APPLIED RESEARCH ASSOCIATES, INC.

August 31, 2018

Jon Zabrocki
Consulting Village Engineer
Village of Romeoville
615 Anderson Drive
Romeoville, IL 60446

Subject: **Proposal for Pavement Condition Assessment and Pavement Management Services, for the Village of Romeoville, IL**

Dear Mr. Zabrocki:

Applied Research Associates (ARA), Inc., appreciates the opportunity to submit this proposal to the Village of Romeoville, Illinois for pavement management system update and condition assessment. This document includes a description of the proposed pavement condition assessment procedure and pavement management system update process.

If you have any questions or need additional information, please do not hesitate to contact us.

Sincerely,

Joseph Stefanski, P.E.
Senior Engineer

William R. Vavrik, Ph.D., P.E.
Vice President & Principal Engineer

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Table of Contents

1. PROJECT UNDERSTANDING

The Village of Romeoville operates approximately 130 centerline miles of village roads, consisting mostly of asphalt surfaced and composite pavements (asphalt over concrete). To facilitate this process the Village maintains a pavement management system (PMS) using the Cartegraph® software. The Village requested Applied Research Associates, Inc. (ARA) to provide a proposal to update the Village's PMS system using Cartegraph ® OMS.

Based on our understating of this effort, ARA presents this proposal for PMS update and condition assessment for the Village of Romeoville, IL. The scope of this project will include update of Cartegraph® OMS software, collection of pavement condition data to populate the software tool's databases, upload of both new and existing data to the pavement management database, developing multi-year capital improvement plans, and training.

2. SCOPE OF SERVICES

2.1 KICKOFF AND RECORDS REVIEW

ARA will correspond with the Village staff for an on-site project kick-off meeting. This meeting will provide ARA and the Village the opportunity to discuss the current needs and long-range plans of the Village in addition to the following:

- General project management
- Project Schedule
- Specific deliverable requirements
- GIS shapefile for the Village network
- Available data for PMS implementation (pavement age and type, traffic data, typical maintenance and rehabilitation activities and cost)
- Network Segmentation
- Access to Cartegraph® OMS

In addition to the kick-off meeting ARA anticipates regular correspondence with the Village throughout the pavement management update process to make sure the end result meet the specific needs of the Village.

2.2 PAVEMENT DATA COLLECTION

ARA maintains and operates Laser Crack Measurement System (LCMS) equipped Digital Survey Vehicles (DSVs) with a high-resolution, 360˚ right-of-way camera, a Class 1 laser profiler (in accordance with ASTM E950), and a high accuracy location system. This LCMS system can provide a wide variety of pavement surface and geometric characteristics including automated surface cracking and multipoint rutting measurement. The DSV is shown in Figure 1.

Figure 1. An example of a Digital Survey Vehicle.

ARA's LCMS system provides the following features:

- A pair of RoLine lasers mounted in the front bumper directly in front of the two wheels of the vehicle. RoLine lasers provide a higher-level accuracy versus standard point lasers because they measure several nearby locations at once and can eliminate certain pavement issues such as tining in concrete pavement and open-graded asphalt mixes that would normally increase a pavement's International Roughness Index (IRI) even though the pavement is behaving as designed. This profile system is a Class 1 profiler compliant with ASTM E 950.
- Panoramic right-of-way (ROW) images that can be extracted to the industry standard JPEG format. Additional metadata including location is stored in an associated database to ease use in the data delivery set (such as GIS, in this case). A panoramic image is typically collected every 20 feet and all images are high-definition.
- Georeferencing provided by an onboard DGPS/INS (Differential Global Positioning System and Inertial Navigation System). The raw GPS signal is received by a pair of antennas mounted to the roof of the DSV and differentially corrected by Trimble's OmniStar service. This provides an accuracy of 1m or less. An Inertial Navigation System supplements the DGPS signal improving its accuracy and allowing for "dead reckoning": the ability to determine location during brief GPS outages through the measurement of vehicle movement. This same system can also provide other attributes such as pavement cross-slope and grade when used in conjunction with the DSV's laser sensors, if requested.
- Linear referencing is provided by an onboard Distance Measurement Instrument (DMI) that measures the linear distance traveled by the vehicle accurate to less than 1 in per mile. For this project, this data will be used in the quality control phase of the process.
- A downward facing laser scanner that performs automatic pavement condition analysis including rutting and surface defects such as cracking and potholes. While some human intervention is required to adjust these automated results, the automated analysis significantly speeds the surface condition analysis process.

ARA plans to collect images in a single-direction in the outermost lane for the Village's pavement network. In case of multi-lane roads with a median, data will be collected in the outermost lane of both directions. ARA will utilize the GIS data provided by the Village during the kickoff phase to create a routing plan for field data collection.

After data collection is complete, quality control checks will be incorporated to ensure the accuracy and consistency of the sensors, quality of collected images, and coverage of the Village's pavement network. An overview of these checks is discussed in the quality control section at the end of this work plan. ARA will collect data based on these requirements:

- Not starting data collection until an hour after sunrise
- Stopping data collection prior to an hour before sunset
- Collecting data only on clear and dry pavements (for accuracy in sensor data collection)

All of the testing performed will be done with the safety of both employees (Village and ARA) and patrons in mind. If our operators feel that data collection is unsafe due to roadway conditions (short lanes, heavy traffic, etc.) they will attempt to return at a later time when conditions have improved. There may be some limited locations where it is not possible to collect data due to safety concerns, although these occur very infrequently.

2.3 Pavement Data Processing and Condition Assessment

Using the collected images and data, a pavement condition survey is performed. There are multiple pavement condition survey methods that have varying complexity, depth of detail, and cost to implement. ARA recommends using a modified version of the Pavement Condition Index (PCI) rating methodology for condition rating of the Village's pavement network. The ARA team has vast experience in performing PCI surveys customized to our client's needs, whether via the specific ASTM D 6433 guidelines or a modified version of PCI. Typically, PCI surveys are conducted foot-on-ground in the field. The modified version allows ARA staff to use the digital images to perform the survey in an office environment and still provide the highest detail of distress rating. ARA identifies the type, severity and extent of key pavement distresses, summarizes distresses for each sample unit, and calculates the PCI rating for each road on a scale of 0 to 100 (0 = very poor, 100 = excellent). This allows comparing all pavements on a common scale and provides an index for monitoring pavement deterioration and treatment selection during the PMS analysis.

ARA will enforce quality control measures during the pavement condition survey effort. Ten percent of the surveyed sections will be subjected to an internal Quality Assurance survey by an independent surveyor. This system will result in accurate data, which can be relied upon for decision-making down the road. Once pavement surveys are underway, ARA will begin creation and population of the pavement management database.

In addition to the condition assessment, ARA will process the raw data to calculate the IRI, rutting and faulting. The IRI is measured in accordance with ASTM 1926.

2.4 Cartegraph® OMS Data Import

After performing the pavement condition assessment for the entire pavement network, the PCI for individual road segments will be imported into Cartegraph® OMS. A sample Cartegraph® OMS interface is shown in Figure 2.

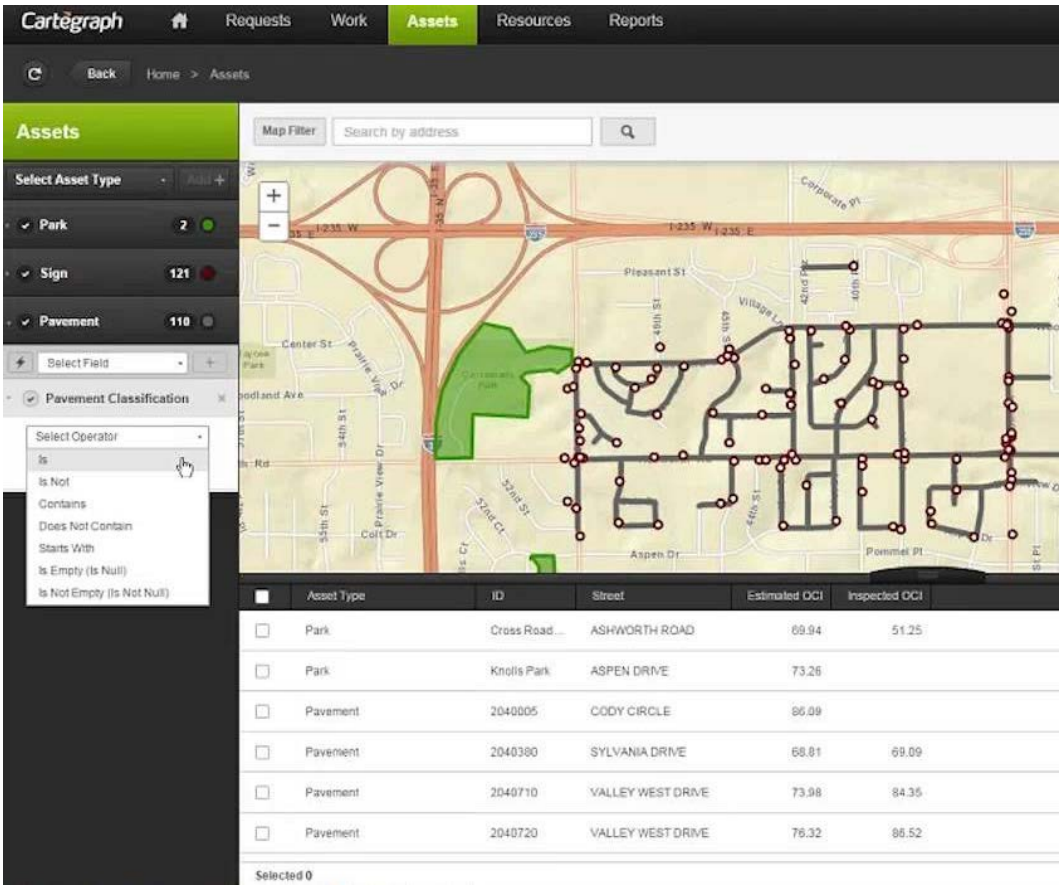

Figure 2. Cartegraph® OMS Interface.

ARA will work with Village staff to obtain the required data inputs for updating the pavement management system. At a minimum, the following will be uploaded in Cartegraph® OMS for further analysis:

1) Pavement network segmentation
2) History of pavement improvements/pavement age
3) Data collected as part of the DSV survey (updated condition values and sensor-based data per PMS segment)
4) Traffic data
5) Typical pavement preservation and maintenance activities utilized by the Village, and associated costs.

2.5 Maintenance and Rehabilitation Program Development

The primary step in developing a multi-year plan is to develop pavement performance models to predict future condition of the pavement network. In Cartegraph® OMS, a pavement performance model can be incorporated using 'Pavement Prediction Group' feature. A pavement management system is only useful for making decisions if pavement performance models can be established, validated, and relied upon to accurately forecast pavement conditions into the future. A pavement performance model is developed based on the date of construction of a road, the types and thicknesses of pavement materials, the traffic level, and the pavement condition of the roadway. The pavement performance model becomes more accurate with multiple pavement condition

ratings, as the model gets calibrated and adjusted to match the conditions present at the time in a pavement's life cycle. A sample pavement performance model for HMA pavements based on PCI is shown in Figure 3.

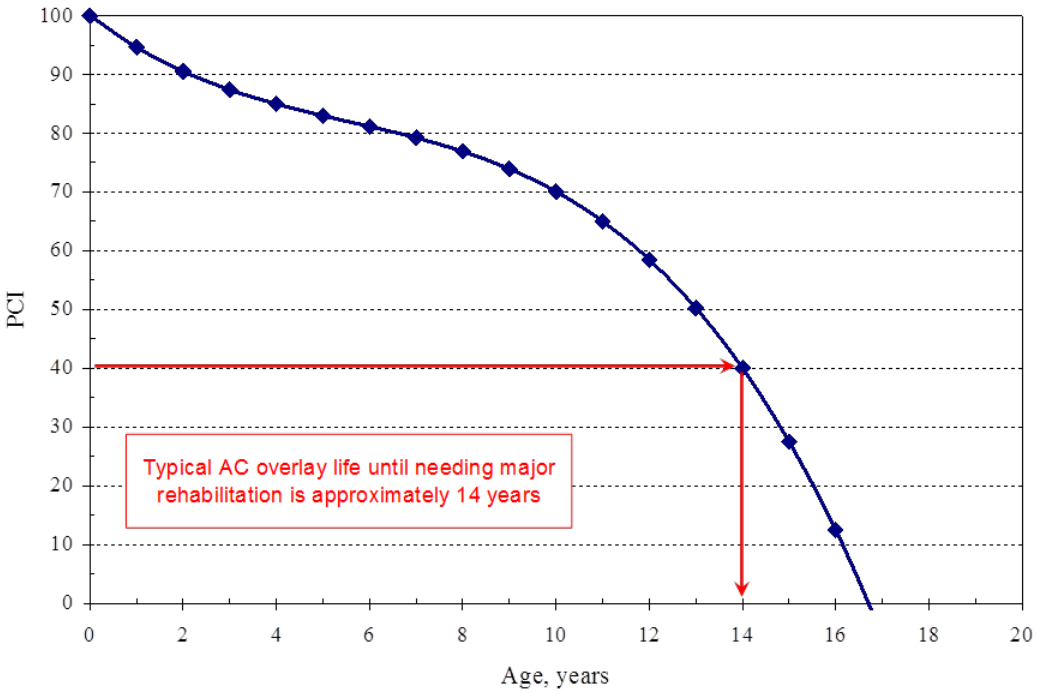

Figure 3. Sample pavement performance model for HMA pavement based on PCI.

ARA will work with the Village to record all available pavement preservation and rehabilitation techniques. Once the available treatments are catalogued, ARA will develop treatment selection criteria (a treatment "matrix") that define when a treatment is to be done and the resulting consequences.

A sample treatment matrix based on PCI, and traffic is shown in Table 3. To properly assign the benefits of applying each treatment, ARA will use industry best practices and the Village's institutional knowledge to establish the service life of each treatment, adjusting for the condition of the pavement before the treatment was applied, and the overall age of the pavement.

Using the pavement condition Index (PCI), and with guidance from the Village, ARA will analyze the existing pavement structure to understand the mechanisms of the pavement problems and offer engineering solutions that meet the desires and constraints of the Village. Once these activities are completed, the following steps are performed to develop and design the appropriate M&R work plan:

- Identify feasible M&R alternatives
- Perform M&R and budget analysis to select the appropriate treatment type and cost

Table 1. Sample M&R selection criteria based on condition rating and traffic.

<table>
<tr><th rowspan="3">Functional Condition</th><th rowspan="3">PCI</th><th colspan="3">AC Pavements</th><th rowspan="3"></th><th rowspan="3">PCC Pavements</th></tr>
<tr><th colspan="3">Traffic</th></tr>
<tr><th>Low</th><th>Medium</th><th>High</th></tr>
<tr><td>Excellent</td><td>95-100</td><td colspan="3">Defer Maintenance</td><td></td><td>Defer Maintenance</td></tr>
<tr><td>Very Good</td><td>85-95</td><td colspan="3">Crack Seal</td><td></td><td>Crack Seal</td></tr>
<tr><td>Good</td><td>70-85</td><td colspan="3">Surface Treatment</td><td></td><td>Patching and Sealing</td></tr>
<tr><td>Fair</td><td>55-70</td><td colspan="2" rowspan="2">2” Mill + 2” AC Overlay (ACOL)</td><td rowspan="2">2” Mill + 3” ACOL</td><td></td><td>Full-Depth PCC Repairs</td></tr>
<tr><td>Poor</td><td>44-55</td><td></td><td>Repairs + ACOL</td></tr>
<tr><td>Very Poor</td><td>10-40</td><td colspan="3" rowspan="2">Reconstruction</td><td></td><td rowspan="2">Reconstruction</td></tr>
<tr><td>Failed</td><td>0-10</td><td></td></tr>
</table>

2.6 Pavement Maintenance and Preservation Budget

With the Cartegraph® OMS, each of the following factors can be created and modified directly in the system:

- M&R activity definition (feasibility, cost, and consequences)
- Analysis period and investment parameters
  - Unlimited funding – determines M&R backlog
  - Fixed-budget scenario – evaluates the effect on condition performance over time
  - Goals-based analysis – varies annual funding to achieve average and deficiency goals
- Project-level reports: local attribute summary, construction history, asset inventory, etc.
- Network-level reports: inventory, condition, maintenance needs, and capital improvement

Cartegraph® OMS will provide recommendations in the form of an optimized list of project selections as well as projected condition performance throughout the analysis period on the basis of projected pavement condition and treatment costs. At a minimum, Cartegraph® OMS will be used to develop multi-year capital improvement plans for the following scenarios:

- To maintain existing PCI
- To achieve target PCI values
- Optimized PCI value
- Maintaining current budget
- Incremental funding every year ($1M in year 1, $2M in year 2 etc.)

Using information populated in the PMS database including pavement construction history data, pavement performance models, a pavement rehabilitation treatment matrix, the capacity to store programmed capital budget scenarios; and working within fixed budgets or toward specific performance targets, projects are selected on the best benefit-cost ratio (“best bang for the buck”) to exhaust the budget and/or to meet performance criteria. As part of the pavement management system analysis, ARA will present the County with the current backlog of required projects, an optimized way of allocating the current budget, and the capital and maintenance programs

associated with other funding scenarios in the form of 5-year plans. Figure 4 shows an example of budget scenario builder in Cartegraph® OMS to achieve a target PCI.

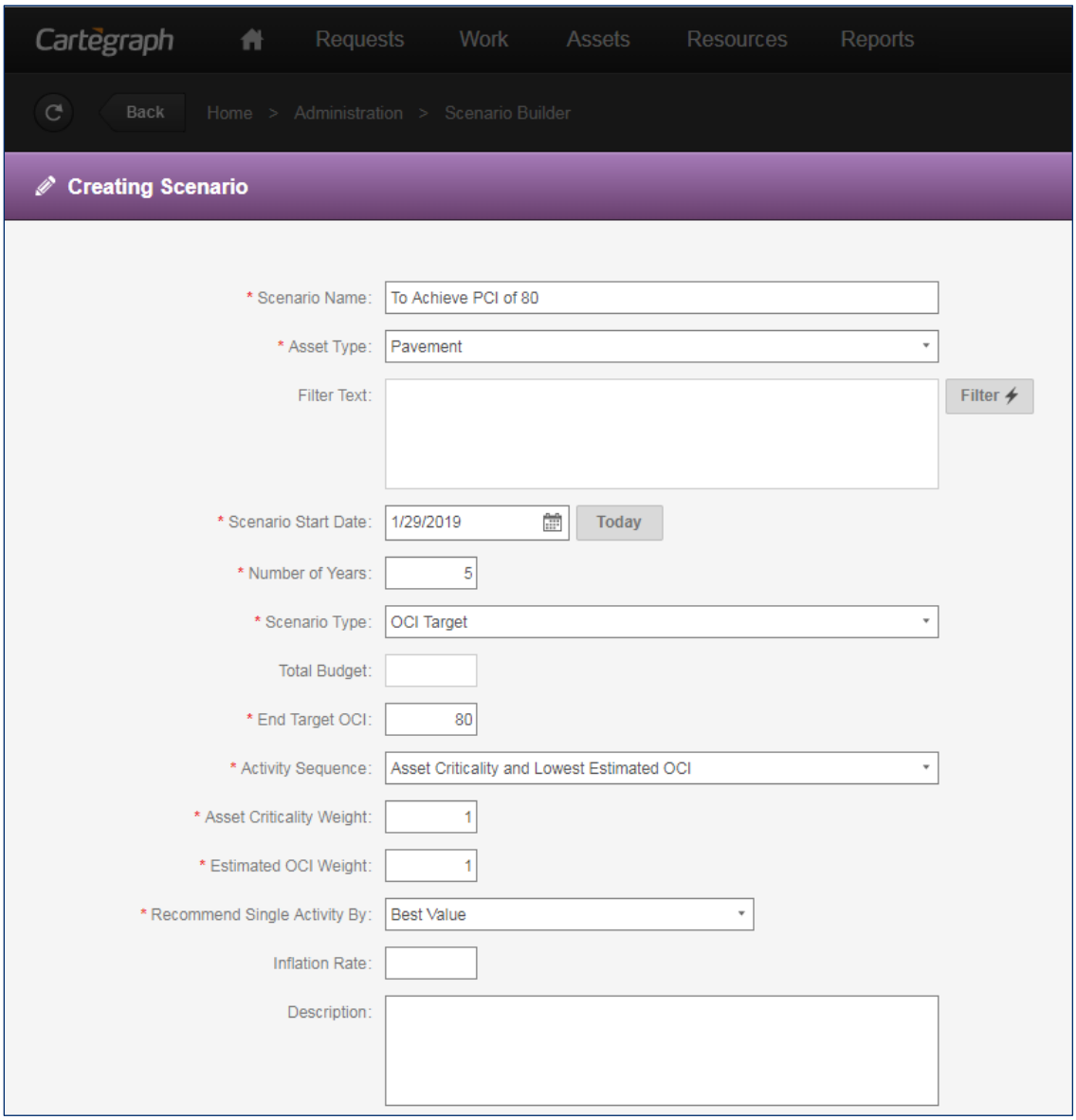

Figure 4. Sample of budget and PCI scenario builder in Cartegraph OMS.

2.7 DELIVERABLES

- The images collected will be provided to the Village in an external hard drive, including an excel table with hyperlinks to the images.

- ARA will upload the following pavement performance data into Cartegraph® OMS:
  - Pavement Condition Index (PCI)
  - Rutting
  - International roughness index (IRI), in inch/mile

- Concrete pavement joint faulting, in inches, categorized as positive and negative faulting

- M&R alternatives for the following options:
  - utilizing current funding levels
  - maintaining the current pavement condition rating
  - increasing the pavement condition rating
  - increasing budget levels
  - optimized pavement condition

2.8 REPORT

ARA will provide the Village with a written report of findings from the updated PMS system. The report will document any maintenance and construction projects performed the previous year, newly collected data, PMS updates, and the updated five-year M&R plan.

2.9 CARTEGRAPH OMS TRAINING

ARA will provide 1-day (8-hour) of on-site training to the Village staff on the details of the PMS update using Cartegraph® OMS. ARA will provide up to 16 hours of technical support via phone and email to the Village on the PMS implementation. The ARA project manager will serve as point of contact for this task.

3. QUALITY CONTROL/QUALITY ASSURANCE (QC/QA) PROCEDURES

ARA defines quality as the degree to which our products and services meet the Village's requirements and expectations. Meeting the proposed technical, cost, and schedule requirements of a project is an absolute prerequisite for quality performance.

While always managing the project's cost and schedule, ARA strives to exceed one or more of the Village's unwritten expectations whenever possible. The ARA quality philosophy follows the same approach, as embodied in the following statements:

- Be Responsible: Each ARA employee is responsible for the quality of his/her work products on a daily basis, and to communicate quality problems to the appropriate manager.
- Two Person Rule: Essential work products and external communications will be reviewed by a second person competent in the subject before the product is transmitted to a customer.

As a part of the scope for this project, specific quality control checks will include:

- GIS checks of coverage from collected images to assure no areas were missed
- Visual image quality checks to check for acceptable focus and clarity
- Data range checks for acceptable data from vehicle sensors
- In-office raters will train prior and calibrate during survey to assure consistent ratings
- Quality checks on 10% of the data after survey is complete. Checks will include pavement and asset data.

Specific quality acceptance measures will include:

- Regular correspondence with the Village to review all collected information

- Submit all deliverables in draft form for review and feedback prior to final delivery

4. SCHEDULE

ARA is ready to perform the requested services in a timely manner. The schedule shown below in Table 4 provides the timeline for the pavement management system and condition assessment for the Village of Romeoville.

Table 2. Project Schedule.

Village of Romeoville, IL	Pavement Management System Update and Condition Assessment						
Year	2018-2019						
Month	Sep	Oct	Nov	Dec	Jan	Feb	March
Kick-Off and Records Review							
Pavement Data Collection							
Data Processing and Condition Assessment							
Cartegraph OMS and Data Import							
Maintenance and Rehabilitation Program							
Pavement Maintenance and Preservation Budget							
Cartegraph OMS Training							
Final Report							

5. PROJECT PRICE

ARA's firm fixed price to perform these services is $64,750. These costs include labor, overhead, travel, and other direct costs. All training is expected during the day on weekdays. ARA will invoice upon completion of work for payment to be made within 30 days of receipt of invoice.

6. GROUND RULES AND ASSUMPTIONS

ARA's offering is based on the following ground rules and assumptions. Should any of these be adjusted during negotiations, the proposed offer, including pricing may be subject to change.

1. ARA anticipates a fixed price contract.

2. The assumed period of performance is 09/15/2018 through 09/30/2019.

3. ARA will submit invoices on a monthly basis on a percent complete basis with payment terms of net30.

4. ARA requires the following support to successfully complete this project in an efficient and effective manner:

- Contact information for project representative for coordination.
- The village will provide access to Cartegraph® OMS,
- The village will provide available information on PMS segmentation, GIS shapefile, and other pavement attributes including age, traffic, maintenance work done, treatment costs, and budget.
- Full access to project site.

We appreciate the opportunity to provide you these services and look forward to working with you on this project. If you have any questions or comments, please do not hesitate to contact us.

7. ACCEPTANCE OF PROPOSAL

Your signature below indicates your acceptance of this proposal and the rental agreement attached in accordance with the scope, price, schedule, and the terms and conditions contained herein, and will create a binding agreement between you and ARA. This acceptance will act as a notice to proceed.

Acceptance and Authorization	
Name (print)	
Title	
Signature:	
Date:	

TERMS & CONDITIONS

Applied Research Associates, Inc. (ARA) agrees to perform the specified work with the professional skill and care ordinarily provided by firms practicing in the same or similar locality under the same or similar circumstances. The parties acknowledge that there has been an opportunity to negotiate the terms and conditions of this Agreement and agree to be bound accordingly.

1. INDEPENDENT CONTRACTOR

ARA will act as an independent contractor and not as Client's agent for any purpose whatsoever, and will have no authority to make any commitments on behalf of Client or to bind Client in any way whatsoever.

2. PROJECT SUPERVISION AND ASSIGNMENT

ARA shall have wide discretion in the methods used to perform any assigned tasks unless specified otherwise. ARA will cooperate with the Client to the extent possible to arrange for consultations between the Client, ARA personnel, and others engaged in rendering services to the Client related to ARA's performance under this agreement. ARA agrees that no tasks shall be performed or expenses incurred without specific authorization of the Client.

3. OWNERSHIP OF DOCUMENTS

All data, information, software, hardware, and documents produced by ARA under this agreement shall remain the property of ARA and may not be used by the Client for any endeavor outside of the scope of this agreement without the written consent of ARA, unless otherwise noted in this agreement.

4. ACCESS TO PROJECT SITE

If required for the performance of this effort, ARA will be granted timely access to the project site as needed. If traffic control or protection is required, it shall be provided by the Client or specific provisions will be made for ARA to provide traffic control or protection at an additional price. ARA will take precautions to minimize damage when performing its work, but ARA is not responsible for any items destroyed as a necessary part of the work.

5. PAYMENT

ARA will invoice monthly and at the completion of the project, with payment due net 30 days. Interest will be charged on amounts outstanding more than 30 days. The interest rate will be 1½ percent per month, compounded until paid. In the event of late payment, the Client agrees to pay all collection costs, legal expenses and attorneys' fees incurred by ARA in collecting payment, including interest. In the event that some portion of the invoice is disputed, payment for the undisputed portion of the invoice will be made within 30 days. If the Parties are unable to reach agreement regarding the disposition of the disputed portions of the invoice within 21 days, the matter will be resolved according to the Dispute Resolution clause of this agreement.

6. HIDDEN CONDITIONS OR HAZARDOUS MATERIALS:

If ARA has reason to believe that a hidden condition may exist, ARA shall notify the client who shall authorize and pay for all costs associated with the investigation of such condition and if necessary, all costs necessary to correct such condition. If (a) the client fails to authorize such investigation of the correction after due notification, or (b) ARA has no reason to believe that such condition exists, the Client is responsible for all risks associated with this condition, and ARA shall not be responsible for the existing condition nor any resulting damages to persons or property. ARA shall have no responsibility for the discovery, presence, handling, removal, disposal or exposure of persons to hazardous materials of any form.

7. TERMINATION OF SERVICES:

This agreement may be terminated upon 10 days written notice by either party. In the event of termination, the Client shall pay ARA for all services performed to the date of termination, all reimbursable expenses and reasonable termination expenses.

8. CONFIDENTIALITY

Each party agrees not to use the other's proprietary information for any purpose other than for the performance of this Agreement. Proprietary information is defined as information concerning techniques, processes, inventions, research and development, and cost data in written form with each sheet thereof marked with an appropriate legend indicating its proprietary nature and delivered by one party to another. Any other use of such proprietary information by the recipient shall be made only upon receipt of the prior written consent from an authorized representative of the other party.

9. INDEMNIFICATION

Client (indemnitor) shall indemnify and hold harmless ARA (indemnitee) from and against any and all (including third party) claims, damages, losses and expenses (including reasonable attorney's fees) arising out of or resulting from the performance of services, provided that any such claims, damage, loss or expense is caused in whole or in part by the negligent act or omission and/or liability of the indemnitor, or anyone directly or indirectly employed by the indemnitor.

10. CONSEQUENTIAL DAMAGES

Neither Party shall be liable to the other for consequential damages, including, without limitation, loss of use or loss of profits, incurred by one another or their subsidiaries or successors, regardless of whether such damages are caused by breach of contract, willful misconduct, negligent act or omission, or other wrongful act of either of them.

11. FORCE MAJEURE

Neither party shall be liable for any failure of or delay in performance of its obligations under this Subcontract to the extent such failure or delay is due to circumstances beyond its reasonable control, including, without limitation, acts of God, acts of a public enemy, fires, floods, wars, civil disturbances, sabotage, accidents, insurrections, blockades, embargoes, storms, explosions, labor disputes , acts of any governmental body, failure or delay of third parties or governmental bodies from whom a party is obtaining or must obtain approvals, authorizations, licenses, franchises or permits, or inability to obtain labor, materials, power, equipment, or transportation (collectively referred to herein as "Force Majeure"). Each party shall use its reasonable efforts to minimize the duration and consequences of any failure of or delay in performance resulting from a Force Majeure event.

12. GOVERNING LAW

This Agreement shall be governed by and construed in accordance with the laws of the State of New Mexico, excluding its principles of conflicts of laws. The United Nations Convention for the International Sale of Goods is expressly excluded from this Agreement, and shall have no force or effect on the parties.

13. DISPUTE RESOLUTION

Any controversy or claim arising out of or relating to this agreement, or breach thereof, which may be properly submitted to arbitration, shall be settled by arbitration. The substantially prevailing party shall be entitled to recover from the non-prevailing party all costs and expenses and attorney's fees it incurred in connection with any suit or legal or administrative action or appeal with respect to this order or the transaction under it.

14. NO THIRD PARTY RIGHTS

This Agreement shall not create any rights or benefits to parties other than Client and ARA. No third party shall have the right to rely on ARA opinions rendered in connection with the Services without ARA written consent and the third party's agreement to be bound to the same conditions and limitations as Client.

15. COMPLETE AGREEMENT; MODIFICATIONS

This Agreement constitutes the entire Agreement of the parties hereto, and all previous communications between the parties, whether written or oral with reference to the subject matter of this Agreement, are hereby canceled and superseded. No modification of this Agreement shall be binding upon the parties hereto, unless such is in writing and duly signed by the respective parties hereto.