget scenarios specific to the City of Bismarck.

To communicate results, QES prepared concise "State of the Streets" reports summarizing pavement conditions, analysis findings, and recommendations. Presentations were developed and executed in front of the City, each one tailored to local priorities and budget considerations. As an optional service, QES also offered comprehensive, hands-on MicroPAVER training, leveraging the team's extensive experience teaching pavement management systems nationwide.

Through this project, QES provided the City of Bismarck with a clear, data-driven foundation for pavement preservation and rehabilitation planning. The combination of advanced data collection, meticulous quality control, and practical program development enabled participating agencies to optimize limited budgets, extend overall pavement vitality, and ultimately maintain higher roadway condition levels across the region

2025 Yuba County, CA, Road Network Inventory Project, Marysville, CA

Owner Agency & Contact Person Information

Yuba County, CA
Brett Poliquin, Principal Engineer
Yuba County Dept. of Public Works
bpoliquin@co.yuba.ca.us
Office: (530) 749-5416
Cell: (530) 812-6417

Narrative of Services

In 2025, QES completed a project for Yuba County that involved updating its PMP for the County's roadway network consisting of 650 centerline miles and encompassing arterials, collectors, and local streets. The objective of the project was to implement the StreetSaver pavement management system by providing accurate roadway inventory, validating pavement condition data, and providing tailored maintenance and rehabilitation strategies to support long-term budget and planning decisions for the County. The same labor effort that was utilized for the successful implementation and execution of this project has been included in this proposal.

QES segmented and took inventory of the County's current road network to ensure each roadway segment reflected consistent pavement type, structural characteristics, traffic loading, and conditions. Using GIS data, prior segmentations, and aerial imagery, preliminary roadway sections and inventory details were created and then verified in the field during the pavement condition surveys. The finalized inventory, which included dimensions, surface type, functional classification, and construction history, was compiled in both tabular and GIS formats and integrated into the StreetSaver database.

Following data collection activities, QES conducted a comprehensive Pavement Condition Index (PCI) survey in accordance with ASTM D6433-20 standards and MTC distress identification manuals. QES' certified distress raters, Matt Baker and Jason Clinton, performed manual ground surveys of sample units across all roadway classifications. This approach ensured the accurate identification of all distress types, including challenging captures with automated technologies. Data was collected using a tablet-based rating system with GPS-tagged photos, immediate PCI calculations, and daily uploads for real-time QC reviews. Rigorous QA/QC protocols, including duplicate ratings, repeatability checks, and comparisons against historical values, were applied to maintain consistency, accuracy, and reliability.

The validated data was imported directly into the StreetSaver database, where PCI summary reports by section were generated across the entire pavement network. These results provided the County with an updated pavement condition snapshot of the entire system and formed the foundation for future planning of Yuba County. QES then worked with County staff to develop decision trees that reflect local practices, pavement types, and budgetary constraints. These trees incorporated preventive, corrective, and restorative treatments with current unit costs, enabling StreetSaver to model future pavement conditions and identify the most cost-effective strategies.

Recognizing the importance of sustainability, QES also delivered comprehensive training to County staff on both the StreetSaver system and PCI survey methodology. Training modules covered inventory management, condition inspections, treatment planning, budgeting, and reporting, along with hands-on instruction in distress identification and data collection procedures. This training equipped County personnel to independently update and manage their pavement program in future cycles.

Through this project, QES successfully provided Yuba County with a complete, data-driven PMP update and a clear roadmap for cost-effective pavement preservation. By combining engineering judgment with the StreetSaver analysis engine, QES helped the County maximize its limited resources, extend pavement life, and maintain a greater percentage of its network in good condition over the long term.

Asphalt Consulting Services, Bike Trails & Parks, Orange, CA

Owner Agency & Contact Person Information

City of Orange, CA

Dave Nobbs, Parks Maintenance Supervisor
Community Services Dept., Orange, CA
dnobbs@cityoforange.org
(714) 532-6468

Narrative of Services

QES provided asphalt consulting services for five parking lots and over seven miles of bike trails for Orange, CA. The objective of this assignment was to evaluate the current conditions of the pavement and associated infrastructure, develop practical and cost-effective maintenance and rehabilitation recommendations, and provide Orange with a comprehensive report to guide future decision-making for the City.

QES kicked off this project by first facilitating a meeting with City staff to establish clear communication protocols, quality assurance measures, and confirm project schedule and budget expectations. Regular follow-up meetings were held at each key project milestone to ensure stakeholder involvement throughout the project.

The QES team of experienced pavement engineers conducted all field inspections and completed comprehensive inventories and condition evaluations of each of the sites. Each site assessment included asphalt and concrete pavements, sidewalks, curbs, gutters, ramps, and drainage features. Evaluations were performed in conformance with ASTM D6433 standards and ADA compliance guidelines, with 100% of the assets inspected. Data was collected using

QES' in-house tablet-based field system, which enabled GPS-tagged photos, direct distress entry, and immediate cloud-based uploads for quality control in real time. This approach provided accurate, consistent, and transparent results for each location.

Based on the inspection findings, QES developed site-specific maintenance and rehabilitation recommendations for each area assessed. The options provided to the City ranged from preventive, corrective, and routine maintenance strategies, as well as rehabilitation alternatives, from overlays to full reconstruction. Particular attention was

given to drainage performance, recognizing its critical role in long-term pavement preservation. Local contractor input was also incorporated to establish realistic unit costs, further enabling the City to make fiscally sound decisions.
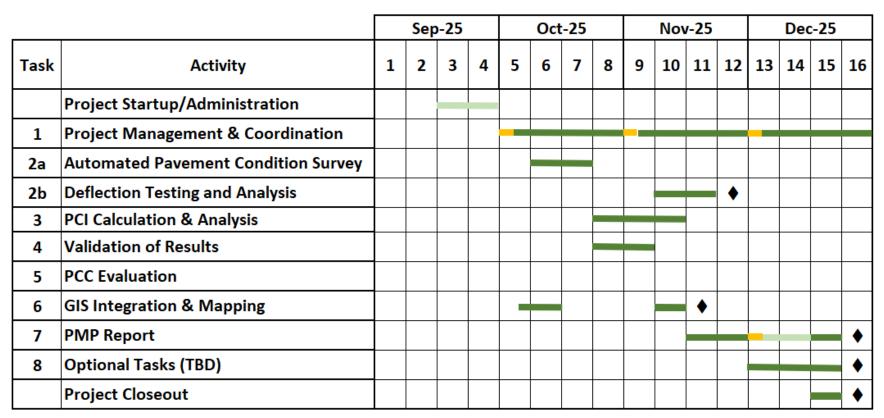
Ultimately, the project culminated in the delivery of a comprehensive written report, which first underwent a demanding draft review period with City staff before being finalized. The report not only documented the condition of each site but also identified key distress mechanisms and provided prioritized treatment recommendations complete with cost estimates. ADA-compliance needs and drainage considerations were also addressed. By applying principles of network-level pavement management, QES both emphasized and prioritized cost-effective preservation methods where possible, recommending higher-cost solutions only in areas for which were absolutely necessary.

Through this effort, QES provided the City of Orange with a clear, data-driven roadmap for maintaining the pavement assets of its bike trail and park areas. The final report provided actionable strategies that balanced performance and compliance while remaining cost-effective, helping the City extend the life of its infrastructure and improve safety, accessibility, and overall enjoyability for its residents.

Section IV: Project Schedule

SCHEDULE OF TASKS

Professional Services for the City of Commerce PMP Update

Task	Activity	Sep-25				Oct-25				Nov-25				Dec-25			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	Project Startup/Administration																
1	Project Management & Coordination																
2a	Automated Pavement Condition Survey																
2b	Deflection Testing and Analysis																
3	PCI Calculation & Analysis																
4	Validation of Results																
5	PCC Evaluation																
6	GIS Integration & Mapping																
7	PMP Report																
8	Optional Tasks (TBD)																
	Project Closeout																

Task Duration
City Review Time
Meeting with City
♦ Milestone Deliverables

Section V: City's Standard Professional Services Agreement

The City of Commerce's Standard Professional Services Agreement can be found in Appendix B

Section VI: Firm Qualifications

Similar Projects and Clients

QES has a long history of repeat clients who return to us for our level of expertise and attention to detail. We have highlighted some of these recently completed or on-going PMS projects in the table below. In each case, the projects included the collection of pavement distress conditions and most also included updating the agencies PMS by entering missing historical M&R treatment data, updating the decision tree treatments and unit costs, loading the data into a pavement management software then running several need assessments and budget option scenarios, and developing the multi-year M&R treatment plan for each street.

All efforts were documented in a final Budget Options Report meeting the project requirements. A selection of our most recent MicroPAVER and StreetSaver projects are described in detail below Figure 8. Project Manager, The QES Team have collaborated on several of the projects listed below as well as the representative projects listed on the following pages.

City/County	Project Manager	Email	Phone	Miles	Year(s)
Yuba County, CA	Brett Poliquin	bpoliquin@co.yuba.ca.us	(530) 749-5416	650	2025
City of Reno, NV	Joe Winkler, P.E.	winklerJ@Reno.Gov	(775)-393-1015	124	2025
Yolo County, CA	Marvin Dinozo	marvin.dinozo@yolocounty.org	(530) 666-8034	657	2024
Bismarck, ND	Gabe Schell, P.E.	gschell@bismarcknd.gov	(701) 355-1507	260	2024
Seattle, WA	Ben Hansen	benjamin.hansen@seattle.gov	(206) 255-1998	1547	2017/2023
Windermere, FL	Tona Elliott Moore	tmoore@town.windermere.fl.us	(407) 876-2563	24	2017/2023
Santee, CA	Jim Tourek, IMS	jtourek@imsanalysis.com	(408) 462-4030	74	2022
San Leandro, CA	Kyle Lei	klei@sanleandro.org	(510) 577-3971	182	2021
Moraga, CA	Sharon Chan	schan@moraga.ca.us	(925) 888-7028	59	2021
Corte Madera, CA	Christopher Good	cgood@tcmmail.org	(415) 927-5794	35	2021
Mill Valley, CA	Ahmed Aly	aaaly@cityofmillvalley.org	(415) 384-4755	61	2021
San Mateo, CA	Otis Chan	chan@cityofsanmateo.org	(650) 522-7305	200	2021
Newark, CA	Trang Tran	trang.tran@newark.org	(510) 578-4298	106	2020
Los Altos, CA	Victor Chen	vchen@losaltos.ca.gov	(650) 947-2623	111	2018/2020
Los Altos Hills, CA	John Chau	jchau@losaltoshills.ca.gov	(650) 947-2510	60	2018/2020
American Canyon, CA	Cheryl Braulik	cbraulik@cityofamericancanyon.org	(707) 647-4688	55	2017/2020
Milpitas, CA	Steve Chan	schan@ci.milpitas.ca.gov	(408) 586-3324	42	2014/2020

Figure 8: Previous Projects of Similar Scope

2024 Pavement Inspection and Pavement Database Updates
Yolo County, California

QES recently completed a contract to perform pavement condition inspections for Yolo County's StreetSaver PMS. We provided updates of the entire 657 centerline miles of paved road network (33 miles of arterials, 142 miles of collectors, 40 miles of residential roads and 442 miles of other rural roads). Douglas Frith was the project manager, supported by Mona Nobakht (PMS Engineer) and Jason Clinton and Matt Baker as distress raters.

Manual distresses surveys, following the MTC distress rating methodology, were completed on 100% of the street segments. All field data was collected in 45 days, underwent a rigorous data quality check prior to entry into the StreetSaver database.

Firm:	Quality Engineering Solutions, Inc.
Project Name:	Pavement Inspection and Pavement Database Updates
Owner:	County of Yolo, CA
Contact:	Marvin Dinozo, Assistant Engineer Department of Community Services Public Works Division (530) 666-8034 marvin.dinozo@yolocounty.org
Budget:	$89,319
Contract Date:	May 30, 2023
Completion Date:	March 31, 2024
Miles:	657 Centerline Miles

2022 Town of Windermere PMP Update
Windermere, Florida

QES was awarded this project issued by the Town of Windermere, FL to update the Town's Pavement Management Plan and continue building upon the current data available in the MicroPAVER software implemented by the Town in 2015. The project began with QES
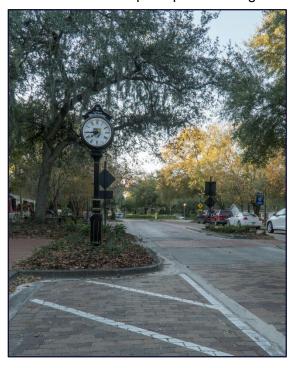
conducting a review and confirmation of roadway inventory and performing ASTM D6433-compliant pavement distress surveys by using tablet-based field software to capture distress data, GPS photos, and PCI calculations. All results were meticulously reviewed by QES against historical PCI values, ensuring accuracy and continuity with the Town's baseline.

QES integrated the updated data into MicroPAVER and generated accurate pavement performance models, deterioration curves, and budget scenarios. QES worked with Windermere Town staff to evaluate unlimited, current, and recommended funding strategies, prioritizing short-term maintenance and rehabilitation project lists through cost-benefit analysis. A 20-year rehabilitation strategy was also developed, providing Town officials with a progressive vision to sustain roadway conditions. Findings and recommendations were presented to staff and Council, equipping the Town with a practical, data-driven roadmap to optimize budgets and extend pavement life.

Firm:	Quality Engineering Solutions, Inc.
Project Name:	2022 Town of Windermere PMP Update
Owner:	Town of Windermere, FL
Contact:	Tonya Elliott-Moore, Director of Public Works
	Main (407) 876-2563 ext. 5325
	Cell (321) 299-2410
	tmoore@town.windermere.fl.us
Budget:	$41,157
Contract Date:	February 01, 2023
Completion Date:	October 05, 2023
Miles:	24.2 Centerline Miles

2022 SDOT Arterial Pavement Condition Rating
Seattle, Washington

QES and Integrated Management Systems, LLC (IMS) completed a pavement condition survey of the arterial street system for the City of Seattle, WA. The Seattle Department of Transportation's (SDOT) arterial pavement network has a total area of approximately 98,000,000 sf (1,547 12-ft. lane-miles), a total length of 491 centerline-miles, and consists of 3,132 management sections. Jeff Uhlmeyer was the project manager, supported by Douglas Frith (Principal Engineer), Mona Nobakht (PMS Engineer), and Jason Clinton (Senior Technician).

Our workflow consists first of collecting 3D pavement imagery in the field using IMS operated Road Surface Tester (RST) with state-of-the-art second-generation Laser Crack Measuring System (LCMS-2) technology which provides twice the resolution of most other systems used in the field, of pavement surveys. The LCMS-2 data collection vehicles give our expert team of engineers detailed, objective, and repeatable data to use for their analysis. Pavement images are next analyzed using automated crack detection and classification software tools

(RoadInspect), then manually verified by QES staff, supplementing the results of the automated data processing. Quality control and assurance checks are in place at all phases of the project. IMS collects the data and then QES completes the manual pavement distress ratings based upon MTC's StreetSaver pavement distress guides. Approximately one third of the pavements are concrete surfacing and the remainder are asphalt concrete or composite roadways. QES uploaded the survey data into SDOT's MTC StreetSaver Online pavement management system database.

Firm:	Quality Engineering Solutions, Inc.
Project Name:	2022 SDOT Arterial Pavement Condition Rating
Owner:	Seattle Department of Transportation
Contact:	Benjamin Hansen, PE, Project Manager Maintenance, and Operations (206) 684-5304 benjamin.hansen@seattle.gov
Budget:	$547,000
Contract Date:	July 15, 2022
Completion Date:	July 31, 2023
Miles:	491 Centerline Miles

MTC P-TAP 21 Pavement Management Updates
Multiple Cities, California

Under the P-TAP 21 contract, QES was assigned six Bay Area cities to provide StreetSaver PMS updates in 2020. Project details include the confirmation and correction of existing management sections, manual pavement distress surveys, StreetSaver updates (including updating the decision tree and cost table), adding any M&R information, and generating various budget option reports. All six of these projects were completed on time and within budget. Douglas Frith served as the Project Manager, supported by Luis Ramierz, Matt Baker, and Jason Clinton.

Two cities provided additional challenges in their request for project lists meeting certain criteria. For the City of San Mateo, the unique challenge of custom scenario generation went beyond StreetSaver's standard capabilities. Many scenarios required the elimination of failed streets (streets that fall below a PCI of 30) over a specified period while maintaining all street sectional PCIs (rather than network PCI) above a certain index such as 50. The desired pavement management plan PMP was achieved with a bit of creativity that involved making changes to the decision tree that would, in turn, generate an annual list of streets which could then be saved as project lists. No single standard StreetSaver analysis or report could be utilized, but by running separate reports and combining the data, QES was able to achieve the City's desired outcome.

Firm:	Quality Engineering Solutions, Inc.
Project Name:	MTC P-TAP 21 Pavement Management Updates
Owner:	Bay Area MTC
San Mateo	
Contact:	Cathi Zammit, Engineering Manager
	(650) 522-7306
	czammit@cityofsanmateo.org
Budget:	$60,000
Miles:	200 Centerline Miles
City of Mill Valley	
Contact:	Faryal Saiidnia, Project Manager
	(415) 384-4830
	fsaiidnia@cityofmillvalley.org
Budget:	$18,400 + $9,300
Miles:	61 Centerline Miles

Additionally, the City of Mill Valley entered into a separate contract with QES to expand on the P-TAP 21 required deliverables, this included updating their 5-year PMP. This update included annual project lists tailored through engineering judgement to reduce treatment costs and provide optimal PCI improvement to their pavement network. Various M&R treatment strategies were evaluated to provide the best solution for long-term pavement performance under their budgetary considerations

Lake Berryessa PCI and FWD Pavement Evaluation

QES was contracted by the Bureau of Reclamation to analyze, evaluate, and report existing pavement conditions following an asset management approach and to provide recommendations for maintenance on approximately 66K SY of asphalt pavements, divided across nine parking lots and roadways. Field testing consisted of PCI distress surveys, deflection testing, and pavement coring and was conducted in November 2015.

The QES team took detailed field measurements of pavement distresses per ASTM D6433 and took photographs of all pavement sections and created GIS maps of the pavement sections. Data were analyzed in MicroPAVER to assess overall pavement functional and structural conditions.

Project-level deflection testing using an FWD was also performed, and coring was conducted to determine the structural capacity of the pavement sections. The ELMOD back calculation software was used to analyze the deflection data.

Firm: Quality Engineering Solutions, Inc.
Project Name: Lake Berryessa PCI and FWD Pavement Evaluation
Location: Lake Berryessa, CA
Owner: Bureau of Reclamation Mid-Pacific Region
Contact: Peter Funkhouser
(916) 978-5100 or (707) 966-2111
pfunkhouser@usbr.gov
Budget: $24,000
Year Completed: 2016
Project Size: 66,000 SY (Roadways & Parking Lots)

QES analyzed the data and developed remaining life predictions. QES then made detailed recommendations for future pavement maintenance and rehabilitation activities.

MTC PCI Surveys and Pavement Management System Update

QES completed four consecutive years of providing ASTM D6433 PCI inspection and pavement management services to San Francisco Bay Area MTC agencies through the P-TAP program. Over these years, QES has been assigned 10 local agencies to provide updates to their current pavement management systems. The agencies include American Canyon, Belvedere, Hercules, Los Gatos, Martinez, Menlo Park, Millbrae, Milpitas, Novato, and Suisun City, all located in the Bay Area. This work was based upon a pavement management system very similar to MicroPAVER called StreetSaver and is similarly based on ASTM D6433 PCI inspection data. (*Note*: StreetSaver is based on MicroPAVER, but it lacks the more sophisticated analysis capabilities of MicroPAVER).

QES provided additional data collection services as subcontractor to both Nichols Consulting Engineers and Harris and Associates during their P-TAP 17 projects. Each of these projects were completed on time and within budget.

Mr. Jason Clinton served as the lead distress rater on these cities and is a certified pavement distress rater. The database updates were completed, and a minimum of five budget scenarios were run for each city. The budget scenarios included:

1) Unconstrained;
2) Current investment level;
3) Maintain current PCI;
4) Increase current PCI by five points, and;
5) Do nothing

Firm:	Quality Engineering Solutions, Inc.
Project Name:	MTC PCI Surveys & Pavement Management System Update
Location:	San Francisco Bay Area, CA
Owner:	San Francisco Metropolitan Transportation Commission (MTC)
Contact:	Christina Hohorst (Project Manager, MTC) (415) 778-6700 or (510) 817-5869 chohorst@bayareametro.gov
Budget:	$228,000
Year Completed:	2014-2017
Project Size:	8,000,000 SY Roadways (approx.)

Mr. Douglas Frith, P.E., provided overall project management, oversight, and quality assurance reviews. In addition to this work as prime contractor, QES has also provided subcontractor services for two additional prime contractors for the cities of Berkley, CA, Pittsburg, CA, San Carlos, CA and for Sonoma County

Section VII: Fee Proposal

Please refer to the Fee Proposal submitted as a separate document supplementary to this proposal.

**Appendix A
Personnel Resumes**

Kurt Keifer, Ph.D., P.E.
Project Manager

QES

Professional Background

As Executive Vice President, Engineering, Kurt Keifer, PhD, PE leads the QES team of civil engineers, pavement engineers, and technicians who provide creative, practical solutions to challenges in aviation, transportation, infrastructure, survey, and water/wastewater. Dr. Keifer has worked in the industry for 26 years developing and deploying both "boots-on-ground" and automated infrastructure condition assessment technologies, including pavement imaging, structural condition evaluation, surface profiling technologies, and software solutions. He has led pavement management system implementations and comprehensive condition surveys for commercial and general aviation airports, states, counties, local agencies, and the DoD across the United States and around the world. Prior to consulting, Dr. Keifer spent a decade with the US Army Corps of Engineers, Construction Engineering Research Laboratory where he served as the Associate Program Manager of the Air Force-funded MicroPAVER™ and Navy-funded WHARFER™ Engineered Management System (EMS) R&D teams. He assisted in updating the ASTM D6433 and D5340 PCI standards and developing the automated PCI method. Dr. Keifer has delivered expert infrastructure management instruction to students and faculty at the US Air Force Academy, Wright-Patterson Air Force Base, University of Illinois at Urbana-Champaign, and Colorado State University. He has taught more than 50 courses and has published several technical papers on infrastructure management.

Education

- Ph.D., Transportation Engineering, University of Illinois at Urbana-Champaign
- M.S., Structural Engineering, University of Illinois at Urbana-Champaign
- B.S., Structural and Geotechnical Engineering, University of Illinois at Urbana-Champaign

Registrations/Certifications

- Professional Engineer: Arizona, Florida, Georgia, Illinois, North Dakota, Ohio, South Dakota, Texas
- Artificial Intelligence (AI) for Leaders Certification Program, University of Texas at Austin (2024)

Affiliations

- American Society of Civil Engineers, Transportation Research Board: AFP10 Committee on Pavement Monitoring and Evaluation (Member 2012 – Present); AKT10 Pavement Management Systems (Member 2008 – 2017)
- American Public Works Association
- University of Illinois at Urbana-Champaign Department of Civil and Environmental Engineering Alumni Association, Board Member (2022 – 2030)
- ASTM International E17, Voting Member
- Transportation Research Board, Committee Member
- ASCE, T&DI, Airfield Pavement Committee
- ASCE, COPRI – Port Pavement Committee, Chair (2008 – 2010)
- ASCE, Illinois YMG, Chair (2009 – 2010)

Key Experience

- Project management
- Quality control/assurance
- Roadway pavement design
- Pavement management
- Research
- Training
- Airport Pavement Design
- Airport Pavement Engineering

Related Project Experience

Project Manager, MicroPAVER™ Pavement and Asset Management System, Prince George's County, MD (2008, 2013, & 2023)

Served as project manager for IMS Infrastructure Management Services, LP (2023) and Dynatest Consulting, Inc. (2008 & 2013) as a major subcontractor to Johnson, Mirmiran and Thompson, Inc. Performed a custom MicroPAVER™ pavement management system implementation and semi-automated pavement distress survey for Prince George's County. Performed an initial MicroPAVER™ implementation and semi-automated PCI survey using 2D/3D pavement imaging technology in 2008 and 2013. The semi-automated PCI distress survey, rutting measurements and roughness evaluation were conducted using the following ASTM standards and uploaded to MicroPAVER™. Worked with the county to develop a "State of the Streets" report and provided a list of MicroPAVER™ candidate projects for federal stimulus funding, assisted county staff in developing MicroPAVER™ based work plans and recommendations.

Project Manager, Pavement Management System Implementation and Condition Survey, Chicago Metropolitan Agency for Planning (CMAP) (2018 – 2020)

Managed the CMAP pilot project and three subsequent rounds of pavement management system implementation for CMAP. The following tasks were performed: *1)* implement MicroPAVER and develop a complete pavement inventory using the municipality's GIS and available historical M&R records; *2)* perform a comprehensive PCI and IRI survey of the municipality's roadways; *3)* upload the collected condition data into MicroPAVER; *4)* develop pavement deterioration trends using MicroPAVER; 5) develop five-year pavement M&R plans for each municipality, which include upcoming "fixed" projects; *6)* develop a comprehensive "State of the Streets" report; and *7)* present the project findings at a formal, open meeting to elected officials and residents. Also provided on-site MicroPAVER and pavement management training workshops for the participating municipalities. Project deliverables included: *1)* MicroPAVER software license; *2)* MicroPAVER database complete with collected PCI and IRI data, historical M&R data, custom pavement deterioration models, and custom M&R unit cost models and decision trees; *3)* five-year M&R recommendations along with analyses illustrating the impact of different M&R funding scenarios, *4)* a comprehensive "State of the Streets" report, *5)* formal, on-site presentation to elected officials and residents, and *6)* MicroPAVER training.

Principal Engineer / Project Manager, MicroPAVER™ Pavement Management System Implementation and Update, Bismarck-Mandan MPO and the City of Bismarck, ND (2015 & 2020)

Dr. Keifer served as project manager and principal engineer for both previous projects with Gorrondona and Associates, Inc. (2020) and Dynatest Consulting Inc. (2015). Performed a custom MicroPAVER™ pavement management system implementation and semi-automated pavement distress survey for Bismarck-Mandan MPO and the City of Bismarck. Performed an initial MicroPAVER™ implementation and semi-automated PCI survey using 2D/3D pavement imaging technology in 2015 and again in 2020. The semi-automated PCI distress survey, rutting measurements and roughness evaluation were conducted using the following ASTM standards and uploaded to MicroPAVER™. Worked with the MPO and the city to develop a "State of the Streets" report and provided a list of candidate M&R projects. Worked collaboratively with the MPO and the city over the past decade and has assisted MPO and city staff in developing MicroPAVER™ based work plans and recommendations.

Project Manager, Airside and Landside Pavement Management System Implementations and MicroPAVER™ Development, US Army Corps of Engineers (2012 – 2017)
Project manager responsible for overseeing the work through all phases of the project. The team implemented MicroPAVER™ and performed both manual and semi-automated ASTM D6433 pavement condition surveys and analyses for more than 30 Army, Air Force, and Navy installations across the United States over a period of five years.

Principal Engineer, Airside Pavement Condition Survey, Eielson AFB, Alaska (2019)
Principal engineer overseeing the performance of a comprehensive PCI inspection of the base's airside pavements and ensuring the data was entered correctly into the MicroPAVER™ pavement management system.

Principal Engineer, Airfield Pavement Management Best Practices Training, Moi International Airport, Kenya (2019).
As principal engineer, Dr. Keifer taught a 40-hour course on airport pavement management to the Kenya Civil Aviation Authority (KCAA). The training included airfield pavement management best practices and how to implement the MicroPAVER™ pavement management system effectively for Kenyan airports. More than 25 KCAA employees and consultants attended the training.

Principal Engineer, Landside Pavement Condition Survey, Raleigh-Durham International Airport, Raleigh, NC (2017)
Principal engineer responsible for leading an automated PCI inspection of select roadways at the airport. Collected data was imported into MicroPAVER™ and used for developing detailed, cost-effective pavement rehabilitation plans.

Dr. Keifer has led pavement management system implementations and condition surveys for several aviation agencies as shown below:

- Eielson AFB, Alaska
- Raleigh-Durham International Airport
- Tyndall AFB, Florida
- Diego Aracena International Airport, Chile
- Laughlin AFB, Texas
- Spofford AFS, Texas
- Niagara Falls ARS, New York
- McGuire AFB, New Jersey
- Charleston AFB, South Carolina

- Cape Canaveral AFS, Florida
- Patrick AFB, Florida
- Orlando International Airport
- Honolulu International Airport
- Inchon International Airport
- O'Hare International Airport
- Philadelphia International Airport
- Colorado GA Airports, Statewide
- Pennsylvania GA Airports, Statewide

QES

Douglas Frith, PE
Deputy Project Manager & Principal Engineer

Professional Background

Mr. Frith is a registered Professional Engineer and has a Master of Science Degree in Civil Engineering with an emphasis in pavement materials. He has 37 years of pavement consulting and construction experience. He is a recognized professional in pavement design and evaluations, quality control and assurance, pavement management, transportation research, training, and pavement construction. He has completed evaluations, designs and design-build efforts for streets, highways, and port facilities. He has been involved in the implementation of various pavement management systems for several cities, counties, military facilities, and airfields using multiple distress rating definitions and methodologies. Mr. Frith has contributed to several local and national research projects including LTPP and WesTrack. As an instructor, Mr. Frith has provided technology transfer for the National Highway Institute and the University of Nevada.

Education

- M.S., Civil Engineering, University of Idaho, Moscow, ID
- B.S., Civil Engineering, University of Idaho, Moscow, ID

Registrations/Certifications

- Professional Engineer: California No. C 047294; Nevada, No. 11071; Idaho, No. 10139; North Carolina, No. 052519

Summary Experience

Mr. Frith's primary emphasis has been in pavement engineering including research, evaluation, management, and design. Currently, he serves as Vice President for QES' Engineering Division applying new technologies in the areas of pavement design, management and quality control. During the past 26 years, Mr. Frith has been applying modern technical developments in pavement management, maintenance, and design in the consulting field. He is currently managing the Independent Validation and Verification (IV&V) efforts for over 22,000 miles of pavement and asset management data for the Virginia Department of Transportation (DOT) and 19,000 miles of pavement condition data for the North Carolina DOT. Mr. Frith served as project manager from 2013 to 2021 overseeing StreetSaver PMS updates for 34 cities in the San Francisco Bay Area. The scope included updating M&R, decision trees, costs, and pavement distress to develop a minimum of five budget scenarios for each agency. He routinely leads our airfield projects, whether in deflection testing, pavement condition surveys, pavement management updates or ACR-PCR evaluations.

Related Project Experience

Project Manager, Ontario International Airport, Heavy Weight Deflectometer Testing, PCR Determination, and Remaining Life Analysis, Ontario, CA (2025)
Under subcontract to HNTB, QES provided HWD testing, PCR determination, and remaining structural life estimates for Runway 8L/26R, 11 taxiways, and one apron area at the Ontario International Airport. Work included a series of tasks, including HWD testing, deflection data analysis, PCR calculations, and estimation of remaining structural life. All pavements were jointed concrete pavements and HWD testing include mid-panel, transverse joint, corner, and longitudinal joint testing.

Project Manager, San Jose International Airport, CA, FWD Data Collection (2025)
Under subcontract to Kimley-Horn and Associates, QES completed the necessary Heavy Falling Weight Deflectometer (HWD) testing and pavement PCN calculations for Taxiways B, E, G, J, K, L, M, Y and Z. All pavements were jointed concrete pavements and HWD testing include mid-panel, transverse joint, and corner testing. PCR and remaining life were calculated using the FAAFIELD software.

Project Manager, Auburn Municipal Airport (AUN) 2024 Airport Pavement Management System Update (2024)
QES was tasked with updating the Airport Pavement Management Program (PMP) for the Auburn Municipal Airport in Auburn, California. This update to the PMP, conducted following FAA Advisory Circular AC No: 150/5380-7B, aimed to assist the airport in finding optimum strategies for maintaining pavements in a safe serviceable condition over a 5-year period for the minimum cost.

Project Manager, Harry Reid International Airport (LAS) Heavy Weight Deflectometer Testing, PCR Determination, and Analysis of Airfield Pavement Areas Above Paradise Road Tunnel, Las Vegas, NV (2023)
QES performed a pavement structural evaluation on several airfield areas above the Paradise Road tunnel at the Las Vegas International Airport (LAS). The key objectives included an assessment of the structural condition of the concrete pavement above and around the tunnel and evaluation of potential structural issues on the pavement related to the tunnel structure. HWD testing was completed on several Runways and Taxiways that crossed Paradise Road. Additionally, the project included PCR and remaining life calculations for Runways 08R/26L, 08L/26R, 01L/19R, and 01R/19L.

Project Manager, Aspen Municipal Airport FWD Testing, PCR Determination, and Remaining Life Analysis (2023)
Under subcontract to Kimley-Horn, QES performed HWD testing, determination of pavement layers and subgrade structural properties, calculation of Pavement Classification Numbers (PCR), and Remaining Life Analysis for the runway at Aspen, CO.

Project Manager, Oakland International Airport FWD Testing, PCR Determination, and Remaining Life Analysis, Oakland, CA (2023)
Under subcontract to Kimley-Horn, QES conducted FWD testing, determination of pavement layers and subgrade structural properties, calculation of pavement classification numbers (PCR), and remaining life analysis for 25 facilities and 81 management sections that included four runways and multiple taxiways and aprons with flexible, rigid, and composite pavement types.

Project Manager, Fresno, CA Airport FWD Data Collection (2021)
Under subcontract to Kimley-Horn, QES completed project level Falling Weight Deflectometer (FWD) testing for pavement evaluation in accordance with the guidelines in FAA AC150/5370-11B. Deflection testing is scheduled for April 26 and 27 on both runways. The Impulse Stiffness Modulus will be reported, along with PCN values and remaining structural life analysis for each runway.

Quality Assurance Engineer/Project Manager, Virginia Statewide Airport Pavement Management Systems Update (2021)

QES teamed with All About Pavements, Inc. in an effort to provide pavement management updates on multiple commercial and general aviation airports throughout Virginia. The distress surveys were conducted following ASTM D5340-12 Standard Test Method for Airport Pavement Condition Index Surveys and MicroPAVER is the software of choice. Mr. Frith supervised the distress data collection at 6 commercial airports and 20 general aviation airports. In addition, oversaw the on-site quality assurance distress reviews for 20% of the collected distress data. He will also provide a quality review of the individual airport pavement management reports. Data collection occurred between September 2020 and March 2021.

Project Manager, Boise, ID Airport FWD Data Collection (2020)

Under subcontract to All-About Pavements, Inc. QES completed project and network level Falling Weight Deflectometer (FWD) testing for pavement evaluation in accordance with the guidelines in FAA AC150/5370-11B. Deflection testing was performed on Runway 10R-28L, Taxiways A6, A7, F, J & S and in the general aviation apron area.

Project Manager, Tucson International Airport (2020)

Under subcontract to Kimley-Horn, QES completed the necessary Falling Weight Deflectometer (FWD) testing and PCN determination on the Cochise Apron and two branches of the Executive Apron at TSU. We also provided backcalculation of subgrade strength properties and PCN calculations for another 128 branches of the airport using historical deflection data.

Project Manager, Lompoc, CA FWD Data Collection and Modulus Estimation (2020)

Under subcontract to All-About Pavements, Inc. Under subcontract to Kimley-Horn and Associates, QES completed the necessary project level Falling Weight Deflectometer (FWD) testing and backcalculation of layer modulus values which will be used for the pavement structural design. Deflection testing was completed on Runway 7-25. A pavement testing and evaluation report was provided to the client.

Project Manager, Hayward, CA Executive Airport Taxiway Pavement Evaluation (2019)

QES provided pavement rehabilitation recommendations for Taxiways A, C, F and Z. QES completed the deflection testing, coring, borings, and materials sampling in August 2019. The data was analyzed through the application of FAARFIELD software to develop pavement rehabilitation recommendations. Final recommendations included full-depth reclamation.

Senior Engineer, Caltrans Airport Pavement Management Systems Update (2019)

QES, as part of the Kimley-Horn project team, provided Pavement Condition Index (PCI) Data Collection efforts in accordance with the procedures described in ASTM D5340-12 Standard Test Method for Airport Pavement Condition Index Surveys. An optional activity is for Mr. Frith to provide MicroPAVER distress training for contractor and Caltrans personnel at the close of the project, although this effort has not yet begun.

Project Manager, Mojave Air and Space Port FWD Data Collection (2019)

Under subcontract to Kimley-Horn and Associates, QES completed the necessary Falling Weight Deflectometer (FWD) testing for pavement evaluation for a new aircraft at the Mojave Air and Space Port. Deflection testing was completed on Runway 12-30, Taxiway Connectors 1 & 2, and Taxiway C.

Project Manager, San Jose International Airport FWD Data Collection (2019)
Under subcontract to Kimley-Horn and Associates, QES completed the necessary Falling Weight Deflectometer (FWD) testing for pavement PCN calculations for Runways 12R-30L and 12L-30R, and Taxiways A, A1, J, K, L, N, Y.

Project Manager, Erie Airport Pavement Management System Update (2018)
Under subcontract to McFarland Johnson, QES completed a PMS update for the airside of Erie Airport in Erie, PA. MicroPAVER was utilized to complete the update. QES provided a 5-year maintenance plan and a 20-year Capital Improvement Plan. In addition, we provided PCN calculations for both runways. Our information was used to complete the Airport Master Plan Study.

Project Manager, Columbia Airport PCN Calculations (2016)
Under subcontract to Kimley-Horn and Associates, QES completed the necessary Falling Weight Deflectometer (FWD) testing and analysis using ComFAA software to develop the PCN values for Taxiway B, Taxiway C, and the hanger apron area.

QES

Mona Nobakht, Ph.D. P.E.
Pavement Management Engineer

Professional Background

Dr. Nobakht is a licensed Professional Engineer with over ten years of experience in the public, private and academic sectors. She holds a Ph.D. in Civil Engineering with a specialization in pavement engineering. Her expertise spans pavement materials characterization, pavement design and evaluation, forensics and pavement management. She is also experienced in automated pavement data collection and surface profiling technologies. Prior to joining QES in June 2023, Dr. Nobakht served as a project manager at the Texas DOT, where she led various pavement forensics, design, and rehabilitation projects and provided technical support to TxDOT districts. Additionally, Dr. Nobakht has successfully implemented Pavement Management Systems for several cities and counties across the U.S. As a former researcher with the Texas A&M Transportation Institute, she also led multiple research projects for the Oklahoma and Texas DOTs. Since joining QES in 2023, Dr. Nobakht has been involved in pavement structural evaluations and traffic impact analyses for energy sector development roads and contributed to QES research projects for state agencies. Additionally, she has led and contributed to multiple Task Orders under QES' FHWA IDIQ contract. She is currently leading the TPF-5(399) Pooled Fund Study efforts to improve the AASHTO R87 and R88 standards.

Education

- Ph.D., Civil Engineering-Pavement Materials, Texas A&M University
- M.S., Civil Engineering-Structure, K.N. Toosi University of Technology, Tehran, Iran
- B.S., Civil Engineering, Amirkabir University of Technology, Tehran, Iran

Registrations/Certifications

- Professional Engineer: Texas, Ohio, North Carolina

Professional Affiliations

- Transportation Research Board

Key Experience
• Pavement Management
• Research
• Training
• Project Management
• QA / QC
• Pavement Design
• Automated Data Collection

Related Project Experience

Since joining QES, Dr. Nobakht has provided engineering support for the following projects:

Task Order Lead/Subject Matter Expert, Federal Highway Administration (FHWA) IDIQ 2025 Pavement Programs (2021- 2024 and 2024 - 2028)
QES has been providing technical and professional support services to FHWA under this project since 2021. Our team has successfully delivered a wide range of services, including developing technical guidance and reports, supporting technology transfer through presentations, workshops, and training, and providing direct technical assistance to state agencies.

Transverse Pavement Profile Study/AASHTO R87 Rut Definition/AI Reference Library TPF-5(399) (2025) - This study facilitates the implementation of the products which are being developed under the pool fund study. Dr. Nobakht is currently leading the efforts to improve AASHTO R87 and R88.

![QES logo]

FHWA Pavement Design Peer Exchanges (2024) – QES conducted a comparative analysis of state DOT pavement design practices by organizing and documenting five regional peer exchanges covering all 50 states. The study captured key practices, challenges, gaps, improvement opportunities, and emerging technologies. Dr. Nobakht contributed to synthesizing the findings and preparing the final report and accompanying white paper.

South Dakota Granular Moisture-Density Curve Development and Dynamic Cone Penetrometer (DCP) Implementation (2024)
QES is currently contracted with the South Dakota DOT to analyze moisture-density data and develop the SDDOT Moisture Density Family of Curves. Additionally, the project involves creating DCP-based specifications for quality control of the compaction of base materials. The project is in progress, with Dr. Nobakht leading the data analysis and programming efforts.

Pre-Construction Roads Assessment, Monte Alto and Monte Cristo Wind Farms, Texas (2023)
QES has completed pre-construction road assessments on nearly 200 miles of local roadways in South Texas designated as haul roads for wind farm projects. Data collection included Falling Weight Deflectometer (FWD) measurements, Ground Penetrating Radar (GPR) measurements, and materials sampling and testing. Dr. Nobakht led the pavement structural and traffic impact analysis, estimating the remaining life of each roadway and assessing the potential impact of wind farm construction traffic on the haul roads.

Seattle Department of Transportation, StreetSaver PMS Update (2023)
Using high speed automated data collection technologies, QES was the prime contractor in updating the StreetSaver pavement distress condition on approximately 950 lane-miles of arterial and collector streets in the City of Seattle. QES hired IMS to collect the condition data using a 3-D LCMS laser system. QES then performed QC/QA efforts on all collected data and uploaded the approved distress data into the StreetSaver pavement management software. Dr. Nobakht developed the QA procedures, oversaw all QA efforts and uploaded the data into StreetSaver.

Road Network Inventory Project Yuba County, CA (2023)
QES is currently contracted to support Yuba County in configuring the newly acquired StreetSaver software. The project involves developing roadway segments, updating the inventory, conducting a distress survey on 662 miles of County roads, and configuring the StreetSaver software. Additionally, QES is assisting in developing decision trees and updating maintenance and rehabilitation fields. The project is in progress, with the QES team working on segmentation and data collection. Dr. Nobakht oversees the entire process, including segmentation, data import, quality checks, performance measures calculations, decision tree development, budget scenario analysis, and report development.

Windermere Florida Pavement Management Update (2023)
QES completed a PAVER pavement management system update for the Town of Windermere Florida. QES had performed the initial PMS implementation in 2017. QES completed distress surveys and then developed four budget options illustrating the effects of various budgets over the next five years. In addition, a 20-year maintenance and rehabilitation plan were provided. Dr. Nobakht completed the PAVER analysis to include developing the budget option reports as well as the 20-year M&R plan.

Pavement Inspection and Pavement Database Updates Yolo County, CA (2023)
QES completed a StreetSaver pavement management system (PMS) update for Yolo County covering the entire 657 centerline miles of the paved road network. QES has completed distress surveys, following the MTC distress rating methodology, data quality checks, and the StreetSaver database update. Dr. Nobakht developed the QA procedures, oversaw all QA efforts and uploaded the data into StreetSaver.

Dr. Nobakht's Pavement Engineering experience prior to joining the QES team includes the following projects:

Transportation Engineer IV (Pavement Preservation Branch), Texas Dept. of Transportation (TxDOT), Pavement Asset Management, Austin, TX (12/2022 – 5/2023)
- Conducted the 4-year pavement analysis including prediction and project selection and developed the statewide 4-year pavement management plan report.
- Provided support for TxDOT Pavement Management System - Pavement Analyst, including updating the existing deterioration/statistical pavement and optimization models.
- Provided analytical related specifications for new configuration and testing them in PA.
- Conducted the quality check/quality assurance on the annually collected network-level pavement distress data.
- Served in the research project panels to oversee the PMIS related research projects at both the TxDOT and national levels.

Transportation Engineer IV (Pavement Analysis & Design Branch), TxDOT, Pavement Asset Management, Austin, TX (4/2021 – 11/2022)
- Served as a project manager on pavement forensics and pavement design/rehabilitation projects.
- Provided technical/engineering support to the districts for design and rehabilitation projects scheduled for letting.
- Conducted site visits and supervised non-destructive and destructive testing such as FWD, AC-GPR, GC-GPR and DCP to conduct forensic evaluations.
- Performed pavement data analyses, forecasts, and plan development using TxDOT pavement software packages.
- Coordinated and monitored consultant projects and oversaw their engineering work.
- Involved in evaluation and preparation of Super Heavy Load Permits and changing Load Zone on Roads.
- Served on TxDOT research panels to review proposals and oversee research projects.

QES

Pavement Engineer (Pavement Management), Fugro USA Land, Inc.,
Austin, TX (3/2019 – 3/2021)

- Analyzed and interpreted collected asset data using analytical methods and asset management software products to assist transportation agencies in evaluating their pavement and asset inventories.

- Performed pavement management services and developed long-term maintenance and rehabilitation strategies for transportation agencies using the corporate in-house and commercial pavement management software packages.

- Performed network and project level evaluation of pavements using non-destructive testing.

- Developed Quality Control (QC) procedures for transportation infrastructure data such as traffic, friction testing (skid), FWD, and GPR data.

- Developed and analyzed GIS databases using ArcGIS software.

- Involved in business development activities by reviewing RFPs/RFQs, estimating cost, writing proposals, and preparing bid packages.

Pavement Materials Research Engineer, Texas Transportation Institute (TTI),
College Station, TX (9/2013 – 12/2018)

Research Project: Asset Management, extreme weather, and proxy indicators (sponsored by Federal Highway Administration/Texas DOT)

- Investigated soil properties in Houston District and extracted required data for pavement analyses.

- Conducted a simulation study to assess the performance of inundated flexible pavements in Houston district.

- Prepared the progress reports and presented the results to FHWA and TxDOT.

Research Project: Compilation of local studies and regional calibration of Pavement ME design for rigid and flexible pavements in Oklahoma (sponsored by Oklahoma DOT)

- Extracted pavement condition data of flexible pavements in the State of Oklahoma from the LTPP database.

- Conducted Pavement-ME analysis and compared distress predictions with LTPP distress data.

- Assisted in calibration of Pavement ME Design for application in the State of Oklahoma.

Research Project: Selection of long-lasting rehabilitation treatments using life-cycle cost analysis and present serviceability rating (sponsored by Oklahoma DOT)

- Conducted performance tests to determine material properties and damage characterization of asphalt mixtures.

- Performed detailed (project level) analyses, including evaluation of FWD data, and structural design of pavements with Pavement-ME Design software.

- Conducted life-cycle cost analysis on a series of flexible and composite pavements.

- Established a decision-making methodology, and a series of time-based rehabilitation strategies for a network of flexible and composite pavement sections in the State of Oklahoma.

- Wrote the project progress reports and research papers.

**Lecturer & Lab Instructor, Texas A&M University,
College Station, TX**

Courses: Mechanics of Materials, Materials Engineering for Civil Engineers,
     Materials of Construction

- Designed the course(s), delivered lectures, and performed assessments.

**Structural Engineer, ITCEN Engineering / Consulting Co.
Tehran, Iran (7/2006 – 9/2009)**

- Created structural models by using computer-aided design software for simulation purposes.
- Checked the safety and stability of the industrial/commercial structures in accordance with engineering codes.
- Monitored on-site construction and project progress.

Publications:

Nobakht, M. and **MS Sakhaeifar**, *Dynamic modulus and phase angle prediction of laboratory aged asphalt mixtures, Construction and Building Materials 190, 740-751, 2018.*

Nobakht, M., D. Zhang, **MS Sakhaeifar**, and **RL Lytton**, *Characterization of the adhesive and cohesive moisture damage for asphalt concrete, Construction and Building Materials 247, 118616, 2020.*

Nobakht, M., **MS Sakhaeifar**, **D Newcomb**, and **S Underwood**, *Mechanistic-empirical methodology for the selection of cost-effective rehabilitation strategy for flexible pavements, International Journal of Pavement Engineering 19 (8), 675-684, 2018.*

Nobakht, M., **MS Sakhaeifar**, and **DE Newcomb**, *Selection of structural overlays using asphalt mixture performance, Journal of Materials in Civil Engineering 29 (11), 04017209, 2017.*

Nobakht, M., **MS Sakhaeifar**, and **D Newcomb**, *Development of rehabilitation strategies based on structural capacity for composite and flexible pavements, Journal of Transportation Engineering, Part A: Systems 143 (4), 04016016, 2017.*

Sakhaeifar, MS, **D Newcomb**, **M Nobakht**, **S Underwood**, and **PP Gudipudi**, *Selection of long lasting rehabilitation treatment using life cycle cost analysis and present serviceability rating, 2015.*

Nobakht, M., **MS Sakhaeifar**, **D Newcomb**, **P Gudipudi**, and **J Stempihar**, *Development of performance-based and cost-effective rehabilitation strategies for high-traffic-volume flexible pavement, Transportation Research Board 95th Annual Meeting, Transportation Research Board, 2016.*

Nobakht, M., *Characterization of Coupled Aging-Moisture Degradation for Hot Mix Asphalt Concrete, 2018.*

Nobakht, M. and **D Zhang**, *Characterization of the Combined Effect of Temperature and Moisture on the Adhesive Bond Energy of Asphalt Concrete, Transportation Research Board 100th Annual Meeting, Transportation Research, 2021.*

Carlos Cary, Ph.D. P.E.
Project Engineer

Professional Background

Carlos Cary, PhD, PE specializes in pavement design and analysis and has 18 years of experience in geotechnical/pavement engineering with more than seven years dedicated to investigations on airport pavement design and construction. In 2014, Dr. Cary took a leadership role in planning and implementing airport pavement research projects for the FAA ATR-E26 branch in support of data development for evaluating the adequacy of current pavement design-standards/ construction-specifications and implementing updates accordingly. Dr. Cary's areas of expertise include geotechnical engineering for pavement structures, unsaturated soil mechanics, highway/airport pavement design and analysis, laboratory and field characterization of pavement construction materials, pavement instrumentation and full-scale accelerated testing, non-destructive evaluation of pavements, and environmental effects on the mechanical response of pavements materials. He is the author of more than 40 publications including technical articles and reports.

Education

- Ph.D., Civil Engineering, Arizona State University, Tempe, AZ
- M.S., Civil Engineering, Arizona State University, Tempe, AZ
- B.S., Civil Engineering, Ricardo Palma University, Peru

Registrations/Certifications

- Professional Engineer: Delaware

Key Experience

- Geotechnical Engineering
- Highway & Airport Pavement Design
- Full Scale Accelerated Testing
- Non-Destructive Evaluations
- Construction Specifications

Professional Development & Service

- Former technical committee member for the Transportation Research Board of the National Academies - Engineering Behavior of Unsaturated Soils Committee.
- Reviewer for the Transportation Research Record: Journal of the Transportation Research Board, Transportation Research Board of the National Academies.
- Reviewer for ASCE International Journals: Transportation Engineering, Journal of Geomechanics, and Journal of Materials in Civil Engineering.
- Reviewer for the International Journal of Pavement Research and Technology

Related Project Experience

South Dakota Granular Moisture-Density Curve Development and Dynamic Cone Penetrometer Implementation (Feb. 2024 – Present)

Dr. Cary serves as the principal investigator for this research project. The Ohio moisture-density family of curves used by the South Dakota Department of Transportation (SDDOT) were not developed specifically for native granular base/subbase materials. The available moisture-density family of curves developed for South Dakota in past research efforts are not useable in their current form and further refinement is needed. Recommendations from previous research also suggested SDDOT use the strength-based Dynamic Cone Penetrometer (DCP) testing procedure for quality control (QC) in field compaction of granular materials. Dr. Cary is leading

the research effort in refining the new SDDOT granular moisture-density curves and validating the DCP-based specifications proposed for SDDOT in past studies.

Quality Assurance of Pavement Distress Data for the North Carolina Department of Transportation (NCDOT) (Jan. 2023 – Present)
Dr. Cary is leading the independent quality assurance effort for the control of pavement distress data for the NCDOT. Pavement data is being collected by Fugro Roadware and delivered to the NCDOT. The project includes over 20,000 miles of pavement survey data from Interstate and Primary route pavements. Data is collected using 3-D digital imaging and automated pavement distress identification techniques. Dr. Cary develops the independent QA reports and Year-to-Year comparison reports, documenting that high quality distress data is delivered.

NCHRP 01-57B: Validating Standard Definitions for Comparable Pavement Cracking Data (Jul. 2023 – Present)
QES is part of the research team working on the validation and refinement of the proposed definitions developed in NCHRP Web-Only Document 288 for cracking in asphalt- and concrete-surfaced pavements. Dr. Cary assisted in the literature review to document current state agency practices related to collection and use of cracking data. Also, Dr. Cary assisted in the development of a cracking data quality assessment plan using the field-based ground referencing method. This plan will be implemented in the second phase of the project as part of the validation of standard crack definitions effort.

Tucson International Airport, PCN and PCR Determination (Jun. 2024 – Present)
QES provides pavement consulting services for the calculation of Pavement Classification Numbers (PCN) and Pavement Classification Ratings (PCR) for 46 facilities and 186 management sections including two runways and multiple taxiways and aprons with flexible and rigid pavement types. Dr. Cary conducted the PCR calculations and assists with the PCN calculations and development of the draft report.

Oakland International Airport FWD Testing, PCR Determination, and Remaining Life Analysis (2023)
QES executed FWD testing, determination of pavement layers and subgrade structural properties, calculation of Pavement Classification Numbers (PCR), and Remaining Life Analysis for 25 facilities and 81 management sections including four runways and multiple taxiways and aprons with flexible, rigid, and composite pavement types. Dr. Cary conducted the data analysis, structural analysis, PCR calculations and Remaining Life analysis and developed the draft report.

Las Vegas International Airport HWD Testing and Tunnel Support Evaluations (2023)
QES completed HWD testing on five separate facilities (two runways and three taxiways) having a tunnel running transversely across the features. Deflection and joint testing were completed before, after, and above the tunnels to evaluate the pavement structural support. Dr. Cary analyzed the HWD data for subgrade support, load transfer, and material properties. Dr. Cary aided in the development of the pavement performance report.

Aspen Municipal Airport FWD Testing, PCR Determination, and Remaining Life Analysis (2023)
QES executed HWD testing, determination of pavement layers and subgrade structural properties, calculation of Pavement Classification Numbers (PCR), and Remaining Life Analysis for the runway at Aspen, CO. Dr. Cary conducted the data analysis, structural analysis, PCR calculations, and Remaining Life analysis, and aided in the development of the draft report.

Post-Construction Roads Assessment, Blue Sky Greenfield Wind Farm, Fond Du Lac County WI and Crane Creek Wind Farm Howard County, IA (2023)
In 2022, QES performed pre-construction assessments of several miles of roadways associated with two separate wind farms collecting base line pavement condition data. In 2023, after completion of the wind farm construction and maintenance operations, QES again collected pavement condition data on the same roadways. The damage created from the construction efforts was documented and reported as the reduction in remaining service life of each route. All efforts were documented in a final report. Dr. Cary assisted in the data analysis, remaining life evaluations and development of draft reports

*Dr. Cary's Engineering experience prior to joining the QES team includes:

Horizon Engineering Consulting
Principal Engineer (Mar. 2020 – Dec 2022)
Roles and Duties: Contract technical lead for planning, design, and implementation of airport pavement investigation projects in support of the development of design standards and construction methods/specifications at the FAA's National Airport Pavement Test Facility (NAPTF). Lead geotechnical engineer for the FAA's ATR-E26 sponsored projects. Specialist in laboratory and field characterization of pavement materials for verification of compliance with and revision of current construction specifications.
Achievements: In support of development and improvement of airport pavement design standards and construction methods/specifications at the NAPTF: (1) Implementation of Construction Cycle 9 (CC9) construction material characterization, full-scale pre-traffic, and traffic test plans, (2) Completion of Construction Cycle 7 (CC7) and Construction Cycle 8 (CC8) comprehensive test reports, and (3) Joint publishing with the FAA's ATR branch personnel and dissemination of findings at conferences.

Gemini Technologies Inc.
Lead Pavement/Geotechnical Engineer (Nov. 2014 – Feb. 2020)
Roles and Duties: Pavement team lead for planning, design, and implementation of airport pavement investigation projects in support of the development of design standards and construction methods/specifications at the FAA's NAPTF. Lead geotechnical engineer for the FAA's ATR-E26 sponsored projects. Field inspection and oversight of laboratory and field technician crews during construction, performance monitoring, condition evaluation, and forensic investigation of flexible and rigid test pavements.
Achievements: In support of development and improvement of airport pavement design standards and construction methods/specifications at the NAPTF: (1) Planed and implemented CC9 material characterization and traffic test plans, (2) Provided technical expertise during construction of NAPTF's CC8 and CC9, and National Airport Pavement and Materials Research Center (NAPMRC) – Test Cycle 1 (TC1), (3) Planning of CC8 post-traffic test, (4) Planning and execution of CC7 post-traffic forensic investigation and preparation of comprehensive technical reports, (5) Execution of full-scale traffic test and preparation of comprehensive technical

reports for CC7 and CC8 projects, (6) Provided geotechnical expertise on field soil exploration as part of FAA's Extended Airport Pavement Life project, (7) Joint publishing with the FAA's ATR branch personnel and dissemination of findings at conferences, and (8) Development of in-house standard operating procedures for construction material characterization and maintenance of the related equipment.

Rowan University
Postdoctoral Research Scholar (Sept. 2013 – Jun. 2014)
Roles and Duties*:* Program assistant, leading civil engineering undergraduate students in FAA's ATR-E26 sponsored airport pavement research projects to support the development of design/construction methods and standards at the NAPTF. Specialist in laboratory characterization methods for airport pavement construction materials.
Achievements: Investigation of traffic induced compaction using NAPTF instrumentation data. Dissemination of research findings.

North Carolina State University
Postdoctoral Research Scholar (Aug. 2012 – Jul. 2013)
Roles and Duties*:* Lead geotechnical engineer with specialty in advanced laboratory testing methods/standards. Trained graduate students in advance testing methods for unsaturated soils. Lecturer for graduate level class on Unsaturated Soil Mechanics.
Achievements: Laboratory upgrade of advanced unsaturated soil testing equipment. Provided specialized personnel training and guidance in the implementation of laboratory capabilities for unsaturated soil testing.

Arizona State University
Postdoctoral Research Scholar (Feb. 2012 – Jun. 2012)
Roles and Duties*:* Team member in the planning and implementation of pavement research projects. Prepared comprehensive technical reports documenting research findings.
Achievements: Completion of a feasibility study on unsaturated soil modeling for airport pavement design methods. Dissemination of research findings.

Arizona State University
Graduate Research Associate (Jan. 2009 – Dec. 2011)
Roles and Duties*:* Graduate researcher. Specialist in advanced laboratory testing methods for soils and highway pavement materials. Material characterization, data analysis and modeling. Preparation of research reports and technical articles. Teaching assistant for undergraduate level civil engineering courses including geotechnical engineering related subjects and engineering drafting with AutoCAD.
Achievements: Development of a model for pore-water pressure response of a soil subjected to traffic loading under saturated and unsaturated conditions. Integration of a national database of subgrade soil-water characteristic curves and soil index properties for use with the Mechanistic-Empirical Pavement Design Guide (MEPDG). Development of computer program for the structural design of airfield pavements incorporating unsaturated soil mechanics principles. Development of an enhanced model for resilient response of soil resulting from seasonal changes as implemented in the MEPDG. Dissemination of research findings.

Arizona State University
Graduate Research Assistant (Aug. 2006 – Dec. 2008)
Roles and Duties: Graduate researcher. Specialist in advanced laboratory testing for soils and highway pavement materials. Material characterization, data analysis, and modeling. Preparation of research reports and technical articles.
Achievements: Development of stress-dependent predictive model for resilient modulus in unsaturated unbound materials. Completed research towards the implementation of the MEPDG for the Maricopa County. Collaborated in initial efforts for the development and implementation of the MEPDG in Arizona. Dissemination of research findings.

Camineros S.A.C. - Peru
Junior Engineer (Sept. 2005 – Jun. 2006)
Roles and Duties: Civil engineer supporting projects on rehabilitation and improvement of highways in South America. In-situ evaluation of pavement condition and performance. Preparation of reports.
Achievements: Collaborated in studies on the rehabilitation and improvement of the Ilo-Desaguadero Highway and Highway Corridor Amazonas-Centro in Peru, and the Santa Cruz-Montero Highway in Bolivia.

Publications

Peer-Reviewed Papers
- Evaluation of Concrete Pavement Joint Performance at the FAA National Airport Pavement Test Facility. In Conference Proceedings of the ISCP 12th International Conference on Concrete Pavements (ICCP), Virtual Conference, 2021.
- Field and Laboratory Characterization of Cement Treated Permeable Base for Flexible Airport Pavement at the FAA's National Airport Pavement Test Facility. In Conference Proceedings of the ASCE International Airfield and Highway Pavements Conference, Virtual Conference, 2021.
- Mechanical Response of Unbound Materials in Perpetual Pavement Sections at the National Airport Pavement Test Facility. In Conference Proceedings of the International Society for Asphalt Pavements 2018 - Fortaleza, Brazil, 2018.
- Effect of Pavement Structure on the Mechanical Response and Performance of Perpetual Pavements at the National Airport Pavement Test Facility. Transportation Research Record, No 2672, 2018.
- Pore-Water Pressure Response of a Soil Subjected to Dynamic Loading Under Saturated and Unsaturated Conditions. In the ASCE International Journal of Geomechanics, Vol. 16, No. 6, 2016.
- Evaluation of Asphalt Concrete Layer Response Using Asphalt Strain Gauges and Fiber Optic Strain Gauges. In Conference Proceedings of the International Conference on Transportation and Development 2016 - Houston, Texas, 2016.
- Subgrade Moisture Measurement at the National Airport Pavement Test Facility. Presented at the Transportation Research Board 95th Annual Meeting, Washington, D.C., 2016.
- Evaluation of Asphalt Concrete Layer Response Using Fiber-Optic Strain Plate and H-bar Strain Gauge. Presented at the Transportation Research Board 95th Annual Meeting, Washington, D.C., 2016.

- Suitability of the Superpave Gyratory Compactor for the Assessment of Compaction Characteristics of Unbound Materials. In Conference Proceedings of the International Symposium on Geomechanics from Micro to Macro (IS-Cambridge 2014), Cambridge, UK, 2014.
- Characterizing and Incorporating Particle Morphology in Discrete Element Modeling. In Conference Proceedings of the International Symposium on Geomechanics from Micro to Macro (IS-Cambridge 2014), Cambridge, UK, 2014.
- Unsaturated Soil Modeling for Airfield Pavement Design. In the ASCE Journal of Transportation Engineering, Vol. 140, No. 1, 2014.
- Integrating a National Database of Subgrade Soil-Water Characteristic Curves and Soil Index Properties with the MEPDG. In Transportation Research Record: Journal of the Transportation Research Board, No 2349, 2013.
- Comparison of Airfield Flexible Pavement Design Thickness Based Upon Differing Agency Limiting Subgrade Strain Criteria. In Transportation Research Record: Journal of the Transportation Research Board, No 2305, 2012.
- Modelo de Predicción del Módulo Resiliente para Suelos no Saturados. In Revista Internacional de Desastres Naturales, Accidentes e Infraestructura Civil, Vol. 12, No 1, Universidad de Puerto Rico, 2012.
- Resilient Modulus for Unsaturated Unbound Materials. In International Journal of Road Materials and Pavement Design, Vol. 12, No 3, 2011.
- Example of data Collection to Support the MEPDG Implementation for County Roads. In Transportation Research Record: Journal of the Transportation Research Board, No 2225, 2011.
- Enhanced Model for Resilient Response of Soil Resulting from Seasonal Changes as Implemented in "Mechanistic–Empirical Pavement Design Guide". In Transportation Research Record: Journal of the Transportation Research Board, No 2170, 2010.
- Comparative Study of a Mechanistic Resilient Modulus Predictive Equation for Unbound Materials. In Conference Proceedings of the 2nd International Conference on Transport Infrastructures ICTI-2010, Sao Paulo, Brazil, 2010.
- Resilient Modulus Testing for Unsaturated Unbound Materials. In Proceedings (Annual Meeting DVD) of the Transportation Research Board-Annual Meeting, 2010.
- A New Generation of Resilient Modulus Characterization of Unbound Materials. In Geotechnical Special Publication No. 187: Selected Papers from the 2009 ASCE International Foundations Congress and Equipment Expo, Orlando, Florida, 2009.
- Evaluating the Utility of Existing Pavement Management System State Deflection Data for Use in the Implementation of the ME-PDG for Arizona. In Proceedings (Annual Meeting DVD) of the Transportation Research Board-Annual Meeting, 2009.

Technical Reports
- Construction Cycle 9 - Construction Report, FAA, 2020.
- Construction Cycle 9 - Comprehensive Test Plan, FAA, 2020.
- Construction Cycle 9 - Material Characterization Plan, FAA, 2018.
- Construction Cycle 8 - Comprehensive Post-Traffic Test Plan, FAA, 2020.
- Construction Cycle 8 Phase 4 – Strength/Fatigue Test Report, FAA, 2020.
- Construction Cycle 8 Phase 3 – Joint Comparison Test Report, FAA, 2019.
- Construction Cycle 8 Phase 2 – Overlay Test Report, FAA, 2018.
- Construction Cycle 7 Post-Traffic Report – Laboratory Testing, FAA, 2019.
- Construction Cycle 7 Test Report – Overload Test, FAA, 2017.

- Construction Cycle 7 Test Report – Perpetual and Asphalt Treated Drainable Base Test, FAA, 2017.
- Compaction Characteristics of Subbase material using the Superpave Gyratory Compactor – Interim Report, FAA, 2014.
- Unsaturated Soil Modeling for Military Airfield Pavement Design – A Feasibility Study, Tigerbrain Engineering Inc./USACE, 2012.
- NCHRP 9-23B-Integrating the National Database of Subgrade Soil-Water Characteristic Curves and Soil Index Properties with the MEPDG, NCHRP, 2012.
- Pore-Water Pressure Response of a Soil Subjected to Traffic Loading under Saturated and Unsaturated Conditions, PhD Dissertation, Arizona State University, 2011.
- Design Practices for Aggregate Bases (AB) in Arizona-Influence of Fines on AB Material Performance, Arizona DOT, 2011.
- Resilient Modulus Testing for Unsaturated Unbound Materials, Master Thesis, Arizona State University, 2008.
- Evaluation of FORTA Fiber Reinforced Asphalt Mixtures Using Advanced Material Characterization Tests, FORTA Corporation, 2008.
- Pavement Design Research Towards the Implementation of the Mechanistic-Empirical Pavement Design Guide – Second Year Summary Report. Maricopa County DOT, 2008.
- Evaluating the Utility of Existing PMS State FWD Deflection Data for Use in Implementing the ME-PDG for Arizona DOT – SPR 606 - Development and Implementation of the Mechanistic Empirical (M-E) Pavement Design Guide for Arizona (Inter Team Technical Report), Arizona DOT, 2008.
- Pavement Design Research Towards the Implementation of the Mechanistic-Empirical Pavement Design Guide – First Year Summary Report, Maricopa County DOT, 2007.

Luis Ramirez, P.E.
Data Quality Management Engineer

Professional Background

Luis Ramirez, P.E. is a licensed Professional Engineer with a Master of Science in Civil Engineering from the University of Pittsburgh. Specializing in pavement engineering, he brings extensive experience in the design and analysis of pavement structures, pavement management systems, and condition assessments. His expertise also encompasses pavement instrumentation and data acquisition, along with field and laboratory testing of construction materials. Adept in geotechnical investigation and design, Luis is well-qualified in overseeing construction activities for transportation projects. He excels in cost analysis and budget management, backed by a solid background in estimation. Additionally, he has a proven track record in crafting comprehensive engineering and investigative reports. Technically proficient, he is skilled in a range of Civil Engineering software including AutoCAD and MicroStation, as well as specialized pavement engineering applications such as Pavement ME, PAVER, Kenlayer, StreetSaver, and MODULUS.

Education

- M.S., Civil Engineering, University of Pittsburgh
- B.S., Civil Engineering, Escuela Colombiana de Ingeniería Julio Garavito (Julio Garavito Columbian School of Engineering)

Registrations/Certifications

- Professional Engineer: Maryland No. 52770

Key Experience
• Pavement Evaluation
• Pavement Design
• Pavement Management
• Material Characterization
• Instrumentation
• Non-Destructive Testing
• Cost Estimating

Related Project Experience

Project Engineer, QA/QC for Semi-Automated Distress Data Collection for the District of Columbia DOT (PSI, 2022-2024)

As Project Engineer, Mr. Ramirez performed comprehensive quality assurance and quality control reviews of semi-automated pavement distress data for approximately 200 lane-miles of the DDOT roadway network each year. Responsibilities included verifying field-collected imagery and sensor data for accuracy, identifying discrepancies in pavement condition ratings, and ensuring compliance with DDOT and industry standards for data integrity. He conducted in-depth analysis to assess surface distresses, categorize severity levels, and validate network-level pavement condition indices. His work directly supported engineering decisions for pavement preservation and rehabilitation, ensuring that the data used for design and maintenance planning was complete, reliable, and technically sound.

Project Engineer, North Carolina Department of Transportation (NCDOT, 2020-2023)

Mr. Ramirez contributed to the development and refinement of distress data control limits for NCDOT's statewide pavement management program, encompassing over 19,000 centerline miles of roadway annually. He established parameters to minimize variability in distress measurement results, ensuring consistency and reliability across multiple data collection cycles and contractors. Mr. Ramirez also performed detailed year-over-year comparative analyses to identify network-level pavement performance trends, assess changes in surface condition, and verify that recorded distresses aligned with expected deterioration patterns. His efforts

enhanced the accuracy of NCDOT's pavement condition database, enabling more effective prioritization of roadway rehabilitation and preservation projects.

Research Engineer, Research for the Federal Highway Administration (FHWA) Office of Federal Lands Highway (FHWA, 2022)
As Research Engineer, Mr. Ramirez conducted in-depth statistical analysis of Highway Performance Monitoring System (HPMS) cracking data collected at six designated control sites. The study evaluated results from both manual and automated distress surveys performed by multiple pavement data collection vendors, enabling a comprehensive assessment of measurement variability and accuracy. He applied statistical methods to compare cracking type, extent, and severity classifications across systems, identifying discrepancies and potential sources of error. His findings provided FHWA with actionable insights to improve data collection protocols, enhance the reliability of HPMS pavement condition reporting, and support more consistent decision-making for roadway asset management.

Project Engineer, Fresno Yosemite International Airport FWD Testing, PCN Determination, and Remaining Life Analysis (Kimley Horn, 2021)
Mr. Ramirez conducted Falling Weight Deflectometer (FWD) testing to evaluate the structural response of airfield pavements on Runways 11R/29L and 11L/29R at Fresno Yosemite International Airport. He analyzed deflection data to determine subgrade and pavement layer moduli, providing critical insight into the structural capacity of the pavement system. Mr. Ramirez calculated Pavement Classification Numbers (PCN) in accordance with FAA standards to assess the runways' capability to support various aircraft loadings, and estimated the remaining structural life to inform long-term rehabilitation strategies. His work supplied FHWA with accurate, engineering-grade data to guide investment decisions and ensure the continued safety and performance of the Fresno-Yosemite International Airport.

Project Engineer, Pavement Management Technical Assistant Program for Multiple Cities in the Bay Area [Metropolitan Transportation Commission (MTC), 2021]
Mr. Ramirez served as a project engineer for the P-TAP 21 contract, which assigned six Bay Area cities to receive StreetSaver PMS updates in 2020. Project details include the confirmation and correction of existing management sections, manual pavement distress surveys, StreetSaver updates (including updating the decision tree and cost table), adding any M&R information, and generating various budget option reports. **All six of these projects were completed on time and within budget.** Two cities provided additional challenges in their request for project lists meeting certain criteria (references provided). For the City of San Mateo, the unique challenge of custom scenario generation went beyond StreetSaver's standard capabilities. Many scenarios required the elimination of failed streets (streets that fall below a PCI of 30) over a specified period while maintaining all street sectional PCIs (rather than network PCI) above a certain index such as 50. The desired PMP was achieved with a bit of creativity that involved making changes to the decision tree that would, in turn, generate an annual list of streets which could then be saved as project lists. No single standard StreetSaver analysis or report could be utilized, but by running separate reports and combining the data, QES was able to achieve the City's desired outcome.

QES

Matthew Baker
Field Distress Rater

Professional Background

Mr. Baker joined QES in 2016 rating pavement distresses and developing software programs. He developed the tablet application we currently use for manual distress ratings. This application is GIS based, has built-in PCI calculations, and provides cloud storage. He has developed several applications for the processing and comparison of high-speed pavement distress data and has rated hundreds of miles of roadway pavements. Mr. Baker has been performing StreetSaver distress ratings since 2018 and is an MTC certified pavement distress rater. He is the lead data analyst for our distress data Quality Assurance review of 12,000 miles of roadway in New Mexico, annually.

Education

- B.S., Computer Science and Engineering, University of Nevada, Reno, NV
- A.A., Criminal Justice, Los Angeles Pierce College, Los Angeles, CA

Registrations/Certifications

- MTC-Certified Pavement Distress Rater

Key Experience

- Roadway Pavement Distress Identification
- Automated Distress Quality Assurance
- StreetSaver PMS System
- Software Development

Related Project Experience

Implementation of TPF-5(299) study products: Transverse Profiler Certification, 2D/3D Pavement Image Standard Data Format, and Cracking Assessment, Federal Highway Administration (FHWA) (2022 – Active/Ongoing)

This study facilitates the implementation of the three products which have been developed under the TPF pool fund: (1) Transverse Profile Certification Standards (2) 2D/3D Pavement Surface Image Standard Data Format (3) Guidelines for Cracking Assessment for Use in Vendor Selection Process for Pavement Crack Data Collection/Analysis Systems and/or Service. Mr. Baker provides support in conducting TPP certification assessments and processes the resulting data. He provides recommendations and revisions to AASHTO PP106 – PP110 standards and maintains the algorithms used for certification assessment processing.

Distress Data Quality Assurance, New Mexico Dept. of Transportation (NMDOT) (Sub to Fugro) (2022-2023)

QES provided a 2% Quality Assurance check on the pavement distress data provided by the vendor on 12,000 miles annually. Mr. Baker selected samples, directed and reviewed distress ratings by two rating technicians, processed the rating databases and developed comparison reports for NMDOT. In addition to annual checks, a year-to-year data check was also conducted as required.

Bay Area MTC P-TAP 19 through P-TAP 21 (2018-2021)

Led the pavement distress data collection efforts following StreetSaver survey criteria for Alameda, Atherton, Cloverdale, Healdsburg, Los Gatos, Mountain View, San Leandro, San Mateo, and Sebastopol.

Independent Verification & Validation (IV&V) of Pavement Distress Data for the Virginia Department of Transportation (VDOT) (Sub to Fugro Roadware) (2016 – Active/Ongoing)
QES provides direction and oversight of the IV&V of 25,000 miles of pavement distress data collected using digital imaging and semi-automated pavement distress identification. Mr. Baker provides distress rating efforts, completes data processing, and generates comparison files for 19 separate deliverables per year.

CERTIFICATE OF ACHIEVEMENT

This is to certify that

Matthew Baker

has completed the requirements of the

MTC StreetSaver Rater Certification Program

with the skills and knowledge on pavement condition
assessment based on the MTC's modified ASTM D6433

Certificate valid until Dec 05 2024

Serial no: 1147

Sui Tan, StreetSaver Program Manager
Metropolitan Transportation Commission

Street Saver

Jason Clinton
Senior Technician & Distress Rater

QES

Professional Background

Since June 2004, Mr. Clinton has assisted the QES engineering staff in pavement engineering efforts including pavement distress identification, deflection testing, materials sampling, coring, traffic control and computer maintenance. He has over 15 years' experience in pavement distress evaluations ranging from windshield level surveys to automated data imaging. He is experienced in various distress identification methods including PAVER, StreetSaver, ICON, Pennsylvania DOT, Ohio DOT and Virginia DOT. He has worked on projects ranging from city streets to interstate highways and commercial aviation airfields. Mr. Clinton was initially trained in pavement distress identification by Mr. Frith using the ASTM D6433 principals. Mr. Frith was a primary instructor for the NHI pavement distress identification course as well as for the LTPP regional contracts. Mr. Clinton completes a refresher course and evaluates a minimum of 10 control sites annually for re-certification. He completed the Metropolitan Transportation Commission (MTC) Pavement Management Technical Assistance Program (P-TAP) qualification test and is a certified distress rater.

Key Experience
• Roadway Pavement Distress Identification
• Automated Distress Measurements
• Airfield Pavement Distress Identification

Education

- High School Diploma, McQueen High School, Reno, NV

Registrations/Certifications

- MTC-Certified Pavement Distress Rater

Related Project Experience

Lead Distress Rater, Bay Area MTC P-TAP 14 through P-TAP21 (2013-2021)
Mr. Clinton led the pavement distress data collection efforts following StreetSaver survey criteria for American Canyon (2), Atherton, Belvedere, Cloverdale, Colma, Foster City, Healdsburg, Hercules, Los Altos (2), Los Altos Hills (2), Los Gatos (2), Martinez, Menlo Park, Millbrae, Milpitas, Monte Sereno, Mountain View, Newark, Novato, Pacifica, San Bruno, Sebastopol, Suisun City, Union City, Walnut Creek, and Yountville.

Lead Non-PMS Asset Rater, Bay Area MTC P-TAP 20 (2019)
Led the Non-PMS asset inventory and data collection efforts for the City of Clayton which consisted of the survey of all curb ramps.

Lead Non-PMS Asset Rater, Bay Area MTC P-TAP 18 (2017)
Led the Non-PMS asset inventory and data collection efforts for the Town of Colma which consisted of the survey of all sidewalks, curb, and curb ramps.

Lead Distress Rater, Sonoma County (2016-2022), Berkeley, CA (2015) City of Pittsburg, CA (2016), City of Richmond, CA (2019), and City of Fairfield, CA (2021)
Under subcontract to NCE, served as the lead pavement distress rater for data collection efforts following StreetSaver survey criteria for the entire City of Berkeley, CA, the City of Pittsburg, CA 180 miles of Sonoma County, and 42 miles of the City of Richmond.

Lead Distress Rater, Santa Clara County, CA (2019)
Under subcontract to Harris, served as the lead pavement distress rater for data collection efforts following StreetSaver survey criteria for 35 miles.

Lead Distress Rater, City of Saratoga, CA (2019) & San Jose, CA (2019)
Under subcontract to Fugro, served as the lead pavement distress rater for data collection efforts following StreetSaver survey criteria for the entire City of Saratoga and for 327 miles in the City of San Jose, CA

Associate Distress Rater, Caltrans Airport Pavement Management Systems Update, (2018)
Under contract to Kimley-Horn, completed airside pavement distress evaluations on 15 general aviation airports located throughout California using ASTM 5340 procedures.

Lead Distress Rater, 2014 Statewide Airport Pavement Management Study (DOAV PC# VASP-33, 841:14-002 Pavement Management Services) (2014/2015) Commonwealth of Virginia
Led the pavement distress data collection efforts on numerous commercial and general aviation airfield pavements located throughout Virginia.

Senior Rater, Independent Verification & Validation of Pavement Distress Data for the Virginia Department of Transportation (VDOT) under contract to Fugro Roadware (2004-Present)
QES provides direction and oversight of the Independent Verification and Validation (IV&V) of 25,000 miles of pavement distress data collected using digital imaging and semi-automated pavement distress identification. Mr. Clinton leads the distress rating efforts, completes data processing and analysis for more than 1,250 miles of Interstate, Primary, and Secondary route pavements per year.

Senior Technician, New Mexico High Speed Data Collection (2013)
Developed two data collection verification sites in Santa Fe and Roswell. Provided IV&V of road assets collected under contract to Mandli Communications.

Senior Technician, Southern California IRI Data Collection, Caltrans (2012)
Setup four IRI control sites using ASTM E-950 in Oxnard, Lancaster, Riverside and Escondido, under contract to Mandli Communications.

Senior Technician, Nevada High Speed Data Collection (2012)
Developed three data collection verification sites in Reno, Las Vegas, and Elko areas. Provided independent verification and validation of road assets collected under contract to Mandli Communications.

Lead Distress Rater, Caltrans Airport Pavement Management Systems Update, (2011)
Completed airside pavement distress evaluations on 71 general aviation airports located throughout California using ASTM 5340 procedures.

Field Distress Rater, Arlington County Pavement Distress Survey Updates, Arlington County, Virginia (2007-2009)
Mr. Clinton was the lead pavement distress rater for the collection of 125 roadway miles per year using the ASTM D6433 methodology.

Field Distress Rater, PAVER Pavement Management System Implementation for the National Roads Authority, Cayman Islands (2008)
Mr. Clinton assisted in the pavement distress data collection, using ASTM D6433, for 90 miles of urban roadways.

Senior Rater, City of Cleveland Pavement Distress Data Collection (2007-2008)
Performed pavement distress ratings on six control sites and then on-going QA efforts for over 100 miles of city streets, using the Ohio DOT methodology.

Field Distress Rater, Caltrans Airport Pavement Management Systems Update, (2007)
Completed airside pavement distress evaluations on 22 general aviation airports located throughout Northern California using ASTM 5340 procedures.

Field Technician/Distress Rater, Highway 160 Pavement Evaluation and Remaining Life Analysis, City of Sacramento, CA (2008)
Assisted the QES engineering staff in collection of existing pavement conditions including distress, deflection, and materials sampling.

CERTIFICATE OF ACHIEVEMENT

This is to certify that

Jason Clinton

has completed the requirements of the

MTC StreetSaver Rater Certification Program

with the skills and knowledge on pavement condition
assessment based on the MTC's modified ASTM D6433

Certificate valid until Nov 02 2024

Serial no: 1145

Sui Tan, StreetSaver Program Manager
Metropolitan Transportation Commission

Street Saver

QES

Eric Miskow
Staff Engineer

Professional Background

Mr. Miskow began working with the KDG Pavements team in 2022 while completing his Geological Engineering degree at the University of Nevada, Reno. Mr. Miskow began as a part-time pavement distress rater. Upon graduation, he joined our team full time continuing as a pavement distress rater while also assisting senior engineering staff in the processing and analysis of distress QA data. He has completed many miles of manual distress ratings, in addition to distress ratings from digital images. Mr. Miskow is a key team member in the NCDOT QA project.

Education

- B.S., Geological Engineering, University of Nevada, Reno, NV

Key Experience
• Roadway Pavement Distress Identification
• Automated Distress Measurements

Related Project Experience

Pavement Distress Rater, Quality Assurance of Pavement Distress Data, North Carolina Department of Transportation (NCDOT) (2023-Present)
This ongoing project consists of QA reviews on 19,000 miles of Interstate and Primary route pavements in North Carolina.

Distress Rater, Independent Verification & Validation of Pavement Distress Data for the Virginia Department of Transportation (VDOT) under contract to Fugro Roadware (2004-Present)
QES provides direction and oversight of the Independent Verification and Validation (IV&V) of 25,000 miles of pavement distress data collected using digital imaging and semi-automated pavement distress identification.

Distress Data Quality Assurance for the New Mexico Department of Transportation (NMDOT) under contract to Fugro (2022-2023)
QES provided a 2% Quality Assurance check on the pavement distress data provided by the vendor on 12,000 miles annually. Mr. Miskow served as a pavement distress rater for data collection efforts.

Distress Rater, Yolo County Distress Data Collection (2024)
QES completed a contract to perform pavement condition inspections for Yolo County's Pavement Management System (PMS) covering the entire 657 centerline miles of the paved road network. QES completed manual distress surveys, following the MTC distress rating methodology, as well as data quality checks and updated the distress data in the StreetSaver database. Mr. Miskow served as a pavement distress rater for data collection efforts following StreetSaver survey criteria.

Distress Rater, Yuba County Distress Data Collection (2024)
QES is currently contracted to support Yuba County in configuring the recently acquired StreetSaver software. The project involves developing roadway segments, updating inventory, conducting a PCI distress survey on 662 miles of County roads, and configuring the StreetSaver software. QES will also aid in developing decision trees and updating maintenance and rehabilitation fields. Mr. Miskow served as a pavement distress rater for data collection efforts following StreetSaver survey criteria.

Distress Rater, Seattle Department of Transportation, StreetSaver PMS Update (2023)
Using high speed automated data collection technologies, QES was the prime contractor in updating the StreetSaver pavement distress condition on approximately 950 lane-miles of arterial and collector streets in the City of Seattle. Mr. Miskow was part of the QC Team.

Distress Rater, North Carolina Department of Transportation (2022-2024)
QES provides direction and oversight of approximately 19,000 miles per year. of pavement distress data collected using digital imaging and semi-automated pavement distress identification. Mr. Miskow served as a pavement distress rater for data collection efforts.

Mostafa Nakhaei, Ph.D. | Data Analysis Engineer

12 Years of Experience

Mostafa Nakhaei, Ph.D. is Consulting Manager and Senior Pavement Engineer at Civil Infrastructure Solution (CIS) with over 12 years of civil engineering experience. He has developed Capital Improvement Programs for more than 120 U.S. cities and counties in the past four years, totaling over $1 billion in capital improvement projects. Mostafa specializes in pavement engineering, including construction, management, structural design, lab testing, and FWD analysis. With a dual degree in Data Science, he created MASTIC and Back-MASTIC for layered elastic analysis and modulus back-calculation, and led the development of ISA, a deep learning software for structural data analysis. He has implemented pavement and asset management systems for municipal agencies and is proficient in tools such as SAMS™, ESA™, StreetLogix™, AgileAssets™, PAVER™, StreetSaver™, Lucity™, and Cartegraph™.

Education & Credentials

- Ph.D., Civil and Environmental Engineering, Auburn University
- M.S., Data Science, Auburn University

Relevant Experience

City of Dallas, Texas – Project Manager

Mostafa led the comprehensive pavement and asset data collection initiative for the entire City of Dallas, Texas, encompassing over 6,000 centerline miles of roadway. The project utilized a fleet of seven collection vans operating within a compressed schedule, requiring significant coordination to ensure data quality and comparability across all vehicles.

To maintain data consistency, Mostafa established control sites located throughout the city. These sites were evaluated at the start and end of each van's deployment, as well as on a monthly basis, to verify uniformity in measurements. The scope extended beyond pavement assessment to include other critical municipal assets such as sidewalk ramps, retaining walls, and additional infrastructure elements.

Pavement management and analysis were conducted within the AgileAssets platform, with condition ratings reported in accordance with ASTM D6433 and ASTM E3303 standards. Data was collected and delivered at a high-resolution 50-foot interval, providing the City with highly detailed and actionable insights. With operational efficiency, the project was completed and delivered in May 2025—four months ahead of schedule—allowing the City's engineering team ample time to prepare and refine their presentation to the City Council in August 2025.

City of Riverside, California – Project Engineer

From 2022 to 2025, Mostafa led a multi-year pavement condition assessment and management effort for the City of Riverside, building upon a baseline network survey completed in 2017. He oversaw pavement data collection for approximately 875 centerline miles of roadway, as well as a network-level structural evaluation of about 100 test miles using a FastFWD system.

A central success factor of the project was Mostafa's implementation of a rigorous year-to-year comparison methodology. This approach ensured consistency in data across multiple collection cycles, enabling the City to accurately track network health over time and present a clear, reliable narrative to City Council. By maintaining uniform evaluation standards, the program could measure the actual returns on investment from various rehabilitation activities, validate the effectiveness of past interventions, and inform refinements to the City's maintenance strategies.

Drawing on these insights, Mostafa developed a data-driven pavement management plan and multi-year budget forecast within the City's Lucity™ asset management platform. The plan was tailored to integrate seamlessly with Riverside's established rehabilitation strategies, cost models, and priority frameworks—ensuring both operational compatibility and long-term sustainability in the City's pavement management program.

City of Winnipeg, MB – Project Manager

Mostafa served as the project manager for a citywide pavement and asset management program in Winnipeg, Manitoba. The project focused on comprehensive pavement condition surveys and a dedicated sidewalk inventory to support ADA compliance evaluations and long-term accessibility planning.

The asset management implementation utilized the AgileAssets™ Pavement Analyst module, incorporating a highly tailored decision tree model that aligned with the City's funding allocation policies across multiple electoral wards. This customization ensured that rehabilitation and maintenance priorities reflected both engineering best practices and the municipality's budgetary framework. Data collection was completed in 2024, followed by a successful asset management implementation in 2025, providing the City of Winnipeg with a robust, data-driven foundation for long-term asset management and strategic investment planning.

City of North Port, Florida – Project Engineer

Mostafa has collaborated with the City of North Port, Florida, on six separate network-level pavement and asset management projects. Serving as Project Engineer, he oversaw the collection and quality assurance of pavement condition data gathered through an automated ASTM D6433 PCI survey covering 814 centerline miles of city-managed roads. He also managed a structural evaluation program for 100 miles of arterials and collectors within the city.

High-resolution roadway imagery was leveraged to conduct a citywide sidewalk inventory, assessing both condition and compliance. As part of the project, Mostafa facilitated the integration of pavement and sidewalk data into the City's Lucity™ asset management program. He performed budget analyses and developed a comprehensive 5-year maintenance and rehabilitation (M&R) plan, addressing the condition of both roadway and sidewalk infrastructure.

Mostafa Nakhaei, Ph.D., CIS Civil Infrastructure Solutions

City of Euless, Texas – Project Manager

In 2022, Mostafa directed the implementation of a pavement management system for the City of Euless' roadway network. This work included an automated ASTM D6433 PCI survey of 184 test miles, along with IRI ride quality and rutting data collection for every roadway segment. In addition, 81 miles of arterials and collectors underwent structural testing using a FastFWD system to evaluate network-level structural integrity.The project utilized the ESA™ pavement management platform. Working closely with City staff, Mostafa developed a 5-year pavement preservation and M&R plan, and provided hands-on ESA training to ensure long-term program sustainabilityHe enabled the City to accurately assess roadway conditions, identify critical maintenance needs, and establish a data-driven plan for strategic investment.

City of Deerfield Beach, Florida – Project Manager

From 2021 to 2022, Mostafa led a full-scale pavement management project for the City of Deerfield Beach. This included an automated ASTM D6433 pavement condition survey of roughly 136 miles of city roadways, supplemented with IRI ride quality measurements.

He collaborated closely with City staff to refine project objectives, scope, and schedule, ensuring alignment with municipal priorities. Using the ESA™ optimization tool, he developed cost-effective rehabilitation strategies that maximized available resources, enabling the City to plan targeted and efficient roadway improvements.

City of Long Beach, California – Project Engineer

Mostafa served as Project Engineer for multiple pavement management program updates in Long Beach, beginning with the original survey in 2013 and continuing through subsequent updates in 2017 and beyond. The initial project encompassed over 900 test miles of roadway, incorporating high-definition imagery and structural deflection testing for arterials. Mostafa has contributed to the City's ongoing pavement and asset management initiatives, ensuring reliable condition assessments and supporting data-driven decision-making.
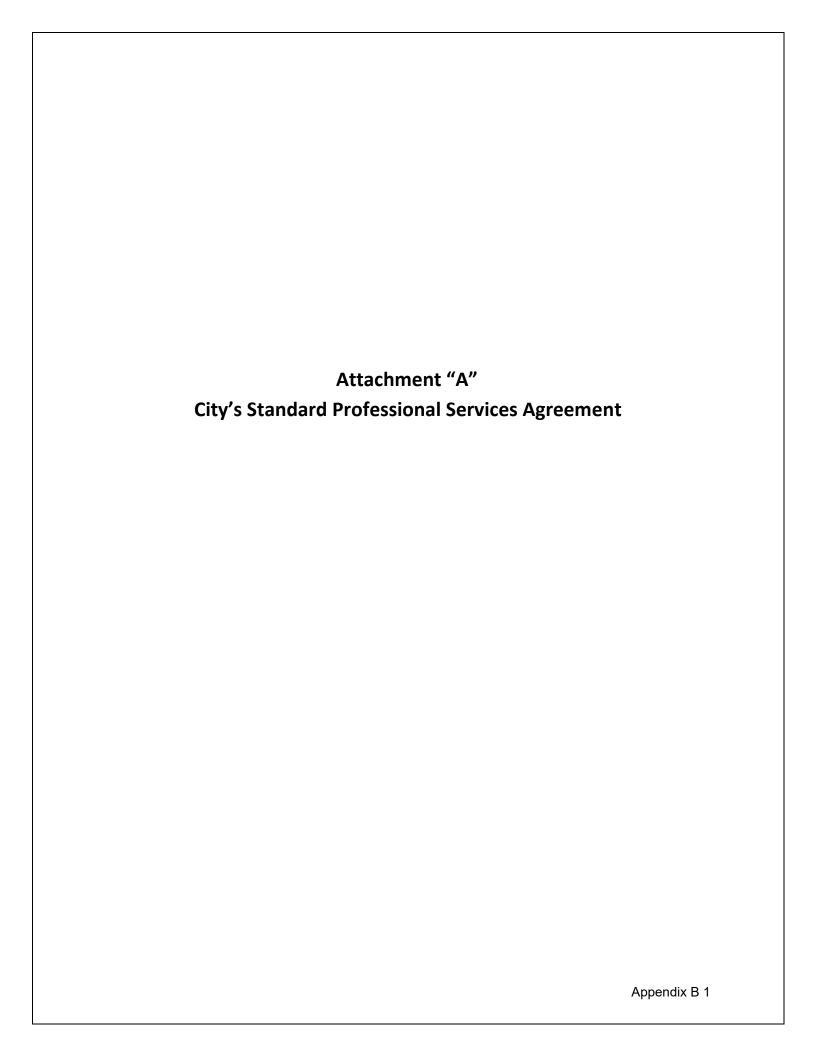
City of Manhattan, Kansas – Project Manager

From 2021 to 2022, Mostafa managed the development of a pavement management system for Manhattan, Kansas, which included an automated ASTM D6433 PCI survey covering 71 miles of city roadways. The project also gathered IRI ride quality and rutting data for each segment. Structural testing on arterials and collectors was performed with a Dynaflect system to assess pavement layer integrity. The PAVER™ platform was used for management and analysis, and Mostafa worked with City officials to create a 5-year pavement preservation and M&R plan tailored to local needs and budget constraints.

City of Seattle DOT, Washington – Project Engineer

Mostafa served as Project Engineer for the Seattle Department of Transportation's, encompassing approximately 1,547 lane-miles of 12-foot-wide pavement. The survey included both asphalt and concrete surfaces, with about one-third of the network consisting of concrete pavements. Using multiple survey vans, Mostafa ensured accurate data capture and analysis. PCI ratings were developed in StreetSaver™, providing Seattle DOT with a reliable assessment of pavement conditions to inform maintenance strategies and capital planning.

Mostafa Nakhaei, Ph.D., CIS Civil Infrastructure Solutions

Appendix B
Professional Services Agreement

Attachment "A"
City's Standard Professional Services Agreement

PROFESSIONAL SERVICES AGREEMENT

This agreement ("Agreement") is made as of [Insert month and date] _____, [Insert Year] by and between the **City of Commerce**, a municipal corporation ("City") and_____ ("Consultant"). City and Consultant are sometimes hereinafter individually referred to as a "Party" and collectively referred to as the "Parties."

R E C I T A L S

WHEREAS, City desires to utilize the services of Consultant as an independent contractor to [insert brief description of work] as set forth in the Scope of Services attached hereto as **Exhibit A;** and

WHEREAS, Consultant represents that it is fully qualified to perform such consulting services by virtue of its experience and the training, education and expertise of its principals and employees.

NOW, THEREFORE, in consideration of performance by the parties of the covenants and conditions herein contained, the parties hereto agree as follows:

1.   Company's Scope of Services. The nature and scope of the specific services to be performed by Consultant are as described in **Exhibit A**.

2.   Term of Agreement. This Agreement shall commence on [Insert month and date], [Insert year] (the "Commencement Date") and shall remain and continue in effect until tasks described in **Exhibit A** are completed, but in no event later than [Insert Date], unless sooner terminated pursuant to the provisions of this Agreement.

3.   Compensation.

A. City agrees to compensate Consultant for services under this Agreement in compliance with the schedule set forth in **Exhibit A**. Consultant shall submit proper monthly invoices in the form and manner specified by City. Each invoice shall include a monthly breakdown of all monthly services performed together with the hours spent on each service. Consultant shall maintain appropriate and necessary documentation supporting the monthly invoices detailing the type of service provided. It shall be available for review by the City at all reasonable times upon request.

B. Total payment to Consultant pursuant to this Agreement shall not exceed _____.

C. If at the request of the City, Consultant is required to incur out of pocket expenses (including but not limited to, out-of-town travel and lodging) which are above and beyond the ordinary expenses associated with performance of this Agreement, Consultant shall be entitled to reimbursement of such expenses. Consultant shall only be reimbursed for those expenses which: (I) appear on Consultant's monthly invoices; (II) are accompanied by a copy of the City's written authorization for Consultant to incur

such expenses; and (III) receipts documenting such expenses.

4.   **General Terms and Conditions**. The General Terms and Conditions set forth in **Exhibit B** are incorporated as part of this Agreement. In the event of any inconsistency between the General Terms and Conditions and any other exhibit to this Agreement, the General Terms and Conditions shall control unless it is clear from the context that both parties intend the provisions of the other exhibit(s) to control.

5.   **Addresses**.

City of Commerce

City of Commerce
2535 Commerce Way
Commerce, CA 90040
Attn: Ernie Hernandez, City Manager

Company

[Insert Selected Consulting Firm]
Attn: [Insert Contact Name]

6.   **Exhibits**. All exhibits referred to in this Agreement are listed here and are incorporated and made part of this Agreement by this reference.

> **Exhibit A** – Scope of Services and Compensation Schedule
> **Exhibit B** – General Terms and Conditions
>
> **SIGNATURES ON FOLLOWING PAGE**

IN WITNESS WHEREOF, the parties have executed this Agreement as of the dates written below.

CITY

CITY OF COMMERCE

By: _____   _____
        Hugo A. Argumedo, Mayor   Date

CONSULTANT

[Insert Consultant Name]

By: _____   _____
        [Insert Consultant Name]   Date

ATTEST:

By: _____   _____
        Lena Shumway, City Clerk   Date

APPROVED AS TO FORM:

By: _____   _____
        Noel Tapia, City Attorney   Date

Appendix C
Quality Control / Quality Assurance Program

Quality Control / Quality Assurance Program

Project-Specific Quality Management Plan (QMP) Development

The QES Team understands that successful projects implement quality control/quality assurance (QC/QA) processes and procedures to ensure that high quality standards are met. We will implement a project-specific version of our standard, rigorous QMP for this project. Our team is committed to providing quality solutions to our clients, and for all our projects we implement project-specific QMPs that address field activities, data processing, analysis, and reporting. Our final QMP plan will consist of these elements, all of which will be formalized with the City prior to data collection.

Phase 1. Project Planning – Before Data Collection

- Project team
- Project schedule
- GIS map and routing plan
- Rater training requirements and equipment calibration
- Systematic data collection process management
- Systematic data processing plan
- Acceptance procedures
- Control sites and ground truth determination plan
- Pilot project data collection/reporting plan

Phase 2. Field Data Collection and Processing

- Pilot data collection and processing
- Production data collection and processing
- Control site testing plan
- Routine equipment inspection and calibration procedures
- Real-time data checks (e.g., imagery and IRI data)
- Corrective action procedures (missing/incomplete data)
- Periodic reports documenting control site and routine accuracy/ precision checks

Phase 3. PCI Rating

- Pavement rater calibration process
- Pavement rating review process
- PCI values final review process

Phase 4. Analysis and Reporting – Post Data Collection

- MicroPAVER database review process
- M&R treatment types and unit cost data development/verification
- Deterioration model development/verification
- Draft/Final report review process

Pavement Data Collection & Processing QC/QA Activities
Our QMP for data collection and processing for this project will be based, in part, on the NCHRP Synthesis 401 titled "Quality Management of Pavement Condition Data Collection."

In developing an effective QMP, it is essential to agree on the terms being used:

1. **Quality Control (QC)** is a system of routine technical activities to measure and control the quality of data as it is being developed. A QC system is designed to: (1) provide routine and consistent checks to ensure data integrity, correctness, and completeness; (2) identify and address errors and omissions; and (3) document and archive data.

2. **Quality Assurance (QA)** activities include a planned system of review procedures conducted by personnel not directly involved in the data development process. Reviews, preferably including independent third parties, should be performed upon a finalized data set following the implementation of QC procedures. These reviews should verify that data quality objectives were met and ensure that the data represents the best possible estimates.

QC/QA Activities during Data Acquisition: As part of our QMP plan, proper calibration and configuration of the data collection vehicle is essential to collecting accurate pavement condition data. Not only does this apply to ensuring that all subsystems are operating within specifications, but defining control sites that will be run throughout the duration of the project to ensure that the data collection equipment is operating within specification and collecting accurate data throughout the duration of the data collection phase. Field operators perform equipment quality control and calibration checks daily to minimize issues with raw data.

QC/QA Activities during Data Processing For data processing, we have programmatically set up quality processing checks to minimize errors and omissions in our work. For quality control, we use personnel not assigned to other tasks on the project to eliminate bias and allow for proper quality assurance.

Project-Specific QC/QA Activities & Team Responsibilities

For this project, we have identified the following major data sets that will require QC/QA as part of this project. These tasks will be conducted by both QES and the City of Commerce, CA. It is critical that the City actively participates in QA activities to ensure confident "ownership" of the data at the end of the project.

Data Element(s)	Responsible Parties		Description of Check (Standard Practice)
	Quality Control	**Quality Assurance**	
Pavement Inventory Definition (and MicroPAVER Database Integrity, when applicable)	QES Project Manager (**Kurt Keifer**) and Project Engineer (**Mona Nobakht**)	QES QC/QA Manager (**Luis Ramirez**) and City of Commerce – *Before and after the pavement condition survey*	Verify that pavement sections and attribute data were collected and entered into MicroPAVER prior to and after performing the PCI survey.
GIS Sectioning	QES Project Manager (**Kurt Keifer**) and Project Engineer (**Mona Nobakht**)	QES QC/QA Manager (**Luis Ramirez**)) and City of Commerce – *Before and after the pavement condition survey*	Verify that pavement sections were correctly defined in GIS and properly linked to the MicroPAVER database.

Automated PCI Inspection Data Collection	QES Data Collection Lead (**Jason Clinton**)	QES Project Manager (**Kurt Keifer**) – *Review status reports remotely.*	Daily checks and calibration of vehicle instrumentation, including DMI, RSP, and image collection hardware and software.
PCI Inspection Data Interpretation and IRI data	QES Data Processing Lead (**Jason Clinton**)	QES Project Manager (**Kurt Keifer**) and City of Commerce – *Review imagery and ratings.*	Verify accuracy of PCI data.
MicroPAVER System Tables	QES Project Engineer (**Mona Nobakht**)	QES Project Manager (**Kurt Keifer**) and City of Commerce	Verify the accuracy of deterioration models, unit cost data, and M&R policies in MicroPAVER.
MicroPAVER Analyses and Reports	QES Project Engineer (**Mona Nobakht**)	QES Project Manager (**Kurt Keifer**) and City of Commerce	Verify the accuracy and repeatability of M&R analyses performed with MicroPAVER.

QES will ensure that all data and deliverables are thoroughly reviewed before acceptance by the City and its member jurisdictions. QES will adhere to the principle of third-party review of pavement inventory and condition data collected and entered into the MicroPAVER database. This means that staff that collected and entered data will not perform the final review their own work. Instead, data will be reviewed by other members of QES team prior to submission to the City of Commerce.

We have significant experience with pavement condition surveys and understand the necessity of collecting accurate data in the field. Incorrect data will inevitably lead to incorrect pavement conditions and thus incorrect treatments. Thus, it is critical that data interpretation be conducted by properly trained and experienced pavement inspectors. QES believes that high quality products are produced by quality people with the right attitude. QES goes to great lengths to recruit technically excellent people and then indoctrinate them with our culture of producing high quality products on schedule and within budget. QES also goes to great lengths to facilitate communications with our clients at every step of our projects to ensure that technical excellence is always achieved.

BUDGET BREAKDOWN AND SUMMARY
2025 City of Commerce PMP Update
Quality Engineering Solutions

LABOR COSTS				Task 1 Proj Mgmt Hrs	Cost	Task 2 PCI Survey Hrs	Cost	Task 3 FWD Testing Hrs	Cost	Task 4 Coring Hrs	Cost	Task 5 PCI Analysis Hrs	Cost	Task 6 FWD Analysis Hrs	Cost	Task 7 QC/QA Validation Hrs	Cost	Task 8 PCC Evaluation Hrs	Cost	Task 9 GIS/PAVER Impl. Hrs	Cost	Task 10 PMP Report Hrs	Cost	TOTALS HRS	COST ($)
Project Staff	Role in Study	% Time	Rate ($/hr)																						
Kurt Keifer	Project Manager		$87.69	48	$4,209	8	$702	4	$351	4	$351	8	$702	4	$351	4	$351	2	$175	4	$351	12	$1,052	98	$8,595
Douglas Frith	Principal Engineer		$87.69	4	$351	4	$351		$0		$0		$0		$0	4	$351		$0		$0	2	$175	14	$1,228
Carlos Cary	Senior Engineer		$68.85		$0		$0		$0		$0	20	$1,377	40	$2,754	16	$1,102		$0		$0		$0	76	$5,233
Luis Ramirez	Senior Engineer		$62.50		$0		$0	60	$3,750	8	$500		$0	80	$5,000		$0		$0		$0	6	$375	154	$9,625
Mona Nobakht	Project Engineer		$55.82		$0		$0		$0		$0	60	$3,349		$0		$0	8	$447	24	$1,340	32	$1,786	124	$6,922
Matthew Baker	Staff Engineer		$34.32		$0		$0		$0		$0		$0		$0	16	$549		$0		$0		$0	16	$549
Jason Clinton	Senior Technician		$31.46		$0	56	$1,762	56	$1,762	12	$378		$0		$0		$0		$0	60	$1,888		$0	184	$5,790
LABOR HOURS/COSTS				52	$4,560	68	$2,815	120	$5,863	24	$1,229	88	$5,428	124	$8,105	40	$2,353	10	$622	88	$3,579	52	$3,388	666	$37,942
Escalation		0.000%			$0		$0		$0		$0		$0		$0		$0		$0		$0		$0		$0
TOTAL LABOR COSTS				52	$4,560	68	$2,815	120	$5,863	24	$1,229	88	$5,428	124	$8,105	40	$2,353	10	$622	88	$3,579	52	$3,388	666	$37,942
OVERHEAD FEE (% of Total Labor Cost)		156.000%			$7,114		$4,391		$9,146		$1,917		$8,468		$12,644		$3,671		$970		$5,583		$5,285		$59,190
ENGINEERING LABOR + OVERHEAD FEE					$11,674		$7,206		$15,009		$3,146		$13,896		$20,749		$6,024		$1,592		$9,162		$8,673		$97,132

SUBCONTRACTOR COSTS		Rate ($/hr)	Proj Mgmt Hrs	Cost	PCI Survey Hrs	Cost	FWD Testing Hrs	Cost	Coring Hrs	Cost	PCI Analysis Hrs	Cost	FWD Analysis Hrs	Cost	QC/QA Validation Hrs	Cost	PCC Evaluation Hrs	Cost	GIS/PAVER Impl. Hrs	Cost	PMP Report Hrs	Cost	HRS	COST ($)
Subcontractor / Role in Study																								
Civ. Infra. Solutions / Data Analysis		$55.00		$0	100	$5,500		$0		$0		$0		$0		$0	20	$1,100		$0		$0	120	$6,600
		$0.00		$0		$0		$0		$0		$0		$0		$0		$0		$0		$0	0	$0
TOTAL SUBCONTRACTOR COSTS			0	$0	100	$5,500	0	$0	0	$0	0	$0	0	$0	0	$0	20	$1,100	0	$0	0	$0	120	$6,600

OTHER DIRECT COSTS	Unit	Rate	Proj Mgmt Unit	Cost	PCI Survey Unit	Cost	FWD Testing Unit	Cost	Coring Unit	Cost	PCI Analysis Unit	Cost	FWD Analysis Unit	Cost	QC/QA Validation Unit	Cost	PCC Evaluation Unit	Cost	GIS/PAVER Impl. Unit	Cost	PMP Report Unit	Cost	Unit	COST ($)
Description																								
Airfare	Trip	$400.00		$0		$0		$0		$0		$0		$0		$0		$0		$0	2	$800	2	$800
Hotel	Day	$229.20		$0		$0	6	$1,375		$0		$0		$0		$0		$0		$0	2	$458	8	$1,834
Per Diem	Day	$86.00		$0		$0	7	$602		$0		$0		$0		$0		$0		$0	2	$172	9	$774
Rental Car	Day	$100.00		$0		$0		$0		$0		$0		$0		$0		$0		$0	2	$200	2	$200
Mileage	Mile	$0.700		$0		$0		$0		$0		$0		$0		$0		$0		$0		$0	0	$0
Airport Parking	Day	$32.00		$0		$0		$0		$0		$0		$0		$0		$0		$0		$0	0	$0
Data Collection Equipment (GoPro, batteries, card	Day	$300.00		$0	4	$1,200		$0		$0		$0		$0		$0		$0		$0		$0	4	$1,200
Company Vehicle	Day	$120.00		$0	4	$480		$0		$0		$0		$0		$0		$0		$0		$0	4	$480
Safety Vehicle for FWD (Attenuator)	Day	$2,500.00		$0		$0	5	$12,500		$0		$0		$0		$0		$0		$0		$0	5	$12,500
Coring - Arterials	Core	$775.00		$0		$0		$0	20	$15,500		$0		$0		$0		$0		$0		$0		$0
Coring - Residentials	Core	$400.00		$0		$0		$0	15	$6,000		$0		$0		$0		$0		$0		$0		$0
Coring - Alleys	Core	$400.00		$0		$0		$0		$0		$0		$0		$0		$0		$0		$0		$0
FWD Equipment	Day	$2,800.00		$0		$0	5	$14,000	1	$2,800		$0		$0		$0		$0		$0		$0	6	$16,800
FWD Mobilizaton	Mile	$2.50		$0		$0	1000	$2,500	1	$3		$0		$0		$0		$0		$0		$0	1001	$2,503
TOTAL OTHER DIRECT COSTS			0	$0	8	$1,680	1023	$30,977	37	$24,303	0	$0	0	$0	0	$0	0	$0	0	$0	8	$1,630	1076	$58,590
TOTAL COSTS				$11,674		$14,386		$45,986		$27,449		$13,896		$20,749		$6,024		$2,692		$9,162		$10,304		$162,322
FEE (% of total QES Labor + Escalation + OH)		12.00%		$1,401		$865		$1,801		$378		$1,667		$2,490		$723		$191		$1,099		$1,041		$11,656
TOTAL COSTS AND FEE				$13,074		$15,251		$47,788		$27,826		$15,563		$23,239		$6,747		$2,883		$10,262		$11,344		$173,977

EXHIBIT B
GENERAL TERMS AND CONDITIONS

1.   Status as Independent Contractor.

A.   Consultant is, and shall at all times remain as to City, a wholly independent contractor. Consultant shall have no power to incur any debt, obligation, or liability on behalf of the City of Commerce or otherwise act on behalf of Commerce as an agent. Neither the City of Commerce nor any of its agents shall have control over the conduct of Consultant or any of Consultant's employees, except as set forth in this Agreement. Consultant shall not, at any time, or in any manner, represent that it or any of its agents or employees are in any manner agents or employees of the City of Commerce.

B.   Consultant agrees to pay all required taxes on amounts paid to Consultant under this Agreement, and to indemnify and hold City harmless from any and all taxes, assessments, penalties, and interests asserted against City by reason of the independent Consultant relationship created by this Agreement. In the event that City is audited by any Federal or State agency regarding the independent status of Consultant and the audit in any way fails to sustain the validity of a wholly independent Consultant relationship between City and Consultant, then Consultant agrees to reimburse City for all costs, including accounting and attorney's fees, arising out of such audit and any appeals relating thereto.

C.   Consultant shall fully comply with the workers' compensation law regarding Consultant and Consultant's employees. Consultant further agrees to indemnify and hold City harmless from any failure of Consultant to comply with applicable worker's compensation laws. City shall have the right to offset against the amount of any fees due to Consultant under this Agreement any amount due to City from Consultant as a result of Consultant's failure to promptly pay to City any reimbursement or indemnification arising under this Section 1.

D.   Consultant represents to the City, and City relies on Consultant's representations, that Consultant shall serve solely in the capacity of an independent contractor to the City. Neither the City nor any of its agents will have control over the conduct of Consultant or any of Consultant's employees, except as otherwise set forth in the Agreement. Consultant may not, at any time or in any manner, represent that it or any of its agents or employees are in any manner agents or employees of the City. The City has no duty, obligation, or responsibility to the Consultant's agents or employees, including the Affordable Care Act coverage requirements. Consultant is solely responsible for any tax penalties associated with the failure to offer affordable coverage to its agents and employees under the Affordable Care Act with respect to Consultant's agents and employees. Consultant warrants and represents that the City will not be responsible and will not be held liable for issues related to Consultant's status as an independent contractor, including Consultant's failure to comply with Consultant's duties, obligations, and responsibilities under the Affordable Care Act. Consultant further agrees to defend, indemnify, and hold the City harmless

for any and all taxes, claims, and penalties against the City related to Consultant's obligations under the Affordable Care Act.

2.   Standard of Performance

Consultant shall perform all work to the highest professional standards and in a manner reasonably satisfactory to the City Manager or his/her designee. No additional or different tasks or services shall be performed by Consultant other than those specified in **Exhibit A**.

3.   Indemnification.

A.   Consultant is skilled in the professional calling necessary to perform the services and duties agreed to be performed under this Agreement, and City is relying upon the skill and knowledge of Consultant to perform said services and duties.

B. City and its respective elected and appointed boards, officials, officers, agents, employees and volunteers (individually and collectively, "Indemnities") shall have no liability to Consultant or any other person for, and Consultant shall indemnify, defend, protect and hold harmless Indemnities from and against, any and all liabilities, claims, actions, causes of action, proceedings, suits, damages, judgments, liens, levies, costs and expenses of whatever nature, including reasonable attorneys' fees and disbursements (collectively "Claims"), which Indemnities may suffer or incur or to which Indemnities may become subject by reason of or arising out of any injury to or death of any person(s), damage to property, loss of use of property, economic loss or other loss occurring as a result of or allegedly caused by Consultant's performance of or failure to perform any services under this Agreement or by the negligent or willful acts or omissions of Consultant, its agents, officers, directors, subcontractor, sub consultant or employees, committed in performing any of the services under this Agreement. Notwithstanding the foregoing, the provisions of this subsection shall not apply to Claims occurring as a result of the City's sole negligence or willful acts or omissions.

C.   Consultant agrees to obtain executed indemnity agreements with provisions identical to those set forth in this Section from each and every subcontractor, sub consultant or any other person or entity involved by, for, with or on behalf of Consultant in the performance of this Agreement. In the event Consultant fails to obtain such indemnity obligations from others as required in this Section, Consultant agrees to be fully responsible according to the terms of this Section. Failure of the City to monitor compliance with these requirements imposes no additional obligations on City and will in no way serve as a waiver of any rights hereunder. This obligation to indemnify and defend Indemnities as set forth herein shall survive the termination of this Agreement and is in addition to any rights which City may have under the law. This indemnity is effective without reference to the existence or applicability of any insurance coverage which may have been required under this Agreement or any additional insured endorsements which may extend to

City.

4.   Insurance.
        A.   Without limiting Consultant's indemnification of Indemnities pursuant to Section 3 of this Agreement, Consultant shall obtain and provide and maintain at its own expense during the term of this Agreement the types and amounts of insurance as described below:

        (I)   Consultant shall maintain Commercial General Liability Insurance with coverage at least as broad as Insurance Services Office Commercial General Liability Form CG 00 01 in an amount not less than $1,000,000 per occurrence, $2,000,000 general aggregate, for bodily injury, personal injury, and property damage. Defense costs must be paid in addition to limits. There shall be no cross liability exclusion for claims or suits by one insured against another.   The policy must include contractual liability that has not been amended.   Any endorsement restricting standard ISO "insured contract" language will not be accepted.

        (II)   Consultant shall maintain Business Auto Coverage on ISO Business Auto Coverage Form CA 00 01 covering bodily injury and property damage for all activities of the Consultant arising out of or in connection with Work to be performed under this Agreement, including coverage for any owned, hired, non-owned or rented vehicles, in an amount not less than $1,000,000 combined single limit for each accident.

        (III)   Consultant shall maintain Workers' Compensation Insurance (Statutory Limits) and Employer's Liability Insurance with on a state approved policy form providing statutory benefits as required by law with employer's liability limits no less than $1,000,000 per accident for all covered losses;

        (IV)   Consultant shall maintain Professional Liability or Errors and Omissions Insurance that covers the services to be performed in connection with this Agreement, in the minimum amount of $1,000,000 per claim and in the aggregate.   Any policy inception date, continuity date, or retroactive date must be before the effective date of this Agreement and Consultant agrees to maintain continuous coverage through a period no less than three (3) years after completion of the services required by this Agreement.

        B.   City, its officers, officials, employees and volunteers shall be named as additional insureds on the policy(ies) as to commercial general liability and automotive liability.

        C.   All insurance policies shall be issued by an insurance company currently authorized by the Insurance Commissioner to transact business of insurance or is on the List of Approved Surplus Line Insurers in the State of California, with an assigned policyholders' Rating of A- (or higher) and Financial Size Category Class VI (or larger)

in accordance with the latest edition of Best's Key Rating Guide, unless otherwise approved by the City's Risk Manager.

D. All insurance policies shall provide that the insurance coverage shall not be non-renewed, canceled, reduced, or otherwise modified (except through the addition of additional insureds to the policy) by the insurance carrier without the insurance carrier giving City thirty (30) days' prior written notice thereof. Any such thirty (30) day notice shall be submitted to CITY via certified mail, return receipt requested, addressed to "Director of Human Resources & Risk Management," City of Commerce, 2535 Commerce Way, Commerce, California, 90040. Consultant agrees that it will not cancel, reduce or otherwise modify said insurance coverage.

E. Consultant shall submit to City (I) insurance certificates indicating compliance with the minimum worker's compensation insurance requirements above, and (II) insurance policy endorsements indicating compliance with all other minimum insurance requirements above, not less than one (1) day prior to beginning of performance under this Agreement. Endorsements shall be executed on City's appropriate standard forms entitled "Additional Insured Endorsement".

F. Consultant's insurance shall be primary as respects the City, its officers, officials, employees and volunteers. Any insurance or self-insurance maintained by the City, its officers, officials, employees and volunteers shall be excess of Consultant's insurance and shall not contribute with it.

G. Consultant agrees that if it does not keep the aforesaid insurance in full force and effect, and such insurance is available at a reasonable cost. City may take out the necessary insurance and pay the premium thereon, and the repayment thereof shall be deemed an obligation of Consultant's and the cost of such insurance may be deducted, at the option of City, from payments due Consultant.

5.   **Release of Information/Confidentiality.**

A.   Consultant in the course of its duties may have access to confidential data of City, private individuals, or employees of the City. Consultant covenants that all data, documents, discussion, or other information developed or received by Consultant or provided for performance of this Agreement are deemed confidential and shall not be disclosed by Consultant without written authorization by City. City shall grant such authorization if disclosure is required by law. All City data shall be returned to City upon the termination of this Agreement. Consultant, its officers, employees, agents, or subconsultants, shall not without written authorization from the City Manager, voluntarily provide declarations, letters of support, testimony at depositions, response to interrogatories, or other information concerning the work performed under this Agreement or relating to any project or property located within the City. Response to a subpoena or court order shall not be considered "voluntary" provided Consultant gives City notice of such court order or subpoena. Consultant's covenant under this section shall survive the termination of this Agreement.

B.   Consultant shall promptly notify City should Consultant, its officers, employees, agents, or subconsultants be served with any summons, complaint, subpoena, notice of deposition, request for documents, interrogatories, request for admissions, or other discovery request, court order, or subpoena from any person or party regarding this Agreement and the work performed thereunder. City retains the right, but has no obligation, to represent Consultant and/or be present at any deposition, hearing, or similar proceeding. Consultant agrees to cooperate fully with City and to provide the opportunity to review any response to discovery requests provided by Consultant. However, City's right to review any such response does not imply or mean the right by City to control, direct, or rewrite said response

6.   Ownership of Work Product.

A.   Consultant shall maintain complete and accurate records with respect to sales, costs, expenses, receipts, and other such information required by the City that relate to the performance of services under this Agreement. Consultant shall maintain adequate records of services provided in sufficient detail to permit an evaluation of services. All such records shall be maintained in accordance with generally accepted accounting principles and shall be clearly identi¬fied and readily accessible. Consultant shall provide free access to the representatives of the City or its designees at reasonable times to such books and records; shall give the City the right to examine and audit said books and records; shall permit the City to make transcripts therefrom as necessary; and shall allow inspection of all work, data, documents, proceedings, and activities related to this Agreement. Such records, together with supporting documents, shall be maintained for a period of three (3) years after receipt of final payment.

B.   Upon completion of, or in the event of termination or suspension of this Agreement, all original documents, designs, drawings, maps, models, computer files, surveys, notes, and other documents prepared in the course of providing the services to be performed pursuant to this Agreement shall become the sole property of the City and may be used, reused, or otherwise disposed of by the City without the permission of the Consultant. With respect to computer files, Consultant shall make available to the City, at the Consultant's office and upon reasonable written request by the City, the necessary computer software and hardware for purposes of accessing, compiling, transferring, and printing computer files.

7.   Conflict of Interest.

A. Consultant covenants that it presently has no interest and shall not acquire any interest, direct or indirect, which may be affected by the services to be performed by Consultant under this Agreement, or which would conflict in any manner with the performance of its services hereunder.   Consultant further covenants that, in performance of this Agreement, no person having any such interest shall be employed by it. Furthermore, Consultant shall avoid the appearance of having any interest which would conflict in any manner with the performance of its services pursuant to this

Agreement.

B. Consultant covenants not to give or receive any compensation, monetary or otherwise, to or from the ultimate vendor(s) of services to City as a result of the performance of this Agreement, or the services that may be procured by the City as a result of the recommendations made by   Consultant's covenants under this section shall survive the termination of this Agreement.

8.   Termination. Notwithstanding any other provision, this Agreement may be duly terminated at any time by the City at its sole discretion with or without cause by serving upon the consultant at least ten (10) days prior written notice ("Notice of Termination"). Upon receipt of said notice, the Consultant shall immediately cease all work under this Agreement, unless the notice provides otherwise. Unless expressly agreed upon in writing by the City, the City shall not be obligated to pay for any services rendered nor any costs or expenses paid or incurred after the date of termination. The effective date of termination shall be upon the date specified in the written Notice of Termination. Consultant agrees that in the event of such termination, Consultant must refund the City its prorated share, except for services satisfactorily rendered prior to the effective date of termination. Immediately upon receiving written Notice of Termination, Consultant shall discontinue performing services, preserve the product of the services and upon payment for services, turn over to City the product of the services in accordance with written instructions of City.

In the event this Agreement is terminated pursuant to this Section, the City shall pay to Consultant the actual value of the work performed up to the time of termination, provided that the work performed is of value to the City. Upon termination of the Agreement pursuant to this Section, the Consultant will submit an invoice to the City.

9.   Personnel. Consultant represents that it has, or will secure at its own expense, all personnel required to perform the services under this Agreement. All of the services required under this Agreement will be performed by Consultant or under its supervision, and all personnel engaged in the work shall be qualified to perform such services. Consultant reserves the right to determine the assignment of its own employees to the performance of Consultant's services under this Agreement, but City reserves the right, for good cause, to require Consultant to exclude any employee from performing services on City's premises.

10.   Non-Discrimination and Equal Employment Opportunity.

A. Consultant shall not discriminate as to race, color, creed, religion, sex, marital status, national origin, ancestry, age, physical or mental handicap, medical condition, or sexual orientation, in the performance of its services and duties pursuant to this Agreement, and will comply with all rules and regulations of City relating thereto. Such nondiscrimination shall include but not be limited to the following: employment, upgrading, demotion, transfers, recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training,

including apprenticeship.

B. Consultant will, in all solicitations or advertisements for employees placed by or on behalf of Consultant state either that it is an equal opportunity employer or that all qualified applicants will receive consideration for employment without regard to race, color, creed, religion, sex, marital status, national origin, ancestry, age, physical or mental handicap, medical condition, or sexual orientation.

C. Consultant will cause the foregoing provisions to be inserted in all subcontracts for any work covered by this Agreement except contracts or subcontracts for standard commercial supplies or raw materials.

11.   Assignment. Consultant shall not assign or transfer any interest in this Agreement nor the performance of any of Consultant obligations hereunder, without the prior written consent of City, and any attempt by Consultant to assign this Agreement or any rights, duties, or obligations arising hereunder shall be void and of no effect.

12.   Performance Evaluation. For any Agreement in effect for twelve months or longer, the City Manager may require a written annual administrative performance evaluation within ninety (90) days of the first anniversary of the effective date of this Agreement, and each year thereafter throughout the term of this Agreement. The work product required by this Agreement shall be utilized as the basis for review, and any comments or complaints received by City during the review period, either orally or in writing, shall be considered. City shall meet with Consultant prior to preparing the written report. If any noncompliance with the Agreement is found, City may direct Consultant to correct the inadequacies, or, in the alternative, may terminate this Agreement as provided herein.

13.   Compliance with Laws. Consultant shall keep itself informed of State, Federal and Local laws, ordinances, codes and regulations which in any manner affect those employed by it or in any way affect the performance of its service pursuant to this Agreement. Consultant shall at all times comply with such laws, ordinances, codes and regulations. The City, its officers and employees shall not be liable at law or in equity occasioned by failure of Consultant to comply with this Section.

14.   Licenses. At all times during the term of this Agreement, Consultant shall have in full force and effect all licenses (including a City business license) required of it by law for performance of the services hereunder.

15.   Non-Waiver of Terms, Rights and Remedies. Waiver by either party of any one or more of the conditions of performance under this Agreement shall not be a waiver of any other condition of performance under this Agreement. In no event shall the making by City of any payment to Consultant constitute or be construed as a waiver by City of any breach of covenant, or any default which may then exist on the part of Consultant, and the making of any such payment by City shall in no way impair or prejudice any right or remedy available to City with regard to such breach or default.

16.   Attorney's Fees.   In the event that either party to this Agreement shall commence any legal or equitable action or proceeding to enforce or interpret the provisions of this Agreement, the prevailing party in such action or proceeding shall be entitled to recover its costs of suit, including reasonable attorney's fees and costs, including costs of expert witnesses and Consultant.

17.   Notices.   Any notices, bills, invoices, or reports required by this Agreement shall be deemed received on (a) the day of delivery if delivered by hand during Consultant regular business hours or by facsimile before or during Consultant regular business hours; or (b) on the third business day following deposit in the United States mail, postage prepaid, to the addresses heretofore set forth in the Agreement, or to such other addresses as the parties may, from time to time, designate in writing pursuant to the provisions of this section.

18.   Governing Law.   This Agreement shall be construed and interpreted both as to validity and to performance of the Parties in accordance with the laws of the State of California.   Legal actions concerning any dispute, claim or matter arising out of or in relation to this Agreement shall be instituted in the Superior Court of the County of Los Angeles, State of California.   However, the Parties may agree to submit any dispute to non-binding arbitration.

19.   Counterparts.   This Agreement may be executed in any number of counterparts, each of which shall be deemed to be the original, and all of which together shall constitute one and the same instrument.

20.   Severability.   If any provision or any part of any provision of this Agreement is found to be invalid or unenforceable, the balance of this Agreement shall remain in full force and effect.

21.   Entire Agreement.   This Agreement, and any other documents incorporated herein by specific reference, represents the entire and integrated agreement between Consultant and City.   This Agreement supersedes all prior oral or written negotiations, representations or agreements.   This Agreement may not be amended, nor any provision or breach hereof waived, except in a writing signed by the Parties which expressly refers to this Agreement.   Amendments on behalf of the City will only be valid if signed by the Mayor and attested by the City Clerk.

22.   **Authority**.   The person or persons executing this Agreement on behalf of Consultant warrants and represents that he/she has the authority to execute this Agreement on behalf of Consultant and has the authority to bind Consultant to the performance of its obligations hereunder.

23.   Force Majeure.   A Party's performance of any obligation under this Agreement shall be suspended if, and to the extent that, the Party is unable to perform because of any event of Force Majeure. In any such event, the Party unable to perform shall be

required to resume performance of its obligations under this Agreement upon the termination of the event or cause that excused performance hereunder. "Force Majeure" herein means an event which is beyond the reasonable control of a Party, including without limitation, (a) acts of God including flood, fire, earthquake, hurricane or explosion, pandemic; (b) war, invasion, hostilities (whether war is declared or not), terrorist threats or acts, riot or other civil unrest; (c) government order or law that prevents either Party from performing its obligations as set forth in this Agreement; (d) actions, embargoes or blockades in effect on or after the date of this Agreement; (e) action by any governmental authority that prevents either Party from performing its obligations as set forth in this Agreement; (f) national or regional emergency; (g) strikes, labor stoppages or slowdowns or other industrial disturbances, other than those involving the affected parties employees; (h) shortage of adequate power or transportation facilities.

Neither Party shall be liable for any delay or default in, or failure of, performance resulting from or arising out of any Force Majeure event, and no such delay, default in, or failure of performance shall constitute a breach by either Party hereunder. Where a Force Majeure event gives rise to a failure or delay in either Party performing its obligations under this Agreement (other than obligations to make payment), those obligations will be suspended for the duration of the Force Majeure event. A Party who becomes aware of a Force Majeure event which gives rise to, or which is likely to give rise to, any failure or delay in performing its obligations under this Agreement, will forthwith notify the other and inform the other of the period for which it is estimated that such failure or delay will continue. The affected Party shall take reasonable steps to mitigate the effects of the Force Majeure event.