

Drop Camera Video Collection

Standard Operating Procedure for the Great Lakes Benthic Mapping Project

Version: 1.2 (2025-01-27)

I. Purpose

This standard operating procedure (SOP) outlines the methods and considerations for collecting underwater videos using a tethered underwater video camera, hereafter referred to as a drop camera, suitable for benthic characterizations. These videos are intended to characterize benthic habitats, ground-truth remotely sensed data (e.g., multibeam and LIDAR), and support predictive models for substrate, species, and habitat.

II. Scope and applicability

High-definition underwater video cameras are among the most efficient and versatile tools for characterizing benthic habitats because they can be deployed in a range of habitats using a range of vessel types, utilized as a standalone device, or mounted to other data collection instruments. Since a tethered camera is addressed, this SOP is intended for sites between 3m and 100m.

Assumptions

This SOP was developed to support the objectives of the Great Lakes Benthic Mapping (GLBM) project. It is intended to standardize data collection and ensure that derived data can be integrated with other benthic data collected using other platforms (e.g. ROVs, AUVs) for the GLBM project.

This SOP focuses on using a tethered, live-feed camera system, which displays camera footage in real-time to operators on the surface, as opposed to cameras that do not have a live feed. The advantage of a live-feed camera is that videos can be used to assess data quality, avoid underwater obstructions, and annotate videos in the field in real-time.

This SOP makes no endorsement or recommendation by mentioning brand names or commercial goods. This SOP uses the Seaviewer 6000 HD live camera system to describe methods because this was the camera system authors have used for several years in the Great Lakes. Other camera systems may be used instead if they meet video minimum requirements.

Regulatory requirements

NOAA Administrative Order (NAO) 216-6A, Environmental Review Procedures for implementing the National Environmental Policy Act (NEPA), requires all proposed federal projects to undergo a review with respect to environmental consequences on the human environment. Underwater video collections that meet the criteria of the Categorical Exclusion for NCCOS Great Lakes Mapping Projects memorandum (NCCOS, 2021) qualify to be categorically excluded from further NEPA review. The criteria include reference to distinct study areas and frequency of sampling.

Permits are generally not needed to collect video data since the bottom is not impacted. However, it is advantageous to communicate sampling plans to the appropriate regulatory agencies if the sampling will take place within a National Park or National Marine Sanctuary. It is also a good practice to reach out to the relevant state agencies to determine if additional state permits are needed.

SOP modification

Field researchers should follow this SOP's instructions precisely when collecting data for the GLBM. If any changes are made, they shall be recorded in the field logbook along with a description of the circumstances requiring their use.

Sampling Roles and Responsibilities

The drop camera field survey team typically consists of three people. 1) A boat captain handles the vessel operations and navigates to target sites. 2) A topside console operator records and manages the data collected in the field. 3) A camera operator deploys and retrieves the camera and manipulates the camera orientation while collecting data. It is important that all members of the team can communicate while collecting data.

1) Boat Captain Responsibilities

- a) Vessel operation and navigation to target sites.
- b) Communicate with the back deck about the distance to the sample site and water depth at the location, and give permission to drop/retrieve the drop camera.

2) Topside Console Operator Responsibilities

- a) Coordinate with the captain on the sample site to be visited.
- b) Create an ID plaque (Cruise ID, Date (MMDDYYYY), Site ID, and Deployment Number (Dxxxx)) for each site and film for 5 seconds before the drop camera is deployed in the water.
- c) Records and annotates the underwater videos and manages the data collected in the field using Survey 123.
- d) Operate the ultra-short baseline (USBL) acoustic positioning system (MicroRanger 2).
- e) Manage sample location maps and cross off completed sites digitally through ArcPro/ArcMap..
- f) Verify all equipment and materials are accounted for prior to the start of the day using the equipment checklist.
- g) Assist with communication between the captain and camera operator
- h) Oversee operations, and ensure all data is being recorded and the best safety practices are being used.
- i) Transfer videos and any other data, such as USBL data, to two mirrored external drives for backup and further processing. Onboard Starlink connection may also be used for direct upload to the google drive.

3) Camera Operator Responsibilities

- a) Ensure that the drop camera is set up and working properly, including video, lasers, and lights.
- b) Deploy/retrieve the drop camera and manipulate the camera orientation.
- c) At the end of the day, ensure all equipment is clean, organized, and secured.

SOP Outputs

- HD videos for the lakebed and the ID plaque at each site. The HD videos are recorded at 25-30 frames/second (or 60 based on the camera used) with a resolution of 1920x1080 pixels and .mov or .avi files based on the DVR used.
- SQLite database from Survey 123 with the sampling site's information and data collected.
- Excel files with USBL navigation data.

III. Methodology and procedures

Requirements

- 1) Research vessel: A small vessel (6-10m long) is preferred because it can collect data in shallow waters and is maneuverable. It also takes advantage of the drop camera's ability to collect data quickly and over many sites.
- 2) Vessel cabin and deck space: A dry cabin is needed to secure sensitive electronics from getting wet (Figure 1). Adequate deck space is required in order to store the camera and associated cables on the deck securely, as well as provide room for safe deployment. A minimum of 2 sq m (~25 sq feet) of open deck space is required. A 120VAC Power on the boat is preferred. Although the Seaviewer 6000 HD can work off batteries, it is ideal to have a 120 Volt AC Power adapter to ensure a full day of work, recharge batteries when needed, and provide a power backup.
- 3) Lifting davit or downrigger/winch (optional): A lifting davit or downrigger/winch on the deck can aid in more rapidly deploying and recovering the live camera system, especially for deep (>30m) sites.
- 4) Seaviewer 6000 HD live camera system. Consists of;
 - A Seaviewer 6000 HD camera with attached dive lights, laser scale, USBL transponder, dive weight (2-3 kg), stabilization fin, tether, and umbilical cable (Figure 2).
 - A topside console contains a TV monitor, video recorder (Seaviewer DVR/Blackmagic DVR), SD cards for storage, an HD video receiver, and a built-in 12-volt dry battery (Figure 2).
- 5) Ultra-Short Baseline (USBL) System: A USBL system is a method of underwater acoustic positioning and is used for tracking underwater objects such as AUVs, ROVs, drop cameras and even divers. Here it will be used for tracking the drop camera to provide a more precise location for the sample. The system used in this SOP is a Sonardyne Micro-Ranger 2 USBL system, and it consists of;

- A Micro-Ranger Transceiver (MRT) mounts on the USBL pole and submerges a few feet (2-3) below the boat hull to transmit an acoustic signal to the transponder attached to the drop camera.
 - A Nano transponder attaches to the drop camera to determine its location and depth.
- 6) A laptop or PC with Micro-Ranger 2 Software installed. This computer displays the results on a radar-style monitor and stores navigation files (Figure 3).
 - 7) A second laptop or PC with Survey123 and ArcMap. This computer will be used to record event data and visualize site locations. A second computer has been required because operating Survey123 and Ranger simultaneously has been very challenging. If possible, the two computers should mirror each other to provide redundant systems.
 - 8) Vessel Navigation system - A dedicated system for the boat captain to visualize the location of sites and map a course to sites



Figure 1. NOAA vessel (R2601 26' SeaArc) used by NCCOS for the ground-truthing missions for the study area at Bayfield Marina, Lake Superior-Wisconsin. Photo: NOAA/NCCOS

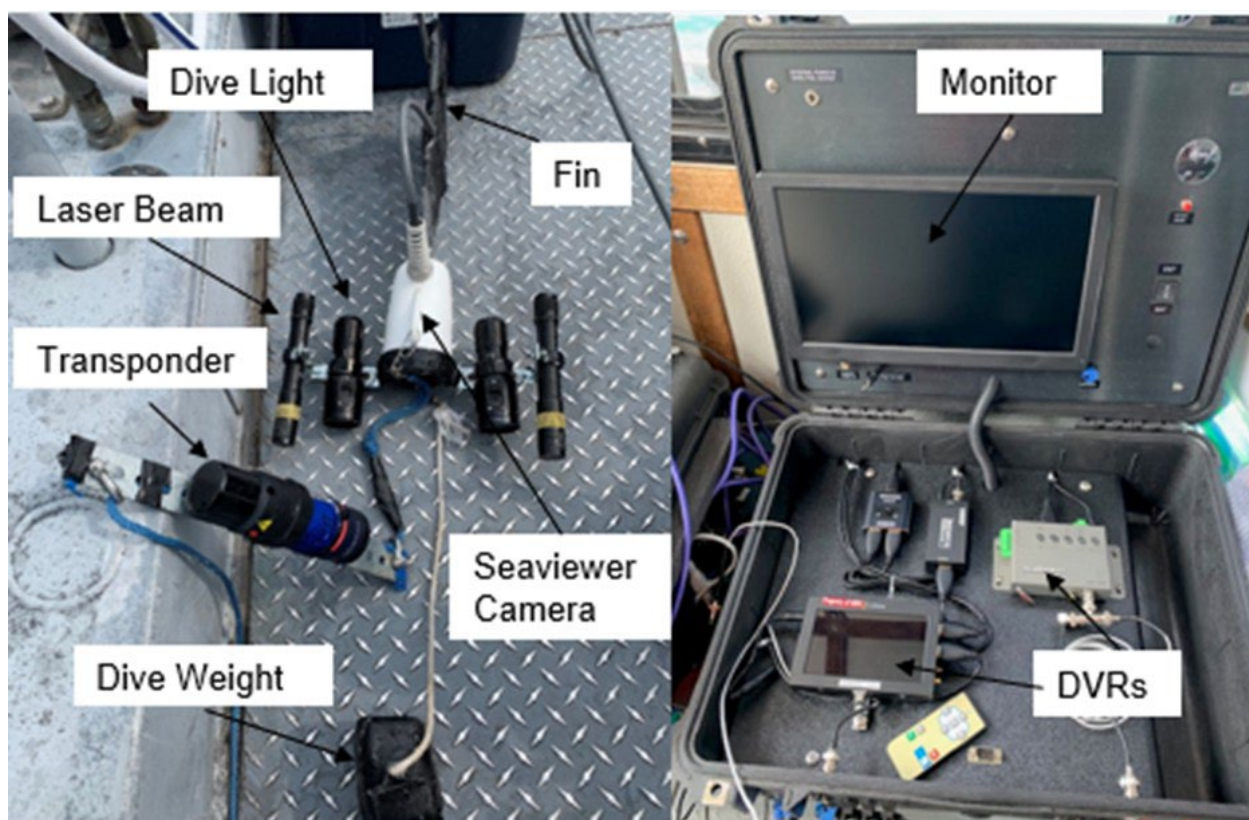


Figure 2. Right, the Seaviewer camera topside console contains a TV monitor, transformer, video recorder, video receiver, camera remote controller, HDMI adapters, and a built-in 12V dry battery. Left, the Seaviewer 6000 HD camera with attached dive lights, laser scale, transponder, dive weight, stabilization fin, tether, and umbilical cable. Photo: NOAA/NCCOS

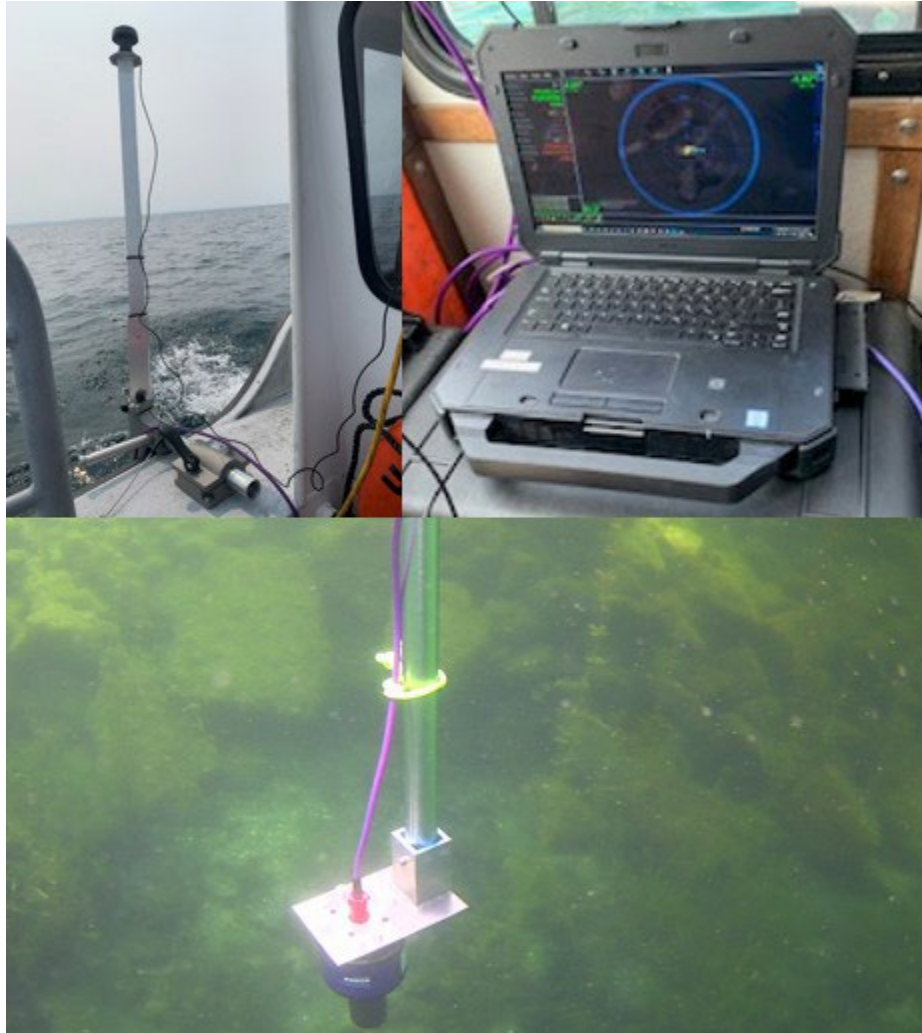


Figure 3. Top right, Micro-Ranger 2 application on a laptop showing the transponder location. Top left, Micro-Ranger 2 pole with the GPS antenna. Bottom, Micro-Ranger 2 transceiver underwater on the USBL pole. Photo: NOAA/NCCOS

Equipment Setup

The standard setup for the live underwater camera uses a durable braided hand line as the tether, a fiber optic umbilical cable, a 2.3 kg (5 lbs max) dive weight, a metal rod below the camera, and a small plastic fin to position the camera view forward (Figure 3). The dive weight is very important for any drop camera setup. It allows the underwater camera to descend more rapidly, particularly in high current areas. The metal rod helps classify fine unconsolidated sediments by contacting the bottom and penetrating the sediment layer. Since a live video feed is available, the operator can decide where to contact the bottom and ensure sensitive habitats or features on the bottom are not disturbed. As the rod makes contact with the bottom, the analyst can estimate the composition of unconsolidated sediments by observing the settling rate of suspended particles. Coarse sands resettle quickly, while fine sands and silts remain suspended in the water column for longer periods of time.

Other accessories need to be attached to the drop camera to enhance the video quality and increase annotation precision. These accessories include two dive lights to provide better visibility in deeper or more turbid sites and a pair of parallel laser beams for scaling sediment grain size on the bottom and for frame calibration in the annotation process.

To set up the USBL (Micro-Ranger 2 system by Sonardyne), simply connect your computer, external GNSS, and transceiver to the system's interface unit (topside unit), then attach the transponder to the drop camera. With the transceiver lowered into the water and your laptop linked via WiFi to the topside unit, you're ready to start tracking at up to ranges of 995 m. A built-in battery provides more than 10 hours of continuous use, enough for a full day of activity out on the water. The case can also accept external power from a boat or shore supply.

Procedures

1) Field Mission Preparation

• Prior to Cruise

- Read and understand the cruise/mission plan
- Create an equipment checklist [example of a packing checklist](#)
- Check that all essential field gear is on-site using the checklist
- Send target sites to the boat captain to upload to the boat's navigation system
- Check out ArcGIS offline license, survey 123 on field laptop/PC
- Check digital/hard copy binder including all SOPs, sites list, sites maps, mission plan, GAR, permits, equipment manuals, ...)
- Format SD cards to be used in DVR recorders (Seaviewer and Blackmagic) and assign an SD card for each since each one has a different format.

• At Dock (Everyday)

- Assess mission risk, typically performed by the captain using a GAR
- Decide on target sites for the day
- Set up field laptop/PC - plug-in, open ArcGIS and Online Survey 123
- Set up USBL computer - plug-in, sign in, open Ranger 2 software
- Ensure USBL GNSS, transceiver, and transponder are working
- Ensure all clocks on equipment (DVRs, USBL/field computers) are synchronized to UTC time
- Assemble the camera with the accessories (dive lights and laser beams) and lubricate the O-rings with silicon grease.
- Check batteries and change them if needed.
- Test drop camera equipment is working properly (video recorder in HD sitting 1920x1080, lights, lasers)
- Perform scale calibration of the laser beams. Set to 25.6 cm.
- Attach one USBL transponder to the camera (if two transponders are available, attach the other to the PONAR sampler)

- Ensure transponders are enabled before attaching.
- Secure equipment and USBL Pole on the boat for transit
- Inform the captain of any potential issues or concerns

2) Pre-deployment Preparation

- During transit to the site
 - Record the target site information on a tablet (cruise ID, date, site ID, dive ID)
 - Enter site information using Survey 123
 - Look for hazards and obstacles (in GIS and buoys for trap nets, etc)
- Approaching the target site:
 - At 100-200 ft from the site, drop the USBL pole as directed by the captain
 - Ensure the camera, light, and calibrated laser are working properly.
 - At 50 ft, start recording tablet and UTC time (Figure 4)

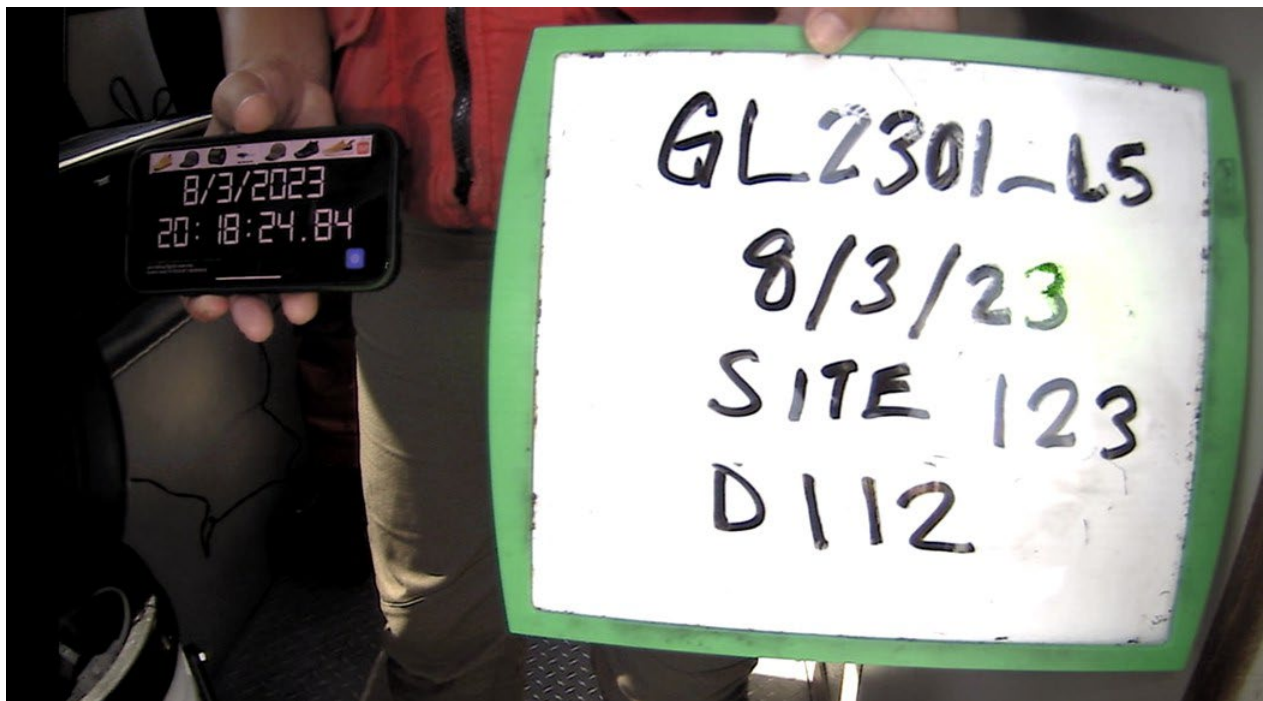


Figure 4. A placard with the site information of a ground-truthing (GT) site. This information must be recorded prior to deployment to identify the site and time of underwater videos. Photo: NOAA/NCCOS

3) Deployment and Data Collection Procedure

- At site (0-6 m, 0-20 ft)
 - The team should be ready with equipment in hand

- When the ship is within 6 m (20 ft) of a site, the boat captain should direct the Topside Console Operator and Camera Operator to deploy the camera. A countdown or calling out the distance is helpful. Generally, deploying the camera on the upwind side of the vessel is best, but the boat captain should specify the Deployment Specifics.
- Depending on depths and conditions, captain may hold station by backing into the wind with one engine, upwind of the target site, so that the camera can safely reach annotation height without drifting beyond the target. Such a maneuver requires greater awareness of tether position and scope and verbal communication from Camera Operator
- Deploy the camera as directed by the captain and communicate to the captain that the camera was deployed (Figure 6).
- Check USBL logging, video recording, video quality, laser, and light.
- The camera operator should deploy the camera in a downward position to provide a look at the benthic habitat as it descends, while guarding against straining the tether.
- The transect on the bottom includes a range of perspectives and altitudes to provide as full a picture of the lakebed as possible with a drop camera. These are detailed in the following steps and summarized in figure 5.

Drop Camera Transect: Orientation and Height changes

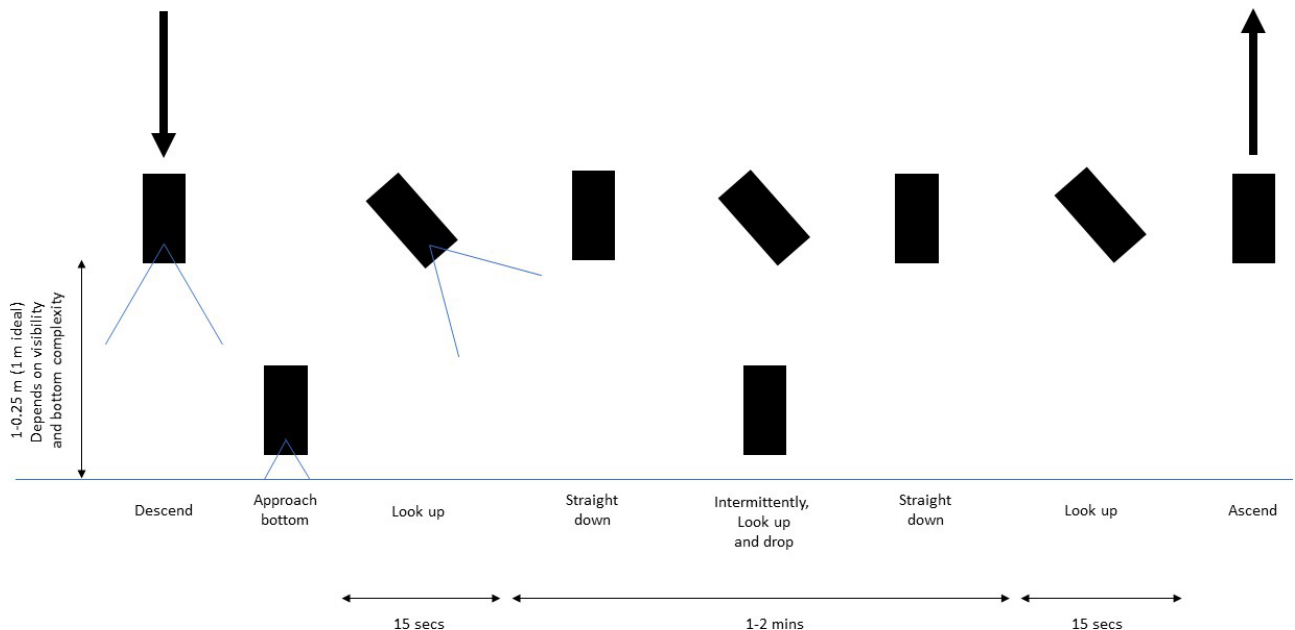


Figure 5. Schematic of a drop camera transect

- If safe, descend so that the camera stops right above the bottom, but not touching. This adjusts the camera color settings and improves the video.
- Bring the camera up to survey height, ~ 1 meter above the bottom. The height can be less than 1 m if water visibility is poor and is needed to better discern benthic substrates.
- Once the camera arrives at survey height, it should be shifted to provide an oblique view (close to perpendicular to the lakebed) for approximately 15 seconds.
- The camera should then point downward or as close to downward as possible so that the camera weight is not in the frame for 2 min. If the bottom is heterogeneous, the transect should extend to 2 min; otherwise, 1 min is sufficient. If the bottom is heterogeneous, it is also advisable to change the orientation of the camera and decrease the height above the bottom at major benthic transitions to get different and better perspectives of the lakebed. These deviations from a downward pointing orientation should be brief, 5-10 secs so that the majority of the transect is accomplished with a downward pointing camera at survey height.
- Before retrieving the camera, it should again change to an oblique view for 15 seconds (Figure 5).
- During the video collection, it is advisable to use the weight to test the type of fine sediment (sand, silt, or clay) every 30 seconds or so.
- Communicate deployment camera events to the Topside Operator and boat captain, including: on the bottom, off the bottom, and onboard.
- The topside operator records events and observations on Survey 123 and provides directions to the camera operator if needed (view, altitude, bottom check, site termination)
- The camera operator retrieves the camera, communicates camera on board
- The topside operator stops video recording and transponder recording when the camera comes onboard
- The dive information is submitted to Survey 123, and records are checked for completeness.



Figure 6. The camera operator deploys the camera with the accessories and USBL transponder (Nano) attached. Photo: Kaden Staley (MTU)

4) Post -Deployment Procedures

- Pull up the USBL pole with the attached MRT and secure it.
- Prepare for the next site
- Monitor time to account for transit back at the end of the day

5) End of Day

- Rinse the drop camera, accessories, and cable with fresh water and let dry.
- Confirm all HD videos are saved on the SD drive
- Confirm USBL/Survey 123 data are exported and saved on the hard drive/memory stick
- Take SD drive, hard drive/memory stick for backups and copy data to 2 NCCOS hard drives
- Copy ArcGIS Dive Reporting Layer to 2 NCCOS hard drives
- Fill out the Cruise End-of-Day Data Collection Sheet ([link](#))
- Ensure that Topsides and batteries used are fully charged for the next day.

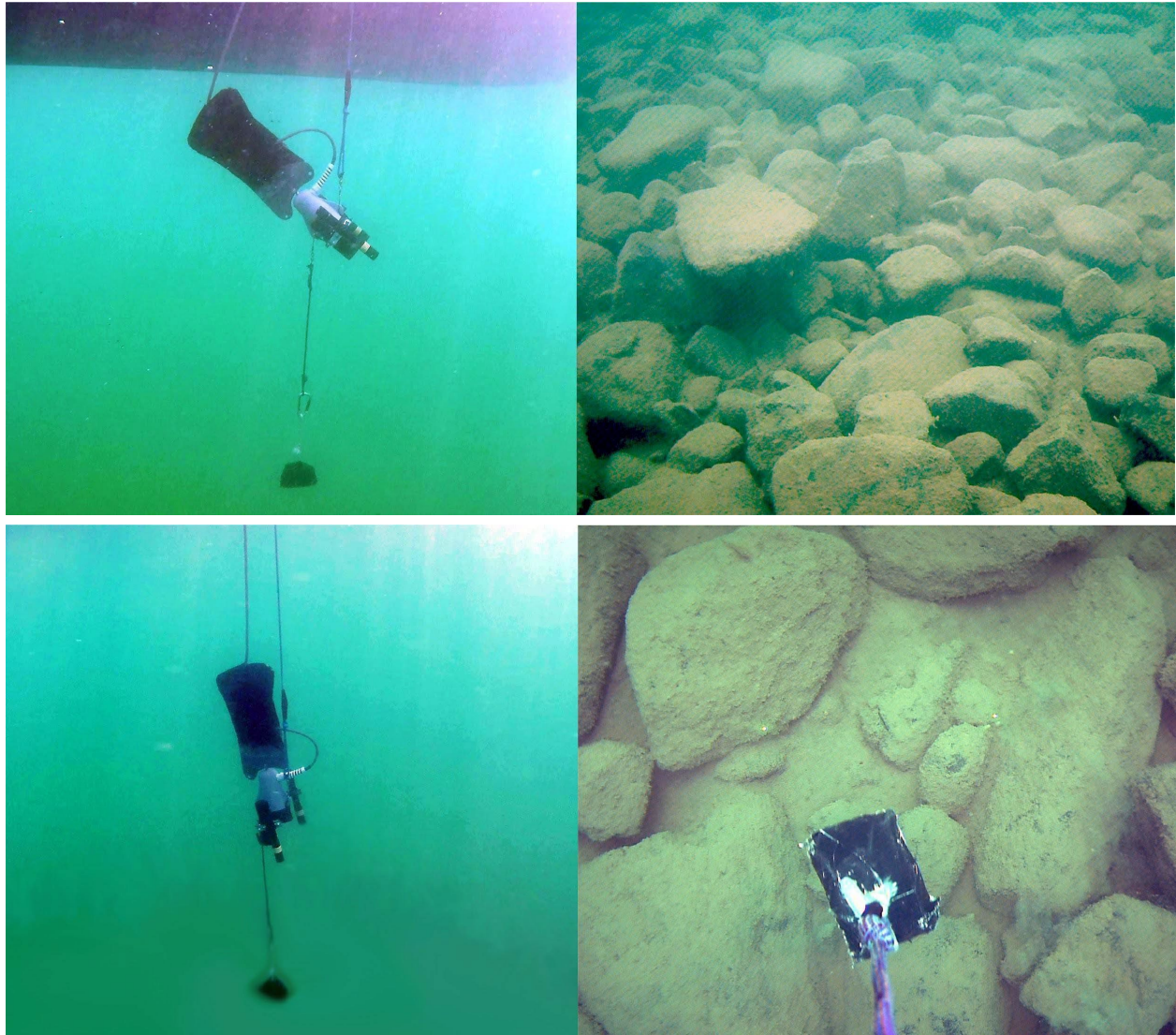


Figure 7. Top the Seaviewer camera is in a forward/oblique position (left), and the camera forward/oblique view with a larger footprint (right). Bottom, the Seaviewer camera is in a downward position (left), and the camera downward view at 1m from the lakebed (right). (Mabrouk et al., 2020)

IV. Clarification of terminology

AHD	Analog High-Definition
AUV	Autonomous Underwater Vehicle
DVR	Digital Video Recording
GLBM	Great Lakes Benthic Mapping
GNSS	Global Navigation Satellite System
GT	Ground Truthing

HD	High Definition
MTU	Michigan Technology University
NCCOS	National Coastal Centers for Ocean Science
ROV	Remotely Operated Vehicle
USBL	Ultra-Short Baseline Acoustic Positioning System

V. Equipment and supplies

The field team lead must develop a checklist of sampling equipment and materials prior to the start day of the field trip and ensure that proper sample containers and labeling materials are accounted for. The list must include field measurement equipment and materials listed below. The field team must also ensure that all field equipment is in good working condition and have backups for critical equipment.

Drop Camera

1. SeaViewer Camera HD-AHD with 350 ft cable, power switch, and camera setting remote controller
2. Topside Unit (contains a TV monitor, transformer, video recorders, video receiver, HDMI adapters, and 12V dry battery)
3. AC Adaptor & Charger Adaptors
4. (2) SD Card + 2 Card Reader
5. Fin for the camera
6. (1) 5lb plastic enclosed lead weight
7. (2) Rope 200 ft (length depending on the depths of the sites)
8. (2) LED Light for the camera
9. (2) Laser beams
10. Backup batteries and chargers for the lights and lasers
11. Frame for mounting the lights and laser beams around the camera
12. Data collection sheets (printed on water resistance papers) to serve as a backup if Survey 123 does not function
13. Whiteboard slate
14. Pens, pencils, sharpies, write-in-rain paper, clipboards

Navigation System (USBL)

1. USBL system (Topside controller unit, Transponder, Transceiver, Laptop)

Data Storage

1. Two hard drives for storing videos, USBL, and Survey123 data. Each hard drive should be at least 1 TB, and ideally more, to ensure adequate space for multiple days of collection.

Extra/Backup Equipment

1. SeaViewer camera HD-AHD with 350 ft cable
2. 2 external dive lights
3. 2 laser beams
4. 1 Fins for the camera

VI. Cautions and interferences

- The team should avoid deploying the drop camera at the target sites if fishing gear is found nearby. If possible, an alternative site should be visited instead.
- Ensure the boat is within 6 m (20ft) of the planned site before deployment. Ask the captain for a second attempt to get within this range (0-20ft)
- In case laser beams are not visible while recording, check batteries and resample the site. Laser points in the video are essential for video annotation.
- Camera deployment should be upwind as the boat drifts away from the camera. This decreases the chances of the umbilical going under the boat or getting entangled in the propeller.
- The drop camera operator should keep a one-meter distance from the bottom when drifting and avoid getting close to debris or logs due to the risk of entanglement. If any branches are observed, the camera should immediately be hauled up to a safe altitude. If the site is deemed safe, the camera can then descend to complete the site.

VII. Data and Records Management

The console operator must ensure that all the required ground-truthing data is recorded at each site before moving to the next one. At the end of each day, collected data (videos, field maps, notes, and USBL files) should be transferred to two mirrored external hard drives for backup. ViceVersa or other data management software can be used to transfer and update the data collection safely.

VIII. Health and safety warnings (if needed)

When operating the drop camera, follow these safety precautions:

- Wear appropriate apparel and personal safety equipment, including a personal floatation device (PFD), safety boots, helmet, and gloves.
- Ensure implementation of the Operational Risk Assessment Form (GAR) daily.
- Avoid placing any body parts in the path of the cable or camera during deployment or retrieval.
- To avoid tripping and slipping hazards on the boat, keep the camera tether (300-400ft rope) and umbilical cord in a bucket or other container.
- In poor weather, switch to more protected areas or suspend operations if necessary.

- Ensure that the USBL pole, camera, and cable are secured and anchored properly to prevent accidents or damage to equipment, especially in transit.
- Use caution when using the winch and handling the camera and cable, as they may be heavy or cumbersome.
- Make sure to use silicone grease for O-rings (dive light and laser).
- Follow all relevant safety regulations and guidelines.

References

Mabrouk, A., C. Menza, and W. Sautter. 2022. Best Practices for Ground-Truthing and Accuracy Assessment of Lakebed Maps in the Great Lakes: A case study offshore the Bayfield Peninsula in Lake Superior. NOAA Technical Memorandum NOS NCCOS 295 Silver Spring, MD. 25 pp.
<https://doi.org/10.25923/f1tn-0694>

SOP Version table

Version	Date	Notes (e.g. writer, major changes)
1.0	2024-04-24	Ayman Mabrouk
1.1	2025-02-20	Updated after GL2401 (WSCNMS)