SOLICITATION/CONTRACT/ORDER FOR COMMERCIAL ITEMS
OFFEROR TO COMPLETE BLOCKS 12, 17, 23, 24, & 30

1. REQUISITION NO.	PAGE 1 OF 28
J2002257 Basic (1F)	

2. CONTRACT NO.	3. AWARD/EFFECTIVE DATE	4. ORDER NO.	5. SOLICITATION NO.	6. SOLICITATION ISSUE DATE
	See Block 31c.		**RFO 13-SSC-O-02-40**	August 28, 2002

7. FOR SOLICITATION INFORMATION CALL	a. NAME	b. TELEPHONE NO. *(No collect calls)*	8. OFFER DUE DATE/LOCAL TIME
	Robert Harris/James Huk	(228) 688-3862 (228) 688-1045	**September 17, 2002 Not Later Than 3:00pm**

9. ISSUED BY CODE 64

NASA/OFFICE OF PROCUREMENT
OPERATIONS CONTRACTING DIVISION
MAIL CODE DA10
JOHN C. STENNIS SPACE CENTER
STENNIS SPACE CENTER, MS 39529-6000

10. THIS ACQUISITION IS
- ☒ UNRESTRICTED
- ☐ SET ASIDE: 100 % FOR
  - ☐ SMALL BUSINESS
  - ☐ SMALL DISADV. BUSINESS
  - ☐ 8(A)

SIC: NAICS Code: 541370
SIZE STD: $4M

11. DELIVERY FOR FOB DESTINATION UNLESS BLOCK IS MARKED
- ☐ SEE SCHEDULE

12. DISCOUNT TERMS

☒ 13a. THIS CONTRACT IS A RATED ORDER UNDER DPAS (15 CFR 700)

13b. RATING: DO-C9

14. METHOD OF SOLICITATION
☐ RFQ ☐ IFB ☐ RFP ☒ RFO

15. DELIVER TO CODE 64

NASA
John C. Stennis Space Center
Stennis Space Center, MS 39529-6000

16. ADMINISTERED BY CODE

Same as block no. 9

17a. CONTRACTOR/ OFFEROR CODE FACILITY CODE

Taxpayer Identification No. (TIN): _____
Cage Code:
TELEPHONE NO.

18a. PAYMENT WILL BE MADE BY CODE EA22

NASA/Financial Management Office, Code EA22
Building 1100
John C. Stennis Space Center
Stennis Space Center, MS 39529-6000

☐ 17b. CHECK IF REMITTANCE IS DIFFERENT AND PUT SUCH ADDRESS IN OFFER

18b. SUBMIT INVOICES TO ADDRESS SHOWN IN BLOCK 18a UNLESS BLOCK BELOW IS CHECKED ☐ SEE ADDENDUM

19. ITEM NO.	20. SCHEDULE OF SUPPLIES/SERVICES	21. QUANTITY	22. UNIT	23. UNIT PRICE	24. MINIMUM AMOUNT
0001	Light Detection and Ranging (LIDAR) Digital Elevation Data Products In accordance with the attached statement of Work *(Attach Additional Sheets as Necessary)*	1	JB		

25. ACCOUNTING AND APPROPRIATION DATA
801/20110 001 609-00-00-00-00-64-2001-00-00-29-VXG2-00-2550 400000 PPC:BX

26. TOTAL AWARD AMOUNT *(For Govt. Use Only)*

☒ 27a. SOLICITATION INCORPORATES BY REFERENCE FAR 52.212-1, 52.212-4. FAR 52.212-3 AND 52.212-5 ARE ATTACHED. ADDENDA ☒ ARE ☐ ARE NOT ATTACHED.

☐ 27b. CONTRACT/PURCHASE ORDER INCORPORATES BY REFERENCE FAR 52.212-4. FAR 52.212-5 IS ATTACHED. ADDENDA ☐ ARE ☐ ARE NOT ATTACHED.

28. [X] CONTRACTOR IS REQUIRED TO SIGN THIS DOCUMENT AND RETURN 3 COPIES TO ISSUING OFFICE. CONTRACTOR AGREES TO FURNISH AND DELIVER ALL ITEMS SET FORTH OR OTHERWISE IDENTIFIED ABOVE AND ON ANY ADDITIONAL SHEETS SUBJECT TO THE TERMS AND CONDITIONS SPECIFIED HEREIN.

29. [ ] AWARD OF CONTRACT: REFERENCE YOUR OFFER DATED _____. YOUR OFFER ON SOLICITATION (BLOCK 5), INCLUDING ANY ADDITIONS OR CHANGES WHICH ARE SET FORTH HEREIN, IS ACCEPTED AS TO ITEMS:

30a. SIGNATURE OF OFFEROR/CONTRACTOR	31a. UNITED STATES OF AMERICA *(SIGNATURE OF CONTRACTING OFFICER)*

30b. NAME AND TITLE OF SIGNER *(TYPE OR PRINT)*	30c. DATE SIGNED	31b. NAME OF CONTRACTING OFFICER *(TYPE OR PRINT)*	31c. DATE SIGNED
		James D. Huk II	

32a. QUANTITY IN COLUMN 21 HAS BEEN	33. SHIP NUMBER	34. VOUCHER NUMBER	35. AMOUNT VERIFIED CORRECT FOR
☐ RECEIVED ☐ INSPECTED ☐ ACCEPTED, AND CONFORMS TO THE CONTRACT, EXCEPT AS NOTED	☐ PARTIAL ☐		
	36. PAYMENT ☐ COMPLETE ☐ PARTIAL ☐		37. CHECK NUMBER
32b. SIGNATURE OF AUTHORIZED GOVT REPRESENTATIVE / 32c. DATE	38. S/R ACCOUNT NO.	39. S/R VOUCHER NO.	40. PAID BY
	42a. RECEIVED BY *(Print)*		

41a. I CERTIFY THIS ACCOUNT IS CORRECT AND PROPER FOR PAYMENT

41b. SIGNATURE AND TITLE OF CERTIFYING OFFICER	41c. DATE	42b. RECEIVED AT *(Location)*	
		42c. DATE REC'D *(YY/MM/DD)*	42d. TOTAL CONTAINERS

Statement of Work
LIDAR Data Products

SUPPLIES AND/OR SERVICES TO BE FURNISHED. The contractor shall provided all resources necessary to furnish the supplies/services in accordance with the following statement of work:

1.0 Introduction:

NASA seeks sources of Light Detection and Ranging (LIDAR) digital elevation data and related products to support NASA's on-going Earth Science Enterprise research and applications. Data acquisition shall be in collected in three areas.

Two areas are within the continental United States: the western flank of Mount Rainier, Washington and the northernmost portion of the San Andreas Fault zone, California. These data will be used to evaluate natural hazards in these areas in support of the National Aeronautics and Space Administration (NASA) Solid Earth and Natural Hazards (SENH) Program, the United States Geological Survey (USGS), and the Geology component of the Earthscope Plate Boundary Observatory (Geo-PBO). Earthscope is a comprehensive geoscience initiative under development by the National Science Foundation (NSF), the USGS and NASA.

These two areas consist of high-relief, heavily vegetated terrain. Proposal responses are therefore desired that offer approaches for data acquisition, processing, and classification that are well adapted to collection and identification of ground elevations in topographically rugged, vegetated landscapes.

The third area is located in Belize. Data is required to characterize the low-lying topography of coastal areas and off-shore coral reef island in support of storm hazard modeling. Characterization of land cover heights (dense, tropical vegetation cover and locally urbanized areas) is also required in support of the modeling. The work is being done under the auspices of the NASA SENH Program in co-operation with the Organization of American States (OAS) and the Belize government.

2.0 Project Areas

The locations of the Mount Rainier and San Andreas project areas are illustrated in Figures 1 and 2, respectively. The Rainier project area (Figure 1) is outlined in blue. Project subsections are labeled by letters (A-D) and the square mileage of each is indicated on the figure, totaling 202 square miles. Permits required to acquire data within the Mount Rainier National Park (Area D) will be obtained and furnished by NASA. The contour interval is 200 m and the 600 m contour is highlighted in red. The highest elevation is about 1640 m, in the SE corner of the project area. The San Andreas project area (Option 1 in Figure 2) is outlined in black and consists of a land area of 260 square miles. The contour interval is 200 m and the highest elevation is about 700 m.

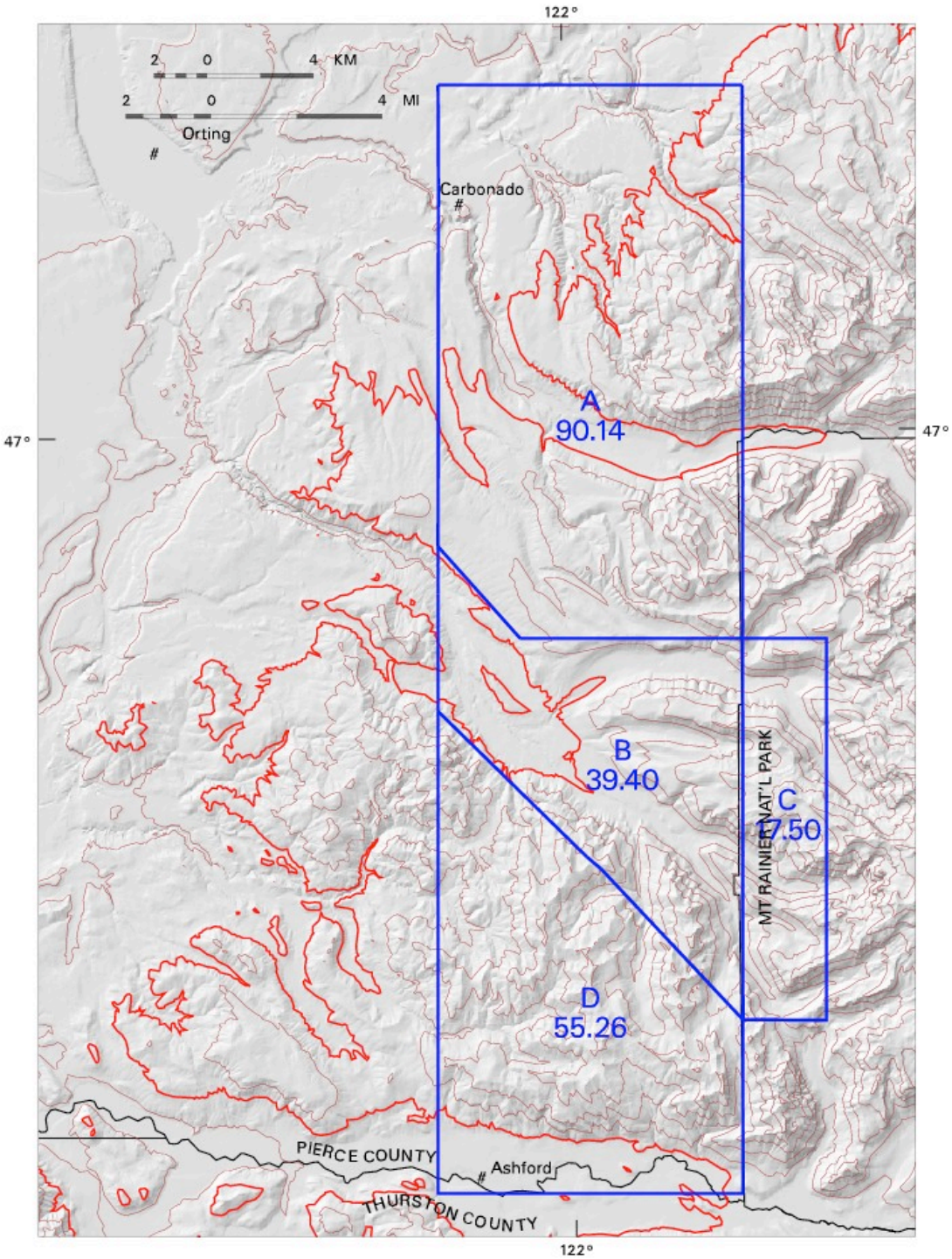

Figure 1. West Rainier Seismic Zone Project Area.

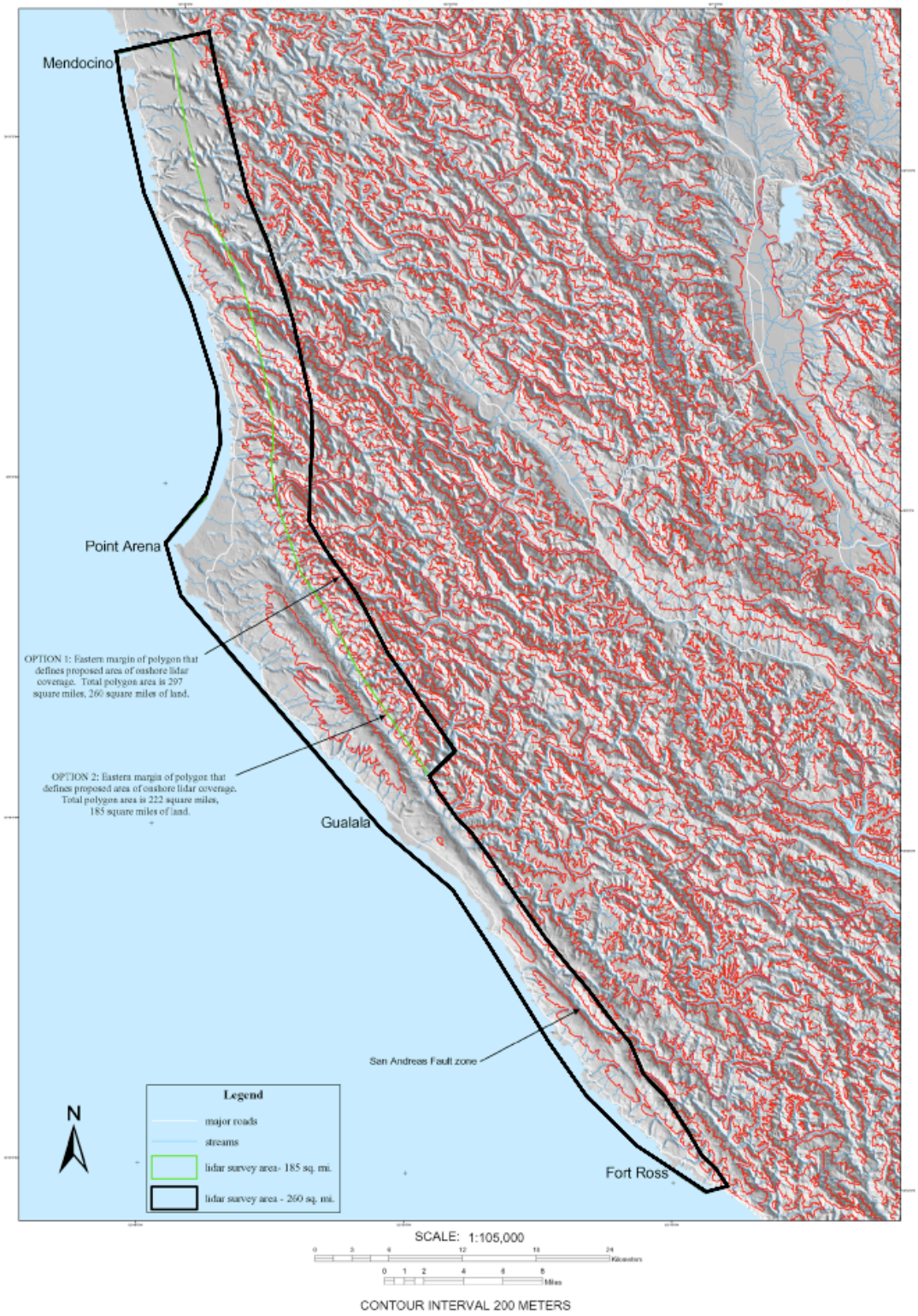

Figure 2. Northern San Andreas Project Area.

The location of the Belize project area is illustrated in Figures 3 and 4. The project area is outlined in white in Figure 4, which shows an enhanced Landsat image with co-ordinates of UTM meters, zone 16. The land area included in the project area is 400 square miles. Permits required to acquire data within Belize will be obtained and furnished by NASA.

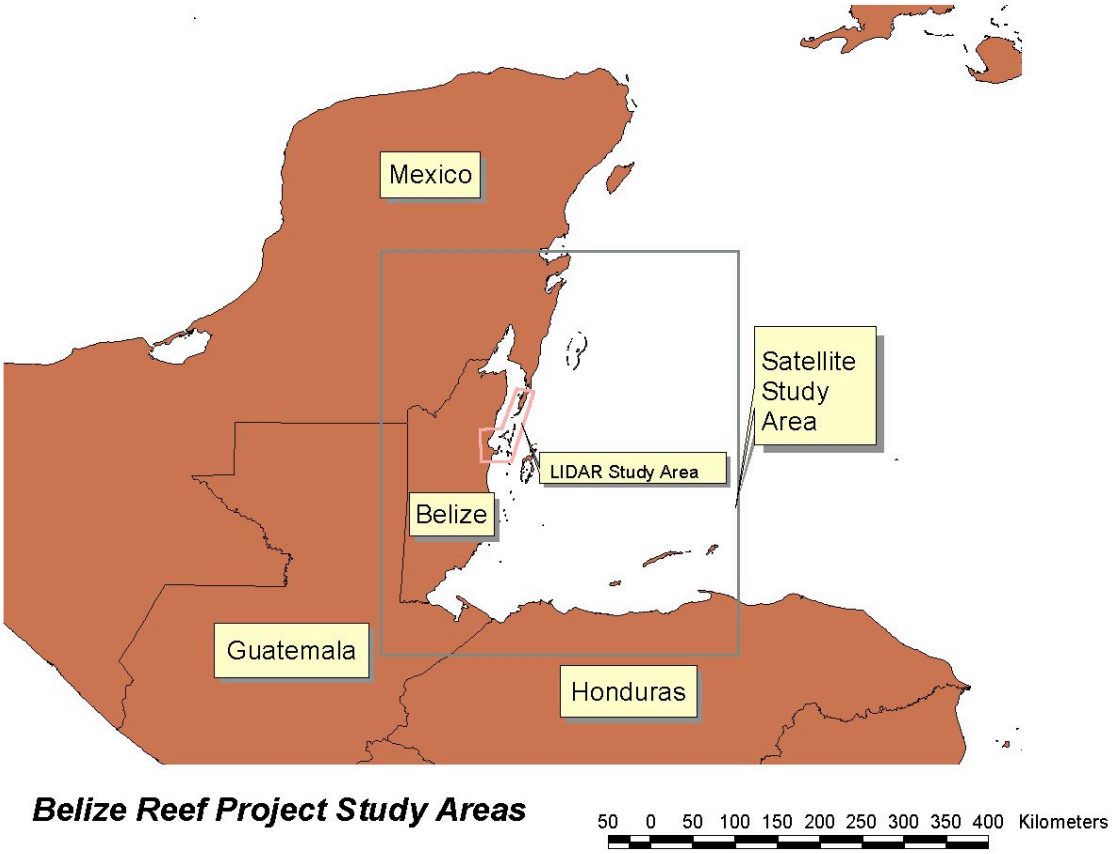

Figure 3. Regional map and location of the project area.

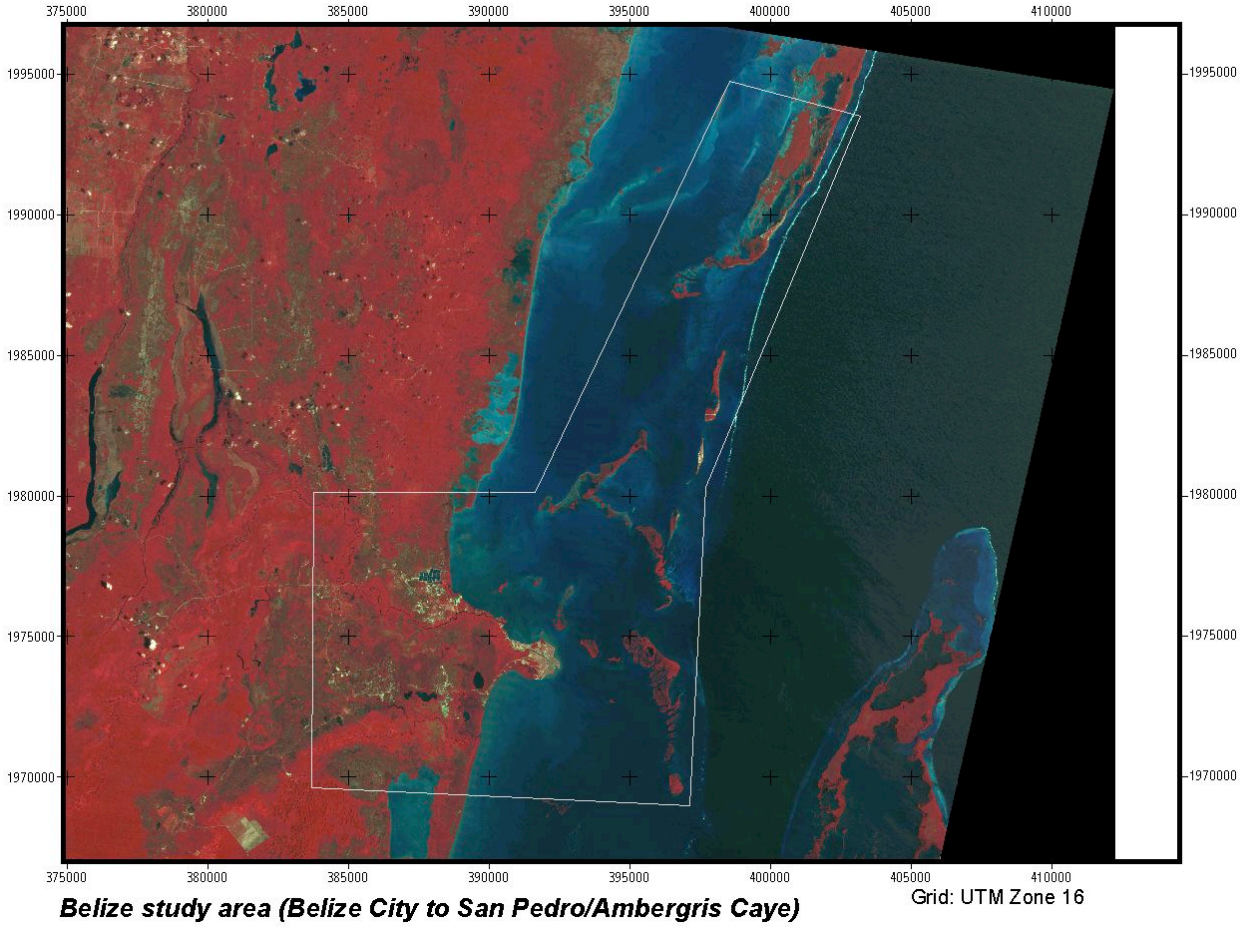

Figure 4. Landsat image and location of the project area.

3.0 Scope

The contractor shall provide data meeting or exceeding the requirements specified, a license to use that data which meets NASA minimum data rights requirements, and information that is required for NASA to validate that the data provided meets the specifications.

4.0 Requirements

A. Data Specifications

NASA seeks to purchase LIDAR data products described in the Deliverables section. The contractor may propose any products that meet or exceed the specifications.

The products are to be generated from LIDAR data meeting or exceeding the following requirements.

(1) Data shall be acquired using instrumentation that records first and last returns for each laser pulse, or multiple returns per laser pulse.

(2) Flight line swath overlap shall be configured so that, at a minimum, 95% of each project area is covered by two or more swaths, thus enabling an evaluation of data reproducibility throughout the areas; no more than 5% of the project area shall be mapped by single swath coverage. No part of the project areas is permitted to have no coverage.

(3) For planar, non-vegetated areas, the elevation reproducibility of closely-spaced laser return pairs from overlapping flight swaths shall be 20 cm RMSE or better,

(4) The density of laser pulse first returns, for the combined swaths, in the San Andreas and Belize project areas and subsections A and D of the Mount Rainier project area shall average at least one first return per square meter and be no worse than 0.4 first returns per square meter at the 95th percentile, exclusive of areas of open water.

(5) In subsections B and C of the Mount Rainier project area, where greater data density is required to better resolve geomorphic features, the density shall be doubled, averaging at least two first returns per square meter and be no worse than 0.8 first returns per square meter at the 95th percentile, exclusive of areas of open water.

B. Data Licensing

NASA desires an unrestricted data use license in which all data products delivered under the terms of this SOW shall become the exclusive property of NASA, and NASA will have the right to publicly distribute the products.

The minimum data rights acceptable to NASA are as follows:

- NASA will reserve the right to publicly distribute the delivered data.
- NASA will not commercially exploit property in which the U.S. Government holds a license.
- The contractor may retain the right to produce and sell value-added products derived from the data delivered to NASA.

C. Reference Systems and Precision

For the Rainier and San Andreas project areas, all deliverables are to conform to:

- **x,y horizontal location as easting and northing in United States Survey Feet referenced to the State Plane Coordinate System, NAD83, 1991 Adjustment and reported to the nearest 0.01 feet,**
- **elevation as Orthometric (NAVD-88) in feet derived using the National Geodetic Survey Geoid Model Geoid99 and reported to the nearest 0.01 feet,**

For the Belize project are, all deliverables are to conform to:

- **x,y horizontal location as latitude and longitude in degrees referenced to the WGS-84 ellipsoid and reported to the nearest 0.0000001 degree,**
- **elevation as meters referenced to the WGS-84 ellipsoid and reported to the nearest 0.001 meter.**

5.0 Deliverables:

1. Pre-Mission Plan for each of the three project areas minimally consisting of the anticipated operating conditions and maps showing the study area boundaries and planned flight path, provided no less than 7 days prior to the start of data acquisition for an area.
2. An Interface Control Document (ICD) and a sample data set shall be delivered not more than 60 days after start of the contract and updated as necessary which defines any media and format interface standards necessary to ensure hardware, software, and operational service compatibility for the transfer of data from vendor to NASA. Items such as media types, tape formats, file formats, file names, and metadata contents shall be defined for all products.

It is desired that the remaining items be delivered within 60 days following completion of data acquisition for each project area, but shall be delivered within 120 days following data acquisition.

3. Post-Mission Report for each of the three project areas minimally consisting of the actual operating conditions and flight lines of the mission and identification of any deviations from pre-flight mission plan.
4. LIDAR point cloud minimally consisting of the data elements defined in Table 1 for each detected laser return. The laser returns are to be classified per the scheme of Table 2. It is desired that returns from vegetation and buildings/structures be separately classified. If vegetation and building/structure returns cannot be reliably distinguished, then a classification of "not ground" should be assigned.
5. Aircraft flight trajectory minimally consisting of the data elements defined in Table 3 for each trajectory solution epoch.
6. For the Rainier and San Andreas project areas only, a "bald Earth" Digital Terrain Model (DTM), meeting or exceeding the specifications defined in Table 4.
7. For the Rainier and San Andreas project areas only, a "highest surface" Digital Surface Model (DSM), meeting or exceeding the specifications defined in Table 4.

8. Documentation describing instrument/system calibration methods, and calibration reports corresponding to the most recent calibration performed prior to each acquisition mission.
9. Documentation describing the procedures by which the point cloud data were classified and the digital terrain models and digital surface models were derived.

The specific products to be delivered for each of the three project areas are summarized in Table 5.

6.0 Quality Assurance

NASA will perform an independent quality assessment for the data products delivered to determine if technical specifications have been met. The quality assurance evaluation will include integrity checks of the files, conformance to file format requirements, and visual inspection of images calculated from the bald Earth DTM and highest surface DSM in order to identify defects. In addition, specific tests will be applied to determine if the technical specifications have been met, differentiating between non-vegetated and vegetated regions. Data density, data overlap, and reproducibility of the laser returns from overlapping flight swaths will be evaluated. Also, the absolute accuracy of the bald Earth DTM will be tested by comparison to independent ground control points (GCPs).

7.0 Surveillance Activities

The contract surveillance will take the following primary forms: (1) communications with the contractor including teleconferences, informal discussions, electronic mail, surveillance team meetings, technical interchange meetings, and other communications as needed; (2) independent product verification and characterization; (3) documentation and reporting.

8.0 Period of Performance

In order to optimize collection of returns from the ground, data acquisition in the Mount Rainier project area is to be completed after deciduous leaves have fallen and prior to significant accumulation of snow, during the period October 1 to November 15. Acquisition is strongly desired in 2002 but shall occur no later than October 1 to November 15, 2003. Coordination and approval of the acquisition window with the NASA Contracting Officer Technical Representative (COTR) is required in order to ensure leaf and snow conditions are appropriate. For the San Andreas project area, data acquisition is to be conducted during deciduous leaf-off conditions during the period December 1, 2002 to February 28, 2003. Data collection in the Belize project area is not restricted by vegetation conditions but is to be completed NLT April 30, 2003, prior to the onset of the rainy season in this region. Considering the above, the maximum period of performance for this data purchase is February 15, 2004.

Table 1: Individual laser return (point cloud) data product specifications

Specification	Description	Notes
Data Field 1: Date	Day or week of acquisition	
Data Field 2: Time	GPS time stamp uniquely identifying laser pulse time, reported to nearest microsecond.	Equivalent time stamp to that of the flight trajectory
Data Field 3: X location	Geographic location of return	RA,SA: US Survey Easting Feet, NAD83 (1991 adjustment) State Plane Coordinate system to nearest 0.01 ft. BZ: Longitude referenced to WGS-84 to nearest 0.1 microdegree (0.0000001 degree).
Data Field 4: Y location	Geographic location of return	RA,SA: US Survey Northing Feet, NAD83 (1991 adjustment) State Plane Coordinate system to nearest 0.01 ft. BZ: Latitude referenced to WGS-84 to nearest 0.1 microdegree (0.0000001 degree).
Data Field 5: Elevation	Elevation of return	RA,SA: Orthometric (NAVD-88) in feet to nearest 0.01 ft, using NGS Geoid Model Geoid99. BZ: Meters referenced to WGS-84 to nearest 0.001 m.
Data Field 6: Number of Returns	Number of returns for this pulse.	
Data Field 7: Return number	Return number of this return.	
Data Field 8: Off Nadir Angle	Angle between nadir and transmitted pulse, reported to nearest 0.01 degrees.	
Data Field 9: Return Intensity	Intensity of return pulse, if recorded by instrument	
Data Field 10: Classification Code	Classification of return	According to Table 2
Data Format:	ASCII fixed length, formatted files with one record per return, or a file structure proposed by the vendor and accepted by NASA	
File Content:	RA,SA: tiles corresponding to uniformly sized geographic areas; BZ: by flight line, or as RA,SA.	The tiling scheme shall be documented using a GIS polygon, or similar, coverage. Maximum uncompressed file size not to exceed 250 Mbytes.
Record Order:	Sequential sorted by time and return number	No duplicate records
Delivery Media:	DVD-ROM, IDE Hard Drive, or USB compatible drive.	

Table 2: Return Classification System

Code	Description	Notes
B	Blunder	an anomalous return above or below the point cloud
G	Ground or water	the "bald Earth" surface
V	Vegetation	
S	Building/Structure	
N	Not ground or water	Could be either vegetation or building/structure

Table 3: Aircraft flight trajectory data product specifications

Specification	Description	Notes
Data Field 1: Date	Day or week of acquisition	
Data Field 2: Time	GPS time stamp uniquely identifying solution epoch time, reported to nearest microsecond.	Equivalent time stamp to that of the point cloud data
Data Field 3: Sensor x location	geographic location of sub-sensor (nadir) point	RA,SA: US Survey Easting Feet, NAD83 (1991 adjustment) State Plane Coordinate system to nearest 0.01 ft. BZ: Longitude referenced to WGS-84 to nearest 0.1 microdegree (0.0000001 degree).
Data Field 4: Sensor y location	geographic location of sub-sensor (nadir) point	RA,SA: US Survey Northing Feet, NAD83 (1991 adjustment) State Plane Coordinate system to nearest 0.01 ft. BZ: Latitude referenced to WGS-84 to nearest 0.1 microdegree (0.0000001 degree).
Data Field 5: sensor altitude	Elevation of the sensor platform	RA,SA: Orthometric (NAVD-88) in feet to nearest 0.01 ft, using NGS Geoid Model Geoid99. BZ: Meters referenced to WGS-84 to nearest 0.001 meter.
Data Field 6: RMS error	RMS error of the platform position solution	
Delivery Media:	DVD-ROM, IDE Hard Drive, or USB compatible drive.	

Key: RA: Mount Rainer study area; SA: San Andreas study area; BZ: Belize study area.

Table 4: Digital Terrain Model and Digital Surface Model Product Specifications

Specification	Bald Earth Digital Terrain Model (DTM)	Highest Surface Digital Surface Model (DSM)
Instrument	LIDAR	LIDAR
Grid Post Spacing	6 feet	6 feet
Generation Method	Derived by linear interpolation of a triangulated irregular network (TIN) built from those laser returns classified as being from the ground or water, or alternate method proposed by the vendor and accepted by NASA	Grid cell elevation value corresponds to the highest non-blunder laser return contained within the grid cell (cells containing no laser returns shall be assigned a "no data" flag), or alternate method proposed by the vendor and accepted by NASA
x,y reference	Easting and northing in United States Survey Feet referenced to the State Plane Coordinate System, NAD83, 1991 Adjustment	Easting and northing in United States Survey Feet referenced to the State Plane Coordinate System, NAD83, 1991 Adjustment
x, y precision	0.01 feet	0.01 feet
Elevation reference	Orthometric (NAVD-88) in feet derived from ellipsoidal datum using the National Geodetic Survey Geoid Model Geoid99	Orthometric (NAVD-88) in feet derived from ellipsoidal datum using the National Geodetic Survey Geoid Model Geoid99
Elevation precision	0.01 feet	0.01 feet
Absolute Vertical Accuracy in Planar, Non-vegetated Areas	1 foot (95^{th} percentile)	1 foot (95^{th} percentile)
Absolute Vertical Accuracy in Planar, Vegetated Areas	3 feet (95^{th} percentile)	1 foot (95^{th} percentile)
Absolute Horizontal Accuracy	6 feet (95^{th} percentile)	6 feet (95^{th} percentile)
Metadata Format	Complies with 1998 FGDC Standard for Content and Format	Complies with 1998 FGDC Standard for Content and Format
Data Format	Georeferenced grids directly readable by ArcInfo: native ArcInfo grids, ArcInfo export (.e00) format, or BIL files	Georeferenced grids directly readable by ArcInfo: native ArcInfo grids, ArcInfo export (.e00) format, or BIL files
Delivered Media	DVD, IDE Hard Drive, or USB compatible drive	DVD, IDE Hard Drive, or USB compatible drive
Geographic Areas	Acquisition area shall be divided into geographic areas corresponding to standard USGS 7.5-minute quarter-quadrangles. No data gaps nor spurious values shall be present at quarter-quadrangle boundaries.	Acquisition area shall be divided into geographic areas corresponding to standard USGS 7.5-minute quarter-quadrangles. No data gaps nor spurious values shall be present at quarter-quadrangle boundaries.
Registration	Grid cell locations must correspond to those of the DSM. Cell easting and northing coordinates must be integer multiples of the cell size, so that adjacent quarter-quadrangles can be merged without resampling or pixel-shift.	Grid cell locations must correspond to those of the DTM. Cell easting and northing coordinates must be integer multiples of the cell size, so that adjacent quarter-quadrangles can be merged without resampling or pixel-shift.

Table 5: Product Delivery Matrix

Site	Point Cloud	Flight Trajectory	Plans and Reports	Bare Earth DTM	Highest Surface DSM
Mount Rainer	X	X	X	X	X
San Andreas	X	X	X	X	X
Belize	X	X	X		