WHATCOM COUNTY CONTRACT INFORMATION SHEET

Whatcom County Contract No.

Originating Department:	Public Works
Division/Program: *(i.e. Dept. Division and Program)*	River & Flood/CFHMP (907525)
Contract or Grant Administrator:	Paula Harris, River & Flood Manager
Contractor's / Agency Name:	WA State Department of Natural Resources

Is this a New Contract? Yes ◉ No ○ If not, is this an Amendment or Renewal to an Existing Contract? Yes ○ No ◉
If Amendment or Renewal, (per WCC 3.08.100 (a)) Original Contract #: _____

Does contract require Council Approval? Yes ◉ No ○ If No, include WCC: _____
Already approved? Council Approved Date: _____ (Exclusions see: Whatcom County Codes 3.06.010, 3.08.090 and 3.08.100)

Is this a grant agreement?
Yes ○ No ◉ If yes, grantor agency contract number(s): _____ CFDA#: _____

Is this contract grant funded?
Yes ◉ No ○ If yes, Whatcom County grant contract number(s): DOE#: OTGP-2325-WhCoPW-00054

Is this contract the result of a RFP or Bid process? Contract
Yes ○ No ◉ If yes, RFP and Bid number(s): _____ Cost Center: 722007

Is this agreement excluded from E-Verify? No ○ Yes ◉ If no, include Attachment D Contractor Declaration form.

If YES, indicate exclusion(s) below:

- ☐ Professional services agreement for certified/licensed professional.
- ☐ Goods and services provided due to an emergency
- ☐ Contract work is for less than $100,000.
- ☐ Contract for Commercial off the shelf items (COTS).
- ☐ Contract work is for less than 120 days.
- ☐ Work related subcontract less than $25,000.
- ■ Interlocal Agreement (between Governments).
- ☐ Public Works - Local Agency/Federally Funded FHWA.

Contract Amount:(sum of original contract amount and any prior amendments):
$ 349,600

This Amendment Amount:
$

Total Amended Amount:
$ 349,600

Council approval required for; all property leases, contracts or bid awards **exceeding $40,000**, and professional service contract amendments that have an increase greater than $10,000 or 10% of contract amount, whichever is greater, **except when:**

1. Exercising an option contained in a contract previously approved by the council.
2. Contract is for design, construction, r-o-w acquisition, prof. services, or other capital costs approved by council in a capital budget appropriation ordinance.
3. Bid or award is for supplies.
4. Equipment is included in Exhibit "B" of the Budget Ordinance.
5. Contract is for manufacturer's technical support and hardware maintenance of electronic systems and/or technical support and software maintenance from the developer of proprietary software currently used by Whatcom County.

Summary of Scope:

Interlocal agreement with Washington State Department of Natural Resources for collection, processing, and delivery of lidar topographic and bathymetric mapping of the Nooksack and Sumas River.

Term of Contract: Not to Exceed	Expiration Date: Project Completion

Contract Routing:

1. Prepared by:	G. Spann	Date: 12/14/23
2. Attorney signoff:	Christopher Quinn	Date: 12/27/23
3. AS Finance reviewed:	Amy Martin	Date: 12/22/23
4. IT reviewed (if IT related):		Date:
5. Contractor signed:		Date:
6. Executive contract review:		Date:
7. Council approved, if necessary:	AB2024-035	Date: 1/9/2024
8. Executive signed:		Date:
9. Original to Council:		Date:

Last edited 06/23/2023

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Cost Share Agreement

DNR Contract No. Contract No. 93-106337

Whatcom County Flood Control Zone District Contract No. _____

In accordance with Chapter 39.34 RCW, Washington State Department of Natural Resources (DNR) and Whatcom County Flood Control Zone District (FCZD) agree to a cost share agreement for lidar collection and geospatial mapping.

Pursuant to Cost Share Agreement number 93-106337 between DNR and FCZD:

1. The FCZD wishes to acquire topobathymetric lidar data, supplemental sonar data, and derivatives for 18.5 square miles covering the Nooksack River and Sumas River areas of interest through DNR's contract with Quantum Spatial, Inc. (dba NV5 Geospatial, Inc.) (DNR# 93-102831).

2. Per the agreement, DNR will act as the agent for this purchase.

3. This agreement covers collection, processing, and delivery of bathymetric lidar data, supplemental sonar data, and derivative products as outlined in Exhibit A – NV5G, Inc. Proposal dated December 1, 2023.

4. The total cost is not to exceed Three Hundred Forty-Nine Thousand Six Hundred Dollars ($349,600). The cost for the topobathymetric lidar collection for the Nooksack and Sumas Rivers is One Hundred Fifty-Seven Thousand Six Hundred Dollars ($157,600) and the cost for the supplemental sonar collection is not to exceed One Hundred Ninety-Two Thousand Dollars ($192,000), as described in Exhibit A.

5. If a suitable collection window for the lidar data does not occur in the winter of 2024, this cost share agreement will become null and void and a new cost share agreement will be developed for the next suitable collection window.

6. DNR shall submit multiple invoices to FCZD upon acquisition of the sonar collection and receipt of the deliverables. Payment for the approved good/services will be made by check, warrant or account transfer within 30 days of receipt of the invoice. Upon expiration of the Agreement, invoice shall be paid, if received within 30 days after the expiration date. However, invoices for all work done within a fiscal year must be submitted within 30 days after the end of the fiscal year.

This agreement may be revoked at any time in writing by either party, provided, however, FCZD agrees to pay for any services rendered under this agreement prior to termination.

Accepted for: Whatcom County Flood Control Zone District	Accepted for: Washington State Department of Natural Resources
SEE ATTACHED SIGNATURE PAGE	
Signature	Signature
Name/Title	Name/Title
Date:	Date:

WHATCOM COUNTY FLOOD CONTROL ZONE DISTRICT:

Recommended for Approval:

_____

Elizabeth Kosa, Public Works Director Date

Approved as to form:

_____

Christopher Quinn Date

Civil Deputy Prosecuting Attorney

Approved:

Accepted for Whatcom County Flood Control Zone District:

By: _____

Satpal Singh Sidhu, Whatcom County Executive

(if Docusign or Adobesign- the notary signature can be removed)

STATE OF WASHINGTON)

) ss

COUNTY OF WHATCOM)

On this _____ day of _____, 20 __, before me personally appeared Satpal Singh Sidhu, to me known to be the Executive of Whatcom County, who executed the above instrument and who acknowledged to me the act of signing and sealing thereof.

_____
_

NOTARY PUBLIC in and for the State of Washington, residing at

_____. My commission expires
_____.

Exhibit A – NV5 Geospatial, Inc. Proposal

December 1, 2023

RE: Nooksack and Sumas Rivers, Whatcom County, WA

NV5 Geospatial (NV5G, Inc.) appreciates the opportunity to present Washington State Department of Natural Resources (DNR) and partners with a quote and brief statement of work for geospatial mapping services for the Nooksack and Sumas Rivers located in Whatcom County, WA. The following provides an overview of services, including product deliverables and timeline. All specifications and deliverables follow those outlined in the NV5G proposal response to the Lidar RFP No. 22-03 issued by DNR (WGS RFP).

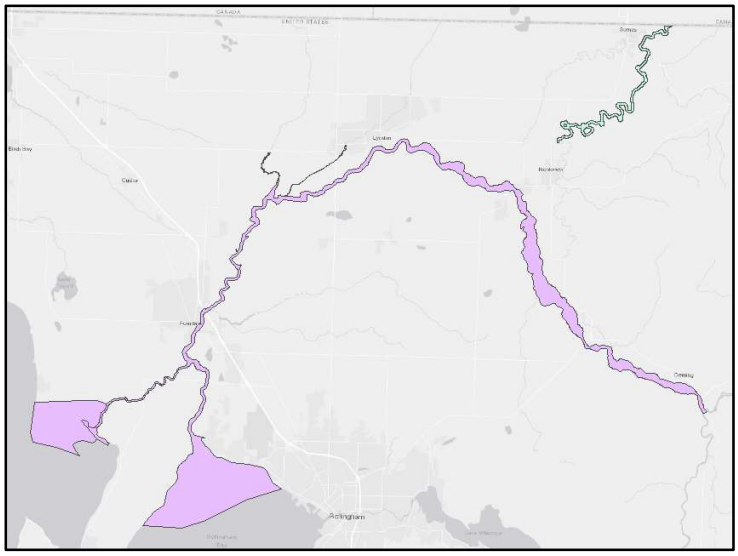


Figure 1: Limits of project areas of interest – the Nooksack River is shown in purple and the Sumas River is shown in green.

Topobathymetric Lidar Acquisition & Processing

Topobathymetric Lidar data will be acquired using one of NV5G's hydrographic airborne laser systems. The systems contain a green wavelength (λ=532 nm) laser capable of penetrating water, with high repetition pulse rate, high scanning speed, small laser footprint, and wide field of view together facilitate high resolution coverage of topographic and bathymetric surfaces. Additionally, the Riegl's short laser pulse length is ideal and critical for shallow-water systems as it allows for effective discrimination between water and bathymetric surfaces which can be challenging when mapping near-shore, shallow, and dynamic aquatic environments.

Topo-Bathy Lidar Specifications Summary	
Target Pulse Rate	245 kHz
Laser Wave Length	532nm
Laser Pulse Diameter	28-53 cm
Intensity	16-bit
Field of View	40°, 20° forward fixed angle

The green laser will collect both topographic and bathymetric Lidar data to produce a high-resolution topobathymetric data set **(≥15 pulses/m²)** with a fixed scan angle of ±20° (off nadir). The Riegl system has demonstrated hydrographic depth ranging capability of at least 1.5 Secchi depth on bright reflective surfaces. The laser will not penetrate dense aquatic vegetation or turbid waters. Water clarity affects the depth penetration capability of the bathymetric laser with returning laser energy diminishing by scattering throughout the water column. Additionally, the bottom surface must be reflective enough to return remaining laser energy back to the sensor at a detectable level. Actual depth performance will depend on bottom reflectivity and water clarity at time of acquisition. Data will be collected during the best possible conditions for success which include no fog/rain and any other conditions affecting water clarity.

Lidar processing tasks involve echo extraction; calculations of laser point position; flight line calibration; water surface extraction; refraction correction; point classification; and accuracy assessments. Derived topobathymetric Digital Elevation Models (DEMs) will be developed once the seamless topographic/bathymetric Lidar point cloud is finalized for positional and classification accuracy. NV5G will evaluate clarity and reflectivity as they impact the dataset. Depths ranging beyond the sensor's detection capability will produce voids in the data set. Voids will be identified in the dataset as well as evaluated in reporting. Our team will assess the accuracy of the topobathymetric Lidar system using bare earth and, if available, shallow water check points collected during the survey.

Sonar Acquisition and Processing

Sonar collection and processing within the project site will be completed by our sonar partner, AKS. NV5G, Inc. will perform the topobathymetric data collection and processing, sonar dataset integration and prepare all final products, field survey, QA/QC and reporting. A complete writeup of the approach and deliverables to NV5G, Inc. l is included in this technical cost proposal as Attachment A. Should a sonar solution be under contract, we will request DNR's approval to use AKS on this project and will provide all required documentation for approval.

Survey Control

Depending on acquisition logistics (configuration of sites, access, schedule, and weather), NV5G, Inc. will use one or more appropriate methods to enable geo-spatial correction of aircraft positional coordinate data. These include conventional base supported ('BS') survey control, TerraPos® Precise Point Positioning ('PPP'), or Trimble® CenterPoint™ Post-Processed Real-Time Extended ('PP-RTX'). To verify Lidar point calibration and enable accuracy assessment, our field crew will collect ground check points (GCPs) using GPS-based real-time kinematic (RTK) survey techniques. For an RTK survey, the ground crew uses a roving unit to receive radio-relayed corrected positional coordinates for all ground points from a GPS base unit set up over a survey control monument. The roving unit records precise location measurements with an error (σ) of ≤1.5 cm relative to the base control. Our team will distribute a suitable number of hard, bare earth ground check points (GCPs) on level slope throughout project areas, as feasible given road access and GPS conditions. The techniques for establishing all ground check points will be outlined in the Report of Survey, including the identity, locations, and position residuals of all GCPs used to evaluate survey accuracy. All survey control and accuracy will be validated and certified by NV5G, Inc. registered land surveyor for Washington State. Secci depth measurements will be taken at suitable locations as close to acquisition time as possible and at locations safe for the field surveyor to access.

Deliverables

Coordinate System

Washington State Plane North, NAD83 (HARN), NAVD88 (Geoid 12b), US Survey Feet unless otherwise specified.

NIR Lidar with Bathy

Ground Control Points: Location and orthometric height of all GCPs. Additional attributes that may be included are ellipsoidal height and a description of the ground cover type where the measurement was taken, *shapefile format*
Aircraft Trajectories: Smoothed Best Estimate of Trajectory (SBET) files with aircraft position (easting, northing, and

elevation), attitude (heading, pitch, roll, yaw) and GPS time recorded at regular intervals of 1 second or less. May include additional attributes (PDOP and estimated positional and velocity errors).
Lidar Flightlines: attributed with project name, and date of acquisition of each flightline, *shapefile or ASCII text format*

All Return Point Cloud:

- LAS V1.4 format
- Including all valid returns, with all fields populated
- Attributes must include, at a minimum, class number, class name, line number, GPS seconds per week, echo label (only, last, etc.), easting/northing/elevation (reported to nearest 0.01 meter), intensity, scan angle, echo number, and system gain or scanner
- Following USGS LBS 2020 revision A (or most current version thereof) for classification scheme (No points should retain a classification of 0)
- Red, Green, Blue Infrared (RGBI) values must be attributed when applicable
- No duplicate entries
- Time reported to the nearest microsecond or better
- Classification of ground returns must be as complete as is feasible and without avoidable return misclassification
- ***Topobathy*** Includes additional bathymetric ground, water column, water surface classifications

Bare Earth Surface Model:

- *Erdas .img, GeoTiff, Esri Grid formats*
- No tiling artifacts and no gaps at tile boundaries, or artifacts such as pits, birds, striping or aliasing.
- Areas outside survey boundary shall be coded as NoData with the value '-999999'.
- Internal voids (e.g., open water areas) shall be coded with the value '-999999'.
- 32-bit pixel depth floating point grid at a 1.5 ft (0.5 meter) cell resolution snapped to the corner
- ***Topobathy*** Includes seamless ***(optional) sonar*** and topobathymetric Bare Earth Digital Elevation Model (DEM), 1 m (3-ft) resolution, *ERDAS IMG format*
- ***Topobathy*** Bathymetric Coverage Polygon, *shapefile format*

First Return Surface Model:

- Raster generated from the highest collected return for each cell
- Same specifications as for Bare Earth Surface Model
- Cells without first returns will be coded as No Data.

Intensity Images:

- *GeoTiff format, grayscale*
- Normalized if the sensor or combination of sensors used on the project allow
- Grids must be georeferenced 8-bit pixel depth (unless otherwise specified in the purchase order)
- 1.5ft (0.5 meter) cell resolution

Survey Report

- *Delivered in .pdf or .docx formats*
- **Project Overview**, including:
  - project name, location map, date collection was ordered, acquisition window, delivery date(s), project AOI, project total area flown, specified units, coordinate system and datum, list of options requested
- **Lidar Acquisition Information**, including:
  - map of flightlines indicating dates of collection
  - acquisition parameters (table) including aircraft, sensor, acquisition settings, flight elevation
- **Report of the ground survey**, including
  - reference map and table listing monuments used and location
  - detailed description of GPS procedures used in establishing the reference network and control points for the project
  - location and height (orthometric) shall be included in as a digital appendix to the report, *shapefile format*
- **Washington State Licensed Surveyor Certification**
- **Calibration Report** for the system(s) used in the data acquisition
- **Projection, datum, epoch of adjustment, and Geoid** used for the survey.

- **Accuracy Assessment**:
    - Relative Accuracy, Absolute Accuracy (summary statistics and histogram).
    - Reported to meet the guidelines of the National Standard for Spatial Data Accuracy (FGDC 1998) and ASPRS 2014).
- **Assessment of Pulse Density**, including maps showing design pulse density and ground return densities by quarter-quadrangle and histograms of both density parameters.
- **Summary Table of Deliverables**, listing file formats and total number and data volume of each deliverable, paths on the delivered hard drive, a standardized description of the data tiling scheme, and a checklist of all deliverables.
- **Metadata:** GIS-compatible data and files shall be explained with XML format metadata that follows the Federal Geographic Data Committee's (FGDC) Content Standard for Digital Geospatial Data. Metadata may be a single file that describes an entire survey or multiple files each of which describes a constituent part (e.g., area A, area B, area C) of the survey.

Tiling Scheme

All geospatial products will be delivered in a 4500 x 4500 foot tiling scheme unless otherwise specified. Esri grids, shapefiles will have complete and correct associated projection files. Tiled products will be edge matched, without gaps or overlap.

Delivery Method

All data will be provided on marked (following consistent nomenclature and versioning info) portable hard drives with appropriate documentation and metadata records. All filenames will follow mutually agreed upon nomenclature. Each drive will have an identification sticker, identifying the project, delivery, and ship date, as well as serialize the drive ID. Each drive will be delivered with a hard and soft copy of a transmittal letter (emailed to DNR the day of shipment). Version control will feature records of each version including (as a minimum) version, date, size, impacted bins, and fixes.

Schedule & Timeline

NV5G, Inc. will work with DNR to coordinate data collection to coincide with optimal weather conditions and as best meets the needs of the project. NV5G anticipates collection to occur in January/February of 2024 during low flow, leaf off and low tide conditions. See Attachment B for specific condition parameters for tides and turbidity. All products will be delivered 60 - 90 business days from date of successful acquisition and completion of survey depending on total area chosen. NV5G, Inc. will coordinate with DNR and stakeholders to utilize established survey monuments where possible and gain access to property.

Cost Estimate

A lump sum cost is provided here for mapping the area outlined in Figure 1 above, assuming timeline and the deliverables listed above. Changes in the size and/or shape of the area of interest will result in modifications to the cost structure. Costs include mobilization, acquisition, survey, processing to products and reporting.

Service	Cost
Nooksack + Sumas topobathymetric lidar collection (11,839 acres)	$157,600
Supplemental Sonar on Nooksack	$192,000

AKS SCOPE OF WORK

NV5G, Inc. will subcontract with AKS for the following work:

AKS will be directed by NV5G, Inc. to complete a hydrographic survey of the Nooksack River in the Northwestern portion of Washington State according to their separate subcontract. The overall project objectives are to measure the riverbed elevations where otherwise infeasible by aerial methods (i.e., via topobathymetric Lidar). The bathymetric survey will be used in conjunction with forthcoming aerial Lidar (to be collected by NV5G, Inc.) to create a continuous elevation surface. The ultimate hydrographic survey product will be a 3-ft x 3-ft DEM within topobathymetric Lidar data gaps (voids). All work outlined below will be performed by or under the direct supervision of a licensed Professional Land Surveyor (PLS), licensed Professional Engineer (PE), and/or an National Society of Professional Surveyors/The Hydrographic Society Of America (NSPS/THSOA) Certified Hydrographer.

The project site is shown below (Figure 1). The overall project area of interest (AOI) is shown by a yellow outline. The anticipated hydrographic infill survey areas are outlined in blue and are only within the mainstem Nooksack River. The only known boat access locations are shown as yellow pins.

NV5G, Inc. will direct AKS to complete the survey between the river mouth and the Everson Road Bridge (Everson, WA) using multi-beam echosounder (MBES). A single-beam echosounder (SBES) will be used in the area between Everson and the Route 9 Bridge in Deming, WA. In general, MBES data will be acquired in areas where it is safely navigable, deeper than e.g., 10-ft, and clear of woody debris. In areas shallower than 10-ft and/or containing hazardous submerged debris, NV5G, Inc. will direct AKS to collect data via SBES.

APPROACH SUMMARY

- Nooksack River Mouth upstream to Everson, WA: Infill topobathy Lidar data voids with MBES where feasible (i.e., sufficiently deep and not containing submerged aquatic vegetation, SAV)
- Everson, WA upstream to Deming, WA: Infill topobathy Lidar data voids with SBES where not possible with MBES
- Equipment:
    - MBES – R2Sonic 2024 MBES (or similar) with Applanix POS/MV IMU (or similar) and Trimble R10 base/rover receivers (or similar)
    - SBES – CEE Hydrosystems CEE ECHO SBES (or similar) with Applanix POS/MV IMU (or similar) and Trimble R10 base/rover receivers (or similar)

DELIVERABLES (TO NV5G, INC.)

- ASCII XYZ text data in a 3-ft x 3-ft uniformly gridded DEM only within the topobathy Lidar void areas
- Brief survey memorandum indicating the survey methodologies, equipment used, survey accuracy, and post-processing methods

Project Site Map

ASSUMPTIONS/CAVEATS

- Assumes 7-9 days for MBES data collection and 6-7 days for SBES data collection
- These duration estimates assume that the water depth within the voids at the time of survey is at least 10-ft. Actual duration required to survey may be longer than this if the water depths are shallower than 10-ft.
- These duration estimates assume that the 2024 topobathymetric lidar void areas comprise a surface area no greater than 20% larger than the previous 2022 NV5G, Inc. topobathymetric lidar survey
- Full bottom coverage with MBES of all accessible and safely navigable areas within the survey extent, using GNSS and sonar, will be captured
- SBES data will also only be collected where safely navigable and feasible using GNSS and sonar
- SBES data will be measured at 25-ft transect intervals, or smaller, depending upon the void size and site condition(s) at the time of surveying
- Data to be collected at as high a water level as possible and at times when the aquatic vegetation growth is at the lowest, if any exists
- The 3 boat ramps shown in the exhibit will be accessible and open at the time of the survey
- Assumes vessels are not restricted from navigating this portion of the river with a motorized craft
- Assumes these portions of the river will be navigable with a shallow-draft survey vessel and 150-200 HP motor
- Assume 12 hour working days (8 hours of on-line surveying). If completed in winter or times of shorter daylight, the survey may require additional time, so long as entire project is completed within contract period of performance.

- NV5G, Inc. will follow terms of their own subcontract with AKS regarding cost, including cost of 2 mobilizations. Two mobilizations will likely be needed due to the use of different equipment and survey vessels/platforms between the upstream and downstream survey areas.
- Data will be provided in a standard project coordinate system (e.g., NAD83/11 SPCS Washington North, U.S. Survey Feet) and vertical datum (NAVD88), or as preferred by DNR.
- AKS assumes there are no restrictions on the size of the boat or motor that is used for hydrographic surveying. NV5G, Inc. will direct work and type of boats used with AKS as it's subcontractor, including use of the following:
    - AKS' MBES boat is a 24-ft aluminum Oakes with a 200 HP outboard prop motor
    - AKS' SBES boat is a 20-ft aluminum Wooldridge with a 140 HP outboard jet motor
    - AKS' optional SBES boat is a lightweight, portable cataraft that can be used to float downstream for SBES infill
    - A second optional SBES boat is a lightweight, portable unmanned survey vessel that can be controlled from shore.
- No additional documentation or reporting costs have been included in separate contract between NV5G, Inc. and AKS (e.g., HASP, AHA, Work Plan, Survey Plan)
- NV5G, Inc. will provide the topobathy Lidar void data prior to mobilizing for the hydrographic survey
- NV5G, Inc. will provide the topobathy Lidar data after data cleaning so that the data can be used to QC the sonar bathymetry data in overlapping areas

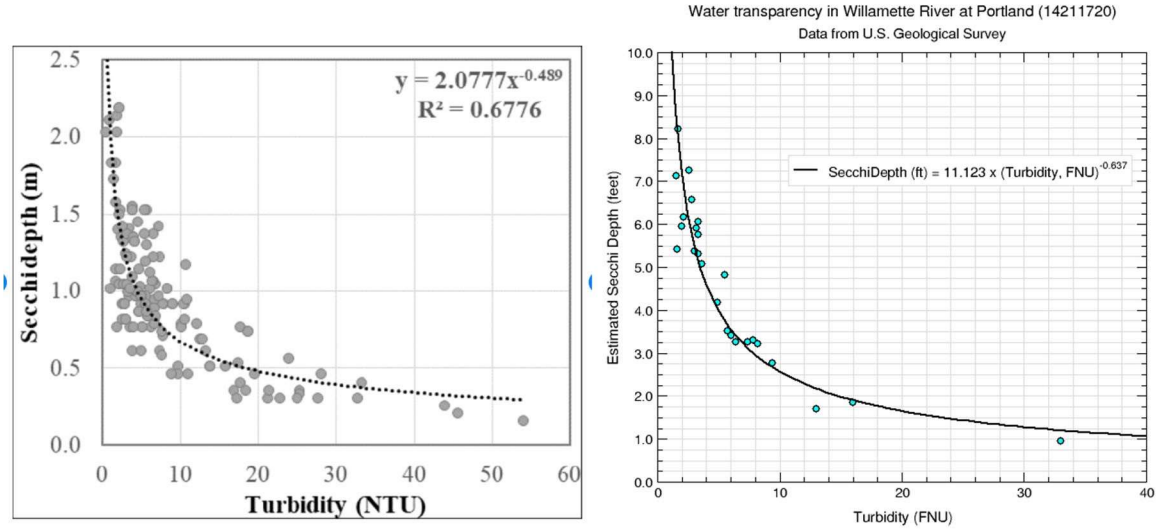
Proposed Constraints for Topo-Bathy LiDAR acquisition for Nooksack River

Updated 12/4/2023 (originally provided 11/4/2021)

Turbidity Criteria

The Nooksack River is glacially fed and has a high turbidity level much of the time. In order to acquire the highest quality bathymetric data, constraints are needed to guide NV5G, Inc. on when data acquisition flights are allowed. These constraints must allow a realistic opportunity to acquire the data during the winter of 2024.

Bathymetric Lidar penetration estimates: Under typical conditions, the Lidar data can be acquired to 1.5X Secchi depth. On the Nooksack River real-time turbidity data is available, so a correlation with Secchi depth allows the parties to estimate equivalent turbidity levels. Whatcom County found correlations using a quick web search and the results were similar:



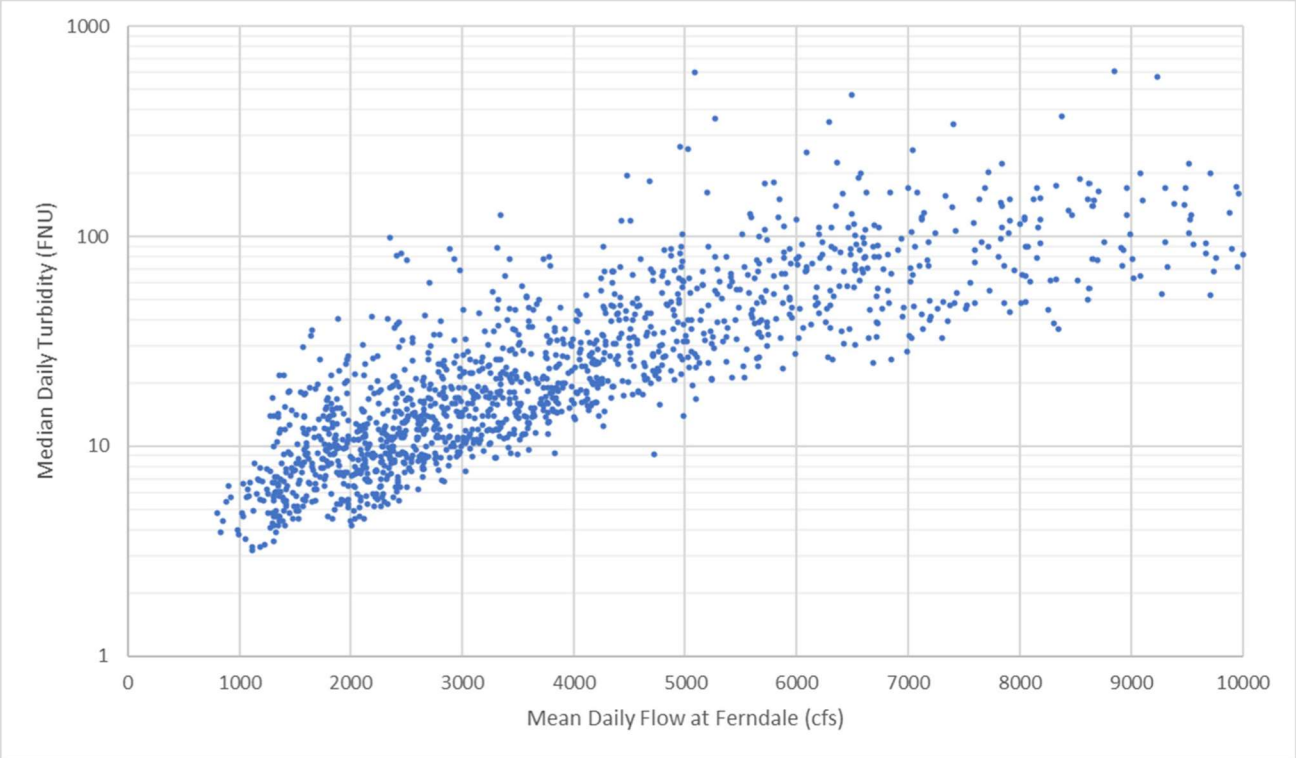
Power relationship between turbidity (NTU) and Secchi depth (m).

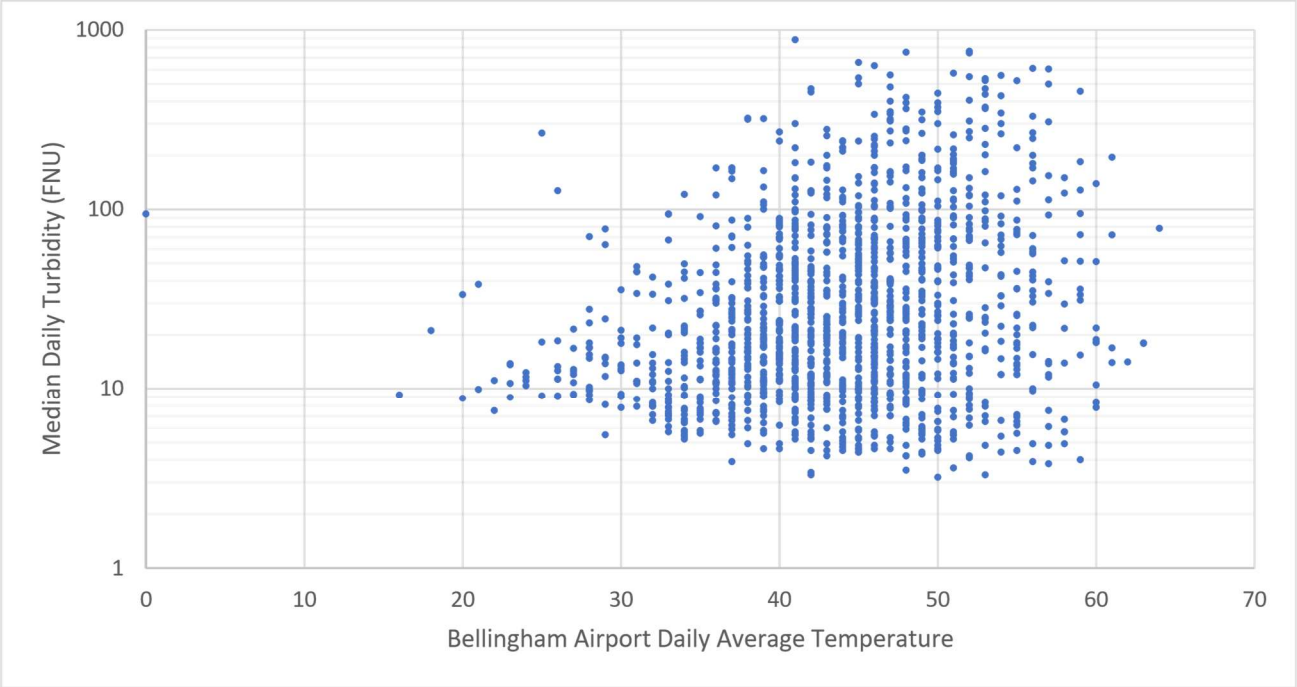
https://www.researchgate.net/figure/Power-relationship-between-turbidity-NTU-and-Secchi-depth-m_fig2_338113358

https://or.water.usgs.gov/will_morrison/secchi_depth_model.html

From these curves it is apparent that turbidities less than 5 Nephelometric Turbidity Units (NTUs) would be desirable, and less than 10 NTUs required to get any amount of significant bathymetric coverage of the riverbed, especially considering the data acquisition will occur during deeper winter flow conditions.

The next question is whether or not these targets are achievable on the Nooksack River. Whatcom County downloaded all available flow and turbidity data for the Ferndale gage (2011 – present, with significant missing data periods), and filtered it for winter months (Oct-Mar). The weather data for Bellingham Airport was also downloaded. The hypothesis is that the clearest water in the winter months occurs during long cold spells when most of the basin is not generating runoff and flows are low. The following figures present some correlations with turbidity, note the log scale for turbidity.





- Key Findings
  - Turbidities less than 5 NTUs rarely occur on the Nooksack River
  - Turbidities less than 10 NTU never occur when flows exceed 4000 cfs
  - Somewhat surprisingly, the lowest turbidities occur during warmer temperatures, not during frozen conditions.

Based on the data, Whatcom County believes that 10 NTU is a reasonable compromise upper turbidity threshold for LiDAR data acquisition. Whatcom County checked if this was reasonable by calculating the number of days/month turbidities were less than 10 NTU for the period of record. Note: water year

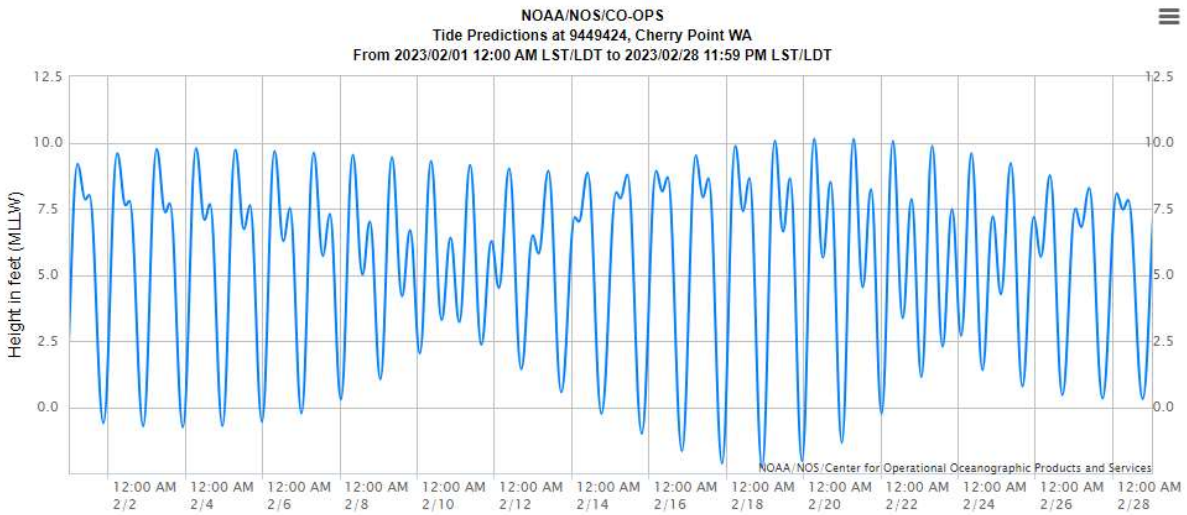
2018 had no data, and there are periods of missing data throughout the record, so the numbers may underestimate the total number of days that met the criteria.

Mon	2011	2012	2013	2014	2015	2016	2017	2019	2020	2021	Totals
Oct	1	3	14	0	19	8	0	9	1	0	55
Nov	15	0	8	3	0	0	0	20	2	0	48
Dec	19	3	8	0	1	1	0	12	5		49
Jan		3	13	2	1	11	14	0	0	6	50
Feb		3	19	5	7	0	4	4	1	3	46
Mar		6	6	0	6	0	0	17	16	27	78
Total	**35**	**18**	**68**	**10**	**34**	**20**	**18**	**62**	**25**	**36**	**326**

The table shows that every winter month has had low turbidity days. March had had the highest number of clear water days, especially in the last three years.

Tide Criteria:

Whatcom County suggests requiring NV5G, Inc. to limit acquisition in tidal areas to times when the National Ocean and Atmospheric Administration (NOAA) Cherry Point tide gage is at or below Mean Low Low Water (MLLW). This will almost certainly require nighttime acquisition for any period before March. Sequences of low tides below MLLW occur every other week, and this criterion should allow around half of the days in each month to be considered.



https://tidesandcurrents.noaa.gov/stationhome.html?id=9449424