PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM
TECHNICAL SPECIFICATIONS

SUBJECT: Annual LiDAR and Aerial Photography

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I. OVERVIEW

The Platte River Recovery Implementation Program (**Program**) was initiated on January 1, 2007 between Nebraska, Wyoming, and Colorado and the Department of the Interior to address endangered species issues in the central and lower Platte River basin. The species considered in the Program, referred to as "target species", are the whooping crane, piping plover, interior least tern, and pallid sturgeon.

A Governance Committee (**GC**) has been established that reviews, directs, and provides oversight for activities undertaken during the Program. The GC is comprised of one representative from each of the three states, three water user representatives, two representatives from environmental groups, and two members representing federal agencies. The GC named Dr. Jerry Kenny to serve as the Program Executive Director (**ED**). Dr. Kenny established Headwaters Corporation as the staffing mechanism for Program. Program staff are located in Nebraska and Colorado and are responsible for assisting in carrying out the various Program-related activities.

Annual aerial photography is a requirement of the Program's Adaptive Management Plan and an integral part of several research and monitoring protocols. This annual aerial photography is typically acquired in June when piping plovers and interior least terns are nesting.

The Program acquired LiDAR for the central Platte River in the spring of 2009 as a part of baseline data collection. In the fall of 2010, the Program again acquired LiDAR over a portion of the original acquisition in order to assess change within the river banks. The Program will acquire LiDAR over this area annually to document change in channel characteristics and to assist in habitat availability evaluations for target species. Additional aerial photography that accompanies the LiDAR acquisition will assist in, and add value to the evaluation.

II. PROJECT DESCRIPTION

Annual color-infrared (**CIR**) orthophotography will be used to help document habitat conditions for Program target species. In addition, it can be used to document summertime vegetation characteristics throughout the system, on Program lands, and within managed areas. For example, bare sand substrates will be identified that may be potential least tern and piping plover nesting habitat, and major management changes can be tracked, such as tree clearing or cropland

changes. Changes in available tern/plover nesting habitat will be tracked throughout the First Increment. Information gained from aerial photography will also be used in conjunction with measurements taken at specific sites on the ground that relate to vegetation establishment on sandbars, height of sandbars, etc. CIR photos will be used to estimate the land use/land cover types present (e.g., amount of grassland, forest, etc). This CIR photography will also be used for channel morphology measurements. The photos will be used to help measure parameters such as channel width, bank position, island position and stability, hydraulic geometry characteristics of width, and track changes associated with management techniques. Photos will be taken on an annual basis between late May and late June with flows at or near 1,200 cfs (i.e., Program target flow levels during this time of year). Aerial photography will be acquired in color-infrared at a two-foot digital resolution. The contractor will work with Program staff during the acquisition window to schedule flights in accordance with these requirements.

Acquiring LiDAR within the river channel every year allows the Program to evaluate the effects of annual flow conditions on channel morphology. These analyses will affect how the Program uses its limited water resources to manage habitat. CIR orthophotography will be acquired in combination with the LiDAR acquisition. This photography will be used as a tool to further assess both the quality and accuracy of the LiDAR, and as an additional data set for evaluating geomorphic change. Since the LiDAR and this additional photography acquisition will take place under low-flow conditions, this photography will also provide a picture of the Platte River under different conditions than the Program's annual spring aerial photography acquisition. CIR photography acquired in combination with the LiDAR also provides a way to examine land cover types and condition for use in modeling efforts. Aerial photography will be acquired in color-infrared at a two-foot (or better) digital resolution, and will be acquired concurrently with the LiDAR. Contractor will work with Program staff during the acquisition window to schedule flights in accordance with these requirements.

III. SCOPE OF WORK

Minimum LiDAR and digital aerial imagery technical specifications follow:

1) **Schedule**

a) Sub-Project 1 - November/December concurrent LiDAR and Aerial photography.

i) LiDAR and imagery will be acquired each year in November/December from 2011 through 2014 under leaf-off and low Platte River flow conditions. Contractor must be flexible and work with Program staff during that time to schedule flights such that river flows in the project area are as low as possible (ideally under 1,000 cfs).

ii) Imagery will be acquired on cloud-free days with the sun at a sufficient angle to reduce the effect of shadows from trees and structures and efforts should be made to reduce sun glare on water surfaces.

iii) Imagery will be acquired in combination with LiDAR such that the imagery reflects the condition of the river during the LiDAR acquisition. River conditions can change daily, and imagery must be flown at least the same day, if not at the exact same time as the LiDAR.

iv) The acquisition area must be free of snow and ice, and extraneous environmental conditions such as rain, fog or smoke should be avoided.
v) Final delivery of product will be within 60 days of final acquisition flight each year.

b) Sub-Project 2 - May/June Aerial photography.
i) Imagery will be acquired each year between May 15 and June 30. Contractor must be flexible and work with Program staff during that time to schedule flights such that river flows in the project area are as close to 1,200 cfs as possible.
ii) Imagery will be acquired on cloud-free days with the sun at a sufficient angle to reduce the effect of shadows from trees and structures and efforts should be made to reduce sun glare on water surfaces.
iii) Final delivery of product will be within 30 days of final acquisition flight each year.

2) Project Area

a) The area of interest for Sub-Project 1 consists of an area generally between the high banks of the Platte River beginning near the junction of U.S. Highway 283 and Interstate 80 near Lexington, Nebraska, and extending eastward to near Chapman, Nebraska (approximately 127 square miles). A polygon shapefile of the acquisition area is included on the Program website (www.platteriverprogram.org) in the same location as this solicitation.
b) The area of interest for Sub-Project 2 consists of an area 3.5 miles either side of the centerline of the Platte River beginning at the junction of U.S. Highway 283 and Interstate 80 near Lexington, Nebraska, and extending eastward to Chapman, Nebraska (approximately 750 square miles). A polygon shapefile of the acquisition area is included on the Program website (www.platteriverprogram.org) in the same location as this solicitation.

3) Sub-Project 1 Technical Specifications

a) LiDAR Technical Specifications
i) The LiDAR data will be collected at a mean resolution of 2.3 ft (0.7 m) GSD or better.
ii) The contractor shall ensure that the area of interest is fully and sufficiently covered with no data voids due to gaps between flightlines or system malfunction.
iii) Data voids in the bare-earth not caused by classification of geographic features shall not exceed three times the point spacing. Data voids of this size are sufficient reason to reject the dataset.
iv) LiDAR data should be classified using the following ASPRS Standard LiDAR Point Classes:
- Class 1 – Unclassified
- Class 2 – Ground
- Class 7 – Low point and noise

- Class 9 – Water
- Class 12 – Overlap

(1) Class 1 will be used for feature points that are not in Classes 2, 7, 9, or 12. These typically represent returns from man-made structures, vegetation etc.
(2) Class 2 will be used for feature points that represent the bare-earth.
(3) Class 7 will be used for artifacts that do not represent the ground, manmade structures or vegetation. Typically these are extraneous points that are either below, or well above the surface not representing any true feature.
(4) Class 9 will be used to identify points found within water bodies, including streams and rivers.
(5) Class 12 will be used for LiDAR points in the overlap portion of flight lines that have been removed due to redundancy (if necessary).
(6) No points shall be deleted from the LAS files.

v) Bare-earth classification shall adhere to the following specifications using both automated and manual filtering classification routines:

- 90% of artifacts classified
- 95% of outliers classified
- 95% of vegetation classified
- 98% of building classified

vi) Special attention must be applied to the classification process due to the geographic nature of the project area which consists of extremely flat terrain mixed with important hydrographic characteristics. Channel geometry of streams and drainage features must be maintained as well as the ability to identify sand bar features within the Platte River. Dense vegetation data voids must also be minimized by the automatic removal process and "over smoothing" due to aggressive classification must be avoided.

vii) Vertical accuracy for LiDAR will meet or exceed 3.6 in (9.2 cm) RMSE ($Accuracy_z$ = 7.1 in (0.18 m) at the 95% confidence level).

viii) Horizontal accuracy for LiDAR will meet or exceed 1.97 ft (0.6 m) RMSE ($Accuracy_r$ = 3.41 ft (1.04 m) at the 95% confidence level).

ix) The vertical datum for LiDAR is NAVD88 (Geoid03), and the horizontal datum is Nebraska State Plane (1983). Elevation and projection in feet.

b) Aerial Photography Technical Specifications

i) The imagery will be two-foot (0.61m) pixel resolution or better.
ii) The imagery will be color-infrared.
iii) The imagery will be ortho-rectified and seamless, and will be tone-balanced with adjacent images across the project area.
iv) Imagery will be acquired on cloud-free days with the sun at a sufficient angle to reduce the effect of shadows from trees and structures and efforts should be made to reduce sun glare on water surfaces.
v) The imagery will be projected in Nebraska State Plane Feet (1983 datum).

vi) The imagery must be acquired concurrently with the LiDAR so as to reflect river conditions during acquisition. The imagery must be collected at least the same day, if not at the exact same time, as the LiDAR.

4) **Sub-Project 2 Technical Specifications**

a) Aerial Photography Technical Specifications
   i) The imagery will be two-foot (0.61m) pixel resolution or better.
   ii) The imagery will be color-infrared.
   iii) The imagery will be ortho-rectified and seamless, and will be tone-balanced with adjacent images across the project area.
   iv) Imagery will be acquired on cloud-free days with the sun at a sufficient angle to reduce the effect of shadows from trees and structures and efforts should be made to reduce sun glare on water surfaces.
   v) The imagery will be projected in Nebraska State Plane Feet (1983 datum).

5) **Project Deliverables**

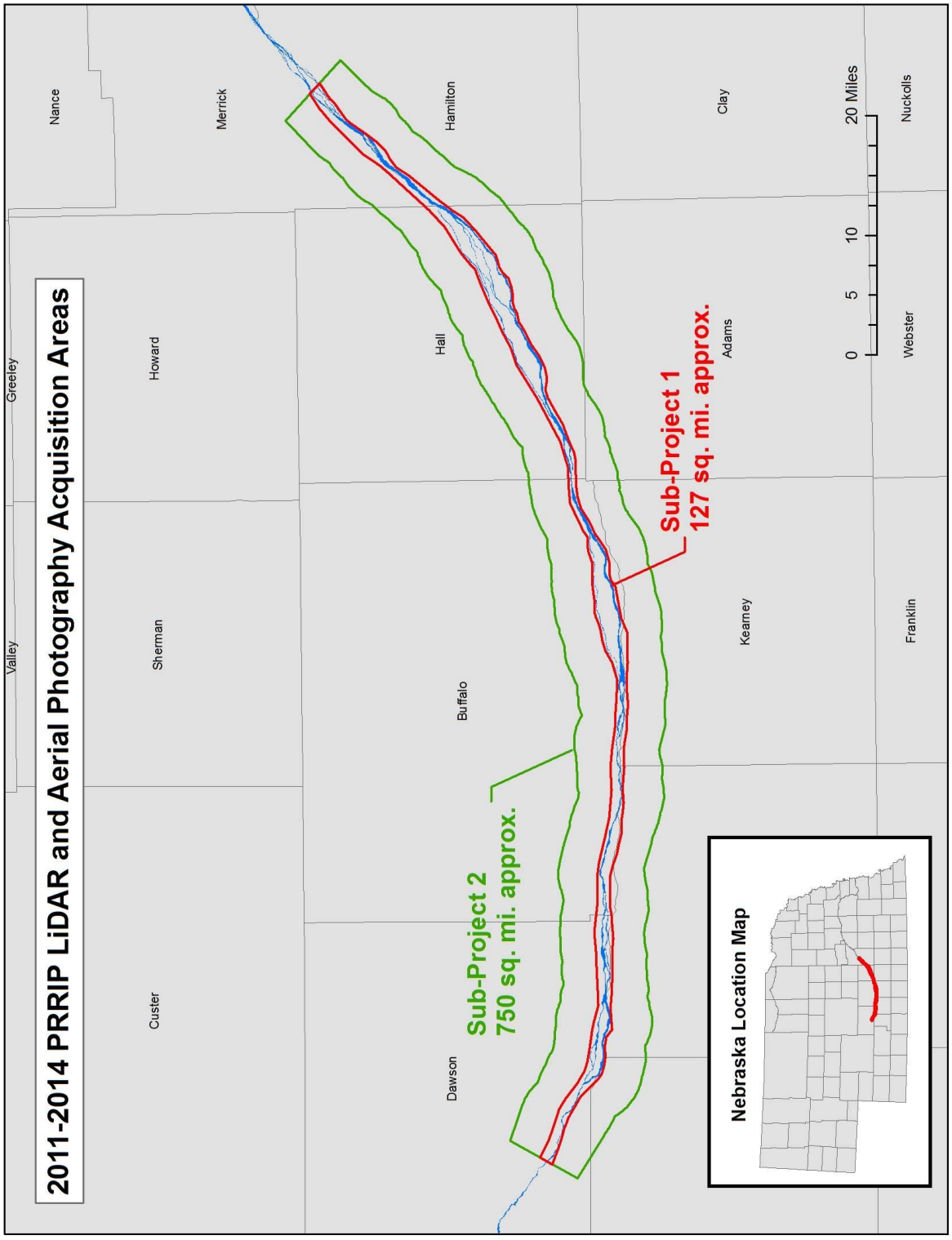
a) LiDAR
   i) LiDAR point data meeting or exceeding 2.3 ft (0.7 m) GSD resolution in a classified LAS file format and adhering to the technical specifications in 3) above. LAS file projected to Nebraska State Plane Feet (1983 datum) and vertical reference NAVD88 feet. Classified LAS file will include all LiDAR points, including first and last returns.
   ii) Daily reports during acquisition that display all flight lines, as well as completed areas. Once acquisition is complete, a project summary report that shows time and date of all flightline acquisitions. Time of day, not just the day, is important to match river flow condition to acquisition.
   iii) Tiling scheme will be provided to contractor. Tiles are 2,500 meters x 2,500 meters and will match existing Program LiDAR tiles.
   iv) Bare-earth digital elevation model raster (3-foot cell size) of project area, projected in Nebraska State Plane coordinate system – elevation and projection in feet.

b) Imagery
   i) Color-infrared digital orthophotography with a two-foot pixel resolution (or better), covering the entire project area seamlessly and without data gaps.
   ii) The imagery should be geo-referenced and provided in GeoTIFF (.tif) format.
   iii) Shapefiles displaying photocenters and flight dates and times for image acquisitions. Time of day, not just the day, is important to match river flow condition to acquisition.
   iv) Compressed imagery mosaic (.sid). Typically entire reach compiled into one mosaic, but may be split due to file size.

c) LiDAR and Imagery
   i) FGDC-compliant metadata to include, but not limited to: flight dates and times, flight altitude, camera system information, LiDAR system information, aircraft information, imagery resolution, LiDAR point density, horizontal accuracy, post-processing software and steps, and horizontal and vertical control references.
   ii) All LiDAR data, photography, and supplemental products will be delivered on USB external hard drives and will become the property of the Program. All media and data collected under the contract shall be the sole property of and can be freely distributed by the Program. No restrictions shall be placed on the data by the contractor.

6) **Permits and Clearances**

a) It is the contractor's responsibility to file all required flight plans and obtain all necessary approvals to fly over and acquire aerial imagery and LiDAR in the project area**.**


2011-2014 PRRIP LiDAR and Aerial Photography Acquisition Areas
Sub-Project 1
127 sq. mi. approx.
Sub-Project 2
750 sq. mi. approx.
Nebraska Location Map
20 Miles
0 5 10
Nance
Merrick
Hamilton
Clay
Nuckolls
Greeley
Howard
Hall
Adams
Webster
Valley
Sherman
Buffalo
Kearney
Franklin
Custer
Dawson