

Advertised: **JUNE 01, 2019**

**NO ADDENDUM NECESSARY/
NO ADDENDUM ISSUED.**

**Highway Operations -- Operations Program Management --
Pavement Management Section**

REVIEWED
By Robert J. Stroup, PE at 8:12 am, Jun 20, 2019

REQUEST for LETTERS of INTEREST (RFLOI)

**2019 High Speed Data Collection and Processing for Pavement
Management Section (PMS)**

**TITLE: 2019 High Speed Data Collection and Processing for Pavement
Management Section (PMS)**

**USING AGENCY: North Carolina Department of Transportation
Highway Operations -- Operations Program Management -- PMS**

ISSUE DATE: JUNE 01, 2019

SUBMITTAL DEADLINE: JUNE 28, 2019

**ISSUING AGENCY: North Carolina Department of Transportation
Technical Services Division
Professional Services Management Unit**

SYNOPSIS

SUBCONSULTANTS ARE NOT PERMITTED UNDER THIS CONTRACT.

The primary and/or subconsultant firm(s) (*if Subconsultants are allowed under this RFLOI*) shall be pre-qualified to perform ALL of the work codes listed below for the Highway Operations -- Operations Program Management -- Pavement Management Section. Work Codes required are:

- 404 – High Speed Data Collection and Processing
- 405 – Quality Assurance for High Speed Data Collection

WORK CODES for each primary and/or subconsultant firm(s) (*if Subconsultants are allowed under this RFLOI*) SHALL be listed on the respective RS-2 FORMS (see section 'SUBMISSION ORGANIZATION AND INFORMATION REQUIREMENTS').

This RFLOI is to solicit responses (LETTERS of INTEREST, or LOIs) from qualified firms to provide professional consulting services to:

The scope of work includes sections of both asphalt and concrete surfaced pavements covering all the interstate and primary routes, any route on the NHS, any route with an AADT greater than 10,000, assigned non-system routes, and any route identified as an HPMS sample. In addition, NCDOT, at its discretion, may require data collection for routes on the Federal, secondary and local road networks.

Except as provided below any firm wishing to be considered must be properly registered with the Office of the Secretary of State and with the North Carolina Board of Examiners for Engineers and Surveyors. Any firm proposing to use corporate subsidiaries or subcontractors must include a statement that these companies are properly registered with the North Carolina Board of Examiners for Engineers and Surveyors and/or the NC Board for Licensing of Geologists. The Engineers performing the work and in responsible charge of the work must be registered Professional Engineers in the State of North Carolina and must have a good ethical and professional standing. It will be the responsibility of the selected private firm to verify the registration of any corporate subsidiary or subcontractor prior to submitting a Letter of Interest. Firms which are not providing engineering services need not be registered with the North Carolina Board of Examiners for Engineers and Surveyors. Some of the services being solicited may not require a license. It is the responsibility of each firm to adhere to all laws of the State of North Carolina.

The firm must have the financial ability to undertake the work and assume the liability. The selected firm(s) will be required to furnish proof of Professional Liability insurance coverage in the minimum amount of \$1,000,000.00. The firm(s) must have an adequate accounting system to identify costs chargeable to the project.

SCOPE OF WORK

The North Carolina Department of Transportation (NCDOT) is soliciting proposals for the services of a firm/team for the following contract scope of work:

SEE ATTACHMENT: "High Speed Data Collection for PMS -- Scope of Work and Deliverables - 2019 - Final" for Scope of Work Details.

PROPOSED CONTRACT TIME: ONE (1) YEAR and FOUR (4) ONE-YEAR EXTENSIONS possible.

PROPOSED CONTRACT PAYMENT TYPE: Cost-Plus payment structure.

SUBMITTAL REQUIREMENTS

All LOIs are limited to **FIFTEEN (15)** pages (RS-2 forms are not included in the page count) inclusive of the cover sheet, and shall be typed on 8-1/2" x 11" sheets, single-spaced, one-sided.

LOIs containing more than FIFTEEN (15) pages will not be considered.

WORK CODES for each primary and/or subconsultant firm(s) (if Subconsultants are allowed under this RFLO) SHALL be listed on the respective RS-2 FORMS (see section 'SUBMISSION ORGANIZATION AND INFORMATION REQUIREMENTS').

ONLY ELECTRONIC LOIs WILL BE ACCEPTED.

LOIs should be submitted in .pdf format using software such as Adobe, CutePDF PDF Writer, DocuDesk deskPDF, etc.

One copy of the LOI should be sent as a .pdf file, **through NCDOT's FTS System**, to: psmu-411@ncdot.gov. **The FTS system will send you an electronic receipt when your LOI is uploaded to NCDOT's FTS system.** Paper copies are not required. The subject line should contain the Firm's Name, and "LOI for 2019 High Speed Data Collection and Processing for Pavement Management Section (PMS)".

If an interested firm does not have an FTS account they should send a request through regular e-mail to psmu-411@ncdot.gov. A response will be sent via the FTS system that will provide a login username, password, and login procedures.

LOIs SHALL be received electronically no later than 12:00 P.M., JUNE 28, 2019.

LOIs received after this deadline will not be considered.

Firms submitting LOIs are encouraged to carefully check them for conformance to the requirements stated above (and any other requirements in this Advertisement). If LOIs are submitted late, exceed the maximum number of pages, are sent by any means other than NCDOT's FTS system, or are sent to any address other than psmu-411@ncdot.gov they will be disqualified.

The Department reserves the right to reject all LOIs and not proceed with procurement.

The Department reserves the right to waive any technicality in LOIs, or notify the Firm(s) of such technicality and allow the Firm(s) up to two (2) business days to rectify the technicality.

SELECTION PROCESS

Following is a general description of the selection process:

- The NCDOT Selection Committee will review all qualifying LOI submittals.

- For Limited Services Contracts (On-Call type contracts), the NCDOT Selection Committee MAY, at the Department's discretion, choose any number of firms to provide the services being solicited.
- For Project-Specific Contracts (non On-Call type contracts), the Selection Committee MAY, at the Department's discretion, shortlist a minimum of three (3) firms to be interviewed. IF APPLICABLE, dates of shortlisting and dates for interviews are shown in the section SUBMISSION SCHEDULE AND KEY DATES at the end of this RFLOI.
- In order to be considered for selection, consultants must submit a complete response to this RFLOI prior to the specified deadlines. Failure to submit all information in a timely manner will result in disqualification.

SMALL PROFESSIONAL SERVICE FIRM (SPSF) PARTICIPATION

The Department encourages the use of Small Professional Services Firms (SPSF). Small businesses determined to be eligible for participation in the SPSF program are those meeting size standards defined by Small Business Administration (SBA) regulations, 13 CFR Part 121 in Sector 54 under the North American Industrial Classification System (NAICS). The SPSF program is a race, ethnicity, and gender neutral program designed to increase the availability of contracting opportunities for small businesses on federal, state or locally funded contracts. SPSF participation is not contingent upon the funding source.

The Firm, at the time the Letter of Interest is submitted, shall submit a listing of all known SPSF firms that will participate in the performance of the identified work. The participation shall be submitted on the Department's Subconsultant Form RS-2. RS-2 forms may be accessed on the Department's website at [NCDOT Connect Guidelines & Forms](#).

The SPSF must be qualified with the Department to perform the work for which they are listed.

Real-time information about firms doing business with the Department and firms that are SPSF certified through the Contractual Services Unit is available in the Directory of Transportation Firms. The Directory can be accessed on the Department's website at [Directory of Firms](#) -- Complete listing of certified and prequalified firms.

The listing of an individual firm in the Department's directory shall not be construed as an endorsement of the firm.

PREQUALIFICATION

The Department maintains on file the qualifications and key personnel for each approved discipline, as well as any required samples of work. Each year on the anniversary date of the company, the firm shall renew their prequalified disciplines. If your firm has not renewed its application as required by your anniversary date or if your firm is not currently prequalified, please submit an application to the Department **prior to submittal of your LOI**. An application may be accessed on the Department's website at [Prequalifying Private Consulting Firms](#) -- Learn how to become Prequalified as a Private Consulting Firm with NCDOT. Having this data on file with the Department eliminates the need to resubmit this data with each letter of interest.

Even though specific DBE/MBE/WBE goals are not required for this project, the Department of Transportation is committed to providing opportunity for small and disadvantaged businesses to perform on its contracts through established Department goals. The Firm, subconsultant and subfirm shall not discriminate on the basis of race, religion, color, national origin, age, disability or sex in the performance of this contract.

SELECTION CRITERIA

All prequalified firms who submit responsive letters of interest will be considered.

In selecting a firm/team, the selection committee will take into consideration qualification information including such factors as:

1. **50%** = The firm's understanding of high speed data collection and processing and approach to provide the required services.
2. **50%** = The firm's experience and staff to perform the type of work required.
3. **N/A%** = N/A.
4. **N/A%** = N/A.
5. **N/A%** = N/A.

After reviewing qualifications, if firms are equal on the evaluation review, then those qualified firms with proposed SPSF participation will be given priority consideration.

SUBMISSION ORGANIZATION AND INFORMATION REQUIREMENTS

The LOI should be addressed to **Mr. Robert J. Stroup, PE -- State Professional Services Engineer** and must include the name, address, telephone number, and e-mail address of the prime consultant's contact person for this RFLOI.

The LOI must also include the information outlined below:

Chapter 1 - Introduction

The Introduction should demonstrate the consultant's overall qualifications to fulfill the requirements of the scope of work and should contain the following elements of information:

- Expression of firm's interest in the work;
- Statement of whether firm is on register;
- Date of most recent private engineering firm qualification;
- Statement regarding firm's(') possible conflict of interest for the work; and
- Summation of information contained in the letter of interest.

Chapter 2 - Team Qualifications

This chapter should elaborate on the general information presented in the introduction, to establish the credentials and experience of the consultant to undertake this type of effort. The following must be included:

1. Identify recent, similar projects the firm, acting as the prime contractor, has conducted which demonstrates its ability to conduct and manage the project. Provide a synopsis of each project and include the date completed, and contact person.
2. If subconsultants are involved, provide corresponding information describing their qualifications as requested in bullet number 1 above.

Chapter 3 - Team Experience

This chapter must provide the names, classifications, and location of the firm's North Carolina employees and resources to be assigned to the advertised work; and the professional credentials and experience of the persons assigned to the project, along with any unique qualifications of key personnel. Although standard personnel resumes may be included, identify pertinent team experience to be applied to this project. Specifically, the Department is interested in the experience, expertise, and total quality of the consultant's proposed team. If principals of the firm will not be actively involved in the study/contract/project, do not list them. The submittal shall clearly indicate the Consultant's Project Manager, other key Team Members and his/her qualifications for the proposed work. Also, include the team's organization chart for the Project / Plan. A Capacity Chart / Graph (available work force) should also be included. Any other pertinent information should also be listed in this section.

Note: If a project team or subconsultant encounters personnel changes, or any other changes of significance dealing with the company, NCDOT should be notified immediately.

Chapter 4 - Technical Approach

The consultant shall provide information on its understanding of, and approach to accomplish, this project, including their envisioned scope for the work and any innovative ideas/approaches, and a schedule to achieve the dates outlined in this RFLOI (if any project-specific dates are outlined below).

Data collection and delivery is due by June 30th, 2020 and by June 30th of each successive contract year.

APPENDICES-

CONSULTANT CERTIFICATION Form RS-2

Completed Form RS-2 forms SHALL be submitted with the firm's letter of interest. This section is limited to the number of pages required to provide the requested information.

Submit Form RS-2 forms for the following:

- **Prime Consultant firm**

- Prime Consultant Form RS-2 Rev 1/14/08; and
- **ANY/ALL Subconsultant firms** (*If Subconsultants are allowed under this RFLOI*) to be, or anticipated to be, utilized by your firm.
 - Subconsultant Form RS-2 Rev 1/15/08.
 - In the event the firm has no subconsultant, it is required that this be indicated on the Subconsultant Form RS-2 by entering the word “None” or the number “ZERO” and signing the form.

Complete and sign each Form RS-2 (instructions are listed on the form).

The required forms are available on the Department’s website at:

<https://connect.ncdot.gov/business/consultants/Pages/Guidelines-Forms.aspx>

[Prime Consultant Form RS-2](#)

[Subconsultant Form RS-2](#)

All submissions, correspondence, and questions concerning this RFLOI should be directed to **Mr. Thomas G. Payne, PE** at tgpayne@ncdot.gov. However, the LOI itself must be submitted to psmu-411@ncdot.gov via NCDOT’s FTS System.

IF APPLICABLE, questions may be submitted electronically only, to the contact above. Responses will be issued in the form of an addendum available to all interested parties. Interested parties should also send a request, by email only, to the person listed above to be placed on a public correspondence list to ensure future updates regarding the RFP or other project information can be conveyed. Questions must be submitted to the person listed above no later than **JUNE 10, 2019**. The last addendum will be issued no later than **JUNE 20, 2019**.

NOTE: To adhere to the Timeframe, a Notice to Proceed is expected to be issued shortly after (a) firm(s)/team(s) is/are selected. All firm(s)/team(s) submitting a LETTER OF INTEREST should make sure that their rates and overheads are current and have been audited by NCDOT.

SUBMISSION SCHEDULE AND KEY DATES

RFLOI Release – **JUNE 01, 2019**

Deadline for Questions – **JUNE 10, 2019**

Issue Final Addendum – **JUNE 20, 2019**

Deadline for LOI Submission – **JUNE 28, 2019**

Shortlist Announced * - **JULY 19, 2019, if the Department elects this option.**

Interviews - the week of **JULY 29, 2019, if the Department elects this option.**

Firm Selection and Notification ** - **on or around AUGUST 07, 2019 (or earlier if no interviews).**

Anticipated Notice to Proceed – **OCTOBER 01, 2019**

* Notification will **ONLY** be sent to shortlisted firms.

** Notification will **ONLY** be sent to selected firms.

High Speed Data Collection for PMS -- Scope of Work and Deliverables - 2019 - Final

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I. Scope of Work

The scope of work includes sections of both asphalt and concrete surfaced pavements covering all the interstate and primary routes, any route on the NHS, any route with an AADT greater than 10,000, assigned non-system routes, and any route identified as an HPMS sample. In addition, NCDOT, at its discretion, may require data collection for routes on the Federal, secondary and local road networks.

II. Background

II.A Location-Reference System

The Asset Management System uses route and mile-point for identifying pavement locations. The mile-points are county-relative locations: the milepoint is typically zero at the southern or western county line or at the route's beginning point from another route and increases north or east depending on the ordinal direction of the road. The county milepoints reset to zero each time the road crosses a county line. The milepoints are based on spatial data as maintained by the NCDOT GIS Unit. The county relative mile-point system will be used as the linear referencing system for data reported by the vendor.

Base linework for each data collection cycle will be provided by NCDOT in a shape file or geodatabase format. The vendor shall use high quality GPS units to collected data such that it can be associated with this linework. Terminal (begin and end) GPS coordinates shall be reported for each data item.

An Inertial Measurement Unit (IMU) is required in each vehicle to insure high quality location data and to allow for optional collection of curve and grade data.

II.B Section Condition Data Summarization Requirements

II.B.1 NCDOT Pavement Sections

All pavement condition data (discussed in detail later) shall be summarized in one-tenth (0.100) mile sections starting at the mile-point 0.000 beginning at the state or county boundary or the route origination point. Milepoints shall increase from south to north and west to east depending on the assigned direction of the route. Where data are to be collected in only one direction the data collection vehicle shall travel in the direction of increasing mileposts. Therefore, the "to" milepost will always exceed the "from" milepost.

The tenth mile sections will be broken at overlaps of higher priority routes, the next county boundary, and pavement change/homogeneous section limits. At each break of this type, the last section length will be less than one-tenth mile, that length dependent on the distance from the last even one-tenth mile section to the break point. When the end of the break is reached, a new pavement sectioning of one-tenth mile increments shall begin. Figure 1, below is an example of how NCDOT deals with route overlap. The standard is that when two or more routes run concurrently on the same location the route designation and mileposts are assigned to the higher classed route (This is indicated by a lower 8-digit route number). If routes of the same class run concurrently mileposts are assigned to the lower route number.

Aggregated pavement condition data shall be summarized on homogenous sections based on information collected by the vendor and by route intersection breaks provided by NCDOT. **Aggregate data sections will be broken at overlaps of higher priority routes, the next county boundary, and pavement change/homogeneous section limits.** These sections are also typically limited to 1 mile in length for concrete data and 2 miles in length for asphalt data.

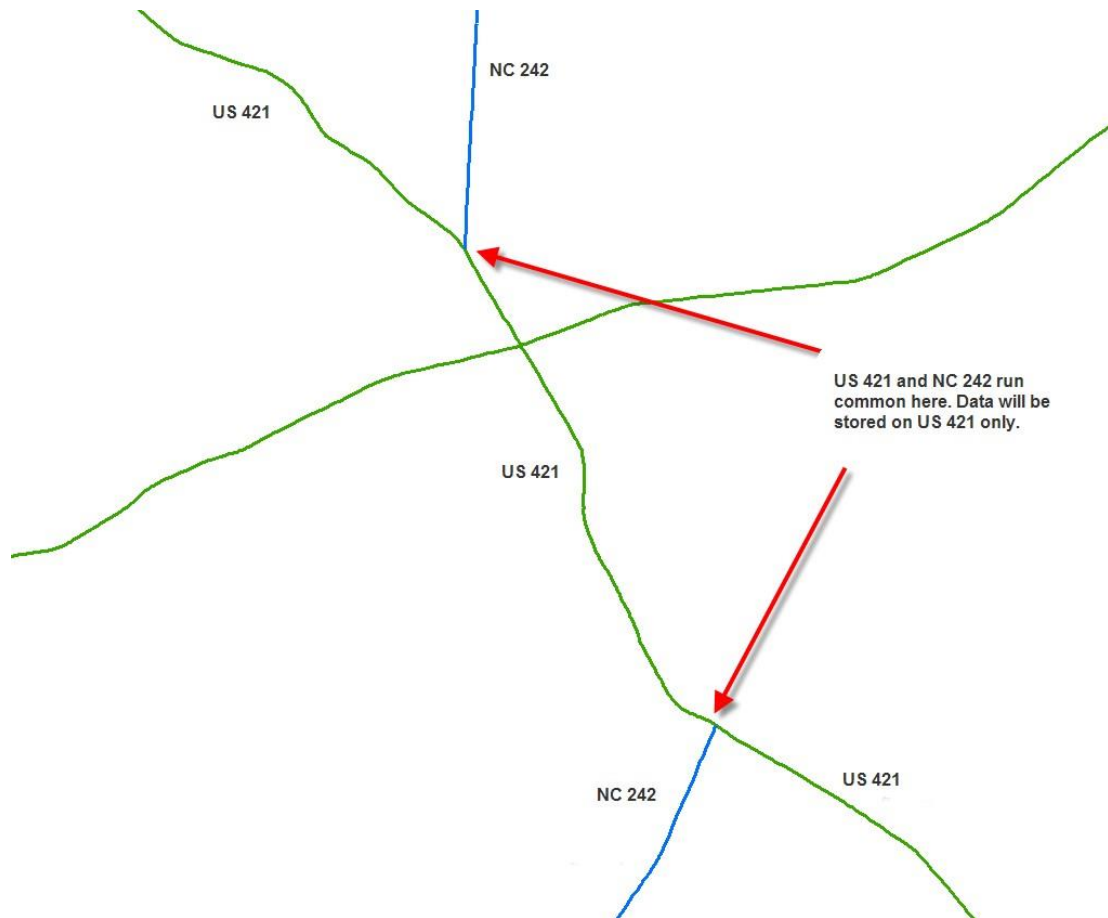


Figure 1 – Common/Overlapping Route Scenario

II.B.2 Inclusion/Exclusion of Bridges, Construction Zones etc.

Distress condition data from Bridges, Construction Zones, Detours, etc. shall not be used in calculating one-tenth mile averages and other statistics for pavement distress. However, roughness (IRI) data shall include bridges and other areas and be made available to NCDOT for asset management and HPMS reporting purposes.

The Consultant shall report the location of construction encountered during data collection that affects the data collection process.

II.C Data Reporting Format

The summarized condition data shall be placed in Microsoft Excel files (or compatible) and a format suitable for import into an Oracle database with a database structure provided by NCDOT. This data structure will follow the most recent version of NCDOT High Speed Distress Manual. The data shall be delivered in conformance with the provided structure and will be dependent upon pavement type (ASP/CRC/JCP). For reporting the beginning and ending mile points of bridges, the pavement type field should have a "BR" and the mile points will be listed in thousandth increments as indicated in Paragraph II.F.1 below. Pavement type designations are based on the existing pavement surface as follows:

- **ASP:** Asphalt Concrete Pavement
- **CRC:** Continuously Reinforced Concrete Pavement
- **JCP:** Jointed Concrete pavement.

II.D Speed Requirement

Condition data shall be collected at or near the posted highway speeds and in conformance to all applicable traffic laws in North Carolina. The Consultant shall not impede the flow of traffic at any time.

II.E Work Plan

The Consultant is required to provide a detailed work plan that addresses pavement data and inventory needs outlined in the RFP, within 10 business days of receiving the Notice to Proceed. The plan must contain, at a minimum, well-identified milestones (defined in Section III.N.2) and the activities considered necessary by the Vendor and NCDOT to achieve those milestones. The plan shall address all deliverables required by this RFP. The NCDOT Project Manager shall approve this work plan prior to the beginning of work. Also, weekly and monthly status reports will be submitted to the NCDOT Project Manager to closely monitor and demonstrate that the project is on schedule and that the data collected conforms to NCDOT requirements.

II.E.1 Minimum Work Plan Requirements

The work plan shall address as a minimum the details in the Statement of Needs, sections III.H, III.I, III.J, III.K and III.L and shall provide a thorough description of the Offeror's staffing and equipment plan as detailed in sections III.M and III.N. In addition, the work plan will describe the Offeror's vision of the project and for accomplishing the work on time.

II.E.2 Delivery Date Establishment

The consultant shall provide delivery dates for all deliverables identified in Table 7. The consultant shall establish delivery dates for milestones which are defined in Table 3.

II.F General Quality Requirements

Anticipated Standard Operating Procedures (SOPs) are summarized in Table 7. After approval by the NCDOT Project Manager, NCDOT will monitor compliance with these SOPs and may require re-calibration and an equipment assessment if such events occur.

II.F.1 Bridge Start and End Locations

Consistent with the provisions of Paragraph II.E above **the Consultant shall report all bridge start and end locations** to the nearest one thousandth (0.001) mile in county relative mile-points as an aid in quality assurance of the Location Referencing System.

II.F.2 Multiple Vehicles

If the Consultant uses two or more vehicles to collect the data, all vehicles and equipment shall employ the same technologies and configurations of those technologies. The NCDOT Project Manager must approve any proposed non-conforming vehicle prior to its use in data collection.

II.F.3 Equipment Adjustments and Repairs

The Consultant shall provide training to equipment operators to recognize equipment malfunctions. When malfunctions do occur, all adjustments and repairs shall be brought to the attention of the NCDOT Project Manager as part of the weekly report.

The NCDOT Project Manager may require recalibration of repaired equipment.

II.F.4 Quality Control Plan

The Consultant shall develop and execute a Quality Control Plan for the collection and processing of data items. The plan shall include personnel certification training, the validation of equipment accuracy and precision, daily quality control procedures, and on-going quality control procedures. The plan shall include the establishment and use of appropriate limits of variation of each data item. A critical element of the plan shall be the establishment of statistically valid precision and bias limits including the actions to be taken whenever those limits are exceeded. The NCDOT Project Manager and designated Quality Control Vendor shall approve the Quality Control Plan.

II.F.5 Precision and Bias

The Precision and bias terms used in this document are as defined by ASTM E177-14, Standard Practice for Use of the Terms Precision and Bias in ASTM Test Methods. In general, bias refers to systematic error against an independent measure and precision refers to variability of the data item in question. The Consultant must submit statements of precision and bias practically achievable for each sensor data item separately. The NCDOT Project Manager must approve those statements prior to the collection of production data. Precision and bias limits of 5% will be assumed for sensor data items not otherwise documented by the Consultant. In the determination of bias, 'ground truth' will be as specified by NCDOT on sites identified by the Quality Assurance Consultants plan.

II.F.6 Calibrations

The Consultant shall provide a weekly equipment calibration schedule and maintain a record of the calibrations carried out during the project. The calibration schedule and record shall be furnished to the NCDOT Project Manager on a weekly basis to demonstrate that the equipment is collecting within accepted variances. **No payment shall be made for condition data collected without the support of the weekly calibration data.** The NCDOT Project Manager must approve deviations outside the range of expected variances provided later in this document. Calibration details shall be identified and included in the Consultant's Quality Control Plan.

II.F.7 Adverse Weather Conditions

NCDOT shall reserve the right to require stoppage of data collection if it deems that weather conditions will adversely affect data quality. The consultant shall provide to NCDOT an SOP that addresses adverse weather conditions. Data inappropriately collected under adverse conditions shall be re-collected at consultant cost.

II.F.8 Standard Operating Procedures

The Consultant shall provide to NCDOT standard operating procedures for commonly occurring events and tasks during data collection and processing. These will include, but not be limited to, procedures to be used in the event of a major mechanical or electronic repairs to data collection vehicles, such as recalibration activities, slow and high-speed roughness collection, etc.

II.F.9 Location-Reference Acceptance Criteria

Consultant reported landmarks shall be evaluated through a random sampling process wherein the reported and NCDOT LRS landmarks shall be compared. In the absence of proof to the contrary NCDOT references are considered to be “ground truth.” In the case of disputed locations, the NCDOT Project Manager shall be the arbiter. The location reference data shall be accepted when 90% of the reported landmarks are within 0.01 mile of ground truth for sections less than one-mile in length and within 0.05 mile for sections one-mile or greater in length. The Consultant is urged to make location reference compliance a part of the initial data screening process as data not meeting these criteria will not be further evaluated by NCDOT for pay purposes.

II.F.10 Initial Data Screening

The consultant shall provide an initial data screening (filtering) methodology designed and configured to ensure that unreasonable data are not processed or reported. As a minimum, this methodology shall ensure that required data fields have been populated and that the data are within ranges deemed realistic for the parameters measured. Suggested ranges, based on a nominal section length of 1/100 mile (52.8 feet) are provided in Table 1. If the data is rejected for more than 10% of the length of the homogeneous section, the data shall be re-collected and re-processed by the vendor for the entire homogeneous section, at no cost to NCDOT.

Parameters	Low		High	
	Reject	Investigate	Investigate	Reject
IRI	<0	<30 in/mile	>300 in/mile	>500 in/mile
Rut	<0	n/a	>1 inch	>2.5 in.
Speed	Vehicle dependent- follow Consultant's SOP			

Table 1 - Expected data ranges

III. Statement of Needs

III.A Pavement Assets

A pavement asset is defined as any homogeneous pavement section. Homogeneous means the pavement cross-section is of substantially the same materials and geometrics throughout the section. **It is expected that the vendor will produce and validate homogeneous sections based on collection of inventory data. All items listed in section III. that indicate addition cost or separate line items, shall only be included once the contractor has been selected.**

III.B Pavement Sections

Pavement sections for this evaluation shall consist of approximately 23,091 survey miles broken down as follows:

III.B.1 Interstate Highways – Asphalt and Concrete

All asphalt and concrete surfaced interstate highways, totaling approximately 2,733 directional miles statewide.

III.B.2 Primary Highways – Asphalt and Concrete

All asphalt and concrete surfaced primary highways, totaling approximately 17,346 directional miles statewide.

III.B.3 NHS, Secondary, Municipal, and Federal Routes

All identified asphalt and concrete surfaced routes on the NHS, secondary, municipal, federal, and local road networks; totaling approximately 3,012 directional miles, statewide.

III.C Highway Pavements to be surveyed

As indicated in III.A and III.B above, the “Homogeneous Sections” listing will constitute the NCDOT interstate and primary system identified for pavement distress evaluations and sensor measurements. NCDOT reserves the right to increase or decrease these mileages by as much as 25% at any time before completion of the field data collection.

III.D Data Collection Startup Process and Evaluation

III.D.1 Annual Requirement

An initial pavement data collection/processing validation and calibration exercise shall be carried out on an annual basis. The startup process must be finished (including NCDOT review) before production data may be collected.

III.D.2 Basic Start-up Requirements

Site Certification: The start-up process must include the following. A test section is min 528 feet long. This will allow for automated starting and stopping of the test section (Auto triggered). There must be a site for each pavement type that is representative of what is to be measured.

- Asphalt section
- JCP section (includes CRC)

Certification shall be made with a minimum of 5 runs of the certification site for each data collection vehicle that will collect in the state. The certification frequency shall be at the beginning of every collection season. Every data collection vehicle may require periodic checking at a frequency defined by the NCDOT. State personnel will be overseeing testing and certification process. A log of all calibration test should remain in each vehicle and be available to NCDOT when requested. Periodically (at NCDOT request), the data collection vehicles will run on a known section of pavement and have data compared. These records are to be supplied to NCDOT.

During this exercise, precision and bias tests will be conducted for all data items. In addition, calibration procedures, camera angles and coverage, data calculation methods and standard operating procedures will be verified. **All start-up work shall be reported to NCDOT at one time in a well-documented concisely written report.**

III.D.3 Project Manager Approval of Start-up

The NCDOT Project Manager must approve the start-up report and its findings in writing before future work is undertaken. No payment will be provided for production data collected or analyzed prior to approval of the start-up report.

III.E Data Collection Direction

Pavement condition data shall be collected for both directions of travel on all highways that are divided. For undivided highways of four or more lanes, the same rule shall apply. However, for undivided roads having less than four lanes (total in both directions) condition data shall be collected in the ‘primary’ direction only (northbound for routes designated as north/south and eastbound for routes designated as east/west)

III.F Data Collection Lane

Condition data shall be collected for the right-most travel lane (not including turning, acceleration or deceleration lanes) unless otherwise directed by NCDOT staff in the “homogeneous sections” listing. For rating paved shoulders see section III.K.1.e.

III.G Pavement Asset Condition Data Units of Measurement

Pavement data collection shall be measured in units of “directional mile.” Paragraph III.E identifies the data collection direction. Directional-miles and other units of measurement are defined in Table 2:

Highway Type	Definition
Interstate	1 reading in each direction, outside thru-lane (equals 2 directional miles per mile of roadway) and includes adjacent shoulder.
Primary	1 reading in each direction for divided roadways (equals 2 directional miles per mile of roadway) and includes adjacent shoulder. 1 reading in each direction for undivided roads with four or more lanes total in both directions and includes adjacent shoulder. 1 reading in primary direction for undivided roads with less than four lanes in both directions, outside thru-lane (equals 1 directional mile per mile of roadway) and includes adjacent shoulder.

Table 2 - Units of Measurement

III.H Data Delivery Schedule

III.H.1 Data Collection Timeframe and Delivery Due Date

Data collection, data processing, and data delivery shall be performed in the months of January 2020 through June 2020, with milestone deliverables of processed data as outlined in Table 3.

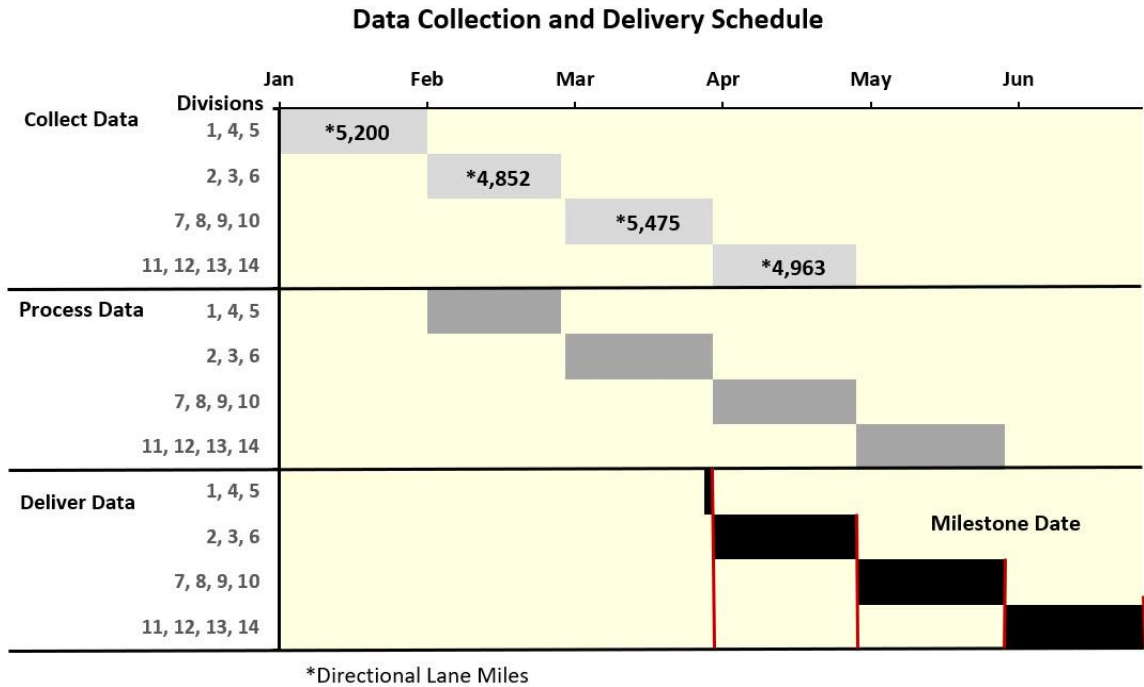


Table 3 – Data Collection and Delivery Schedule

The milestone dates for data received and accepted by NCDOT and the designated quality control vendor shall start on March 31, 2020. The data shall be grouped by completed Division as indicated in Table 3. The final deliverables shall be received and accepted by NCDOT no later than June 30, 2020, for all interstate and primary routes, any route on the NHS, any route with an AADT greater than 10,000, assigned non-system routes, and any route identified as an HPMS sample routes, Federal routes, secondary routes, and routes on the local road network.

Similar deadlines are applicable each year, subject to the requirements herein. Completion is defined as collection, processing (including distress reduction from images), submission for QA, reporting and acceptance by NCDOT. A detailed data delivery schedule, with incremental deliverables, must be provided in the Consultant’s work-plan subject to change according to award date. These dates may be adjusted by NCDOT during data collection to account for weather issue and equipment failure.

III.I Sensor Data Collection Requirements

General Requirements for Pavement Condition Data Collected by Sensors (IRI, Rutting and Faulting data) are summarized in Table 4. The equipment shall conform to ASTM Designation E1656/E1656M-11, “Standard Guide for Classification of Automated Pavement Condition Survey Equipment”, or latest version.

III.I.1 Real Time Data Monitoring

The Consultant shall have the capability of monitoring sensor data collection and processing in real time in the data collection vehicles. The Consultant shall maintain a monitoring system such that measurement problems will be detected and corrected while still in proximity to data collection sites. As a minimum, real time data processing and monitoring are required for IRI and rut depth.

III.I.2 Multiple Data Collection Vehicles

It shall be demonstrated that all vehicles are calibrated to produce between vehicle measurements differences (IRI, rutting data) of 5% or less or as specified in the corresponding specifications in this document.

Summary of Data Collection Requirements for Sensor Data		
	Roughness (IRI)	Rut Depth
Scope	All pavement surfaces as mentioned in III.A and III.B	All asphalt surfaces
Definition	Longitudinal Profile, both wheel paths	Rutting in each wheel path
Sampling Interval	Max. 6 inches	Max. 10 ft.
Calculations and Statistics	IRI (AASHTO Standard R 43), each wheel path and average of both wheel paths	Each transverse profile use deeper of both wheel paths and for section report average.
Units	Inches/mile	Inches (nearest 1/100th inch)
Equipment Configurations	Lasers and accelerometers, both wheel paths	It is preferable to record data with a scanning laser device with a minimum of 1000 points for entire lane and a little beyond on each side so as to determine drop-offs and curbs. (10 ft lane width coverage would be minimum)
Standards	ASTM E950/E950M-09(2018) or later version. HPMS field manual (2018)	AASHTO Rut Depth Measurement Protocol (AASHTO R 87 and R 88) or later version.
Precision and Bias	Consultant to provide	Consultant to provide
Initial Verification	Test section comparison of Longitudinal profile with NCDOT owned equipment.	Test section comparison of transverse profile with NCDOT owned equipment.
Ongoing Quality Monitoring	Calibration and Control Section comparisons (both vendor and NCDOT)	Calibration and Control Section comparisons (both vendor and NCDOT)
Special Requirements	Correct/report low speed sections. Bridge IRI should not be excluded from roadway roughness calculations.	

Table 4 - Sensor Data Requirements

III.1.3 Roughness Data

III.1.3.a - Definition

The longitudinal profile of the pavement surface shall be measured on 100% of the length of all pavements for both wheel paths.

III.1.3.b - Sampling

A maximum sampling interval of 6 inches shall be used during longitudinal profile measurement.

III.1.3.c - Calculations and Statistics

The International Roughness Index (IRI) shall be computed from each longitudinal profile using quarter-car simulation. The IRI shall be reported for each wheel path along with the average of both wheel paths as indicated in Table 5. The data will be summarized for each tenth of a mile segment of the roadway and for every homogeneous section, for reporting purposes.

Left Wheel Path	Right Wheel Path	Average of Wheel Paths
-	-	-

Table 5 - IRI Reporting

III.1.3.d - Units

IRI shall be reported in units of inches per mile to the nearest inch per mile.

III.1.3.e - Equipment Configuration

Longitudinal profiles shall be measured using a profiler equipped with lasers and accelerometers in both wheel paths.

III.1.3.f - Conformance to Standards

Conformance with AAHSTO R56-14 "Certification of Profiling Systems", AASHTO R 43 "Quantifying Roughness of Pavements", ASTM E950/E950M-09 "Standard Test Method for Measuring the Longitudinal Profile of Traveled Surfaces with an Accelerometer Established Inertial Profiling Reference" is required for roughness data and equipment. The equipment shall conform to Class I profiling equipment requirements as specified in the above referenced HPMS Field Manual.

III.1.3.g - Initial Equipment Calibration and Certification Test

A reference profiling device such as Surpro will be used to collect IRI on a control site. The data collection vehicle will collect IRI on the same site for comparison. IRI calculations shall be performed using the latest version of PROVAL. These comparisons shall be used to verify that the Consultant's equipment meets the requirements specified in Paragraph III.1.3.f above. IRI values determined with the Consultant's equipment shall be compared across all consultant data collection vehicles on a control site and reported to NCDOT at the beginning of the project in the annual start-up report.

III.1.3.h - Special Roughness Requirement for Low Speed

The detrimental effect of low speed on IRI data quality is well known. The Consultant must be able to prove and implement a methodology for handling low speed sections. The equipment shall be capable of measuring IRI within the accuracy requirements specified elsewhere at speed ranges between 15 and 55 mph. For homogeneous sections where speeds fall below 15 mph, the consultant will implement a methodology for taking the low speed portion out of the homogeneous section average calculations. If more than 10% of readings within a homogeneous section are rejected due to low speed or any other reason, the consultant shall re-collect and re-process the data for the entire section. Where extended sections of road cannot be tested between the ranges specified above, the consultant shall attempt to change the time of testing to allow testing at the proper speed. If this is not feasible then the consultant will flag the data as invalid. The consultant shall provide a standard operating procedure (SOP) for low speed section roughness data collection and processing for review and approval by the NCDOT Project Manager.

III.1.3.i - IRI Standard Operating Procedure (SOP)

The consultant shall develop and deliver to the NCDOT Project Manager an IRI standard operating procedure which shall address the elements of IRI data collection and reporting and shall be integrated with the Consultant's quality control plan, item II.F.4. The NCDOT Project Manager must approve the IRI SOP prior to the collection of production data.

III.1.3.j - IRI Data Acceptance Criteria

The following steps will be followed to determine the acceptability of the IRI data:

III.1.3.j.1

IRI data shall be checked against the criteria mentioned in Table 1 for initial data screening.

III.1.3.j.2

The SOP documents identified in sections III.1.3.h and III.1.3.i must be submitted to the NCDOT Project Manager before the start of the production data collection.

III.1.3.j.3

'Bias' and 'Precision' statistics shall be calculated for the preselected control sites using the data collected by NCDOT-owned equipment and the consultant's equipment. The bias and precision percentages should be less than 5% or as reported in accordance with section II.F.5.

III.1.4 Rutting Data

III.1.4.a - Definition

Rutting data shall be collected on 100% of the length of the asphalt concrete surfaced pavements. Rut depths shall be collected for each wheel path. Rutting data shall be collected using a 3-dimensional camera system or high-speed scanning laser capable of measuring across the width of the entire representative lane.

III.I.4.b - Sampling

Measurements to estimate rut depth shall be made longitudinally at maximum intervals of 10 feet.

III.I.4.c - Calculations and Statistics

The deeper of the two wheel path ruts from each transverse profile sample shall be used in rut depth calculations. Rut depth shall be averaged and reported on 0.1 mile sections corresponding to the IRI data sections. Rut depth shall also be averaged and reported for an entire pavement management homogeneous section.

III.I.4.d - Units

The section average rut depth shall be reported to the nearest one-hundredth (0.01) inch. The severity levels shall be reported as percentages of section length to the nearest whole number.

III.I.4.e - Rut Measurement Standard Operating Procedure (SOP)

The consultant shall develop and deliver to the NCDOT Project Manager a rut measurement standard operating procedure which shall address the elements of rut depth data collection and reporting and shall be integrated with the Consultant's quality control plan, item II.F.4. The NCDOT Project Manager must approve the rut depth SOP prior to the collection of production data.

III.I.4.f - Rut Depth Data Acceptance Criteria

The following steps will be followed to determine the acceptability of the rutting data:

III.I.4.f.1

Rutting data shall be checked against the criteria mentioned in Table 1 for initial data screening.

III.I.4.f.2

The SOP documents identified in section III.I.4.e must be submitted to the NCDOT Project Manager before the start of the production data collection.

III.I.4.f.3

Vendor selected control sites shall be used to compare rutting data across vehicles. The consultant will be asked to collect data on these sites before the production level data collection begins. 'Bias' and 'Precision' statistics shall be calculated for the preselected control site. The bias and precision percentages between vehicles should be less than 5% or as reported in accordance with section II.F.5.

III.I.5 Curvature and Grade Data (Optional Item 1)

At the discretion of NCDOT, the consultant will provide curvature and grade data from the IMU. The specifications of this will be based on industry standards and refined after discussion with appropriate NCDOT business owners. **This should be listed as a separate line item.**

III.J Pavement Image Collection Requirements

III.J.1 General Requirements for Systems used for Capture and Processing of Data with Downward and Forward Perspective Images for Pavement Data Collection:

III.J.1.a - Downward Perspective Image Resolution

The Consultant shall collect and capture Downward Perspective Images of the pavement surface to produce a full 14-foot width view of the pavement surface for visual pavement distress condition evaluation, detailed in Section III.K. These images shall be collected from downward pointing, 3-dimensional (collecting x-y-z data) camera(s), which are orthogonal to the pavement surface. The Consultant must demonstrate that the resultant video image has a resolution to identify cracking of 1/8th inch width when traveling at survey speeds. This shall include the disclosure of equipment specifications, details or other proprietary information needed to support this resolution requirement. The burden of proof for this requirement shall be on the consultant. No production data shall be collected/processed until image resolution meets the approval of the NCDOT Project Manager. The downward and forward cameras (see forward images in III.J.1.c below) shall be synchronized such that both simultaneously image the same roadway location.

III.J.1.b - Artificial Illumination of Pavement

The Downward Perspective Image shall be collected with a uniform and consistent form of illumination applied to the pavement surface. The illumination shall be regulated to provide sufficient contrast and crack-shadows for the clear discernment of cracking and patching. Images bearing ambient and/or vehicle shadows that obscure pavement features will not be accepted.

III.J.1.c - Forward Perspective, Rear or 360-degree Perspective and Right of Way Images

The Consultant shall collect and capture forward perspective and the right of way (two side views) images from cameras pointed ahead and sideways of the vehicle and mounted either to the vehicle roof or just inside the vehicle. The forward perspective image shall resemble a windshield view of the roadway such that the pavement surface and condition in the travel lane ahead of the survey vehicle shall be captured.

The forward perspective image shall have a resolution to identify ¼-inch wide cracks on the pavement immediately ahead of the survey vehicle when traveling at highway speeds. **The right of way images shall be sufficiently clear so that these images can be used to inventory, assess conditions, and determine dimensions of such roadside assets as guardrails, guardrail terminals, signs, traffic signals, pavement markings and unpaved shoulders.**

Use of a single wide angled/high definition camera in place of forward, left and right cameras is acceptable if the images satisfy the requirements above. The downward, right of way and forward cameras (see downward images in III.J.1.a above) shall be synchronized such that all simultaneously image the same roadway location. The consultant shall also propose a method using captured images to perform a shoulder condition rating as identified in section III.K.1.e.

In addition, a rear high definition or 360-degree top-mounted camera shall be used to capture images behind the vehicle. **Costs for both rear-mounted and 360-degree option shall be provided.**

III.J.1.c.1 - Highway paved travel lane and shoulder width inventory data collection—**Optional Item 2 (mandatory in year 1)**

In order to produce an updated inventory of the network and to create accurate homogeneous sections, the consultant shall propose a method and process to record the actual paved width of the highway pavement, from edge-of-pavement to edge-of-pavement, a representative lane width from centerline to centerline of the lane markers of the driving lane, and paved and unpaved shoulder width. Measurement shall be to the nearest whole foot, or to a better accuracy. **This item shall be listed as a separate line item.**

III.J.1.c.2- Highway Asset Inventory Data Collection—**Optional Item 3**

The consultant shall propose a method to gather asset location and inventory data for selected highway assets using the forward perspective and right of way images and/or mobile Lidar technology. **The assets to be considered include but are not limited to: traffic signals, signs, guardrail, guardrail terminals, pavement markings and unpaved shoulders.** The inventory attributes to be collected for these assets and other relevant technical details shall be determined by NCDOT and will be partially based on the Maintenance Condition Assessment Program data items.

As a separate line item, the consultant shall propose a cost per directional mile using the images collected as per requirements III.J.1.c, by highway system. One, all, any combination or none of these inventory items may be selected by NCDOT.

Requirements for each inventory item will be developed by the vendor and the appropriate NCDOT business unit.

III.J.1.c.3 - Lane-shoulder drop-off—**Optional Item 4**

The consultant shall propose a method and process to collect lane-shoulder drop-off during the pavement evaluation process. This is an optional data element, to be report along with other data elements. The rating will be a simple 'yes' or 'no' rating based on a drop-off of 2 inches or greater. The collection interval shall be specified by the consultant, along with precision and bias statements. NCDOT will consider executing this option annually at its discretion, and may include a portion of the network or entire network as directed by the NCDOT Project Manager. **This item shall be listed as a separate line item.**

III.J.1.c.4 - Right-of-way imagery only for Secondary System— **Optional Item 5**

The consultant shall provide **a line item cost** for collection of right-of-way and rear-camera imagery data on portions of the NCDOT secondary network. This should not include pavement distress, roughness or other data types.

III.J.1.c.5 - Highway Rumble Strip Determination—**Optional Item 6**

The consultant shall propose a method to determine the presence of rumble strips on the shoulders of highways. This includes presence of rumble strips on both inside and outside

shoulders for divided highways and the presence of centerline rumble strips on undivided roads.

III.J.1.d - Image Identification/Location

All digital images and roughness/rutting data collected shall be synchronized by use of time codes and distance measurements along a highway for positive location identification. All images and data shall be located to the nearest one-thousandth mile (5.28 feet) or better.

III.J.1.e - Image Storage

All digital images shall be stored electronically in a format that offers reliable, convenient and economical mass storage without discernable loss of the specified resolution of the images. Accordingly, the consultant shall propose an electronic image storage management plan to address the need for reliable storage of all downward, forward and right of way images. The plan must comply with North Carolina Department of IT requirements.

The plan shall also propose a dependable, web-based, consistent and convenient methodology for accessing, distributing and viewing of the forward and the right of way images by Division (field) users of NCDOT.

III.J.1.f - Temperature and Moisture Protection

All exterior mounted pavement digital cameras must be capable of collecting images during normally encountered fair weather conditions in North Carolina. This includes, but is not limited to, temperature and moisture conditions that cause fogging and condensation on the camera lens. Camera enclosures shall have heating devices or other means to eliminate fogging and condensation on camera lens.

III.J.1.g - Visibility Requirement

Images shall not be collected during times when the visibility of cracking and other distress forms are continuously obstructed by road conditions. This includes, but is not limited to, snow on the pavement, water on the pavement surface from rain, dampness/moisture in the cracks, sand on the pavement surface, and excessive salt stains on the pavement. Locations with unacceptable image quality shall be collected again at no additional cost to the Department.

III.J.2 - Storage of digitized Images

The following provisions shall be made for storage and retrieval of all digitized and/or digital downward and forward perspective images and software for image retrieval and display for pavement data collection. All storage of digitized Images and viewing software must comply with North Carolina Department of IT requirements.

III.J.2.a

For all pavement data collection, the Consultant shall collect, convert or otherwise store in digital form pavement images and will provide easy to use retrieval and display software for these images.

III.J.2.b

The Consultant shall collect, convert or otherwise store in digital form the images for each roadway. Image resolution shall meet the requirements stated in Paragraphs III.J.1.a and III.J.1.c.

III.J.2.c

It shall be the responsibility of the Consultant to provide for easy and immediate recall of any and all images.

III.J.2.d

The Consultant shall provide a software package to be operated and installed on personal computers with the capability of displaying all the digital images with the associated database record (indicating the distress quantifications).

The software shall also have the capability of incrementing ahead and/or back one frame at a time to scan the roadway images in sequence or play the images forward or backward to view the images at speeds that could be varied by the user.

The software shall be written for the latest NCDOT approved version of MS Windows operating system and must be capable of accessing the digital image files through convenient mass storage device. The software shall be user-friendly “point and click” type system.

At the conclusion of the contract, the software/hardware provided per this section shall be the property of NCDOT.

Retrieval of images and data should be flexible so that an image and associated data can be recalled by “snapping” to the nearest valid milepost on a route in a case where the milepost is entered that does not correspond precisely to a stored value.

III.J.2.e

The digital downward image shall show the entire lane width, proportioned to fit on the screen of a monitor. The image resolution shall meet the requirements of Paragraph III.J.1.a.

III.J.3 Pavement Imaging Standard Operation Procedure

The consultant shall develop and deliver to the NCDOT Project Manager a pavement imaging standard operating procedure which shall address the elements of pavement image collection and storage and shall be integrated with the consultant’s quality control plan, item II.F.4. The NCDOT Project Manager must approve the pavement imaging SOP prior to the collection of production data.

III.J.4 Summary of Pavement Image Acceptance Criteria

For any identified length of highway, no more than 5 images out of 100 continuous images provided by the Consultant shall be of inferior quality, as determined by NCDOT at its sole discretion. Guidance is provided in III.J.1.g. For amounts exceeding this tolerance, the consultant may be required to re-collect the images for affected sections of highway at no additional cost to the Department.

III.J.5 Image Storage and Usage by NCDOT

III.J.5.a - Image Workstation and software

The Pavement Management Section of NCDOT has a dedicated workstation for the viewing of data collected on this project. The consultant shall provide and support in the Pavement Management Section of NCDOT complete software, of the same configuration and quality used by the consultant's staff for the data collection performed on this project. The costs of the software mentioned in this section shall be included as a part of the overall cost of the project and not be treated as a separate line item. The cost of any needed hardware upgrades for this workstation shall be a **line item** in the contract proposal and shall not be included in the overall cost of the project.

NCDOT shall reserve the right to purchase computer hardware if cost savings can be realized from currently registered hardware vendors. Minimum and recommended hardware and operating system requirements necessary to run the consultant's software shall be provided. In that event, the consultant will provide appropriate software support.

The consultant shall provide reliable, cost effective and efficient media for delivery and archival of all video images at this workstation. The workstation hardware upgrades, software and media shall become the property of NCDOT at contract termination or close out.

III.J.5.a.1

The workstation software shall include the capability of displaying all the digital images with the associated database record (indicating the distress quantifications). The software shall also have the capability of incrementing ahead and/or back one frame at a time to scan the roadway images in sequence, and also be able to play the images forward or backward at variable speeds. The software shall be a user-friendly 'point and click' type system. At the conclusion of the contract, the software provided per this section shall be the property of NCDOT.

III.J.5.b Network Attached Storage for Forward and Right-of-way Images

The consultant shall propose a mass storage device/system to store all forward and right-of-way images for real-time access and dedicated video-image workstations and desktops in Asset Management section.

The image resolution shall remain at high-quality so as to allow reading highway signs at close range (mile-marker signs, reference posts, street names, etc.) and the system will be capable of displaying current and past year's images, using a simple user interface. The system will allow the user to identify the location along the road (in county-route-milepoint and GPS coordinates), cross-sectional offset (measured in feet) and height (measured in feet-inches) of visible roadway features, such as traffic signs, pavement markings, guardrail, pavement width, etc. Highway sections shall be looked up using a tabular entry of county, route, mile direction, or map based location entry. The images and the distress data shall be able to be viewed side by side with the capability of advancing images/data one frame at a time forward or backward, or play the images forward or backward at variable speeds controlled by the user. The consultant shall include and provide all hardware, software and support to make this a 'turnkey' image viewing

and usage solution. This solution shall be scalable to support distribution over local area network at a later date.

The consultant shall also provide software to view the images with data side by side, for NCDOT employees across the state over NCDOT network. For viewing the images over the NCDOT network, the software shall run from the server on which it is loaded. The software shall have the capability to choose required fields from the database to display and apply filters while displaying images for a particular location. The images and distress data shall be able to be viewed side by side with the capability of advancing images/data one frame at a time forward or backward, or play the images forward or backward at variable speeds controlled by the user. The cost of the software mentioned in this section shall be included as a part of the overall cost of the project and not be treated as a separate line item.

The cost of the hardware for this workstation shall be a **line item** in the contract proposal and shall not be included in the overall cost of the project.

NCDOT shall reserve the right to provide alternative forms of storage if cost savings can be realized from currently registered hardware vendors or due to security or policy requirements.

III.J.5.c Ramps and Loops Data Collection and Processing

NCDOT typically does not collect or process ramps and loop data. However, throughout the period of the contract, NCDOT may choose to collect video images and collect and process sensor and distress information. It is expected that the costs for this collection will adhere to the per-mile costs for the project as a whole.

III.J.5.d

Highway Performance Monitoring System (HPMS) data items: NCDOT wishes to collect data for HPMS to submit to FHWA. These data items shall conform to the latest version of HPMS Field Manual. Cracking quantities in HPMS units will be part of the pavement distress evaluation requirements in section III.K below.

III.K Pavement Distress Evaluation Requirements

III.K.1 Collection, Processing and Reporting of Pavement Distresses

The consultant will evaluate pavement surface distresses on the interstate and primary systems on 100% of the pavement sections (continuous) utilizing the downward and forward perspective images.

III.K.1.a - Distress Items to be collected

The Consultant shall evaluate pavement distresses using the Downward Perspective Images and Forward Perspective Images collected according to section III.J, above. This work shall be in conformance to requirements similar to those detailed in the manual "NCDOT High Speed Distress Manual V1.0 11-15-2011" NCDOT wishes to work with the vendor to determine final distress types and evaluation methods. A detailed data deliverable format will be assembled. The consultant shall provide the data in this format using the metadata provided for different data elements.

III.K.1.b - Semi-automated Processing of Distresses

The vendor may propose utilization of a proven, documented and demonstrated system for the processing of collected distresses. The reduction of images and processing of distresses should be mostly automated and consistent, with limited manual intervention to meet the requirements herein. Moreover, it is desirable that the data reduction takes place as it is being collected, so that a lot of processing time is not required following data collection. This way, glaring mistakes, if any, would be brought to the attention of the person in charge of data collection immediately and necessary corrective actions would be taken on a timely basis.

A 3-dimensional system is required for semi-automated and automated techniques.

III.K.1.c - Reporting

For reporting purposes, all distress and sensor collected data shall be summarized and indices calculated separately for each tenth of a mile of roadway and for every homogeneous section as provided by NCDOT. For the first table, the distresses will be summarized and the indices calculated for every tenth of a mile and for the second table, the same information will be summarized for each homogeneous section. The data will be summarized on homogeneous sections based on actual cracking values (as collected on 0.1 mile sections). The manuals will be provided to the consultant.

III.K.1.d - Quality Control and Data Acceptance

III.K.1.d.1

The consultant shall develop and implement a sensor and distress data assessment quality control plan that shall be approved by the NCDOT Project Manager before distress data assessment commences. As a minimum, the quality control plan shall provide for internal random assessment of the Consultant's work and shall be an integral part of the overall quality control plan for the project, as mentioned in item II.F.4.

III.K.1.d.2

For data in years after the first year of data collection, additional checks shall be made by comparing the previous year's survey summaries with current surveys. At locations where large changes occur, the data shall be further evaluated for reasonableness and consistency of trends.

III.K.1.d.3

NCDOT will institute an independent data quality assurance plan that will monitor the Consultant's assessment of pavement distress data. The Consultant is required to cooperate with NCDOT and its designated QC consultant in providing such data/images/software as required for analysis. This includes comparison of condition data from previous years.

III.K.1.d.4

The NCDOT plan will provide for final statistical acceptance of the Consultant's work based on a comparison of pavement condition indices computed from distress data provided by the consultant and distresses determined through NCDOT or independent party analysis of images provided by the Consultant. NCDOT may elect to use a separate contract to provide this data quality assurance function on its behalf. A data delivery is defined as a delivery of

no more than 250 pass miles or it can be defined by NCDOT as needed and agreed upon by both parties.

III.K.1.d.5

Distress Data Acceptance Criteria: When 90% of the Consultant and NCDOT determined indices for randomly selected homogeneous sections are within 10 points of each other, the lot shall be accepted. When the previous criterion is not met, the burden of proof shall be on the Consultant to make any required adjustments and/or reprocessing and for resubmitting the lot at no additional cost to the Department.

III.K.1.e

Rating of Paved Shoulders from Forward Perspective and Right of Way Images: **The consultant shall be required to collect inventory (width, material, type, etc.) and rate paved shoulders along the interstate and primary highways.** The rating methodology would be subjective, satisfy HPMS requirements, and the criteria will be provided to the consultant. For paved shoulder ratings, the consultant will not have to utilize the same techniques as analyzing mainline pavements. Such evaluations may be performed manually from forward perspective and right of way images. The ratings should also meet the most recent HPMS reporting requirements.

III.K.2 Methodology

The Consultant's plan shall address the following distress measurement issues:

III.K.2.a

The method of distress data collection and evaluation must include distress data processing through automated methodologies augmented with manual techniques, if necessary. The images should be viewable through a video workstation and the quantities of distresses should be recorded in a database. The vendor may propose utilization of a proven, documented, and demonstrated system to meet the requirements herein. At a minimum, a methodology description, a cost breakdown, and a task schedule must be provided for any data collection method.

III.K.2.b

The following are the two requirements for distress data reduction:

III.K.2.b.1

The workstations used by the Consultant for the viewing and evaluation of Downward Perspective Images shall be configured so that video monitors display a full-width image of the pavement surface while maintaining the quality of the image such that a 1/8-inch wide crack is visible as described in Paragraph III.J.1.a. This display or composite image will be used for the detailed pavement distress evaluation. If multiple monitors are used at a workstation, the video image must be fully synchronized so that all monitors show the identical location of pavement. The forward perspective image shall be displayed in conjunction with the downward perspective and right of way images to identify pavement distresses not clearly identifiable from the downward perspective images. The forward perspective and the right of way images must have the resolution prescribed in paragraph III.J.1.c. If the forward, right of way and downward cameras are offset on the data collection

vehicle, then the display of the forward and the right of way images shall be synchronized with the downward images, such that all images are of the same pavement location (note the last sentence in both III.J.1.a and III.J.1.c above).

III.K.2.b.2

Distress data shall be processed automatically. Methods shall be used to accurately measure distresses inside and outside the wheel paths and input the length, width and /or areas of pavement distresses should be consistent with the methodologies mentioned in section III.I. The processed images will include the polygons encompassing the distresses with dimensions shown on the image. If there are distresses of multiple severity levels, they should be displayed in the images with different colors schemes to make the QA process convenient and easier. The Consultant shall provide a means to positively and accurately evaluate the distress severities required by the “NCDOT High Speed Distress Manual V1.0 11-15-2011”

III.K.3 Distress Data Reduction Standard Operating Procedure (SOP)

The consultant shall develop and deliver to the NCDOT Project Manager a distress data collection standard operating procedure which shall address the elements of automatic (and manual, if necessary) reduction of distresses data from digital images and this shall be integrated with the consultant’s quality control plan, item II.F.4. The NCDOT Project Manager must approve the distress data reduction SOP prior to the collection of production data.

III.L Consultant Reporting Requirements

III.L.1 Regular Reports Provided to the NCDOT Project Manager

The Consultant shall provide the NCDOT Project Manager with the following information during the collection and/or processing of pavement condition data:

III.L.1.a

Weekly and Monthly reports of all quality checks, calibrations and repairs performed on the equipment used to gather pavement images or data.

III.L.1.b

Weekly status reports to include, but not be limited to, the following items: describing work completed, problems encountered, and work planned for the following week. Written weekly status reports shall be submitted each Friday during the production data collection and subsequent processing periods.

III.L.1.c

Monthly status reports shall detail the progress and status of work completed in each of the 14 Divisions. The monthly status reports shall be due on the first workday of the following month. The following data shall be provided as a minimum:

Division	Total Data Collection Miles	Data Collection Miles Complete	Distress Rating Miles Complete	QC Checks Miles Complete	Estimated Completion Date
1					

2					
3...					
14					

Table 6 - Minimum Monthly Status Report Data

III.M Consultant Personnel Requirements

The consultant shall be required to staff the project in a manner such that the desired product can be delivered effectively and efficiently in compliance with the quality and time requirements imposed above. The Consultant shall have as a team member, and provide a resume with the proposal, for the following:

III.M.1 Pavement Engineer

A Pavement Engineer who is experienced in pavement data collection methods (visual, automated methods, road profilers, etc.) and in pavement data collection, analysis, scheduling and quality control. The individual must also have the capabilities to develop training and to train others in the new and evolving technologies associated with pavement data collection and analysis. The pavement engineer must have a working knowledge of pavement systems and an ability to recognize the various pavement types and the limitations of various pavement data items. A minimum of 5 years of experience as a pavement engineer is required.

III.M.2 Data Collection Equipment Operator(s)

The Consultant’s Data Collection Equipment Operators must be certified in the use of inertial profilers. An acceptable certification can be obtained by successfully completing the FHWA-NHI-131100 (Pavement Smoothness: Use of Inertial Profiler Measurements for Construction Quality Control) training course or equivalent.

III.N Consultant’s Work Plan

The consultant is required to provide a detailed work plan, in Microsoft Project 2003 format, that addresses pavement data needs outlined in this RFP. Upon contract award, on an ongoing basis, the plan will be revised and updated to meet the approval of the NCDOT Project Manager.

III.N.1 Work Plan Minimum Requirements

The work plan shall address as a minimum the details in sections III.H, III.I, III.J, III.K and III.L and shall provide a thorough description of the consultant’s staffing and equipment plan. In addition, the work plan will describe the consultant’s vision of the project and for accomplishing the work on time.

III.N.2 Work Plan Delivery Dates

The consultant shall provide delivery dates for all deliverables identified in Table 7. The consultant shall establish delivery dates for milestones which are defined in Table 3.

III.O Deliverables

The major deliverables to be provided under this contract include, but are not limited to, items summarized by number in Table 7:

Deliverable No.	Deliverable Name	RFP Reference Section(s)	Included in Payment Item	Remarks
D-1	Work-plan	II.E		Included in Mobilization
D-2	Startup Report	III.D		Included in Mobilization
D-3	Quality Control Plan	II.F, III.K.1.d.1		Included in Mobilization
D-4	Location-Reference SOP	II.A, II.F.9		Includes GPS Coordinate Collection
D-5	Adverse Weather SOP	II.F.7		
D-6	Initial Data Screening SOP	II.F.10		
D-7	IRI SOP	III.I.3.i		Includes precision and bias statements
D-8	Rut Depth SOP	III.I.4.e		Includes precision and bias statements
D-9	Pavement Imaging SOP	III.J.3		
D-10	Image Viewing Software	III.J.2		
D-11	Distress Data Reduction SOP	III.K.3		
D-13	Digital Image Storage Management and Distribution Plan	III.J.1.e		
D-12a, b, c, ...	Pavement Condition Data	III.H		Number D-12-a, D-12-b, etc., as define milestones (Table 3) by Division by system.

Table 7 - Deliverables