The following documentation is an electronically-submitted vendor response to an advertised solicitation from the West Virginia Purchasing Bulletin within the Vendor Self-Service portal at wvOASIS.gov. As part of the State of West Virginia’s procurement process, and to maintain the transparency of the bid-opening process, this documentation submitted online is publicly posted by the West Virginia Purchasing Division at WVPurchasing.gov with any other vendor responses to this solicitation submitted to the Purchasing Division in hard copy format.
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**VENDOR**

00000205829
SMITH LAND SURVEYING INC

**FOR INFORMATION CONTACT THE BUYER**

Beth Collins
(304) 558-2157
beth.a.collins@wv.gov

All offers subject to all terms and conditions contained in this solicitation

Signature X FEIN # DATE

Page: 1 FORM ID: WV-PRC-SR-001
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**Comm Code** 81151601

**Extended Description:** (Spec Item 3.1.2 & 4.2)

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PROJECT NAME: SEALLED BID
West Virginia Dept. of Environmental Protection
Office of Abandoned Mine Lands & Reclamation
Mapping Services in Southern Counties of WV

RECIPIENT: BUYER: Beth A. Collins, Senior Buyer
SOLICITATION NUMBER: CRFQ 0313 DEP 1600000053
BID OPENING DATE: June 21, 2016
BID OPENING TIME: 1:30 p.m.
FAX NUMBER: 304-462-5656

DATE: June 21, 2016
Company History

Smith Land Surveying, Inc. (SLS) was founded in 1978 by Gregory A. Smith with one employee. Original services provided by SLS included boundary, construction, and oil & gas well location surveys. SLS experienced steady growth, gaining employees each year and in 1982, services were expanded to include design data surveys for architectural and engineering firms throughout West Virginia.

In 1986, SLS further diversified by forming an environmental service group, providing oil & gas drilling pit waste disposal, independent lab support, water sampling, and erosion and sediment control plans.

A reclamation group was formed in 1988 to provide implementation of erosion and sediment control plans and NPDES permits on both commercial and oil & gas sites. Services such as seeding and mulching provided by the SLS team contributed to numerous reclamation awards for SLS clients.

Services again expanded in 1991 to include project management for developers of shopping centers and retail outlets. The SLS land department was created in 1996 to assist members of the oil & gas industry in identifying tract or parcel ownership and obtaining right-of-way and mineral leases. A demand grew for midstream services and SLS built up the land department to include pipeline route selection, acquisition, mapping/surveys, environmental and regulatory permitting assistance and a complete project management staff.

The mid-to-late 1990s saw SLS serving clients such as the West Virginia School Building Authority, the United States Bureau of Prisons, and the Natural Resources Conservation Service at the Hughes River Dam. From 1998 to present, SLS has primarily served existing clients in the oil, gas, and coal industries, the West Virginia Department of Transportation, and the West Virginia Department of Environmental Protection.

The most recent endeavor for SLS Land & Energy Development was the 2016 addition of an in-house engineer for geotechnical evaluations to complement the core drilling services provided since early 2014. In turn, SLS can provide high quality services in an expedited timeframe. The drilling services, in addition to geotechnical evaluations, aerial and Lidar mapping services, turnkey and design build services for well pads, water impoundment design and certification, and quality control management makes SLS prepared to tackle any job within expected timeframes and within budget.
Under SLS's leadership team, SLS has been able to adapt and grow to meet the needs of its clients. The core of professionals at SLS has over 250 years of combined experience and is supported by a highly qualified group of technical staff. Over three decades of success and steady growth proves that SLS and its variety of services is a trusted source for the energy and land development industries as well as private and government entities.

**Capacity**

SLS employs approximately 50 people. Our core management of experienced surveyors and engineers also includes in-house legal counsel and accountant. We have the capability to send out up to 10 separate field crews at any given time if a project requires it. SLS owns 10 completely equipped four-wheel drive vehicles as well as ATVs and UTVs. Our vehicle fleet and central location in the state of West Virginia allow us to access even the most remote sites in order to accomplish necessary tasks. Our safety record is also of great importance. We have logged 536,444 hours without time lost due to injury.

**Summary**

SLS's 37-year track record has proven that we have the ability and expertise to accomplish even the most difficult of projects and meet our client's needs. Our highly trained staff and state-of-the-art equipment allow us to complete jobs on time and within required budgets.
Legal Business Name: Smith Land Surveying, Inc.

Vendor Code: 000000205829
Smith Land Surveying ftp Site

Pursuant to section 5.1 referencing ordering a payment in the request for quotation, SLS uses Citrix Share File (ftp site). Files can easily be shared outside a network, simply by having a SLS administrator send a post link through to the recipient’s email.

Once the recipient receives the link they select the files to be sent and attach them to the page. The SLS ftp site is capable of storing up to 100 GB of data.

Once the link is sent with the attachments, the SLS administrator downloads the file and shares with the appropriate team member.
Project Manager

Jason McVicker

Telephone Number: 1-304-462-5634
Fax Number: 1-304-462-5656
Email Address: jmcvicker@slssurveys.com
Contact Information

Sarah Smith

Telephone Number: 1-304-462-5634

Fax Number: 1-304-462-5656

Email Address: ssmith@slssurveys.com
GREGORY A. SMITH
President
SMITH LAND SURVEYING, INC.

Education/Special Training

- A.S. Degree in Land Surveying - Glenville State College - 1976
- American Congress on Surveying & Mapping, Association of Photogrammetry & Photo Interpretation (1.3 units)
- US Geological Survey National Mapping Center Resources & Information
- Land Sat Image Interpretation at Purdue University
- Bluefield State College Land Surveying Seminar (1.6 units)
- Pennsylvania State University Computer & Business Courses (2.1 units 1986), Photogrammetry & Business (2.1 units 1985)
- Soil Erosion & Sediment Control Plans (1986)
- Spill Prevention Control & Countermeasure Plans
- Computer Training at CLM Systems, Tampa, FL.
- Auto Cad Training at Putnam County Training Center
- Surface Mine Permitting & Regulations (1990) - WV Dept. of Energy
- Geographic Information System (1990) - RDA Associates, Maryland
- Erosion & Sediment Control (1991) - WV Dept. of Natural Resources
- Law Enforcement Program – National Standards Committee - NCEES (1997)
- IRS Tax & Revenue Program for Employee Classification and Audit (1998)
- Geodetic Control with GPS – NSG Program (1998)
• GPS Advancements/ Applications for Mountainous Terrain (1999)
• Knud Hermanson – Boundary Litigation, the Surveyor & Court (2000)
• Professionalism & Ethics for the Professional Surveyor (2000)
• NGS – HARN Statewide Monument Densification Project (2000)
• Influencing Public Policy to Meet the Needs of the Surveying Profession (2002)
• Boundary Law and Legal Aspects of Surveying (2002)
• Knud Hermanson – Minimum Standards for Boundary Surveys (2003)
• Charm School for Surveyors – Public & Client Relations (2004)
• WVSPS Floodplain Management (2006)
• Knud Hermanson – Minimum Standards & Ethics (2007)
• Surveyor’s Use of Historical Maps (2007)
• NCEES Meeting – Expanding the Scope of Surveying Practice (2007)

Professional Organizations

• Director for WVALS (1984-1989)
• Legislative Chairman for State Surveyors Association (1987-present)
• Exam Evaluation Committee for NCEE (1988-1989)
• President Elect WVALS (1989 – President 1990 – 1991)
• Glenville State College Advisory Board – Land Surveying
• Glenville State College Advisory Board – Environmental Technology
• Glenville State College Advisory Board – Natural Resources Management
• Glenville State College Advisory Board – Landman Program (2002 & 2006)
- Calhoun-Gilmer Career Center Advisory Board – CAD and Drafting Program
- West Virginia Association of Land Surveyors
- American Congress on Surveying & Mapping
- Pennsylvania Society of Land Surveyors
- WV Independent Oil and Gas Association (IOGA)
- National Society of Professional Surveyors
- Gilmer County Industrial Development Association
- WV Society of Architects – Affiliate Member
- National Society of Wetland Scientists
- WV Oil & Gas Association
- Little Kanawha Parkway Authority
- American Association of Petroleum Landmen
- State Democratic Executive Committee
- Democratic Co-Chair for Gilmer County (2006-Present)
- Presenter for the WV Auditor’s Office – Seminar on Recordation Laws (2006)
- Member – Gilmer County Utility Board
- Member, IOGA Board of Governors
- Chairman, Glendale State College Board of Governors
Charles Victor Moyers
Senior Licensed Professional Surveyor
SMITH LAND SURVEYING, INC.

Education
Glenville State College, Glenville, West Virginia
Associate in Science in Land Surveying

Professional Organizations
- Former Member and Chapter Representative for Central Chapter of WVALS
- Former WV Association of Land Surveyors (Now WVSPS) Board of Directors Member, Vice President & President
- Current Member of Professional Land Surveyors of Ohio (PLSO)

Profile
Mr. Vic Moyers was licensed as West Virginia Professional Surveyor No. 849 in 1988. When starting for SLS in 1988, he already had over eight years’ experience in office and field aspects of boundary, oil and gas, and mining surveys. Since then, has worked as Project Surveyor in charge of supervision of surveying oil and gas well locations, pipeline surveys, boundary surveys, control surveys, highway (route) surveys including centerline, cross-section and profile work with all related computations and calculations. Vic’s experience includes supervision and planning of GPS projects as well as processing GPS record research, as-built surveys, topographic mapping, strip mine pit and stockpile volumes, field reconnaissance, instrument man, office calculations & drafting. He has managed several large surveying/mapping projects such as Coal Company purchase of 30+ parcels totaling over 1500 Acres, government purchase/acquisition of over 200
parcels of land for construction and flood easements for the North Fork of Hughes River Dam Project, several miles of four land highway control, stake-out and property acquisition, GPS control surveys for aerial photo mapping projects for commercial development projects, many miles of gas pipeline surveys for construction and permitting. He also supervised all preliminary boundary surveying and topographic mapping for the Federal Prison site in Preston County, West Virginia and normal supervises the surveying of numerous oil and gas related surveys each year and several property surveys. His experience also includes boundary disputes and has served as an expert witness in court proceedings in disputes and property acquisition/condemnations.
JASON McVICKER
Survey Manager & Licensed Professional Surveyor
SMITH LAND SURVEYING, INC.

Education

West Virginia University
Civil Engineering

Glenville State College
Associate Degree – Land Surveying Technology

Licensing, Certificates

State of West Virginia Professional Surveyor License (Obtained in 2001)
Member of the West Virginia Society of Professional Surveyors
CSX Railroad Training and Certification
24 hours MSHA Surface Mine Coal and Construction Safety Certification
24 hours MSHA training towards 40 hr Underground Miner Certification
OSHA 10 Hour Certification
Safeland Certification

Experience

Survey Manager
Smith Land Surveying, Inc., Glenville, West Virginia (2014 to Present)
Schedule and supervise 8 field crews, supervise office personnel performing data reduction of field data, plat work, and deed research; client meetings and client development, oversee vehicle and equipment maintenance.
Field Supervisor and Crew Chief  
Blue Mountain Engineering, Wadestown, West Virginia  
(2012 to 2014)  
Schedule and supervise 2-5 field crews, on well pad and pipeline survey work as well as title mapping work. Supervise 3+ office personnel performing data reduction of field data, plat work, and deed research, client project manager for gas client, client meetings.

Survey Project Manager  
Herbert, Rowland & Grubic, Inc., Morgantown, West Virginia  
(2012)  
Schedule and supervise 2-5 field crews, supervise 3+ office personnel performing data reduction of field data, plat work, and deed research, client project manager for gas client, field reviews for new gas well pad sites, construction management, client meetings, and help to supervise construction management staff, oversee vehicle and equipment maintenance.

Survey Supervisor  
Triad Engineering, Inc., Morgantown, West Virginia  
(2011-2012)  
Management of GPS field operations and equipment, training of staff on GPS field operations and equipment, and field equipment purchasing. Management of coal and oil & gas survey work, job estimates and bids, billing review and over-site, project management for a variety of survey projects ranging from small to large, including rural and residential boundary surveys, topographic surveys, aerial flight control, control surveys, surface mine related surveys, construction stakeout on jobs varying from roadways and site work to concrete and steel work, and Railroad surveys for construction.

Project Manager  
Greenway Engineering, Inc., Winchester, Virginia  
(2003-2011)  
Management of up to 6 office staff, job estimates and bids, project management for a variety of survey projects ranging from small to large, including rural and residential boundary surveys, topographic surveys, aerial flight control, control surveys, surface
mine related surveys, construction stakeout on jobs varying from roadways and site work to concrete and steel work, Oil and Gas related surveys including: the staking of gas wells, topography for gas well pads, ponds, and roads, pipeline surveys, lease unit boundary surveys of up to 2000 acres each.

**Partial management of a sister office (2009 & 2010)**
with duties including: scheduling of up to 6 field crews, management of up to 8 office staff, over site of employee timesheets, pricing of potential new jobs, negotiation of past due bills with clients, vehicle maintenance coordination, over site of survey equipment maintenance and repair, reviewing bills, and reviewing work performed by staff.

**Field Coordinator (2000-2003)**
Order and distribute field supplies, management of up to 4 office staff and up to five 2-man field crews, company vehicle management, job estimates and bids, project management, field data entry, computer drafting, survey computations to include boundary related (calculating surveys as to where property corners are to be set, traverse computations, deed delineation, and deed research), and construction related (calculating stockpile volumes, yardage moved volumes, calculating survey stakeout data from building and site grading plans, and developing as-built drawings of existing structures that are to be moved and re-erected). Direct rural and residential boundary surveys, topographic surveys, aerial flight control, control surveys, and surface mine related surveys, as well as construction stakeout on jobs varying from roadways and site work to concrete and steel work.

**Chief Surveyor and Department Manager**
Personnel management, company vehicle management, order and distribute supplies and equipment, job estimates and bids, project management, field data entry, computer drafting, and survey computations to include boundary related (calculating surveys as to where property corners are to be set, traverse computations, deed delineation, and deed research), and construction related (calculating stockpile volumes, yardage moved volumes, calculating survey stakeout data from building and site grading
plans, and developing as-built drawings of existing structures that are to be moved and re-erected).

Direct and perform rural and residential boundary surveys, topographic, aerial flight control, control surveys, underground and surface mine related surveys, as well as construction stakeout on jobs varying from roadways and site work to concrete and steel work.
Earl Thompson

Project Manager & Licensed Professional Surveyor

SMITH LAND SURVEYING, INC.

Education

Glenville State College
AS – 1994
Land Surveying

Licensing

State of West Virginia Professional Surveyors License
Class A CDL Driver’s License
Fuel Handling Safety (2203)
ABS Brake System Class (2003)
Warehouse Safety & Chemical Neutralization Class (2003)
Airborne Hazards Class (2004)

Experience

• Has experience in hand drafting and entries of field notes.
• Experienced on the operating systems of Carlson Software and several versions of Auto-CAD systems.
• Has experience in the operation of data collection devices and on site calculations and decisions.
• Has worked as a Project Surveyor in charge of surveying oil and gas well locations, and boundary and partition surveys.
• Experienced with pipeline profiles for both road and stream crossings, GPS data processing, construction stakeouts, courthouse research, topographic surveys and mapping, field reconnaissance, all positions on field crews, and drafting. Has been in charge of several projects for EQT including both office and field sides.
Experienced with controlling multiple crews simultaneously and public relations and with designing multiple well pad locations and spacing plans of horizontal well paths.

Has been in charge of and overseen the operation and checking of levels which was performed for a coal company consisting of approximately 1.5 miles located in Wyoming County, WV. And was in charge of the stake-out for tower bases and most of the As-Builts for this project as well.

Marked many miles of seismic lines using long-hand calculations on site in Southern Kentucky.

Several years of experience as an over-the-road truck driver, mechanics on tractor trailers and many military vehicles and associated components.

Experienced with the operation and mechanics of several different pieces of heavy equipment such as bulldozers, trackhoes, backhoes, and fork lifts.
Matthew J. Hilton, Jr.

Project Manager & Licensed Professional Surveyor

SMITH LAND SURVEYING, INC.

Education

Glenville State College
AS – Land Surveying

Licensing

State of West Virginia Professional Surveyors License
OSHA 10 Hour Certification
Heartsaver First Aid, CPR

Experience

2011-Present
Smith Land Surveying, Inc., Glenville, West Virginia - Project Manager
Monitor the progress of projects under my supervision, check well plats and rec plans, perform boundary surveys and compute corners, prepare for drafting, perform level loops and compute elevations for elevation certificates and Loma surveys

2009-2011
Allegheny Surveys Inc., Birch River, West Virginia - Senior Party Chief
Staked gas wells and prepared plats and rec plans for drafting, topo’d coal mine stock piles using conventional and survey grade GPS, set control points using survey grade GPS, set control points using survey grade GPS, ran field crews on boundary surveys.

2009-2009
Pocahontas Coal Company, Beckley, West Virginia - Survey Helper
Assist in setting spads in high wall for lining up high wall mining equipment, assist in running traverse and set bore hole stake, assist in as-built for access roads and high wall reclamation.
2006-2009
**Allegheny Surveys Inc., Birch River, West Virginia - Senior Party Chief**
Staked gas wells and prepared plats and rec plans for drafting, topo coal mine stock piles using conventional and survey grade GPS, set control points using survey grade GPS, ran field crews on boundary surveys.

2001-2006
**Smith Land Surveying Inc., Glenville, West Virginia - Field Technician/Party Chief**
Assist in staking gas wells and access roads, assist with performing boundary surveys, assist with construction surveys, became party chief and began staking gas wells, laying out access roads and preparing well plats for drafting, ran boundary survey crews and helped with the computation of boundary corners and preparing plats and description for drafting, ran level loops and computed elevations for elevation certificates.

1999-2001
**Smith Land Surveying Inc., Glenville, West Virginia**
Assist with the project at hand, which included giving back-sights, head chaining on boundary surveys, assist in staking gas wells.
Leslie Pierce  
**Project Manager & Licensed Professional Surveyor**  
**SMITH LAND SURVEYING, INC.**

**Education**

1967 - King High School- Tampa, Fl

1968-2012 - Continuing educational seminars and training in surveying and business management

2012 - Phase 1 ESA Training (ER-Due Diligence at Dawn Seminar)

**Licensing**

State of Florida Professional Surveyors License

**Experience**

2010-Present  **Project Surveyor, Smith Land Surveying, Inc.**  
Responsibilities include Phase1 Environmental Site Assessments, road condition surveys and reports, preparation of permit applications for local, state and federal agencies, research public records, QAC of field and office data, prepare maps and reports for field surveys.

2009-2010  **Self Employed Professional Surveyor (Florida)**  
Provide professional land surveying and related consulting services to private and public clients. Provide boundary, topographic, photogrammetric control, accident surveys, right of way surveys, subdivision platting and hydrographic surveys.
2006-2009  Hillsborough County Florida-Manager of County Survey Field Office
Managed survey field office for Hillsborough County, Florida. Responsibilities included day to day operations of surveying office and personnel, develop budgets, perform and prepare boundary, topographic, environmental surveys. Provide surveys and data to public and private clients. Establishment of continuously operating GPS reference base stations. Supervised staff in the use of flatbed photogrammetric scanners. Provided QA/QC on photogrammetric projects. Prepared photo overlay exhibits for proposed highway related projects used in property acquisition and eminent domain proceedings. Established three dimensional survey control for large and small projects.

1997-2006  Hillsborough County Florida-Manager of County Right of Way Section
Responsible for management of 20+ staff and contract with 21 surveying and mapping consulting firms. Perform quality control for subdivision platting, road right of way surveys, road design plans and photogrammetric mapping. Created inter-local agreements with other government organizations, develop budget, maintain technical hardware and software. Developed countywide right of way inventory program. Created specifications for individual and county-wide aerial mapping projects (included 1,000 square miles semi-annual flights) both film and digital base. Negotiated and managed contracts for over six photogrammetric consultant contracts. Supervised photogrammetric staff in data acquisition by use of analog and digital stereoplotters.

1990-1997  Hillsborough County Florida-Professional Surveyor

1986-1990  Delta Engineering Corporation-Chief of Surveying

1968-1986  Delta Engineering Corporation-Professional Surveyor
Ken Simmons

CADD Specialist / IT Manager

SMITH LAND SURVEYING, INC.

Education

Lewis County High School, graduate
Fairmont State University AS in Civil Engineering
Glenville State College, BA in Sociology / Psychology

Certifications

Nine Years of office supervisory experience
Twenty/five years of Auto CADD experience
Experienced in field work
OSHA certified in Construction Safety and Health 10 Hour
ComTIA certification in A+
ComTIA certification in Linux+
ComTIA certification in Server+
DCA (Dell Certified Associate)

Experience

IT/CADD Specialist, Smith Land Surveying (2008-current)

Design land features such as ponds, pads and drains using Carlson Civil Software.
Create Topographical data for Quantities for cut and fill.
Created and continue to update written job descriptions for office personnel.
Developed manual for all business office procedures, resulting in standardized operations.
Well Plats, Permits, and Exhibits.
Design of Site Plans for Marcellus Shale Gas Wells.
Take care of all computer and network issues.

Design land features such as ponds, pads and drains using Civil Land Desktop.
Create Topographical data for Quantities for cut and fill.
Deed research and right-of-way information for P.S.D. related jobs and work done for Eastern Coal.
Created and continue to update written job descriptions for office personnel.
Developed manual for all business office procedures, resulting in standardized operations.
Worked primarily for pipeline, pipeyard and test stations for four years.


Performed business office duties.
Field work as instrument man as well as court research.
Survey plats using Eagle Point software.
Ordered office and survey supplies.


Survey and Well Plats using Carlson Software.
Field Work as a rod man


Survey, Mortgage and Alta plats using Auto Cadd and Eagle Point software.
Field work as a rod man and as instrument man.
D. BRADY STUTLER  
Geotechnical Drilling Manager/CAD & GIS Specialist  
SMITH LAND SURVEYING, INC.

EXPERIENCE

2012 - Present  
Smith Land Surveying  
Glenville, WV  
Geotechnical Drilling Manager / CAD & GIS Specialist

- Prepare base mapping and topographic mapping for multiple engineering and as-built sites.
- Complete as-built survey plats from start to finish.
- Worked on multiple proposed pipeline surveys.
- Prepared and set up information for geodatabasing in GIS.
- Drafting well plats, road approaches, and reclamation plans.
- Managing Geotechnical Drilling operations.
- Organizing and completing geotechnical testing evaluations.
- Setup final designs through Carlson Construction for use on Caterpillar and other GPS equipment for well site construction.
- Mapping and topo work with Cyclone and other Point Cloud software.
- Designing rough / preliminary pad and access road locations.
- Converting design files to shape files for client geodatabasing.
- Preparing exhibit maps and information for environmental permitting.
- Completing road condition surveys from start to finish.

2006-2012  
Thrasher Engineering Inc.  
Bridgeport, WV  
Survey CAD Technician

- Worked under five WV Licensed Surveyors and eight WV/PA licensed Professional Engineers.
- Drafted multiple property, easement, condemnation, well, and permit plats.
- Received information from field crews on a daily basis and updated base mapping and topographic mapping for the engineers and GIS departments.
- Drafted as-built surveys and Alta surveys from start to finished product.
- Completed over 1000 miles of proposed and as-built pipeline surveys, working both indoors doing drafting / engineering, and outdoors surveying.
- Worked on long wall mining mapping and water sampling on multiple jobs, covering over 2000 homes and businesses, both in office and out. Doing water well sampling and mapping for every sampled home or business in the project area (within a 2-mile radius of a long wall mine).
EDUCATION

2002-2005  South Harrison High School    Lost Creek, WV
• Completed courses in board and computer aided drafting.
• Graduated with a 3.0 grade average.

2004-2005  United Technical Center     Clarksburg, WV
• Completed 1000 hours of drafting training in a two year course.
• The first year in the course was for mechanical drafting and design.
• During the first year in the course I won 3rd place in the state for the VICA mechanical drafting competition.
• The second year of the course was for architectural drafting.
• During the second year of the course I won 1st place at the state level VICA architectural competition and 15th in the National VICA competition for architectural drafting.

2005-2007  Fairmont State University    Fairmont/Clarksburg, WV
• Completed 1.5 semesters in the civil engineering program.
• 50 hours of Autodesk Land Desktop training.

SOFTWARE EXPERIENCE

I have multiple years of experience with 2009 Autodesk Land Desktop, 2010-2014 Carlson with Autodesk, and 2010-2012 Autodesk Civil 3D. I also have roughly three years of experience with Carlson GIS, ESRI ArcGIS, general point cloud software, and Carlson Construction.

INTERESTS

I enjoy spending time with my children and family, also golfing, hunting, fishing, dirt track racing, donating time to raise money for my Shriners organization, and taking kids to and from multiple Shriners hospital locations.
The purpose of this addendum is to modify the solicitation identified as ("Solicitation") to reflect the change(s) identified and described below.

**Applicable Addendum Category:**

- [ ] Modify bid opening date and time
- [ ] Modify specifications of product or service being sought
- [✓] Attachment of vendor questions and responses
- [ ] Attachment of pre-bid sign-in sheet
- [ ] Correction of error
- [ ] Other

**Description of Modification to Solicitation:**

Addendum issued to publish and distribute the attached documentation to the vendor community.

1. The purpose of this addendum is to answer technical questions received.

No other Changes.

**Additional Documentation:** Documentation related to this Addendum (if any) has been included herewith as Attachment A and is specifically incorporated herein by reference.

**Terms and Conditions:**

1. All provisions of the Solicitation and other addenda not modified herein shall remain in full force and effect.

2. Vendor should acknowledge receipt of all addenda issued for this Solicitation by completing an Addendum Acknowledgment, a copy of which is included herewith. Failure to acknowledge addenda may result in bid disqualification. The addendum acknowledgement should be submitted with the bid to expedite document processing.

Revised 6/8/2012
CRFQ 0313 DEP1600000053 Version 1 Mapping Services in Southern WV

Addendum 1

1. Question: In Section 3.2.1.3 LiDAR of the RFQ LiDAR is mentioned, but there is no line item or bidding. Is LiDAR a requirement?
   Answer: No. Method of data acquisition is at the discretion of the mapping services contractor.

2. Question: In Section 3.2.1.1 Topographic Mapping mentions imagery but there is no line item as in past mapping contracts? Is imagery required as a deliverable?
   Answer: No.

3. Question: In Section 3.3 Mapping Consultant Qualifications Requirements, a Professional Surveyor is mentioned. There is no line item for bidding. Is this a required item?
   Answer: The Professional Surveyor is required to stamp drawings per the RFQ. This cost should be included in the product.

4. Question: In Section 3.3 Mapping Consultant Qualifications Requirements Professional Drafting is mentioned. There is no line item for bidding. Is this a required item?
   Answer: This is at the discretion of the Professional Surveyor who is in responsible charge of the product.
ADDENDUM ACKNOWLEDGEMENT FORM
SOLICITATION NO.: CRFO 0313 DEP 1600000053

Instructions: Please acknowledge receipt of all addenda issued with this solicitation by completing this addendum acknowledgment form. Check the box next to each addendum received and sign below. Failure to acknowledge addenda may result in bid disqualification.

Acknowledgment: I hereby acknowledge receipt of the following addenda and have made the necessary revisions to my proposal, plans and/or specification, etc.

Addendum Numbers Received:
(Check the box next to each addendum received)

[  ] Addendum No. 1  [  ] Addendum No. 6
[  ] Addendum No. 2  [  ] Addendum No. 7
[  ] Addendum No. 3  [  ] Addendum No. 8
[  ] Addendum No. 4  [  ] Addendum No. 9
[  ] Addendum No. 5  [  ] Addendum No. 10

I understand that failure to confirm the receipt of addenda may be cause for rejection of this bid. I further understand that any verbal representation made or assumed to be made during any oral discussion held between Vendor's representatives and any state personnel is not binding. Only the information issued in writing and added to the specifications by an official addendum is binding.

SMITH LAND SURVEYING, INC.
Company

[Signature]
Authorized Signature

6-21-16
Date

NOTE: This addendum acknowledgement should be submitted with the bid to expedite document processing.
Revised 6/8/2012
ADDENDUM ACKNOWLEDGEMENT FORM
SOLICITATION NO.: CRFQ 0313 DEP 1600000053

Instructions: Please acknowledge receipt of all addenda issued with this solicitation by completing this addendum acknowledgment form. Check the box next to each addendum received and sign below. Failure to acknowledge addenda may result in bid disqualification.

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☑ Addendum No. 1  ☑ Addendum No. 6
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☐ Addendum No. 3  ☐ Addendum No. 8
☐ Addendum No. 4  ☐ Addendum No. 9
☐ Addendum No. 5  ☐ Addendum No. 10

I understand that failure to confirm the receipt of addenda may be cause for rejection of this bid. I further understand that any verbal representation made or assumed to be made during any oral discussion held between Vendor’s representatives and any state personnel is not binding. Only the information issued in writing and added to the specifications by an official addendum is binding.

SMITH LAND SURVEYING, INC.

Company  
Gregory A. Smith

Authorized Signature  
6-21-16

Date

NOTE: This addendum acknowledgement should be submitted with the bid to expedite document processing.
CERTIFICATE OF LIABILITY INSURANCE

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER
Assured Partners Inc. of WV dba Commercial Insurance Services
340 MacCorkle Ave. SE
Charleston, WV 25314

CONTACT NAME: Melanie Estep
PHONE (AIC, No, Ext): (304) 345-8000
FAX: (304) 345-8014
E-MAIL: melanie@clsuwv.com

INSURER(S) AFFORDING COVERAGE

INSURER A: RLJ Insurance Company
13056

INSURED
Smith Land Surveying Inc.
P. O. Box 150
Glenville, WV 26351-0150

INSURER B : 
INSURER C : 
INSURER D : 
INSURER E : 
INSURER F : 

COVERAGE NUMBER:

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

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TAR: Prof Liability
RDP022305
10/27/2015 10/27/2016 E&O 2,000,000

DESCRIPTION OF OPERATIONS/LOCATIONS/Vehicles (ACORD 191, Additional Remarks Schedule, may be attached if more space is required)

CERTIFICATE HOLDER
State of West Virginia
2019 Washington Street, E
Charleston, WV 25305-0130

CANCELATION

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.

AUTHORIZED REPRESENTATIVE

© 1988-2014 ACORD CORPORATION. All rights reserved.

ACORD 25 (2014/01) The ACORD name and logo are registered marks of ACORD
# Certificate of Liability Insurance

**Date:** 10/27/2015

**Import:** If the certificate holder is an additional insured, the policy(ies) must be endorsed. If subrogation is waived, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

**Producer:**
- Name: Jim Lively Insurance
- Address: PO Box 150
- City: Glenville
- State: WV
- Zip: 26351

**Insured:**
- Name: Smith Land Surveying, Inc.
- Address: P.O. Box 150
- City: Glenville
- State: WV
- Zip: 26351

**Insurers:**
- Westfield Insurance
- Travelers Insurance

## Coverages

### Commercial General Liability
- Policy Number: TRA7841510
- Policy Rating: 08/01/2015 08/01/2016
- Limits: $1,000,000

### EPLI Incl 3rd Par
- Policy Number: TRA7841510
- Policy Rating: 08/01/2015 08/01/2016
- Limits: $500,000

### Automobile Liability
- Policy Number: TRA7841510
- Policy Rating: 08/01/2015 08/01/2016
- Limits: $1,000,000

### Umbrella Liability
- Policy Number: TRA7841510
- Policy Rating: 08/01/2015 08/01/2016
- Limits: $9,000,000

## Description of Operations / Locations / Vehicles

**State of West Virginia**
- 2019 Washington St., East
- Charleston, WV 25305

**Cancellation**

- Authorized Representative: Robin Chapman

© 1988-2014 ACORD CORPORATION. All rights reserved.
DESIGNATED CONTACT: Vendor appoints the individual identified in this Section as the Contract Administrator and the initial point of contact for matters relating to this Contract.

(Sarah A. Smith)
(Name, Title)

SARAH A. SMITH
(Printed Name and Title)

PO BOX 150 GLENVILLE, WV. 26351
(Address)

1-304-462-5634 / 1-304-462-5656
(Phone Number) / (Fax Number)

SSMITH@SLSSURVEYS.COM
(email address)

CERTIFICATION AND SIGNATURE: By signing below, or submitting documentation through wvOASIS, I certify that I have reviewed this Solicitation in its entirety; that I understand the requirements, terms and conditions, and other information contained herein; that this bid, offer or proposal constitutes an offer to the State that cannot be unilaterally withdrawn; that the product or service proposed meets the mandatory requirements contained in the Solicitation for that product or service, unless otherwise stated herein; that the Vendor accepts the terms and conditions contained in the Solicitation, unless otherwise stated herein; that I am submitting this bid, offer or proposal for review and consideration; that I am authorized by the vendor to execute and submit this bid, offer, or proposal, or any documents related thereto on vendor’s behalf; that I am authorized to bind the vendor in a contractual relationship; and that to the best of my knowledge, the vendor has properly registered with any State agency that may require registration.

SMITH LAND SURVEYING, INC.
(Company)

(Gregory A. Smith)
(Authorized Signature) (Representative Name, Title)

GREGORY A. SMITH PRESIDENT
(Printed Name and Title of Authorized Representative)

6-21-16
(Date)

1-304-462-5634 / 1-304-462-5656
(Phone Number) (Fax Number)
STATE OF WEST VIRGINIA
Purchasing Division

PURCHASING AFFIDAVIT

MANDATE: Under W. Va. Code §5A-3-10a, no contract or renewal of any contract may be awarded by the state or any of its political subdivisions to any vendor or prospective vendor when the vendor or prospective vendor or a related party to the vendor or prospective vendor is a debtor and: (1) the debt owed is an amount greater than one thousand dollars in the aggregate; or (2) the debtor is in employer default.

EXCEPTION: The prohibition listed above does not apply where a vendor has contested any tax administered pursuant to chapter eleven of the W. Va. Code, workers' compensation premium, permit fee or environmental fee or assessment and the matter has not become final or where the vendor has entered into a payment plan or agreement and the vendor is not in default of any of the provisions of such plan or agreement.

DEFINITIONS:

"Debt" means any assessment, premium, penalty, fine, tax or other amount of money owed to the state or any of its political subdivisions because of a judgment, fine, permit violation, license assessment, defaulted workers' compensation premium, penalty or other assessment presently delinquent or due and required to be paid to the state or any of its political subdivisions, including any interest or additional penalties accrued thereon.

"Employer default" means having an outstanding balance or liability to the old fund or to the uninsured employers' fund or being in policy default, as defined in W. Va. Code § 23-2c-2, failure to maintain mandatory workers' compensation coverage, or failure to fully meet its obligations as a workers' compensation self-insured employer. An employer is not in employer default if it has entered into a repayment agreement with the Insurance Commissioner and remains in compliance with the obligations under the repayment agreement.

"Related party" means a party, whether an individual, corporation, partnership, association, limited liability company or any other form or business association or other entity whatsoever, related to any vendor by blood, marriage, ownership or contract through which the party has a relationship of ownership or other interest with the vendor so that the party will actually or by effect receive or control a portion of the benefit, profit or other consideration from performance of a vendor contract with the party receiving an amount that meets or exceed five percent of the total contract amount.

AFFIRMATION: By signing this form, the vendor's authorized signer affirms and acknowledges under penalty of law for false swearing (W. Va. Code §61-5-3) that neither vendor nor any related party owe a debt as defined above and that neither vendor nor any related party are in employer default as defined above, unless the debt or employer default is permitted under the exception above.

WITNESS THE FOLLOWING SIGNATURE:

Vendor's Name: SMITH LAND SURVEYING, INC.
Authorized Signature: ____________________________ Date: 6-21-16

State of West Virginia

County of Gilmer, to-wit:

Taken, subscribed, and sworn to before me this 21st day of June, 2016.

My Commission expires Jan. 22, 2023

OFFICIAL SEAL

NOTARY PUBLIC

Purchasing Affidavit (Revised 07/01/2012)
State of West Virginia

VENDOR PREFERENCE CERTIFICATE

Certification and application* is hereby made for Preference in accordance with West Virginia Code, §5A-3-37. (Does not apply to construction contracts). West Virginia Code, §5A-3-37, provides an opportunity for qualifying vendors to request (at the time of bid) preference for their residency status. Such preference is an evaluation method only and will be applied only to the cost bid in accordance with the West Virginia Code. This certificate for application is to be used to request such preference. The Purchasing Division will make the determination of the Vendor Preference, if applicable.

1. Application is made for 2.5% vendor preference for the reason checked:
   - [ ] Bidder is an individual resident vendor and has resided continuously in West Virginia for four (4) years immediately preceding the date of this certification; or,
   - [x] Bidder is a partnership, association or corporation resident vendor and has maintained its headquarters or principal place of business continuously in West Virginia for four (4) years immediately preceding the date of this certification; or 90% of the ownership interest of Bidder is held by another individual, partnership, association or corporation resident vendor who has maintained its headquarters or principal place of business continuously in West Virginia for four (4) years immediately preceding the date of this certification; or,
   - [ ] Bidder is a nonresident vendor which has an affiliate or subsidiary which employs a minimum of one hundred state residents and which has maintained its headquarters or principal place of business within West Virginia continuously for the four (4) years immediately preceding the date of this certification; or,

2. Application is made for 2.5% vendor preference for the reason checked:
   - [x] Bidder is a resident vendor who certifies that, during the life of the contract, on average at least 75% of the employees working on the project being bid are residents of West Virginia who have resided in the state continuously for the two years immediately preceding submission of this bid; or,

3. Application is made for 2.5% vendor preference for the reason checked:
   - [ ] Bidder is a nonresident vendor employing a minimum of one hundred state residents or is a nonresident vendor with an affiliate or subsidiary which maintains its headquarters or principal place of business within West Virginia employing a minimum of one hundred state residents who certifies that, during the life of the contract, on average at least 75% of the employees or Bidder’s affiliate’s or subsidiary’s employees are residents of West Virginia who have resided in the state continuously for the two years immediately preceding submission of this bid; or,

4. Application is made for 5% vendor preference for the reason checked:
   - [x] Bidder meets either the requirement of both subdivisions (1) and (2) or subdivision (1) and (3) as stated above; or,

5. Application is made for 3.5% vendor preference who is a veteran for the reason checked:
   - [ ] Bidder is an individual resident vendor who is a veteran of the United States armed forces, the reserves or the National Guard and has resided in West Virginia continuously for the four years immediately preceding the date on which the bid is submitted; or,

6. Application is made for 3.5% vendor preference who is a veteran for the reason checked:
   - [ ] Bidder is a resident vendor who is a veteran of the United States armed forces, the reserves or the National Guard, if, for purposes of producing or distributing the commodities or completing the project which is the subject of the vendor’s bid and continuously over the entire term of the project, on average at least seventy-five percent of the vendor’s employees are residents of West Virginia who have resided in the state continuously for the two immediately preceding years.

7. Application is made for preference as a non-resident small, women- and minority-owned business, in accordance with West Virginia Code §5A-3-59 and West Virginia Code of State Rules.
   - [ ] Bidder has been or expects to be approved prior to contract award by the Purchasing Division as a certified small, women- and minority-owned business.

Bidder understands that the Secretary of Revenue determines that a Bidder receiving preference has failed to continue to meet the requirements for such preference, the Secretary may order the Director of Purchasing to: (a) reject the bid; or (b) assess a penalty against such Bidder in an amount not to exceed 5% of the bid amount and that such penalty will be paid to the contracting agency or deducted from any unpaid balance on the contract or purchase order.

By submission of this certificate, Bidder agrees to disclose any reasonably requested information to the Purchasing Division and authorizes the Department of Revenue to disclose to the Director of Purchasing appropriate information verifying that Bidder has paid the required business taxes, provided that such information does not contain the amounts of taxes paid nor any other information deemed by the Tax Commissioner to be confidential.

Under penalty of law for false swearing (West Virginia Code, §61-5-3), Bidder hereby certifies that this certificate is true and accurate in all respects; and that if a contract is issued to Bidder and if anything contained within this certificate changes during the term of the contract, Bidder will notify the Purchasing Division in writing immediately.

Bidder: Smith Land Surveying, Inc.
Signed: [Signature]
Date: 6-21-16
Title: President
Smith Land Surveying, Inc.
Current Aerial Mapping Projects Under Contract

- **Six New Gas Well Pad Sites**
  
  **Client:** EQT Production Company
  
  SLS is providing aerial mapping, survey control, and boundary survey work for well plat and permitting purposes, engineering and site design, survey stakeout for construction and site As-Builts. SLS also provides environmental and regulatory assistance.

- **One New Gas Well Pad Site**
  
  **Client:** Mountaineer Keystone
  
  SLS is providing aerial mapping, survey control, and boundary survey work for well plat and permitting purposes, engineering and site design, survey stakeout for construction and site As-Builts.

- **Two New Gas Well Pad Sites**
  
  **Client:** Larson Design Group
  
  SLS is providing aerial mapping and survey control.

- **500 Acre ± Unit Boundary**
  
  **Client:** Larson Design Group
  
  SLS is providing mapping and boundary survey services for one of Larson Design Group’s clients.

- **Six Cell Tower Sites in North Central West Virginia**
  
  **Client:** Aerial Erectors
  
  SLS is providing field run topography of a .5 Acre ± cell tower site and for access roads ranging in length from 1800 feet to 5000 feet, boundary survey to provide lease area plats and survey stakeout for construction.

- **Individual Boundary Surveys**
  
  **Client:** Various
  
  SLS is providing a variety of boundary and mapping surveys with some environmental and flood plain services, ranging from city lots to large acreage rural tracts.
AERIAL MAPPING CLIENT LIST

EQT Production Company
Contact: Justin Meadows

Larson Design Group
Contact: Rob Matejczyk

Mountaineer Keystone
Contact: Amy Miller

Stantec
Contact: Richard Gaines

Precision Pipeline
Contact: Steven Grice

Allstar Ecology
Contact: Ernie Smith

XTO/Mountain Gathering
Contact: Michael "Mike" Jackson

Stone Energy
Contact: Clayton Ferguson

Mike & Ike LandAPlenty
Contact: Mike Ross

Dominion Transmission (Formerly CNG Transmission)

Louis Berger & Associates
Contact: George Younger

Gilmer County Economic Development Association
Contact: Jim Fealy/Jeff Campbell

West Virginia Department of Commerce
Contact: Canaan Valley Golf Course

Wolfpen Knob Development
Contact: Denny Stanhagen

Consol Coal – Birch Project
Client: Raymond Purr

Century Engineering
Client: Joel Oppenheimer

William Shriver Architects
Contact: Ted Shriver

WV DEP – Bond Forfeiture Projects

Federal Bureau of Prisons
Proc Folder: 189210
Doc Description: Addendum No. 01-Mapping Services in Southern WV

Proc Type: Central Master Agreement

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BID RECEIVING LOCATION

BID CLERK
DEPARTMENT OF ADMINISTRATION
PURCHASING DIVISION
2019 WASHINGTON ST E
CHARLESTON
WV 25305
US

VENDOR

Vendor Name, Address and Telephone Number:

FOR INFORMATION CONTACT THE BUYER
Beth Collins
(304) 558-2157
beth.a.collins@wv.gov

Signature X

FEIN # 55-0669832
DATE 6-21-16

All offers subject to all terms and conditions contained in this solicitation
### ADDITIONAL INFORMATION:

Addendum

Addendum No.01 issued to publish and distribute the attached information to the vendor community.

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OFFICE OF AML&R  
601 57TH ST SE  
CHARLESTON  
WV25304  
US | ENVIRONMENTAL PROTECTION  
OFFICE OF AML&R  
601 57TH ST SE  
CHARLESTON  
WV 25304  
US |

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**Comm Code** | **Manufacturer** | **Specification** | **Model #**
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81151601 |                 |                   |           |

**Extended Description:**  
(Spec Item 3.1.1.2 & 4.2)

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**Comm Code** | **Manufacturer** | **Specification** | **Model #**
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81151601 |                 |                   |           |

**Extended Description:**  
(Spec Item 3.1.1.3 & 4.2)
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(Spec Item 3.2 & 4.2)
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Extended Description:
(Spec Item 3.2 & 4.2)

**SCHEDULE OF EVENTS**

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ADDITIONAL TERMS AND CONDITIONS

See attached document(s) for additional Terms and Conditions
Camera Calibration Certificate
No: DMC Ile 250 – 25521

For

Midwest Aerial Photography
7535 West Broad Street
Galloway, Ohio 43119
DMC Ile 250 Calibration Protocol

Manufacturer: Z/I Imaging GmbH, D-73431 Aalen, Germany
Reference: PAN
Serial Number: 00121780 (PAN Head)
Date of Calibration: 27. October 2014
Date of Report: 10. November 2014
Number of Pages:

Calibration performed at: Carl Zeiss Jena, Carl-Zeiss-Promenade 10, 07745 Jena, Germany.

This camera system is certified by Z/I Imaging and is fully functional within its specifications and tolerances.

Date of Calibration: October 2014          Date of Certification: November 2014

Jürgen Hefele, Senior Software Developer  Dipl. Ing. Christian Müller, Product Manager
Camera Serial Numbers and Burn-In flight

<table>
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<tr>
<th>Camera Head</th>
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<td>PAN (reference)</td>
<td>00121700</td>
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<td>MS1 (NIR)</td>
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Burn-In flight performed: 29. September 2014

Test block configuration

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<td>Flying Altitude [m]</td>
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<td>Side-lap [%]</td>
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<td>End-lap [%]</td>
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<td>Terrain Height [m]</td>
<td>450</td>
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<td>Number of strips</td>
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<td>Photos in one strip</td>
<td>2 x 9 N-S, 4 x 9 W-E</td>
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<td>Control Points Used</td>
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<td>Check Points Used</td>
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<td>GSD [cm]</td>
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Aerial triangulation statistic results:

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<tr>
<th>Parameter</th>
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<td>RMS Check</td>
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<tr>
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<td>Mean Std Dev Object</td>
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<tr>
<td>RMS Photo Position</td>
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<tr>
<td>RMS Photo Altitude</td>
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<tr>
<td>Mean Std Dev Photo Po...</td>
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<tr>
<td>Mean Std Dev Photo Alt...</td>
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</tr>
</tbody>
</table>

Key Statistics:
- Sigma: 1.3 um
- RMS Image (x,y): 1.1, 0.9 um
- Number of iterations: 2
- Degrees of Freedom: 15421
- Gross Image Blunders: 0
- Gross Control Blunders: 0
- Image Blunders: 0
- Solution Status: Solution Successful.

Current Count:
- Control Points Used: 5
- Check Points Used: 38
- Photos Used: 54
- Photos Not Used: 0
- Image Points Used: 13205

Cameras Used:
- Camera Id: DMC_Il_250
- Len: Off
- Grid: Off

Project Settings:
- Linear: Meters
- Refraction: Off
- Angular: Degrees
- Curvature: Off
- German Hauptdeichschnet - Gauss-Kruger (3-degree) (m)

The results of the aerial triangulation were generated with ImageStation Automatic Triangulation (ISAT), Version 2013, from Intergraph Corp. The maximum RMS in check points is ≤ 0.5 GSD in x,y and ≤ 0.7 GSD in z.

Aerial Triangulation performed by

[Signature]
Dipl. Ing. C. Müller

10.11.2014
Date
DMC lie 250 Calibration Protocol

Geometric Calibration
The output image geometry is based on the Pan Camera head (reference head = master camera). All other camera heads are registered and aligned to this head. Aerial triangulation checks overall system performance based on.

Output image

<table>
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<tr>
<th>Reference Camera</th>
<th>PAN</th>
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<tbody>
<tr>
<td>Serial Number</td>
<td>00121780</td>
</tr>
<tr>
<td>Number of rows/columns [pixels]</td>
<td>16768 x 14016</td>
</tr>
<tr>
<td>Pixel Size [µm]</td>
<td>5.600 x 5.600</td>
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<tr>
<td>Image Size [mm]</td>
<td>93.9008 x 78.4896</td>
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<tr>
<td>Focal Length [mm]</td>
<td>111.9906 mm +/− 0.002 mm</td>
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<tr>
<td>Principal Point [mm]</td>
<td>X= 0.0208 mm Y= -0.0019 mm +/− 0.002 mm</td>
</tr>
</tbody>
</table>

The geometric calibration takes place at Carl Zeiss Jena on a certified test stand. More than 800 "light targets", projected on 28 lines that are distributed diagonally on the focal plane, are automatically measured by finding their centers light with a precision of less than 1/10 of a pixel. The light targets are projected from the "infinity" by using a collimator (Figure 1).

Figure 1: Light Target Pattern by Collimator
Geometric Calibration

Image Residuals

Figure 2 shows the image residuals, split in radial and tangential directions after the calibration adjustment. The maximum residuals are less than or equal to 1.5 microns and the RMSE values are below 0.5 microns.

![Figure 2: Tangential/Radial Distortion Residuals](image.png)

Figure 3 shows the 2-D plot of the image residuals in mm.

![Figure 3: 2-D Image Residuals. RMS < 0.19 um (maximum 0.73 microns)](image.png)
Optical System

Modulation Transfer Function, MTF of PAN Camera (Reference)

DMC II PAN – MTF Polychromatic  F/5.6 ; 112 mm – Temperature Stability

The MTF measurement is camera type specific and shows variation of the MTF within the specified temperature range.

This is a camera type specific measurement.
Radiometric Calibration

Sensitivity of PAN camera (Reference)

The sensitivity shows the spectral response curve of the single camera head including the optical system (optics, filter) and the sensor response. The DMC Ile 250 is calibrated with respect to the absolute spectrometer. This allows computing pixel radiance values from pixels digital numbers and is a camera type specific calibration.

This is a camera type specific measurement.
Radiometric Calibration

Sensor Linearity (Reference)

The sensor linearity is measured in the Lab with calibrated spectrometer. This is a camera type specific calibration.
Below figure shows the linearity of the raw sensor and after flat fielding:

The deviation from the linearity is below 1%.

This is a camera type specific measurement.
Radiometric Calibration

Sensor Noise (Reference)

Sensor noise shows image noise with respect to the image center measured at an aperture of 16 with exposure time of 16msec.

Sensor Signal to Noise Ratio

This is from a camera type specific calibration.
Radiometric Calibration

Aperture Correction (Reference)

Camera PAN (00121780)

The light fall off to the border due the influence of the optics depends on the aperture used. Therefore this calibration approach delivers individual calibration images for each aperture (Full F-Stop). In general the light fall off is a function of the image height (radial distance from center). The figure below shows the profile from the upper left corner to the lower right corner of the calibration images. Compensation of the light fall off can be measured after normalization and is within ± 2.5% of the dynamic range.

![Graph showing light fall off and correction after normalization for PAN sensor](image)

Light fall off and correction after normalization (blue) for PAN sensor

This is from a camera type specific calibration.
Radiometric Calibration

Defect Pixel

Camera PAN (00121780)

Defect pixels are detected during radiometric calibration and will be corrected during radiometric processing of the images. The quantity and cumulative percentage and specification of defects is described in Appendix “Defect Pixel Recognition”.

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## DMC Ile 250 Calibration

### Protocol

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Optical System

Modulation Transfer Function, MTF of Green camera

RMK D / RMK DX / DMC II MS Green – MTF F/4.0 ; 45 mm– Temperature Stability
Radiometric Calibration

Sensitivity of Green camera

Spectral response curve of the single camera head.

The sensitivity shows the spectral response curve of the single camera head including the optical system (optics, filter) and the sensor response. The DMC Ile 250 is calibrated with respect to the absolute spectrometer. This allows computing pixel radiance values from pixels digital numbers and is a camera type specific calibration.
Radiometric Calibration

Sensor Linearity (Reference)

The sensor linearity is measured in the Lab with calibrated spectrometer. This is a camera type specific calibration.
Below figure shows the linearity of the raw sensor and after flat fielding:

![Linearity Graph]

Sensor Linearity from Light Level 0 (dark) to (100% = Saturation)

The deviation from the linearity is below 1%.
Radiometric Calibration

Sensor Noise (Reference)

Sensor noise shows image noise with respect to the image center measured at an aperture of 8 with exposure time of 22msec. Sensor noise after calibration shall be less or equal 0.5% of radiometric resolution. At 14bit radiometric resolution 0.5% (of 16384) is equal to 82 gray values. This is a camera type specific calibration.

Image Noise before and after radiometric calibration
Radiometric Calibration

Aperture Correction

Green (00124731)

The light fall off to the border due the influence of the optics depends on the aperture used. Therefore this calibration approach delivers individual calibration images for each aperture (Full F-Stop). In general the light fall off is a function of the image height (radial distance from center). The figure below shows the profile from the upper left corner to the lower right corner of the calibration images.

This is a camera type specific calibration.
Radiometric Calibration

Defect Pixel

Green (00124731)

Defect pixels are detected during radiometric calibration and will be corrected during radiometric processing of the images. The quantity and cumulative percentage and specification of defects is described in Appendix "Defect Pixel Recognition".

<table>
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<td>4</td>
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Optical System

Modulation Transfer Function, MTF of Red camera

RMK D / RMK DX / DMC II MS Red – MTF F/4.0 ; 45 mm – Temperature Stability

[Graphs showing MTF measurements at different temperatures (+40°C, 0°C, +20°C, -20°C)]
Radiometric Calibration

Sensitivity of Red camera

Spectral Response Curves of the single camera head.

The sensitivity shows the spectral response curve of the single camera head including the optical system (optics, filter) and the sensor response. The DMC Ile 250 is calibrated with respect to the absolute spectrometer. This allows computing pixel radiance values from pixels digital numbers and is a camera type specific calibration.
Radiometric Calibration

Sensor Linearity (Reference)

The sensor linearity is measured in the Lab with calibrated spectrometer. This is a camera type specific calibration. Below figure shows the linearity of the raw sensor and after flat fielding:

![Linearity Graph]

Sensor Linearity from Light Level 0 (dark) to (100 % = Saturation)

The deviation from the linearity is below 1%.
Radiometric Calibration

Sensor Noise (Reference)

Sensor noise shows image noise with respect to the image center measured at an aperture of 8 with exposure time of 22msec. Sensor noise after calibration shall be less or equal 0.5% of radiometric resolution. At 14bit radiometric resolution 0.5% (of 16384) is equal to 82 gray values. This is a camera type specific calibration.
Radiometric Calibration

Aperture Correction

Red (00124675)

The light fall off to the border due the influence of the optics depends on the used aperture. Therefore this calibration approach has for each aperture (Full F-Stop) its own calibration image. In general the light fall off is a function of the image radius. In this calibration approach instead of function the real measured values in the image is used. The figure below shows the profile from the upper left corner to the lower right corner of each of this calibration images to give a feeling on the amount of correction.

![Red DMC Ile 250](image)

This is a camera type specific calibration.
Radiometric Calibration

Defect Pixel

Red (00124675)

Defect pixels are detected during radiometric calibration and will be corrected during radiometric processing of the images. The quantity and cumulative percentage and specification of defects is described in Appendix "Defect Pixel Recognition".

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| Defect Column Row Start Column Start Column End Column End |
|-----------------|-----------------|-----------------|-----------------|
| 0               | 8568            | 5744            | 5744            |
| 1               | 6509            | 4415            | 5636            | 4415            |
Optical System

Modulation Transfer Function, MTF of Blue camera

RMK D / RMK DX / DMC II MS Blue – MTF F/4.0; 45 mm – Temperature Stability
Radiometric Calibration

Sensitivity of Blue camera

Spectral Response Curves of the single camera head.

The sensitivity shows the spectral response curve of the single camera head including the optical system (optics, filter) and the sensor response. The DMC Ile 250 is calibrated with respect to the absolute spectrometer. This allows computing pixel radiance values from pixels digital numbers and is a camera type specific calibration.
Radiometric Calibration

Sensor Linearity (Reference)

The sensor linearity is measured in the Lab with calibrated spectrometer. This is a camera type specific calibration. Below figure shows the linearity of the raw sensor and after flat fielding:

![Linearity Graph](image)

Sensor Linearity from Light Level 0 (dark) to (100% = Saturated)

The deviation from the linearity is below 1%.
Radiometric Calibration

Sensor Noise (Reference)

Sensor noise shows image noise with respect to the image center measured at an aperture of 8 with exposure time of 22msec. Sensor noise after calibration shall be less or equal 0.5% of radiometric resolution. At 14-bit radiometric resolution 0.5% (of 16384) is equal to 82 gray values. This is a camera type specific calibration.
Radiometric Calibration

Aperture Correction

Blue (00124750)

The light fall off to the border due the influence of the optics depends on the used aperture. Therefore this calibration approach has for each aperture (Full F-Stop) its own calibration image. In general the light fall off is a function of the image radius. In this calibration approach instead of function the real measured values in the image is used. The figure below shows the profile from the upper left corner to the lower right corner of each of this calibration images to give a feeling on the amount of correction.

![Blue DMC Ilo 250](image)

This is a camera type specific calibration.
Radiometric Calibration

Defect Pixel

Blue (00124750)

Defect pixels are detected during radiometric calibration and will be corrected during radiometric processing of the images. The quantity and cumulative percentage and specification of defects is described in Appendix "Defect Pixel Recognition".

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Defect Column RowStart ColumnStart RowEnd ColumnEnd

Revision of calibration: 131073
CCD/Revision: 1
Date Number: 1410278960
Date: 140906

Number of defect pixels: 1
Number of defect clusters: 0
Number of defect columns: 0
Optical System

Modulation Transfer Function, MTF of IR camera

RMK D / RMK DX / DMC II MS IR – MTF F/4.0; 45 mm – Temperature Stability

![Graphs showing MTF at different temperatures (40°C, 0°C, 20°C, -20°C)]
Radiometric Calibration

Sensitivity of NIR camera

Spectral Response Curves of the single camera head.

The sensitivity shows the spectral response curve of the single camera head including the optical system (optics, filter) and the sensor response. The DMC Ile 250 is calibrated with respect to the absolute spectrometer. This allows computing pixel radiance values from pixels digital numbers and is a camera type specific calibration.
Radiometric Calibration

Sensor Linearity (Reference)

The sensor linearity is measured in the Lab with calibrated spectrometer. This is a camera type specific calibration. Below figure shows the linearity of the raw sensor and after flat fielding:

![Linearity Graph](image)

Sensor Linearity from Light Level 0 (dark) to (100 % = Saturation)

The deviation from the linearity is below 1%.
Radiometric Calibration

Sensor Noise (Reference)

Sensor noise shows image noise with respect to the image center measured at an aperture of 8 with exposure time of 22msec. Sensor noise after calibration shall be less or equal 0.5% of radiometric resolution. At 14bit radiometric resolution 0.5% (of 16384) is equal to 82 gray values. This is a camera type specific calibration.

![Image Noise](image.png)

Image Noise before and after radiometric calibration
Radiometric Calibration

Aperture Correction

NIR (00124702)

The light fall off to the border due the influence of the optics depends on the used aperture. Therefore this calibration approach has for each aperture (Full F-Stop) its own calibration image. In general the light fall off is a function of the image radius. In this calibration approach instead of function the real measured values in the image is used. The figure below shows the profile from the upper left corner to the lower right corner of each of this calibration images to give a feeling on the amount of correction.

This is a camera type specific calibration.
Radiometric Calibration

Defect Pixel

NIR (00124702)

Defect pixels are detected during radiometric calibration and will be corrected during radiometric processing of the images. The quantity and cumulative percentage and specification of defects is described in Appendix "Defect Pixel Recognition".

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| Number of defect pixels: | 0 |
| Number of defect clusters: | 0 |
| Number of defect columns: | 0 |

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Sensor Geometric Accuracy

Large area CCD imagers are composed (stitched) from several blocks. Stitching on wafer with semiconductor lithographic equipment results in geometric accuracy better than 0.1\(\mu\)m (Stoldt, H. (2010)). Therefore the geometric accuracy of individual pixels within a block can be assumed as better or equal the stitching accuracy.
Defect Pixel Recognition
The table below shows the maximal allowed physical defects on the CCD Sensor and its definitions.

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<th>Description</th>
<th>CCD Spec</th>
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<tr>
<td>Bright image</td>
<td>Pixel whose signal, at nominal light (illumination at 50% of the linear range), deviates more than ±30% from its neighboring pixels.</td>
</tr>
<tr>
<td>Dark image</td>
<td>Pixel whose signal, in dark, deviates more than 6mV from its neighboring pixels (about 1% of nominal light).</td>
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<tr>
<td>Max Count</td>
<td>PAN ≤ 3500&lt;br&gt;MS &lt; 500</td>
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<table>
<thead>
<tr>
<th>Description</th>
<th>CCD Spec</th>
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<tr>
<td>Definition</td>
<td>A column which has more than 8 pixel defects in 1 x 12 kernel. Column defects must be horizontally separated by 5 columns for single line defects and 10 for double line defects.</td>
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<tr>
<td>Recognition (bright and dark)</td>
<td>Same as defect pixel recognition</td>
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<td>Max Single column</td>
<td>PAN ≤ 140&lt;br&gt;MS ≤ 20</td>
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<tr>
<td>Max double Column</td>
<td>PAN ≤ 40&lt;br&gt;MS ≤ 6</td>
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The Post-Processing-Software is correcting following pixel and columns:

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Bibliography

Brown D. C. Close-Range Camera Calibration, Photogrammetric Engineering 37(8) 1971


