Please provide the following information, and submit to the NOAA DM Plan Repository.

Reference to Master DM Plan (if applicable)

As stated in Section IV, Requirement 1.3, DM Plans may be hierarchical. If this DM Plan inherits provisions from a higher-level DM Plan already submitted to the Repository, then this more-specific Plan only needs to provide information that differs from what was provided in the Master DM Plan.

URL of higher-level DM Plan (if any) as submitted to DM Plan Repository:

1. General Description of Data to be Managed

1.1. Name of the Data, data collection Project, or data-producing Program:

2022 WA DNR Topobathy Lidar DEM: Nooksack River, WA

1.2. Summary description of the data:

No metadata record was provided with the data. This record is populated with information from the NV5 Geospatial, Inc. technical report downloaded from the Washington Dept. of Natural Resources Washington Lidar Portal. The technical report is available for download from the link provided in the URL section of this metadata record.

In April 2021, NV5 Geospatial (NV5) was contracted by the Washington State Department of Natural Resources (DNR) to collect topobathymetric Light Detection and Ranging (lidar) data in the winter of 2022 for the Nooksack River, Washington 2022 site. The Nooksack River area of interest stretched from Bellingham Bay near the Lummi Reservation and East of the San Juan Islands to Ferndale, Washington then stretched northward to about 4 miles south of the Canadian border and ended to the south east of Deming, Washington. Traditional near-infrared (NIR) lidar was fully integrated with green wavelength return data (bathymetric) lidar in order to provide a seamless topobathymetric lidar dataset. Data were collected to aid DNR in assessing the channel morphology and topobathymetric surface of the study area to support current and assess previous river restoration activities on the Nooksack River.

1.3. Is this a one-time data collection, or an ongoing series of measurements?

One-time data collection

1.4. Actual or planned temporal coverage of the data:

2022-02-24 to 2022-02-25

1.5. Actual or planned geographic coverage of the data:

W: -122.675158, E: -122.199238, N: 48.943068, S: 48.744596

1.6. Type(s) of data:

(e.g., digital numeric data, imagery, photographs, video, audio, database, tabular data, etc.)
Model (digital)

1.7. Data collection method(s):
(e.g., satellite, airplane, unmanned aerial system, radar, weather station, moored buoy, research vessel, autonomous underwater vehicle, animal tagging, manual surveys, enforcement activities, numerical model, etc.)

1.8. If data are from a NOAA Observing System of Record, indicate name of system:

1.8.1. If data are from another observing system, please specify:

2. Point of Contact for this Data Management Plan (author or maintainer)

2.1. Name:
NOAA Office for Coastal Management (NOAA/OCM)

2.2. Title:
Metadata Contact

2.3. Affiliation or facility:
NOAA Office for Coastal Management (NOAA/OCM)

2.4. E-mail address:
coastal.info@noaa.gov

2.5. Phone number:
(843) 740-1202

3. Responsible Party for Data Management
Program Managers, or their designee, shall be responsible for assuring the proper management of the data produced by their Program. Please indicate the responsible party below.

3.1. Name:

3.2. Title:
Data Steward

4. Resources
Programs must identify resources within their own budget for managing the data they produce.

4.1. Have resources for management of these data been identified?
Yes

4.2. Approximate percentage of the budget for these data devoted to data management (specify percentage or "unknown"):
Unknown

5. Data Lineage and Quality

NOAA has issued Information Quality Guidelines for ensuring and maximizing the quality, objectivity, utility, and integrity of information which it disseminates.

5.1. Processing workflow of the data from collection or acquisition to making it publicly accessible

(describe or provide URL of description):

Lineage Statement:
The NOAA Office for Coastal Management (OCM) downloaded the GeoTiff files from the Washington Lidar Portal.

Process Steps:

- Planning: In preparation for data collection, NV5 reviewed the project area and developed a specialized flight plan to ensure complete coverage of the Nooksack River Lidar study area at the target combined point density of greater than or equal to 15 pulses/m2. Acquisition parameters including orientation relative to terrain, flight altitude, pulse rate, scan angle, and ground speed were adapted to optimize flight paths and flight times while meeting all contract specifications. Factors such as satellite constellation availability and weather windows must be considered during the planning stage. Any weather hazards or conditions affecting the flight were continuously monitored due to their potential impact on the daily success of airborne and ground operations. In addition, logistical considerations including private property access, potential air space restrictions, channel flow rate conditions, tidal ranges, and water clarity were reviewed. The turbidity is often high in the Nooksack River, which decreases the depth penetration of Lidar. Because of this, special care was made to ensure that Lidar acquisition occurred when turbidities were below 10 NTU. In this area, preliminary data from Washington DNR illustrated that in order to have turbidities less than 10 NTU the flow rates had to be less than 4,000 cfs. The flow rate was around 2,000 cfs during the time of acquisition. Low turbidities and flow conditions typically occurred in the winter months when the weather was not freezing. Therefore, NV5 acquisition occurred during February 2022 during leaf off conditions as per contract specifications. Washington DNR also determined that acquisition should occur during the Mean Lower Low Water (MLLW), which refers to the lowest daily tide. Secchi depths were recorded close to the time of acquisition during the MLLW. Turbidity Measurements and Secchi Depth Readings In order to assess water clarity conditions prior to and during lidar and digital imagery collection, NV5 collected turbidity measurements and secchi depth readings. Readings were collected at three locations throughout the project site between February 24th and 25th, 2022. Turbidity observations were recorded three times to confirm measurements. A true Secchi depth reading is where the Secchi depth reaches extinction (the point at which you can no longer see the Secchi disk). Please note that the Secchi depth for the second sample location reached the bottom of the riverbed . The Silt substrate made obtaining a Secchi depth reading impractical in the third location. Silt causes several problems in trying to obtain a Secchi depth reading such as creating unsafe wading conditions by causing field crew members to sink, creating a false Secchi

depth due to silt particulates getting stirred up into the water column, and creating very shallow depths at the MLLW (when turbidity values were collected) that doesn' t allow the Secchi disk to be accurately deployed.
- Ground Survey Points Ground survey points were collected using real time kinematic (RTK) and post-processed kinematic (PPK) survey techniques. For RTK surveys, a roving receiver receives corrections from a nearby base station or Real-Time Network (RTN) via radio or cellular network, enabling rapid collection of points with relative errors less than 1.5 cm horizontal and 2.0 cm vertical. PPK surveys compute these corrections during post-processing to achieve comparable accuracy. RTK and PPK surveys record data while stationary for at least five seconds, calculating the position using at least three one-second epochs. All GSP measurements were made during periods with a Position Dilution of Precision (PDOP) of less than or equal to 3.0 with at least six satellites in view of the stationary and roving receivers. GSPs were collected in areas where good satellite visibility was achieved on paved roads and other hard surfaces such as gravel or packed dirt roads. GSP measurements were not taken on highly reflective surfaces such as center line stripes or lane markings on roads due to the increased noise seen in the laser returns over these surfaces. GSPs were collected within as many flightlines as possible; however, the distribution of GSPs depended on ground access constraints and monument locations and may not be equitably distributed throughout the study area. Base Stations Monuments were used for collection of ground survey points using real time kinematic (RTK) , and post processed kinematic (PPK) survey techniques. Base station locations were selected with consideration for satellite visibility, field crew safety, and optimal location for GSP coverage. NV5 Geospatial utilized one permanent real-time network (RTN) base station from the Washington State Reference (WSRN). NV5 also used two existing monuments for the Nooksack River Lidar project. NV5's professional land surveyor, Evon Silvia (WAPLS#53957) oversaw and certified the ground survey. NV5 utilized static Global Navigation Satellite System (GNSS) data collected at 1 Hz recording frequency for each base station. During post-processing, the static GNSS data was triangulated with nearby Continuously Operating Reference Stations (CORS) using the Online Positioning User Service (OPUS1) for precise positioning. Multiple independent sessions over the same monument were processed to confirm antenna height measurements and to refine position accuracy. Monuments were established according to the national standard for geodetic control networks, as specified in the Federal Geographic Data Committee (FGDC) Geospatial Positioning Accuracy Standards for geodetic networks. This standard provides guidelines for classification of monument quality at the 95% confidence interval as a basis for comparing the quality of one control network to another. For the Nooksack River Lidar project, the monument coordinates contributed no more than 5.6 cm of positional error to the geolocation of the final ground survey points and lidar, with 95% confidence.
- Airborne Survey The lidar survey was accomplished using a Riegl VQ-880-GII green laser system mounted in a Cessna Grand Caravan. The Riegl VQ-880-GII boasts a higher repetition pulse rate (up to 550 kHz), higher scanning speed, small

laser footprint, and wide field of view which allows for seamless collection of high resolution data of both topographic and bathymetric surfaces. The green wavelength (532 nm) laser is capable of collecting high resolution topography data, as well as penetrating the water surface with minimal spectral absorption by water. The Riegl VQ-880-GII contains an integrated NIR laser (1064 nm) that adds additional topography data and aids in water surface modeling. The recorded waveform enables range measurements for all discernible targets for a given pulse. systems can record unlimited range measurements (returns) per pulse, however a maximum of 15 returns can be stored due to LAS v1.4 file limitations. It is not uncommon for some types of surfaces (e.g., dense vegetation or water) to return fewer pulses to the lidar sensor than the laser originally emitted. The discrepancy between first return and overall delivered density will vary depending on terrain, land cover, and the prevalence of water bodies. All discernible laser returns were processed for the output dataset. All areas were surveyed with an opposing flight line side-lap of greater than or equal to 60% (greater than or equal to 100% overlap) in order to reduce laser shadowing and increase surface laser painting. To accurately solve for laser point position (geographic coordinates x, y and z), the positional coordinates of the airborne sensor and the attitude of the aircraft were recorded continuously throughout the lidar data collection mission. Position of the aircraft was measured twice per second (2 Hz) by an onboard differential GPS unit, and aircraft attitude was measured 200 times per second (200 Hz) as pitch, roll and yaw (heading) from an onboard inertial measurement unit (IMU). To allow for post-processing correction and calibration, aircraft and sensor position and attitude data are indexed by GPS time.
- Upon completion of data acquisition, NV5 processing staff initiated a suite of automated and manual techniques to process the data into the requested deliverables. Processing tasks included GPS control computations, smoothed best estimate trajectory (SBET) calculations, kinematic corrections, calculation of laser point position, sensor and data calibration for optimal relative and absolute accuracy, and lidar point classification. Riegl's RiProcess software was used to facilitate bathymetric return processing. Once bathymetric points were differentiated, they were spatially corrected for refraction through the water column based on the angle of incidence of the laser. NV5 refracted water column points using NV5's proprietary LAS processing software, Las Monkey. The resulting point cloud data was classified using both manual and automated techniques. Processing methodologies were tailored for the landscape. Brief descriptions of these tasks are shown below. Lidar Processing Steps Resolve kinematic corrections for aircraft position data using kinematic aircraft GPS and static ground GPS data. Develop a smoothed best estimate of trajectory (SBET) file that blends post-processed aircraft position with sensor head position and attitude recorded throughout the survey. Software used - POSPac MMS v8.5 Calculate laser point position by associating SBET position to each laser point return time, scan angle, intensity, etc. Create raw laser point cloud data for the entire survey in *.las (ASPRS v. 1.4) format. Convert data to orthometric elevations by applying a geoid correction.

Software used - RiProcess v1.8.5, Lidar Launcher v1.1 (NV5 proprietary software), Las Monkey v2.6 (NV5 proprietary software) Using ground classified points per each flight line, test the relative accuracy. Perform automated line-to-line calibrations for system attitude parameters (pitch, roll, heading), mirror flex (scale) and GPS/IMU drift. Calculate calibrations on ground classified points from paired flight lines and apply results to all points in a flight line. Use every flight line for relative accuracy calibration. Software used - Bays-StripAlign v2.19 Import calibrated points into manageable blocks for editing. Software used - TerraScan v.19 Apply refraction correction to all subsurface returns. Software used - Las Monkey v2.6 (NV5 proprietary software) Classify resulting data to ground and other client designated ASPRS classifications (Table 9). Assess statistical absolute accuracy via direct comparisons of ground classified points to ground control survey data. Software used - TerraScan v.19, TerraModeler v.19 Generate bare earth models as triangulated surfaces. Generate highest hit models as a surface expression of all classified points. Export all surface models as GeoTIFFs (.tif)) format at a 3.0 foot pixel resolution. Software used - Las Product Creator v3.6 (NV5 proprietary software), ArcMap v10.6
- 2022-08-26 00:00:00 - The NOAA Office for Coastal Management (OCM) downloaded 18 raster DEM files in GeoTiff format from the Washington Lidar Portal. The data were in Washington State Plane South NAD83(HARN), US survey feet coordinates and NAVD88 (Geoid12B) elevations in feet. The bare earth raster files were at a 3 feet grid spacing. No metadata record was provided with the data. This record is populated with information from the NV5 Spatial, Inc. technical report downloaded from the Washington Dept. of Natural Resources Washington Lidar Portal. OCM performed the following processing on the data for Digital Coast storage and provisioning purposes: 1. Used internal an script to assign the EPSG codes (Horizontal EPSG: 2927 and Vertical EPSG: 6360) to the GeoTiff formatted files. 2. Copied the files to https.

5.1.1. If data at different stages of the workflow, or products derived from these data, are subject to a separate data management plan, provide reference to other plan:

5.2. Quality control procedures employed (describe or provide URL of description):

6. Data Documentation

The EDMC Data Documentation Procedural Directive requires that NOAA data be well documented, specifies the use of ISO 19115 and related standards for documentation of new data, and provides links to resources and tools for metadata creation and validation.

6.1. Does metadata comply with EDMC Data Documentation directive?

No

6.1.1. If metadata are non-existent or non-compliant, please explain:

Missing/invalid information:
- 1.7. Data collection method(s)
- 3.1. Responsible Party for Data Management
- 5.2. Quality control procedures employed
- 7.1.1. If data are not available or has limitations, has a Waiver been filed?
- 7.4. Approximate delay between data collection and dissemination
- 8.3. Approximate delay between data collection and submission to an archive facility

6.2. Name of organization or facility providing metadata hosting:
NMFS Office of Science and Technology

6.2.1. If service is needed for metadata hosting, please indicate:

6.3. URL of metadata folder or data catalog, if known:
https://www.fisheries.noaa.gov/inport/item/67771

6.4. Process for producing and maintaining metadata
(describe or provide URL of description):
Metadata produced and maintained in accordance with the NOAA Data Documentation Procedural Directive: https://nosc.noaa.gov/EDMC/DAARWG/docs/EDMC_PD-Data_Documentation_v1.pdf

7. Data Access
NAO 212-15 states that access to environmental data may only be restricted when distribution is explicitly limited by law, regulation, policy (such as those applicable to personally identifiable information or protected critical infrastructure information or proprietary trade information) or by security requirements. The EDMC Data Access Procedural Directive contains specific guidance, recommends the use of open-standard, interoperable, non-proprietary web services, provides information about resources and tools to enable data access, and includes a Waiver to be submitted to justify any approach other than full, unrestricted public access.

7.1. Do these data comply with the Data Access directive?
Yes

7.1.1. If the data are not to be made available to the public at all, or with limitations, has a Waiver (Appendix A of Data Access directive) been filed?

7.1.2. If there are limitations to public data access, describe how data are protected from unauthorized access or disclosure:

7.2. Name of organization of facility providing data access:
NOAA Office for Coastal Management (NOAA/OCM)

7.2.1. If data hosting service is needed, please indicate:

7.2.2. URL of data access service, if known:

https://coast.noaa.gov/dataviewer/#/lidar/search/where:ID=9574/details/9574
https://noaa-nos-coastal-lidar-pds.s3.us-east-1.amazonaws.com/dem/WA_Nooksack_DEM_2022_9574/

7.3. Data access methods or services offered:

Data is available online for bulk and custom downloads.

7.4. Approximate delay between data collection and dissemination:

7.4.1. If delay is longer than latency of automated processing, indicate under what authority data access is delayed:

8. Data Preservation and Protection

The NOAA Procedure for Scientific Records Appraisal and Archive Approval describes how to identify, appraise and decide what scientific records are to be preserved in a NOAA archive.

8.1. Actual or planned long-term data archive location:

(Specify NCEI-MD, NCEI-CO, NCEI-NC, NCEI-MS, World Data Center (WDC) facility, Other, To Be Determined, Unable to Archive, or No Archiving Intended)

NCEI_CO

8.1.1. If World Data Center or Other, specify:

8.1.2. If To Be Determined, Unable to Archive or No Archiving Intended, explain:

8.2. Data storage facility prior to being sent to an archive facility (if any):

Office for Coastal Management - Charleston, SC

8.3. Approximate delay between data collection and submission to an archive facility:

8.4. How will the data be protected from accidental or malicious modification or deletion prior to receipt by the archive?

Discuss data back-up, disaster recovery/contingency planning, and off-site data storage relevant to the data collection

Data is backed up to tape and to cloud storage.

9. Additional Line Office or Staff Office Questions

Line and Staff Offices may extend this template by inserting additional questions in this section.