Missouri
Department
of Transportation

MoDOT

Pete K. Rahn, Director

105 West Capitol Avenue
P.O. Box 270
Jefferson City, MO 65102
(573) 751-2551
Fax (573) 751-6555
www.modot.org

November 3, 2006

Dear Consultant:

The Missouri Highways and Transportation Commission is requesting the services of a photogrammetric consulting firm to provide aerial photography on the projects listed on the attached sheet. Digital photography with IMU data will be required on some flights. The projects are scattered over the entire state with a great portion being large corridor projects with at least 10 miles in length.

Please limit your letter of interest to no more then two pages. This letter should include any information, which might help us in the selection process, such as the qualifications of the firm to perform this service, and similar projects your company has recently completed or is now doing. We will utilize the consultant information already on file so we will not need a lengthy submittal of other general company information. Any firm unable to provide services on one of the projects listed will not be considered to provide services on any of the listed projects.

We encourage DBE firms to submit letters of interest. You must list any sub consultants that you need to complete the professional services requested by MoDOT.

If your firm would like to be considered to provide these services, you must submit letters of interest by 4:00pm, November 22, 2006 to the address listed below.

Missouri Department of Transportation
P.O Box 270
601 W. Main
Jefferson City, MO 65203
Attention: Alexa Mitchell – Photogrammetry

You may also submit letters of interest by fax to (573) 526-4535 or E-mail at Alexa.Mitchell@modot.mo.gov. A fax or E-mail will be sent to notify the sender that the letter of interest was received. If you have any questions feel free to contact Alexa Mitchell at (573) 751-6591.

Sincerely,

Dave Nichols
Director of Program Delivery

am
Attachments

cc: Mr. Shyam Gupta – br
Mrs. Kathy Harvey – de
Mr. Lester Woods - cm

EXHIBIT I

SCOPE OF SERVICES

The work covered by this Agreement shall include furnishing equipment, materials, professional, technical, and personnel resources necessary for the performance of aerial photography services for design and development of the specified highway project.

The following information will explain and define the items of importance relating to this project. All of the elements of work that are necessary to satisfactorily complete the aerial photography for this project may not be listed. The lack of a specific listing of an element or item of work does not in itself constitute a basis for additional services or work supplement, and/or adjustment in compensation.

I. PROJECT

The services shall provide data necessary for application in preliminary highway design.

II. PROJECT LOCATION AND LIMITS

The project sites are located in Missouri. The limits of each site are located in files furnished by MoDOT. Please see section V for special situations.

III. SERVICES AND DATA PROVIDED BY THE COMMISSION

The COMMISSION will provide available information of record to the CONSULTANT. In addition, the following specific items will be furnished or performed by the COMMISSION:

1) The project locations and limits (.dgn format).

2) Flight and photo control plans (ASCII and .dgn format)

3) Mapping and photogrammetry limits (.dgn format)

4) The MoDOT specifications for vertical aerial photography.

5) Roll and county numbers for aerial negative labeling.

6) Found horizontal and vertical control points to be used in the control surveys.

TABLE II-1
MAPPING PROJECT LOCATIONS

Job Number	County	Route	Location	Miles	Scale
J4P0979	Henry	7	1.4 mi N/O and 2 mi S/O Rte o	3.4	1:6000
J4P01103	Lafayette	13	1.7 mi W/O 224 / 24 to Rte 13 / Higginsville Rd.	4.0	1:6000
J4S1940	Jackson	291	2 mi N/O 291 / Courtney Rd to 6 mi N/O 291	1.2	1:6000
J5P0892	Benton	65	1.4 mi S/O Rte 52 to Warsaw	15.4	1:6000
J5P0951	Osage	50	50/63 Interchange to Rte 89 E. of Linn	14.0	1:6000
J5P0925	Morgan	52	Rte 5 in Versailles to Rte W	12.5	1:3600
J5P0922	Benton	52	Rte W to Rte 65	11.2	1:3600
J7P0820	Jasper	171	Rte 96 to Rte 43	5.5	1:3600
J8S0853	Dallas	73	Relocation of Rte 73 to Rte 65	1.0	1:3600
J8S0836	Greene	60	1 mile N/O Rte 60 and MM to 0.9 mi S/O Rte M and ZZ	1.0	1:3600

TABLE II-2
RECON PROJECT LOCATIONS

Job Number	County	Rte	Location	Miles	Scale
J8P0854	Laclede	5	South of I-44 to Rte 64 Intersection	2.3	1:12000

IV. SCOPE OF WORK. Work covered in this document shall include furnishing the professional, technical, and other personnel necessary for aerial photography and control planning for the project. The services shall address the following:

1) **Planning.** The CONSULTANT is responsible for project planning as it relates to coordinating the photo control targeting prior to the photo mission. Upon completion of the flying mission and photography processing, the CONSULTANT shall provide the COMMISSION with digital aerial images and contact prints with the north arrow and the photo control on the front of the photo and a description of the point (s) on the back of the photo.

   If the control survey is being done by another CONSULTANT then the aerial CONSULTANT shall provide the survey CONSULTANT with a set of contact prints for the purpose of graphically depicting the photo control and north arrow on the front of the photo and supplying a description of the point (s) on the back of the photo.

2) **Standards.** The CONSULTANT shall comply with the most recent and applicable state and federal laws. Aerial photographic procedures shall

be preformed in a manner that supports photogrammetric compilation in accordance with United States National Map Accuracy Standards and any applicable portion of the Missouri Department of Transportation Project Development Manual, Chapter III, Section 3-03, Photogrammetric Surveys.

V. SPECIFICATIONS FOR SURVEYING

1) **Project Limits.** Targeting and control surveying will be performed within the limits that are graphically marked and indicated on the COMMISSION provided map files.

2) **Target Planning.** All projects requiring mapping are targeted. Projects are to be targeted so that the use of vertical only points and photo identifiable points are not required. MoDOT Photogrammetry performs the Initial flight planning and flight lines are provided to the CONSULTANT. The flight plan designates the mapping area and any additional photo coverage requested by the district. Control of the largest practical area will be done to allow for the possibility of mapping extra area if needed. Target placement at a minimum must satisfy the control requirements of the mapping area. MoDOT Photogrammetry uses Intergraph ISMP to perform mission planning. The electronic files from ISMP or ASCII export files are available to the CONSULTANT. Flight lines may be adjusted as needed by the CONSULTANT to better accomplish the control of the project. Additional exposures can be added at the discretion of the CONSULTANT if needed to establish target locations at the ends of flight lines.

3) Notification of target placement. The survey CONSULTANT shall notify the photogrammetric CONSULTANT upon placement of targets for each job. This notification may be by phone if followed up by e-mail.

4) **Standards.** The CONSULTANT shall comply with the most recent and applicable state and federal laws. Aerial photographic procedures shall be preformed in a manner that supports photogrammetric compilation in accordance with the United States National Map Accuracy Standards and any applicable portion of the Missouri Department of Transportation Project Development Manual, Chapter III, Section 3-03, Photogrammetric Surveys.

VI . SPECIFICATIONS FOR VERTICAL AERIAL PHOTOGRAPHY

The following specifications set forth the minimum requirements that must be met by the contractor when providing vertical aerial photography to the Missouri Department of Transportation (MoDOT). The photography will be used in softcopy photogrammetry to produce topographic, planimetric mapping and aerial

triangulation.

1) All flights for mapping as listed in table 11-1 are to be flown at 1800 feet above mean terrain (1:3600 photo scale) unless otherwise stated or with the following exceptions:

    a. See table 11-2 for reconnaissance photo scale

    b. Special situations may apply to projects that contain Narrow Valley Section Lines (NVSL) that fall outside the mapping corridor.

        i. If photo coverage for the NVSL cannot be obtained while flying the mapping corridor at 1:3600 photo scale, an additional flight line(s) can be used to obtain the NVSL at a photo scale of 1:6000.

        ii. Additional photo control; as outlined in section V, 12, b, may be planned by the CONSULTANT to control the flight(s). Additional primary control will not be necessary.

2) **Technical Specifications.** The CONSULTANT shall provide the necessary aerial photographic coverage for the project. Specifications and instructions for delivery for aerial photography are contained in the Missouri Department of Transportation Specifications for Vertical Aerial Photography.

3) **Beginning the Work.**

    a. No work shall be done without notification from MoDOT that work may begin.

    b. There is no snow on the ground within the area to be photographed.

    c. The leaves are off deciduous trees.

    d. The procedures indicated in the specifications will be followed.

    e. If the survey CONSULTANT is different then the Aerial, then the aerial CONSULTANT shall not fly until they receive notification that targets are in place.

4) **Last Day For Photography Work.** All Aerial photography shall be completed by April 1st unless approved by MoDOT.

5) **Camera Requirements.**

a. The camera will be a precision vertical format aerial mapping type, capable of taking 9" x 9" aerial photographs compatible with the stereoscopic compilation instruments used by MoDOT. The lens must meet the requirements outlined below based on a U.S. Geological Survey Report of Camera Calibration. Failure of the camera to meet all of the specified requirements shall be cause for rejection of the bid proposal.

b. **Lens.** Shall meet or exceed all the requirements outlined below

i. Calibrated Focal length - 153.0 mm ± 3.0 mm.

ii. Usable angular field – at least 90°

a. Radial Distortion - Radial distortion in the usable angular field, based on the calibrated focal length referred to the calibrated principal point (point of symmetry), shall not exceed 12 um for any tested point, and 16 of the tested points shall have radial distortion values not exceeding 5 um.

iii. Resolution - The lens should have an Area Weighted Average Resolution (AWAR) of at least 72.0 line pairs per millimeter as determined by the U.S. Geological Survey Report of calibration. The following table lists the minimum acceptable radial and tangential lens resolution at various field angles.

Field angle	0°	7.5°	15°	22.5°	30°	35°	40°
Line pairs per mm							
Radial	95	80	80	67	67	67	57
Tangential	95	80	70	67	67	57	45

c. **Filters.** An appropriate glass filter with a metallic anti vignetting coating shall be used. The filter shall have surfaces parallel within 10 seconds of arc and its optical quality shall be such that its addition to the camera shall not cause an undesirable reduction in image definition.

d. **Shutter.** The camera shall be equipped with a between-the-lens shutter with variable speed settings such that in conjunction with flight height and aircraft speed, the camera will produce high definition photographs at full aperture. The shutter shall have a minimum efficiency of 70 percent at a speed of 1/200 second.

e. **Magazine Platen.** The camera shall be equipped with an approved means of flattening the film at the instant of exposure. The platen against which the film is pressed shall not depart from a true plane by more than 15 um when the camera/magazine vacuum is applied.

f. **Fiducial Marks.** The camera shall record eight (8) fiducial marks, which are clear and well defined on each negative. The marks shall be located in each corner and at the center of each side. The corner fiducial marks shall form a quadrilateral whose sides are equal within 0.050 mm.. The midside fiducial marks shall intersect at an angle of 90%+30". The intersection of the lines shall be equidistant within 0.050 mm from the adjacent corner fiducial marks. Lines joining opposite pairs of fiducial marks shall indicate the true position of the principal point of autocollimation within +0.030 mm.

g. **Stereomodel Flatness.** The average departure from flatness (at negative scale) for two computer simulated stereo models may not exceed 15 um for any symmetrically arranged point tested by USGS. The difference between the highest and lowest value shall not exceed 25 um. The average of values given for points tested by USGS (which are averages themselves) shall not exceed 7.5 um.

h. **Calibration Report.** The Contractor shall provide a camera calibration report prepared by the U.S. Geological Survey Optical Calibration Laboratory, which reflects the current condition of the camera to be used. The report shall be based on the laboratory's standard test and measurements, made after complete assembly of all parts of the camera unit, with the light filters in place. This report must be dated within three (3) years of the date of the photography. The absence of such a report verifying that the camera system meets the requirements will be cause for rejection of the bid proposal.

i. The combination of camera cone, lens, camera body and magazine(s) submitted for testing, shall be, if acceptable, the only combination used for this project. Whenever possible only one camera will be used per roll of film. Use of additional equipment shall be equally certified. If requested, the contractor will submit a statement certifying that the camera has not been disturbed, repaired, or modified in any fashion since the submitted calibration report was made.

   If at any time after award of the contract, the camera is disturbed, repaired, or modified in any fashion, the contractor shall submit to MoDOT a new calibration report.

   MoDOT reserves the right to restrict the use of any camera, based upon data contained in the calibration report, or based upon operational results. MoDOT also reserves the right to require only one camera be used per roll of film.

j. **Forward Motion Compensation.** Forward motion compensation is required for all photography requested. The contractor shall provide the proper equipment as well as the experience in the use of forward motion compensation.

6) **Digital Aerial Photography**

a. Digital image data will be captured of selected sites using a high precision digital aerial mapping camera.

b. The digital frame camera system will have a focal length of 120 millimeters.

c. Black and white, color and color-infrared image data will be captured simultaneously.

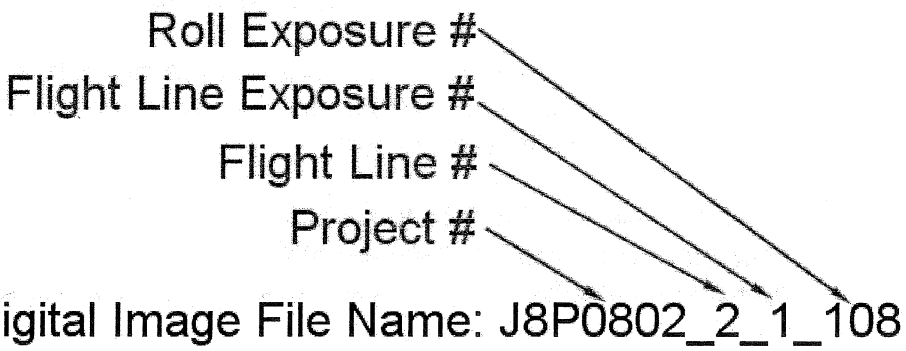
d. The aircraft will be equipped with an Aerial Sensor Management System (ASMS) for guidance, positioning and flight management.

e. The camera will have digital forward motion compensation and gyro-mount leveling.

f. Airborne Global Positioning System (ABGPS) survey measurement technology shall be employed, estimating the imagery capture control stations.

g. The image filename must contain: the Job number, underscore flight line number, underscore flight line exposure number, underscore roll exposure number.

Example:



7) **Camera Data Location**

a. An electronic file is to be delivered for each project containing the photo centers of exposures.

b. The file name must contain the Job number.

c. Coordinate units must be in the datum/coordinate system of the project.

d. The file must be of CCNS4 or ASCOTT format.

e. The flight line and exposure numbers in the file must agree with the film stamping and flight map for film-based photography and with the image filename and flight map for digital photography.

8) **Film Requirements**

a. **Film Type.** A dimensionally stable estar base film, such as Kodak Double X aerographic film (2405), may allow other brands, must be used for black and white photography. Outdated film is not to be used. The film is to be stored and handled in accordance with the manufacturer's recommendations.

b. **Exposure.** Exposure of the film shall be such that the negative images will be of high quality with good density and the best possible image resolution. The images shall be free from static marks and shall

have uniform tone. They shall have the proper degree of contrast for all details to show clearly in the dark-tone areas and high light areas as well as in the halftones between the dark and light. Negatives having excessive contrast or lack of contrast may be rejected.

9) **Photographic Operations**

a. **Flight Conditions.** The photography shall be taken when the deciduous trees are bare and the ground is free of snow. It shall not be taken when the ground is obscured by haze, smoke or dust, or when clouds or shadows of clouds are present. Spring flying season photography shall be taken during the hours of mid-day (3 hours after sunrise to 3 hours before unset).

b. **Flight Lines.** All flight lines are intended to be centered along the highway project, unless noted otherwise. Flight lines shall be continuous and straight with no breaks throughout the entire length of the flight line. Each project shall be flown in its entirety with the same camera. Flight lines shall not be flown around curves. All flights must consist of at least four photographs. The maximum angle of deviation between the actual flight path and the specified flight line shall not exceed three (3) degrees at any point on the lines.

Re-flights for rejected exposures shall include the entire flight line unless the flight line contains more than 15 exposures in which case a portion of the flight line may, with the written permission of MoDOT, be replaced. All re-flights shall be centered on the plotted flight line(s) and shall be retaken with the same camera system as used in the original photography. For re-flights where only a portion of flight line is to be replaced, the re-flight shall provide at least 100% overlap with accepted adjoining exposures in the same flight line. All re-flights must be completed within the shortest practical time.

c. **Flight Height.** The departure above or below the required height above mean terrain to achieve the specified camera negative scale shall not exceed five (5) percent.

d. **Exposure Overlap.** The overlap shall be sufficient to provide full stereoscopic coverage as follows:

i. **End-lap.** The end-lap (overlap in line of flight) shall average sixty (60) percent plus or minus two (2) percent. End-lap of less than fifty-five (55) percent or more than sixty-five (65) percent in

one or more exposures may be cause for rejection of the flight line or exposures in which such deficiency or excess of end-lap occurs.

Wherever there is a change in direction of the flight lines, vertical photography on the beginning of a forward section shall end-lap the photography of a back section by at least 300 percent (3 photographs).

ii. **Side-lap.** Any flight line with an exposure having side-lap (overlap of parallel strips of vertical photography) of less than twenty (20) percent or more than forty (40) percent may be rejected. Side-lap, per strip, shall average thirty (30) percent, plus or minus five (5) percent.

e. **Crabbing**, as measured from the line of flight indicated by the principal points of consecutive photographs, shall not change by more than five (5) degrees between any two consecutive photographs, and shall not average more than five (5) degrees on any one flight line, nor more than two (2) degrees for the entire mission.

f. **Tilt.** Defined as the departure of the optical axis of the camera from a plumb line, shall not exceed five (5) degrees on a single photograph nor average more than one (1) degree for a single flight line. Relative tilt between two successive exposures shall not exceed six (6) degrees.

10) **Processing Photographic Materials.** The development, fixing, washing and drying of all exposed photographic film shall result in the best images possible, with optimum contrast, tone, balance, resolution, density, and fine grain quality. Before, during, and after processing, the film shall not be subjected to extremes of temperature, or rolled tightly on drums or in any way stretched, distorted, scratched or marked and shall be free from finger marks, dirt, chemical and other stains, or blemishes of any kind. The film must remain suitable for making transparencies or contact prints either at this time or in the future. Aerial negatives are to be processed such that the minimum density, as measured with a densitometer with a scale range of 0 to 3.0, is not less than 0.3 and the maximum density not more than 1.5.

11) **Aerial Negative Film Stamping.** The stamped letters and numbers shall be 3/16" in height. The stamp shall be made with a durable media that is designed to remain affixed to film negative for the life of the film. The required information shall be stamped from left to right in the following order:

a. The county of the image covered area. (The county is expressed by a number, that number, will be provided by the COMMISSION).

b. The numeric or alpha designation of the project route.

c. The photographic scale expressed as a ratio.

d. The date of the flight mission when the image was taken.

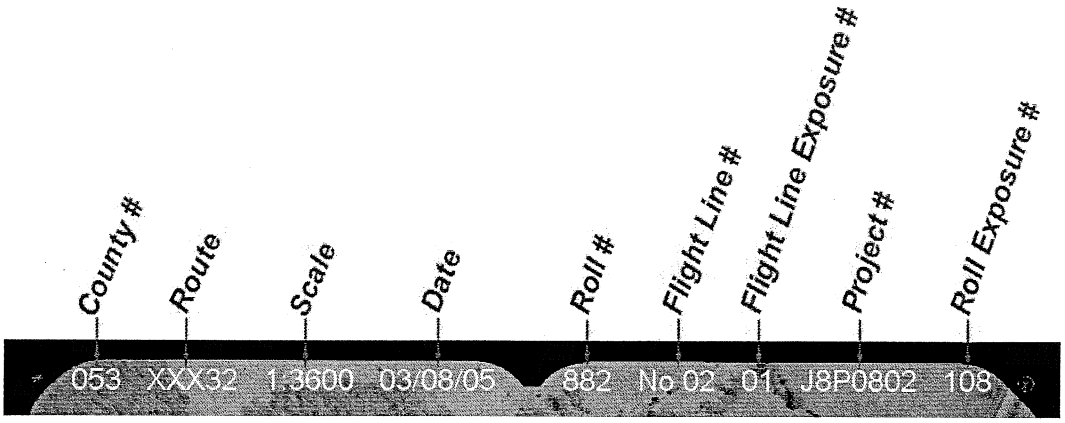
e. The film roll number, provided by the COMMISSION.

f. The flight line number.

g. The exposure number in the flight line.

h. Project number (J8P2202)

i. The unique roll exposure number (exposures are numbered in sequence.) The first exposure on the roll shall be labeled as exposure number 1, with each succeeding exposure having a number one greater then the exposure before it.



12) Aerial Negative Scanning. The CONSULTANT shall also furnish digital aerial photographs numbered as specified below that have been scanned from the aerial negative film. The original aerial film will be scanned on a high precision photogrammetric scanner. This process will convert the aerial photography into digital aerial images. The raw scan resolution is defined by the highest requirement for photogrammetric spatial accuracy and finest final ground resolution for the project. The scans/scanner shall meet the following requirements:

a. Scanner designed for photogrammetric applications and able to accept 9" x 9" aerial roll film.

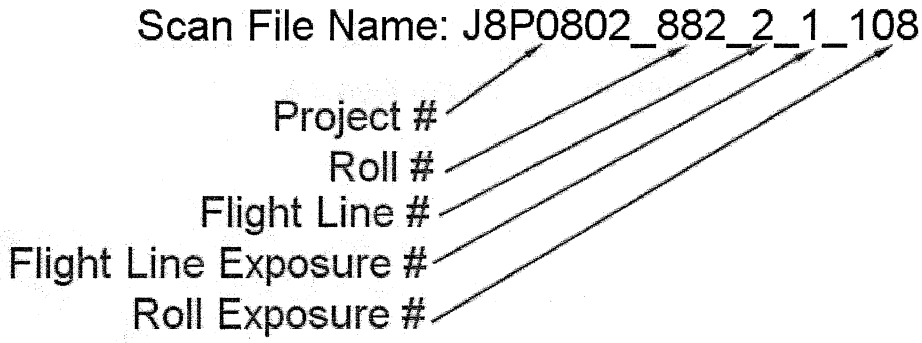
b. Acceptable scan resolution of 12.5 microns for delivered image for MoDOT compilation.

c. The digital aerial photographs shall be in Tagged Image File format (.tif). Image tiling (256) shall be used. JPEG Compression shall be applied at a factor of 80. Minifications / Pyramids shall be re-sampled based on the gaussian filter and embedded to the TIF file.

d. All camera fiducials must be visible on each individual scan.

e. Image file names will include their job number, roll number, fight line number, and flight line exposure number and roll exposure number.

Example:



f. Image files shall be delivered on a DVD-R general media single sided with a 4.7 GB capacity or Fire Wire.

VII. ACCEPTANCE OF COMPLETED WORK

1) The CONSULTANT shall submit all completed work promptly to allow time for proper review. Work reviewed and found in accordance with the specifications shall be considered to constitute "satisfactorily completed and accepted work".

2) The Missouri Department of Transportation will determine which work is in accordance with these specifications and represents acceptable work. Failure to produce acceptable work as specified, and after the CONSULTANT has exercised the right to verify the quality of the work will cause the following:

a. The Missouri Department of Transportation may reject that portion of the work and the CONSULTANT will accept a hundred (100) percent reduction in payment, at the agreement price, for the affected portions of work.

b. In the event that some work is found to be unacceptable in accordance with the specifications, and reworking is deemed necessary, the CONSULTANT agrees that it shall re-fly such work without expense to the Missouri Department of Transportation, even though final payment may have been received. The CONSULTANT must give immediate attention to these changes so there will be a minimum delay. The above and foregoing is not to be construed as a limitation of the Missouri Department of Transportation right to seek recovery of damages for negligence on the part of the CONSULTANT.

3) **Return of Source Data.** The CONSULTANT shall return to the COMMISSION all of the provided source data, including aerial photographs and maps.

4) **Data Quality.** The CONSULTANT shall be responsible for the professional quality, technical accuracy and the coordination of data, documents and other services furnished for this project.

5) **Additional Services.** The COMMISSION reserves the right to request additional work beyond the scope of services addressed in this document. In this event, a supplemental agreement shall be executed and approved prior to the performance of additional services. Changes in compensation will be addressed in the supplemental agreement.

6) **Documentation.** The CONSULTANT shall provide any documentation necessary to explain, support and clarify the procedures used for data development.

7) **Data Ownership.** All data and documents prepared in performance of this Scope of Services shall be delivered to and become the property of the COMMISSION upon suspension, abandonment, cancellation, termination, or completion of the CONSULTANT'S services.

VIII. SCHEDULE AND DELIVERY

1) **Schedule.** Photography shall be taken as early as possible in the leaf-off flying season once the flight conditions are met. Projects that have targeted ground control points must be coordinated with the placing of targets and the photo mission so that a minimum of time will elapse between targeting and

photography. MoDOT will identify priority sites needing final reports for mapping. The CONSULTANT will continuously prosecute the work and survey deliverables shall be submitted to MoDOT as they are completed. The time of completion for all of the work addressed in these documents shall be April 15, 2007.

2) The COMMISSION will grant time extensions for unavoidable delays beyond the control of the CONSULTANT. Requests for extensions of time shall be in writing by the CONSULTANT, before plans are due, stating fully the reasons for the request.

3) **Materials to Be Delivered.** The following items shall be delivered to and shall become the property of the MoDOT:

   a. Processed original aerial negative film.

   b. A copy of the flight map indicating the final exposure numbers that correspond with the contact prints and the direction of flight indicated by an arrow.

   c. A copy of the camera calibration report.

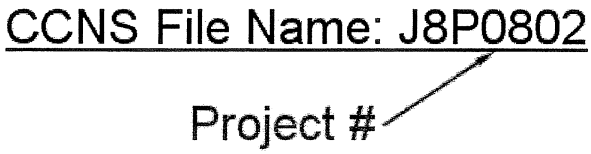
   d. Scanned aerial images from the original aerial negatives

   e. A set of contact prints from film aerial camera will be sent to the survey CONSULTANT to graphically depict the north arrow and the photo control on the front of the photo and place a description of the point(s) and a reference to the corresponding field book printed on the back of the photo.

      Example: Station #_____
      Book _____ Page _____
      Desc. of point _____
      Ground Elev. _____

   f. Digital images from digital photography (all bands).

g. CCNS-4 data containing the position of the photo and the name of the final, as stamped photo. Naming convention will be the same for ASCOTT data.



h. Survey reports and sketches.

4) **All material shall be delivered to:**

Missouri Department of Transportation
P.O. Box 270
200 Harrison St.
Jefferson City MO 65102
Attention: Photogrammetry