APPENDIX H

SCOPE OF WORK
February 5, 2014
Contractor
Contract #
Hyperspectral Image Acquisition for Delineating Permafrost and Ground State Conditions

1. INTRODUCTION: In Arctic environments, infrastructure design, operation and maintenance requires an ability to detect the presence (or absence) of ground ice. Currently, there is no cost effective means of accurately surveying the subsurface for the presence of ground ice. The mean annual temperature in the interior of Alaska (Fairbanks) has increased by 2°C over the past 20 years and is expected to increase by an additional 5°C or more by the year 2100. Numerous locations within interior Alaska have already experienced thawing and permafrost degradation. This phenomenon, permafrost degradation, presents challenges in the planning of future DoD operations, specifically as they relate to transportation and building infrastructure. Permafrost degradation will also affect the interests of the nation in regards to major oil and gas developments, both near term exploration efforts and future long term transportation needs.

The overarching goal of this research project, comprised of three major tasks, is to use air and land based geophysical, spectral, and other to delineate permafrost geomorphology. The ultimate goal is to determine whether the variety of measurements and methods can be synthesized into a tool that identifies surface patterns indicative of subsurface permafrost conditions.

Hyperspectral imagery has proven to be an excellent data source for accurately mapping terrain characteristics including: vegetation species distribution, foliar chemistry, plant stress indices and soil properties. Specifically, high spatial resolution hyperspectral imagery covering the Visible to Short Wave InfraRed will be leveraged to assess changes in vegetation and soil states at the landscape scale. US Army ERDC will use multiple field and image analysis techniques to accurately map the vegetation and soil characteristics within the collected imagery.

2. OBJECTIVE and PROJECT AREA: The objective is to provide very high quality full-range airborne hyperspectral image acquisition and post-processing services over study areas around Fairbanks, Alaska. The project area consists of approximately Six (6) square mile split over two separate polygon areas plus a single swath width flightline approximately 16.8 miles long. Graphic of collection areas is in Attachment A.

3. MAJOR REQUIREMENTS: In order to accomplish work under this purchase order, it shall be necessary for the Contractor to complete the following tasks:

a. **Task 1 -** Flight Plan Development: Develop a flight mission plan to cover the study sites as

shown in Attachment A. All imagery shall be acquired using a suitable airborne full-range hyperspectral imaging system. Specific instrument and mission parameters include:

(1) Spatial resolution = 1.0 meters GSD,

(2) Spectral resolution = 10 nanometer band spacing, full-range hyperspectral imaging to include the continuous wavelength region of approximately 400 to 2500 nanometers,

(3) Radiometric resolution = shall be determined by the hyperspectral imaging device(s), and

(4) Data acquisition temporal window = **14 July to 25 July 2014.**

The selected contractor shall provide specifications of the proposed hyperspectral imaging system in accordance with the parameters list above. The detailed flight mission plan shall include a target flight line map and an estimate of the total time required to successfully image the study site.

b. **Task 2 -** Flight Plan Implementation: Implement the flight plan to successfully acquire the hyperspectral imagery during cloud free conditions over the study sites.

ESRI shape file of acquisition limits provided by the Government.

Units and Projections: Horizontal WGS 84, UTM Zone 6N
and Vertical NAVD88, Geoid 09, Units are Meters

Specific image quality standards are defined as:

(1) All images will be in focus using a vertical (i.e., nadir) nominal view angle,

(2) All images will be acquired using sensor settings to maximize the dynamic range of the digital numbers and minimize pixel saturation,

(3) The flightline-to-flightline sidelap shall be adequate to ensure no holidays, or gaps, in the data, with minimum overlaps between flight lines.

(4) All images will be as free from clouds and cloud-shadows as possible. The contractor shall not collect images with > = 5% cloud cover.

c. **Task 3 -** Post-Processing: The contractor shall perform the following post-processing steps.

(1) Orthorectify the image pixel using digital terrain model data created from the USACE LIDAR collection. USACE will provide the digital terrain model data to the Contractor.

(2) Radiometric calibration to include both radiance images and reflectance calibration data.

(3) Develop high-quality hyperspectral reflectance flightlines of the study site.

d. **Task 4** - Data and Report Delivery: The contractor shall provide all digital hyperspectral imagery, as individual flightlines within 30 days of successful image acquisition. These data shall be in an ENVI 5.0-compatible image format. A comprehensive collection report containing a project overview, technical specification parameters, flight planning criteria, data processing methods, and metadata report shall accompany the final hyperspectral images. A section containing geo-referencing accuracies shall be included that details the positioning and horizontal accuracy obtained.

4. POINTS OF CONTACT (POCs):

Contact Names, Shipping Addresses, e-mail, phone #

No Government personnel, other than the Contracting Officer, will have the authority to do other than clarify technical points or supply relevant information. Specifically, no requirement in these specifications may be altered as a sole result of such verbal clarification.

5. MEETINGS/REVIEWS: None.

6. TRAVEL: It is anticipated that multiple trips for one (1) flight crew for image acquisition is required of the Contractor. The Contractor is responsible for all travel and accommodations, including aircraft mobilization fees

7. REPORTS/DELIVERABLES: The contractor shall deliver a copy of all data and reports to the ERDC-CRREL POC, ERDC-TEC POC and the St. Louis District POC:

a. Digital hyperspectal imagery shall be due no later than **30 days** upon completion of data collection and all required post-processing steps. The imagery shall be transferred on an external hard drive. Specifically the delivered information shall include:

(1) A complete set of reflectance calibrated flightlines in an ENVI 5.0 -compatible file format,

(2) One (1) digital, Microsoft Word (.doc) or adobe PDF (.pdf) format, document containing all associated metafiles acquired by the aircraft at the time of data acquisition.

b. One (1) digital index or schematic (ESRI shapefile (.shp) format) that documents the location and organization of individual flightlines.

c. One (1) digital, Microsoft Word (.doc) or adobe PDF (.pdf) format file containing a comprehensive list of the delivered digital files and a description of the naming convention.

d. One (1) digital copy of a brief, but detailed, acquisition report, including: Nominal aircraft parameters (altitude, heading, airspeed, general flying conditions), description of atmospheric conditions during data acquisition, imaging system parameters, number of flightlines, and a description/evaluation of the post-processing. Report shall be provided in a Microsoft Word (.doc) or a PDF file (.pdf).

8. PERIOD OF PERFORMANCE: All work to be accomplished under this purchase order shall be completed by **25 August 2014**.

9. Reference Contract Clause: 52.243-1 Changes-Fixed Price (August 1987) Alternate III (1984): Only the Contracting Officer has authority to change the contract or issue a task order. No price or completion date changes can be made without approval from the Contracting Officer in advance of commencing work. The Contractor shall not accept directions from any Government employee or otherwise, other than the Contracting Officer, that would involve a change to the contract cost or final completion date.

10. Time Extension

In the event these schedules are exceeded due to causes beyond the control and without fault or negligence of the contractor, as determined by the Contracting Officer, this delivery order completion date will be extended one (1) calendar day for each day of delay.
Requests for time extensions for an individual task order should be forwarded to the Contracting Officer no later than fourteen (14) days preceding the completion date shown on the task order.

11. Shipment

Shipments shall be made to:

Contact Names, Shipping Addresses, e-mail, phone #

12. Inspection

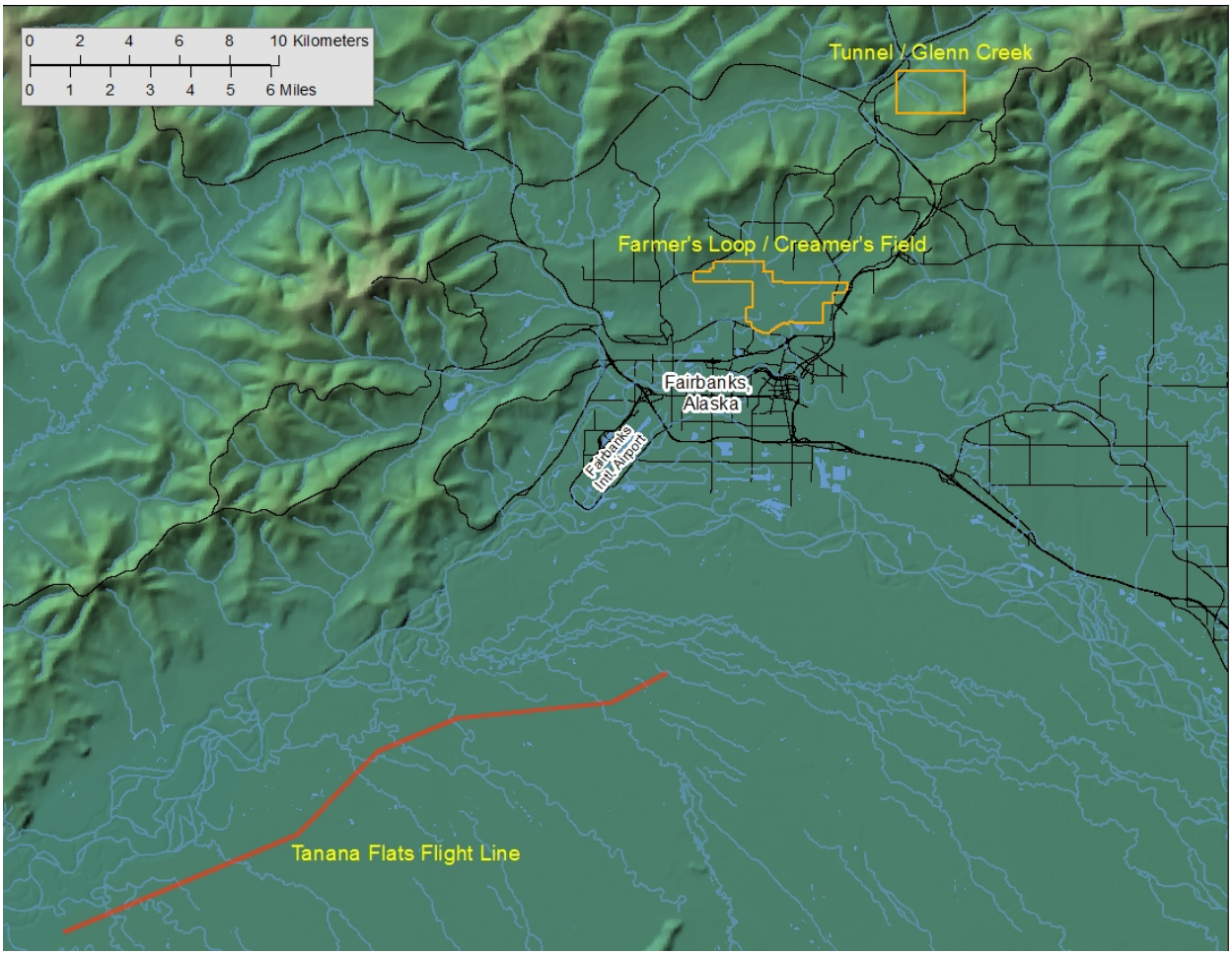
Inspection of the data deliverables including accuracy and quality assurance will be performed by ERDC-CRREL and USACE St. Louis. If the inspection reveals deficiencies or defects the data or issues will be required to be resolved at no additional cost to the USACE. Initial inspections do not relieve the A-E from the responsibility to correct defective work with no further cost to USACE. If the finished items are found to be in full compliance with the specifications, they will be accepted. The acceptance of any item by an inspector shall not preclude subsequent rejection if

such an item is later found to be defective. Inspection of the finished items to determine their conformance to the specifications will be made by a representative of the Contracting Officer upon delivery to the destination. If the inspection reveals any defect or deviation in the manufacture of the items which would make them unfit for the purpose intended, the Contractor will be required to satisfactorily remedy such conditions at no additional cost to the St. Louis District, USACE.

13. Government Pricing Analysis

Attachment B shows the format for the Government's pricing analysis for this SOW. The contractor will submit a cost proposal in this format which the Government will compare with its independent cost estimate. Government independent cost estimates, when completed, are confidential, for Government use only.

ATTACHMENT "A"



HSI Collection Areas: Farmer's Loop/ Creamers Field, Tunnel/Glen Creek and Tanana Flats Flightlines

Attachment B – Form used for Contractor and Government Cost Estimates

CRREL-NH Alaska Sites (6 square miles, 16.8 linear miles area)
Contractor
Contract #
Task Order #

DIRECT LABOR	HOURS	HOURLY RATE	LABORCOST
Project Manager	____	$____.__	$_____.__
Quality Manager	____	$____.__	$_____.__
Supervisory Photogrammetrist	____	$____.__	$_____.__
Photogrammetric Technician (AT Tech)	____	$____.__	$_____.__
Aerial Photography Pilot	____	$____.__	$_____.__
Aerial Photographer	____	$____.__	$_____.__
Airborne GPS Ground Engineer	____	$____.__	$_____.__
Orthophoto Technician	____	$____.__	$_____.__
GIS Supervisor	____	$____.__	$_____.__
Subtotal--Direct Labor	**Use hourly contract rates**		**$_____A_.__**
Overhead on Direct Labor and General and Admin. (G&A) Overhead Combined	___% **Use contract OH, G&A**		**$_____B_.__**

OTHER DIRECT COST	UNIT	UNIT RATE	ODC COST
Aircraft (twin engine turbine) w/Analog Camera and GPS/hr	___	$_____.__	$_____.__
SpecTir Hyperspectral Sensor/day	___	$_____.__	$_____.__
USB External Hard Drives/each	___	$_____.__	$_____.__
Shipping Equipment/each	___	$_____.__	$_____.__
Airfare / Operator/each	___	$_____.__	$_____.__
Travel/Per Diem/day, Vehicle Mileage Fairbanks	___	$_____.__	$_____.__
Rental Car/ Survey Vehicle/day	___	$_____.__	$_____.__
Subtotal--Direct Costs	**Use unit contract rates**		**$_____C__.__**
Subtotal--DL, OH & Direct Costs			$A + $B + $C
Profit (negotiated for individual task orders)		**___%**	**$_____D__.__**
(SUBCONTRACT) Aerial Acquisition (if not performed by prime contractor)			**$_____E__.__**
(SUBCONTRACT) Ground Control (if not performed by prime contractor)			**$_____F__.__**
PROJECT GRAND TOTAL			**$A + $B + $C + $D + $E + $F**

Prepared By: _____ Date: _____

Reviewed By: _____ Date: _____

Approved By: _____ Date: _____

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