PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM
REQUEST FOR PROPOSALS

SUBJECT: 2020-2023 Annual LiDAR and Aerial Photography
PROJECT NUMBER: P20-005
REQUEST DATE: March 16, 2020
CLOSING DATE: April 17, 2020
POINT OF CONTACT: Justin Brei
Headwaters Corporation
4111 4th Ave, Suite 6
Kearney, NE 68845
(308) 237-5728 Ext. 4
breij@headwaterscorp.com

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. Headwaters Corporation serves as the Executive Director's Office of the Program. Program staff are located in Nebraska and Colorado and are responsible for assisting in carrying out the various Program-related activities.

Aerial photography has been collected annually by the Program since 2007. Annual LiDAR collection began in 2009. These data are integral to several of the Program's research and monitoring efforts and are our principle tools for assessing physical changes in river habitat through time.

The GC submits this Request for Proposals (**RFP**) to solicit proposals from contractors to acquire bathymetric LiDAR and aerial photography during the period of 2020 - 2023.

II. PROJECT DESCRIPTION

This scope of work set forth in this RFP includes four summer Program area aerial photography flights with a partial bathymetric LiDAR coverage and four fall/winter bathymetric LiDAR and Aerial photography flights that cover the entire 90-mile reach. Further background information on how the Program uses the data acquired through this RFP is available in an excerpt from the Program's Remote Geomorphology and Vegetation Monitoring Protocol located in Appendix A.

This RFP describes a multi-year program of work encompassing acquisition of aerial imagery and LiDAR in 2020 through 2023 according to the following schedule:

- **June 2020: Full Program area aerial photography and partial area bathymetric LiDAR**
- **November 2020: Bathymetric LiDAR and concurrent aerial photography**
- **June 2021: Full Program area aerial photography and partial area bathymetric LiDAR**
- **November 2021: Bathymetric LiDAR and concurrent aerial photography**
- **June 2022: Full Program area aerial photography and partial area bathymetric LiDAR**
- **November 2022: Bathymetric LiDAR and concurrent aerial photography**
- **June 2023: Full Program area aerial photography and partial area bathymetric LiDAR**
- **November 2023: Bathymetric LiDAR and concurrent aerial photography**

III. SCOPE OF WORK

The Program is requesting proposals from potential bidders to provide bathymetric LiDAR and digital aerial imagery of the project area as described below. Minimum product specifications follow:

1) **Schedule**

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

i) LiDAR and imagery will be acquired each year between November 1 and December 15 under leaf-off and low Platte River flow conditions beginning in November 2020. Bidder 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 Central Platte River is subject to artificial hydrocycling from hydropower operations, and close coordination and care in timing is required to acquire products acceptable to the Program.

v) The acquisition area must be free of snow and ice, and extraneous environmental conditions such as rain, fog or smoke should be avoided.

vi) **Final delivery of Sub-Project 1 aerial imagery deliverables will be within 60 days of final acquisition flight each year.**

vii) **Final delivery of all other Sub-Project 1 deliverables will be within 120 days of final acquisition flight each year.**

b) Sub-Project 2 - June Aerial photography.
   i) Imagery will be acquired each year between May 15 and June 30 beginning in May 2020. Bidder 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) The Central Platte River is subject to artificial hydrocycling from hydropower operations, and close coordination and care in timing is required to acquire products acceptable to the Program.
   iii) 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.
   iv) **Final delivery of Sub-Project 2 deliverables will be within 60 days of final acquisition flight each year.**

c) Sub-Project 2A – June bathymetric LiDAR
   i) LiDAR will be acquired each year between May 15 and June 30 in combination with the Sub-Project 2 imagery acquisition.
   ii) LiDAR will be acquired in combination with imagery 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 over the Sub-Project 2A area.
   iii) **Final delivery of Sub-Project 2A deliverables will be within 90 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 128 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.
c) The area of interest for Sub-Project 2A consists of an area generally between the high banks of the Platte River beginning near the J-2 Hydropower Return southeast of Lexington, NE and extending eastward to the Highway 183 bridge near Elm Creek, NE

(approximately 26 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**
CIR aerial photography and bathymetric LiDAR over approximately 128 sq. mi.

a) LiDAR Technical Specifications
i) Topo-bathymetric LiDAR (green LiDAR) is required.
ii) The LiDAR data will be collected at a mean resolution of 2.3 ft (0.7 m) GSD or better.
iii) 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.
iv) 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.
v) 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.

vi) 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

vii) 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.

viii) Vertical accuracy for LiDAR will meet or exceed 0.3 ft (9.2 cm) RMSE ($Accuracy_z$ = 0.6 ft (0.18 m) at the 95% confidence level).

ix) 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).

x) 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 six-inch (0.5 ft) pixel resolution.

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. Imagery acquired at flows significantly different than that of the LiDAR acquisition may require reflight.

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

Four-band aerial photography over approximately 750 sq. mi. LiDAR over approximately 26 sq. mi.

a) Aerial Photography Technical Specifications

i) The imagery will be six-inch (0.5 ft) pixel resolution.

ii) The imagery will be 4-band (R, G, B, NIR).

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) Deliverables will include both RGB and CIR products described in Section III.6.

b) LiDAR Technical Specifications

i) Same as Sub-Project 1 LiDAR Specifications in Section III.3.a above.

5) **Project Deliverables**

All project deliverables should be processed and delivered according to the schedule in Section III.1.

a) LiDAR (terrestrial and bathymetric)
   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 III.3 above. LAS file projected to Nebraska State Plane Feet (1983 datum) and vertical reference NAVD88 feet (Geoid 03). 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 shapefile for identifying LAS and DEM file locations. Tile size and file size is flexible and will be discussed upon award of project.

b) Digital Elevation Model
   i) Hydro-enforced and bathymetric bare-earth digital elevation model raster tiles (3-foot cell size), projected in Nebraska State Plane coordinate system – elevation and projection in feet.
      (1) See pages 11-13, 15, and Appendix 2 of the USGS LiDAR Guidelines and Base Specifications v13 for details on hydro-flattening: http://pubs.usgs.gov/tm/11b4/. In the proposal, provide details of the software/methodology to be used for this alternative.
      (2) Breaklines used in the generation of the hydro-enforced DEM are also a required deliverable.
   ii) Highest-hit (first return) digital elevation model raster (3-foot cell size). Used to approximate vegetation height.
   iii) Full project area mosaic of digital elevation model tiles (3-foot cell size).
   iv) NOTE: For Bathymetric LiDAR acquisition, two versions of the DEM will be required. One hydro-enforced DEM for the given flow conditions during the flight, and one DEM that incorporates bathymetry below the water surfaces.

c) Imagery
   i) Color-infrared (Sub-Project 1) and 4-band (Sub-Project 2) digital orthophotography with a six-inch (0.5 ft) pixel resolution (or better), covering the entire project area seamlessly and without data gaps.
   ii) The imagery should be geo-referenced and provided in tiled GeoTIFF (.tif) format.
   iii) Compressed imagery mosaic (.sid). Typically entire reach compiled into one mosaic, but may be split due to file size. Sub-Project 2 will require both a RGB mosaic and a CIR mosaic. Sub-Project 1 will be a CIR mosaic only.

d) LiDAR and Imagery
   i) Shapefiles of LiDAR and aerial photography flight lines or photo centers that identify the date and time of the flight line or photo center.
   ii) 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.
   iii) All LiDAR data, photography, and supplemental products will be delivered on USB external hard drives or flash 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.

e) Ground Survey
   i) Proposals should discuss the ground control and survey approach for ensuring accuracy of elevation and imagery deliverables.
   ii) The Program owns several thousand acres of land across the entire acquisition area and can provide access to multiple river survey areas for bathymetric LiDAR ground survey verification.
   iii) Year-to-year compatibility of the deliverables is extremely important and post-processing and ground survey should ensure that datasets are comparable year to year (i.e. immobile objects such as paved roads should not report differing elevations across years).

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**.**

IV. CONTRACT TERMS

The selected contractor will be retained by:

Nebraska Community Foundation
PO Box 83107
Lincoln, NE 68501

Terms and conditions will be negotiated as mutually agreeable. It is understood that the Governance Committee reserves the right to accept any proposal that, in its judgment, is the best proposal, and to waive any irregularities in any proposal.

Proposal costs incurred in response to this RFP will be the responsibility of the bidder. Neither the Nebraska Community Foundation nor the Governance Committee will be liable for any costs incurred by the bidder in the completion and submission of the proposal.

V. SUBMISSION REQUIREMENTS

All interested parties having experience providing the services listed in this RFP are requested to submit a proposal.

Instructions for Submitting Proposals

One electronic copy of your proposal must be submitted in PDF format to Justin Brei at breij@headwaterscorp.com no later than 5:00 p.m. Central Time on Friday, April 17, 2020. Maximum allowable PDF size is 8MB. A proposal is late if received any time after 5:00 p.m. Central Time and will not be eligible for consideration.

Questions regarding the information contained in this RFP must be SUBMITTED IN WRITING by 5:00 p.m. Wednesday, April 8, 2020. No questions on content can be submitted after this time. Questions and answers will be shared with all interested parties. These can be emailed to Justin Brei at *breij@headwaterscorp.com* or mailed to the address at the top of this RFP. Questions can be submitted any time before the above time and answers may be posted intermittently to the Program website during the proposal period. Final questions and answers will be made available on the Program website in the location of this RFP by Thursday, April 9, 2020.

Proposal Content

Proposals must include:

1) **Technical information including:**
   a. Aircraft/LiDAR/camera system details
   b. Ground control/verification methodology/plan
   c. Post-processing software and summary of methodology
   d. Design accuracy information

2) **Relevant LiDAR and aerial photography experience** from the last two years, especially projects related to natural resources and river geomorphology. Example projects should demonstrate experience with bathymetric LiDAR. Please provide a minimum of two project references including the name, location, and brief summary of the projects; name, address, and phone number of the contracting officer for the client; and when the project was completed.

3) **Statement of annual availability** within the acquisition window of November 1 to December 15 for Sub-Project 1 and May 15 to June 30 for Sub-Project 2.

4) **Estimated timeline** for activities including mobilization, acquisition and processing. Also, specify the estimated flight time necessary to complete each acquisition over entire project area (for planning purposes related to river operations in order to achieve lowest possible flow).

5) **Detailed firm fixed price proposal**. At minimum, project budget should itemize Sub-Project 1 and Sub-Project 2 on an annual basis and include estimate of any applicable taxes. **Budget will be considered, but contract will not be awarded solely on a lowest cost basis.** Governance Committee approval is needed before the contractor is authorized to begin implementation. A sample budget table is included for reference. A similar table should be included in the proposal.

	June 2020 SP2	June 2020 SP2a	November 2020 SP1	June 2021 SP2	June 2021 SP2a	November 2021 SP1
Total Cost by Acquisition						

	June 2022 SP2	June 2022 SP2a	November 2022 SP1	June 2023 SP2	June 2023 SP2a	November 2023 SP1
Total Cost by Acquisition						

Total Project Cost

6) **Conflict of interest statement** addressing whether or not any potential conflict of interest exists between this project and other past or on-going projects, including any projects currently being conducted for the Program.

7) **Description of insurance** shall be provided with the proposal. Proof of insurance will be required before a contract is issued. Minimum insurance requirements will include $1,000,000 general liability per occurrence.

VI. CONTRACTOR SELECTION

The GC will appoint a selection committee to review responses to this RFP. Proposals will be reviewed and the award made to the lowest cost proposal that conforms to the specifications of this solicitation and is considered to provide the most value to the Program.

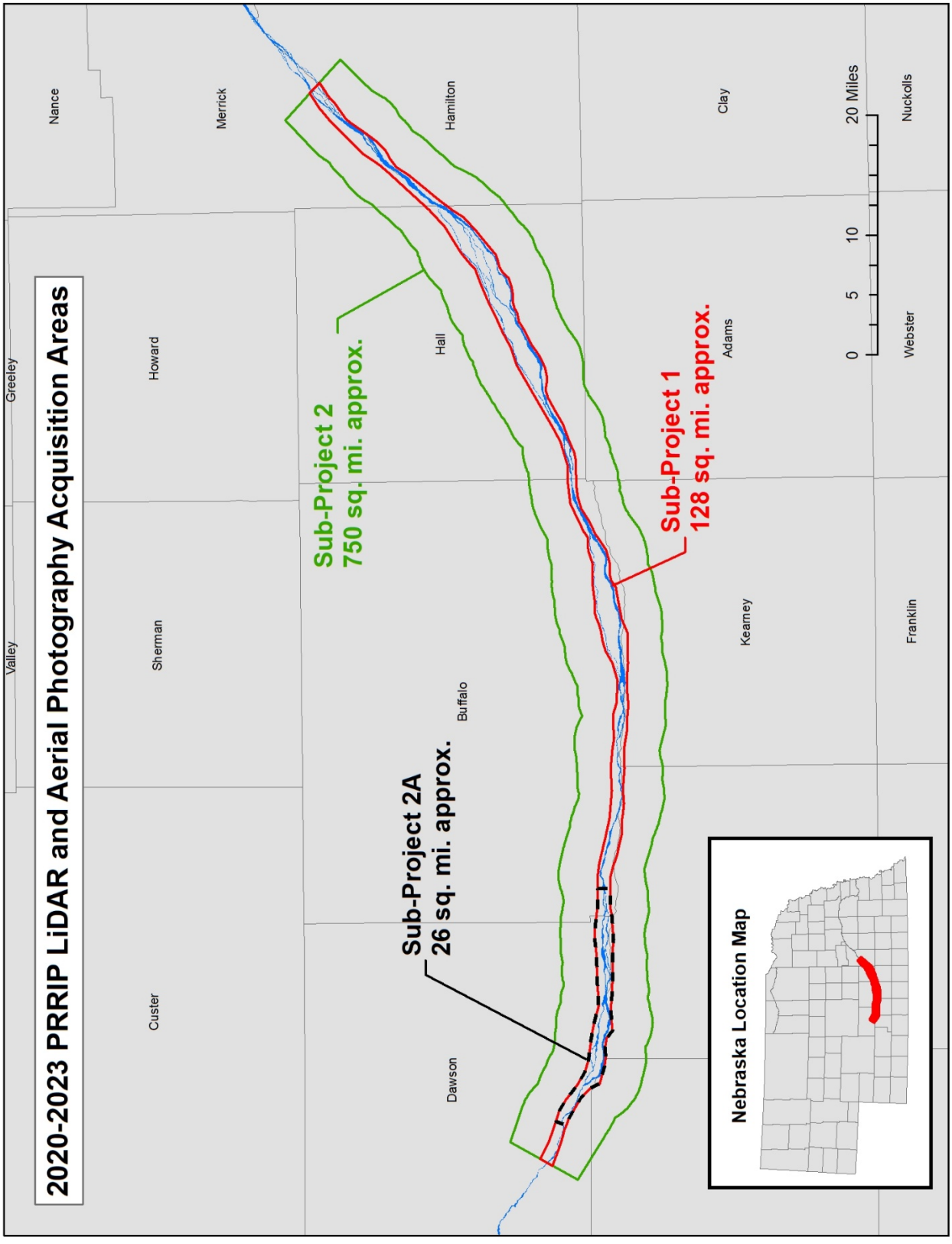
VII. PROGRAM PERSPECTIVE

The GC of the Program has the sole discretion and reserves the right to reject any and all proposals received in response to this RFP and to cancel this solicitation if it is deemed in the best interest of the Program to do so. Issuance of this RFP in no way constitutes a commitment by the Program to award a contract, or to pay contractor's costs incurred either in the preparation of a response to his RFP or during negotiations, if any, of a contract for services. The Program also reserves the right to make amendments to this RFP by giving written notice to contractors, and to request clarification, supplements, and additions to the information provided by a contractor.

By submitting a proposal in response to his solicitation, contractors understand and agree that any selection of a contractor or any decision to reject any or all responses or to establish no contracts shall be at the sole discretion of the Program. To the extent authorized by law, the contractor shall indemnify, save, and hold harmless the Nebraska Community Foundation, the states of Colorado, Wyoming, and Nebraska, the Department of the Interior, members of the GC, and the ED Office, their employees, employers, and agents, against any and all claims, damages, liability, and court awards including costs, expenses, and attorney fees incurred as a result of any act or omission by the contractor or its employees, agents, subcontractors, or assignees pursuant to the terms of this project. Additionally, by submitting a proposal, contractors agree that they waive any claim for the recovery of any costs or expenses incurred in preparing and submitting a proposal.

VIII. AVAILABLE INFORMATION

A shapefile of the acquisition area for Sub-Projects 1, 2, and 2A are available on the Program website (www.platteriverprogram.org) at the same location as this RFP solicitation. A map of the acquisition area is found on the last page of this solicitation.


2020-2023 PRRIP LiDAR and Aerial Photography Acquisition Areas
Sub-Project 2
750 sq. mi. approx.
Sub-Project 1
128 sq. mi. approx.
Sub-Project 2A
26 sq. mi. approx.
Nebraska Location Map
Nance
Merrick
Hamilton
Clay
Nuckolls
Greeley
Howard
Hall
Adams
Webster
Valley
Sherman
Buffalo
Kearney
Franklin
Custer
Dawson
0
5
10
20 Miles

Appendix A:
Excerpt from PRRIP Remote Geomorphology and Vegetation Monitoring Protocol

IV. Data Analysis

A. Preliminary Processing of Aerial Imagery and LiDAR

- The aerial imagery and LiDAR products delivered from the aerial mapping contractor will be processed prior to analyzing the data to reduce file size to a manageable level using the following procedure:
- The imagery and LiDAR surfaces will be degraded to 3-foot pixel resolution, clipped to the channel shapefile discussed in Section IV. A., snapped to a common raster grid system, and merged to facilitate vegetation classification using the Trimble eCognition software. Through this process, care must be taken to ensure that all 4 bands in the aerial imagery are maintained in the processed aerial imagery files.
- A vegetation-height raster file will be created by subtracting the Hydroflattened DTM raster from the highest hit DSM raster.
- A topographic DEM of differences (DOD) will be created by subtracting the processed topobathymetric DTM for the current year from the DTM from the previous year. The DTM will provide base elevation data for cross sections and two-dimensional (2-D) model nodes for the habitat-related analyses, and the DOD will be used to quantify aggradation/degradation changes for purposes of monitoring the system-wide sediment transport balance.

B. Volume Change Analysis

Channel bed-sediment volume change (aggradation/degradation) for each geomorphic reach will be calculated from the topobathymetric DOD by developing a histogram of volume change with bins in 0.1 foot increments, multiplying the number of points in each bin by the square of the pixel resolution (i.e., 9 ft^2) and the magnitude of the corresponding elevation change, and summing the resulting volumes. A consistent sign convention will be used for the analysis, with negative (-) values indicating degradation and positive (+) values indicating aggradation. Consistent with recommendations in Lane, et al., (2000), all pixel values, regardless of their magnitude, will be used in computing the best-estimate magnitude of the volume change. Uncertainty in the estimate will then be computed based on the reported uncertainty for the subaerial and subaqueous portions of the surfaces using the following formula (Lane, et al., 2000):

$$\sigma_v = \pm t * d^2 \left(\sum_{i=1}^{4} N_i \sigma_i^2 \right)^{\frac{1}{2}} \quad (1)$$

Where σ_v is the uncertainty in the estimate volume change, t is the t-statistic associated with the desired level of confidence (e.g., t-1.96 for the 90% confidence bands), d is the pixel resolution, N_i is the number of pixels in each error category (i), and σ_i is the propagated error between the two comparative surfaces, computed by the following formula:

$$\sigma_i = \left(\sigma_j^2 + \sigma_k^2\right)^{1/2} \qquad (2)$$

where σ_j and σ_k are the Root Mean Square Errors (RMSE) of the relevant zones for the current and previous-year surfaces, respectively. Since the mapping error for the LiDAR is different for subaerial and subaqeous areas, there will be two values for σ_j and σ_k for each year of data, and there are, therefore, four possible combinations (i) of j and k for each pixel:

1. Subaerial in both surfaces
2. Subaerial in the prior-year surface and subaqueous in the current-year surface
3. Subaqeous in the prior-year surface and subaerial in the current-year surface
4. Subaqeous in both surfaces

Degradational areas (negative elevation change) will also be differentiated into lateral and general bed erosion components by assuming degradational values of greater than 3 feet represent lateral bank erosion. The 3-foot value is based on EDO observations of average bank height in the AHR and may be adjusted in the future as more data becomes available. Areas initially identified as bank erosion will be manually checked, and those that occur in the middle of the channel reclassified back into bed erosion, because scour holes and erosion into the sides of mid-channel bars can also exceed 3 feet.

Volume change will be reported in cubic yards (CY) as well as tons using a conversion factor of 1.5 tons per CY.

C. Channel Morphology and Hydraulics Assessment and Analysis

Two-dimensional (2-D) hydrodynamic models will be developed internally and updated annually to identify changes in width, depth, and channel depth/height distribution over a range of discharges. Nine hydraulic models will be constructed, one for each geomorphic reach. The model geometries will be bound longitudinally by the adjoining bridges in the bridge segments and laterally by the eCognition analysis hulls. The model will be calibrated for the recorded discharges at the time of the LiDAR flights and ground surveys, and to water-surface profiles from the remote sensing data, surveyed water surface elevations, and stage loggers located throughout the analysis area. Manning's roughness values will be specified for the vegetation polygons from the eCognition analysis, and adjusted, as appropriate, to achieve calibration. A range of flows from 500 cfs to 5,000 cfs will then be run with the calibrated models. It is tentatively assumed that the following 5 discharges within this range will be sufficient to quantify the relationships: 500 cfs, 1,200 cfs, 2,000 cfs, 3,000 cfs and 5,000 cfs. The difference between the predicted water surface elevations and the corresponding channel bed elevation will be computed to quantify the following analysis metrics, by discharge, for each geomorphic reach:

- Total inundated area

- Water volume – Total volume of water within the reach at the indicated water-surface elevation
- Average depth – Ratio of water volume to total inundated area
- Average Top width –Ratio of total inundated area to channel length
- Width-Depth (W/D) ratio – Ratio of average top width to average depth
- Area of inundation of 0.7 foot or less

D. In-Channel Vegetation and Land Cover Classification and Analyses

Trimble eCognition software will be used, along with the training and validation data, to evaluate in-channel vegetation and land cover, primarily to assess the whooping crane metrics. For the basic vegetation and landcover analysis, annual vegetation classifications within the area of interest that include the active channel and approximately 50 feet to 100 feet of the overbanks, will be delineated from the annual aerial imagery using eCognition (Appendix A). To accommodate software limitations, the processed 3-foot pixel resolution fall aerial imagery and vegetation height DEMs developed under Section VII. A. will then be segmented into shorter reaches of river (generally Lexington – Odessa, Odessa – Shelton, Shelton – HWY 281, and HWY 281 – Chapman) prior to initiating the supervised classification to provide more manageable file size. The imagery and vegetation height DEM files will then be imported into eCognition and used to classify imagery into the vegetation and land cover classes defined in Section IV. D. 2. The final vegetation classification file will be exported as a shapefile and evaluated for accuracy in ArcGIS using the field-collected validation data. During the accuracy assessment, wet sand, dry sand, and water will be combined into a single class as these classes are highly variable depending on discharge.

Vegetation classifications will be validated annually to determine the accuracy of the remote-sensing results. For each remote survey, the accuracy for each vegetation classification will be calculated by dividing the number of correct classifications by the total number of field-based classifications collected in each class using the validation data set. In addition, a geodatabase will be developed with an attribute table that will detail the coverage of each vegetation class.

Maximum unvegetated channel width (MUVCW), to be used in evaluating drivers of vegetation change, will be computed by dividing the total unvegetated area (water, bare sand, and sparse short vegetation) by the reach length for each geomorphic reach. This metric will be reported in acres by geomorphic reach.

Final vegetation and land cover class areas and MUVCW will be compared to the corresponding areas from previous years to quantify yearly changes. The results will be reported in acres of change by geomorphic reach for both main and side channels.