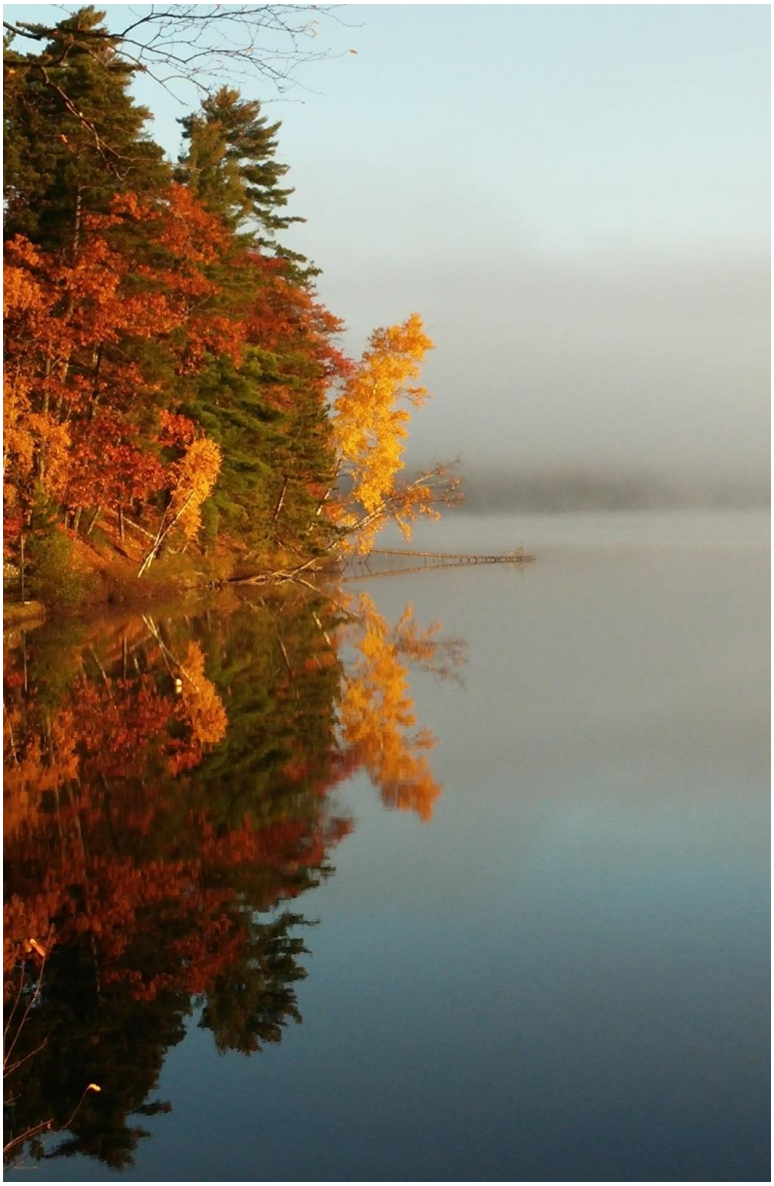
Lake Shoreland & Shallows Habitat Monitoring Field Protocol

Wisconsin Department of Natural Resources
July 20, 2020



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Contents

Overview and Purpose

This protocol provides a standard methodology for surveying, assessing, and mapping habitat in lakeshore areas, including the Riparian Buffer, Bank, and Littoral Zones. This survey will be conducted by county staff, consultants, Wisconsin Department of Natural Resources (WDNR) staff, and other professionals and can be funded through the surface water grant program (Lake Protection, River Protection, and Aquatic Invasive Species are authorized by ss. 281.68, 281.69, 281.70, 281.71, 281.72, and 23.22(2)(c), Wis. Stats. and administered under chapters NR 190, 191, 192, 195, and 198, Wis. Admin. Codes).

The data is being collected to provide important and useful information to local and regional resource managers, community stakeholders, and others who are interested in protecting and enhancing Wisconsin's lakes. We anticipate that the data generated from this protocol will be used for:

- Teaching and outreach
- Identifying areas for protection or restoration
- Targeting future Critical Habitat Designations within lakes
- Creating lake management plans
- Creating county comprehensive plans
- Aiding management at the county level
- Planning Aquatic Plant Management
- Evaluating trends in lakeshore habitat over time (repeat survey every ~5 years)
- Understanding trends in lake ecology (e.g., fish, wildlife, invasive species)

Data collected as part of this survey is submitted to WDNR and then displayed on the Lakes and AIS Viewer. Further lake-wide statistics can be generated from this such as: percent cover of impervious surface, mowed lawn, or plants in the Riparian Buffer Zone, number of parcels with erosion concerns, total length of modified banks, density of human structures (piers, buildings, etc.), general distribution of floating and emergent aquatic plants, and density of coarse woody habitat. For each metric, a threshold identifying healthy habitat will be developed. This information may eventually be used for the WDNR Water Quality Report to Congress, which summarizes the condition of surface waters in Wisconsin.

The time commitment to complete the protocol is reasonable for most Wisconsin lakes, although it will take substantial effort on lakes with long shorelines. We recommend conducting this protocol by circling the lake two times with two people in a small boat:

1. Loop 1 - Take georeferenced photos that slightly overlap and assess the riparian, bank, and littoral habitat by parcel
2. Loop 2 - Count and map all pieces of large woody habitat in water less than 2 feet deep

Woody habitat should be inventoried separately because the team will need to get close to shore and use extreme focus to find all pieces of large woody habitat.

Requirements

- The habitat assessment should be conducted during the growing season at a date late enough for plants to have leafed out and landowners to have landscaped their property, but before plants senesce and landowners store piers and other equipment for the winter.
- The woody habitat survey could occur at a separate time; spring and fall provide optimal conditions with clear water and few aquatic plants in many lakes.
- The same people should assess all properties on the lake.
- The team should calibrate their eyes to recognize distances by physically measuring common distances with a tape measure or range finder (see Estimating Distance).
- The team should calibrate their eyes to recognize log diameters using the wood calibration stick (see Estimating Diameter and Length of Coarse Woody Habitat).

Equipment

General

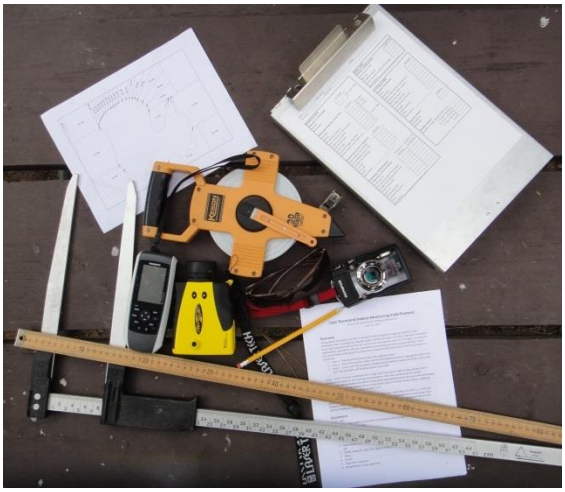
- Data sheets (“Rite in the Rain” paper)
  OR
- Tablet computer with GPS, digital camera, and virtual forms (optional, but useful)
- Pencils
- Boat Equipment
  - Life Jackets
  - Anchor
  - Oars
  - Motor & Fuel

Georeferenced Photos

- Digital camera with GPS
  - Spare SD Card (or other storage)
  - Spare batteries

Habitat Assessment

- GPS
  - Pre-loaded coordinates of shoreland parcel property boundaries
  - Spare batteries
  - Spare GPS unit
- Maps
- Range finder in feet
- Forestry tape measure (50 feet)
- Yard stick or handheld depth finder
- Flagging tape or cones
- Polarized sunglasses



Coarse Woody Habitat Inventory

- GPS
- Secchi disk
- Wood calibration stick
- Polarized sunglasses

Georeferenced Photos (Loop 1)

This is an opportunity to document shoreland habitat condition at a single point in time, and the results may be referred to years later. The entire shoreline should be photographed with slightly overlapping images that are taken from a vantage point ~50 feet from and perpendicular to shore. The water's edge and understory vegetation 35 feet inland should be visible in the photo. Tree crowns may be partially cropped out of the photo.

Photographic Equipment

A variety of cameras may be used:

1. Digital Camera with internal GPS – this option results in high quality, georeferenced photos. The latitude and longitude of the camera's position when the photo was taken is stored with the photo, and locations can be uploaded directly to GIS.
2. Digital Camera and separate GPS unit – this option results in high quality photos that can be georeferenced with post-processing work. Manually adjust your camera's clock so that it displays the same time as your GPS clock. The locations of individual photos can be derived by matching the date/time of each photo with the date/time of the location recorded by the GPS. Check to make sure that the date and time is recorded for each photo and that the GPS unit is continuously recording your path.
3. Smartphone with camera and georeferencing capacity – this option may result in lower photo quality depending on the phone, but has the ability to georeference each photo.
4. Tablet computer with internal GPS and camera – this option has the ability to georeference and store each photo. Check the quality of the camera.

Photo Tips

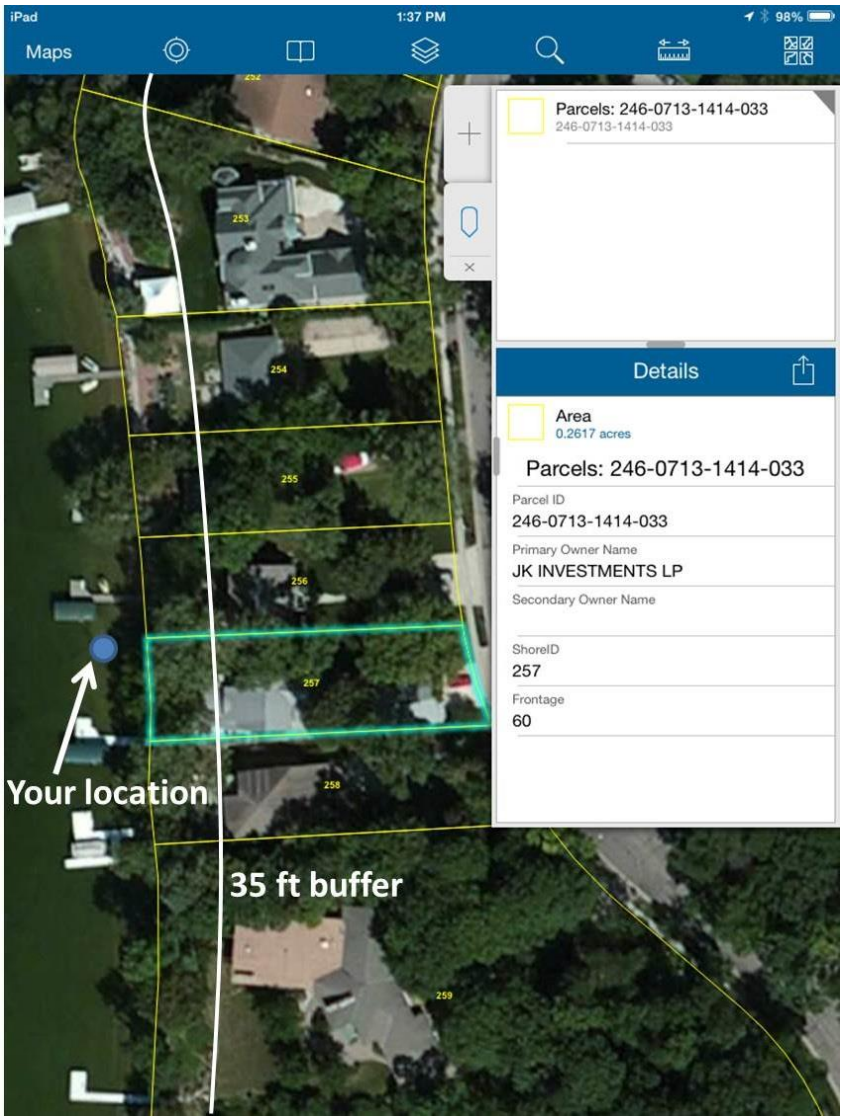
- If possible, photograph early in the morning or early in the evening to avoid harsh sunlight conditions (or do half the lake in the morning and half in the evening to avoid backlit conditions).
- Do not take photos into the sun.
- Make sure the photo is level and in focus.
- Increase the focal length (high f-stop) to improve depth of field (full frame in focus) or use auto settings with Landscape option.
- Increase the shutter speed to prevent blur.
- Avoid zooming in too close. Try to frame the water's edge up to the canopy with sufficient detail for assessment.
- Respect privacy:
    - Notify the lake association or local paper about the habitat survey in advance.
    - Do not take photos with people in them (weekday mornings are ideal).
    - Avoid taking photos too close to shore or into windows.
    - Listen and respect resident's concerns. These photos will primarily be used for shoreland habitat assessment and lake management plans, but will be a public record and may be used for additional purposes.

Habitat Assessment (Loop 1)

Mapping Prior to Field Work

The shoreland habitat assessment is conducted for each parcel around the lake. Prior to doing field work, maps must be created. At a minimum, maps should include:

1. Satellite imagery of the lake (e.g., Google or World Imagery in ArcMap)
2. Parcel layer that shows the parcel boundaries: https://www.sco.wisc.edu/parcels/data/
3. Parcel ID and the feet of frontage for each parcel
4. Line depicting the 35-foot riparian buffer (use the lake edge of the parcel boundary, not a separate lake polygon file)
5. GPS coordinates where each parcel boundary intersects the lake shore (if using paper maps and a GPS without the parcel map displayed)

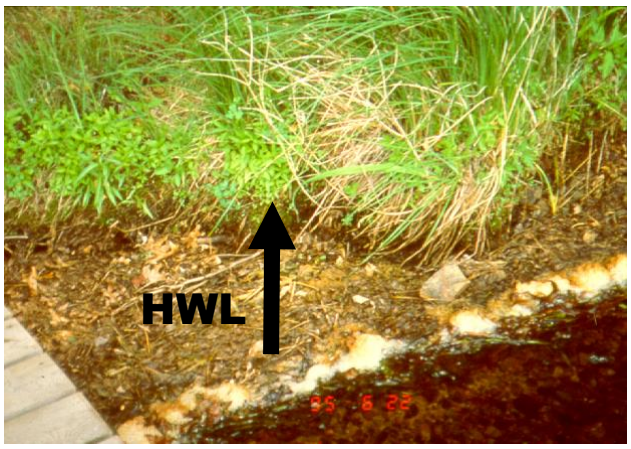


Depending on available technology, there are a variety of ways that navigation in the field may be accomplished. The first option is to use a handheld GPS to navigate to the parcels in conjunction with a paper map. This option requires uploading x,y coordinates for each parcel-lakeshore intersection point to the GPS unit. Use the GPS to navigate close to each point and reference the paper maps to determine the parcel boundaries.

Alternatively, you may take a tablet computer loaded with all necessary map layers into the field. The GPS within the tablet will allow you to view your location relative to the mapped parcel boundaries. This works well with ArcPad, an ESRI software package. If you do not have a license for ArcPad, you may instead use free software (ArcGIS Collector and Google Maps) on a tablet computer or a smartphone. However, a 3G/4G signal is required to view your location relative to the map.

Quality Assurance – Determining High Water Level and Estimating Distances

High Water Level



This protocol is meant to assess habitat regardless of water levels. Before initiating monitoring, the lake level in relation to the approximate Ordinary High Water Mark (OHWM) should be determined and recorded on the quality assurance data sheet. **The OHWM has legal ramifications and must be determined by qualified staff. This protocol will not make legal OHWM determinations, but will borrow the concept to approximate a boundary between land and water called the "High Water Level" or "HWL" in this protocol.** Check the corresponding box if the current water level is below, at, or above the HWL (see Definitions). If water levels are low, the Riparian Buffer Zone could be tens of feet (or more) inland from the present waterline. If the water level is above the HWL, expect to find terrestrial vegetation underwater.

Estimating Distance

This protocol requires estimating distances inland and along the length of shore. Improving your ability to estimate distance inland and along the shore requires practice, so all observers should practice estimating both types of distances before conducting the survey. One quality assurance data sheet must be filled out per crew and lake.

MEASURE & FLAG:
Find a riparian property where you may enter to measure and flag various distances onshore. Measure and flag distances **only** on land you may legally access: public land or private land you were given permission to access.

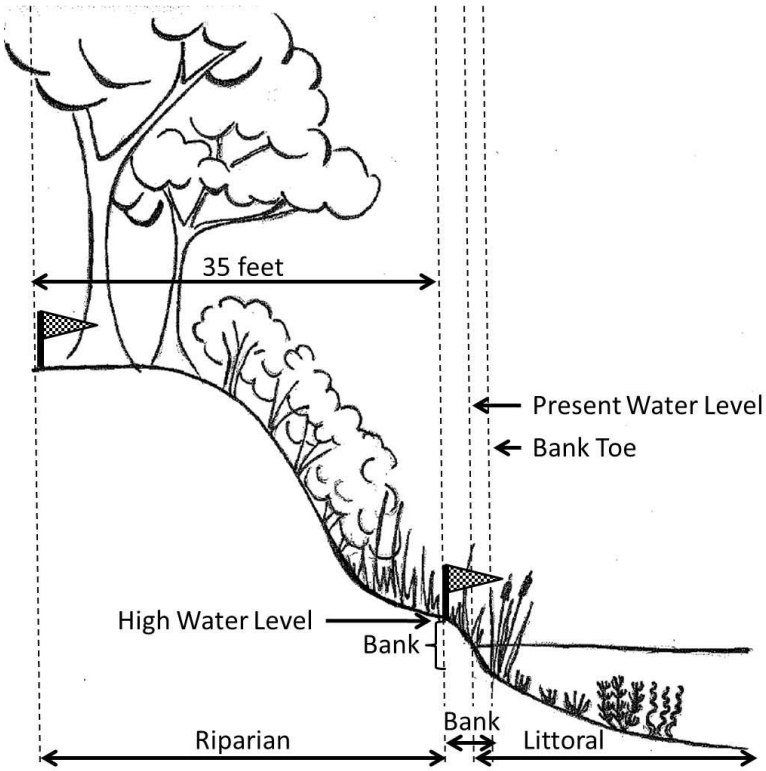
1. Measure distance inland: Measure 35 feet inland from the HWL perpendicular to shore and place a flag at that point. If possible, repeat this exercise on public land with varying degrees of vegetation (e.g., an open boat landing vs. dense forest) and varying slopes. Measure the 35-foot distance inland horizontally (do not follow the slope angle).
2. Measure distances parallel to shore: Measure five 10-foot intervals, one 50-foot interval, and one 100-foot interval on shore and flag them. (Bank modifications require estimating horizontal distances.)
3. Observe those distances from the water: Go out on the boat and observe the flags; try to get a sense of the 35-foot buffer inland distance and the varying distances parallel to shore (Fig. 1).

ESTIMATE:
Next, practice estimating the length of shoreline features of unknown distance. Make all estimations from the boat as if you were conducting the survey.

4. For each of 3 replicates, record the estimated and measured distances. You may either:
    a. Flag at least 3 unknown distances of each type (3 inland and 3 parallel to shore) for the rest of the crew to estimate before going out on the boat.
    b. Choose landmarks on shore and estimate their distances from the water (at least 3 distances of each type for a total of 6). Then go back to shore to measure the actual length of the estimated feature with a tape measure.
    c. Choose landmarks on shore and estimate their distances from the water (at least 3 distances of each type for a total of 6). Then use a range finder to test your inland distances. Use a tape measure on land to test the parallel distances.
5. Test the accuracy of your range finder by shooting it to at least 3 different objects on land and then measuring the distance with a tape measure. For each replicate, record the distance estimated by the range finder and the distance measured with a tape measure. Ensure that the range finder is accurate within 2 feet.

Figure 1. Example of cones marking the Riparian Buffer Zone (yellow vest on post 35 feet inland along the horizontal) and distances parallel to shore as viewed from a boat.

Defining an Assessment Boundary



Shoreland habitat will be evaluated within each parcel. The *Riparian Buffer Zone* begins at the HWL and extends inland 35 feet (Fig. 2). The *Littoral Zone* extends from the present waterline into the lake. The width of the Littoral Zone may vary, but generally includes the area near shore where aquatic plants and human structures are present in the water. The *Bank Zone* is the region between the edge of the top-of-the-bank lip and the bank toe, which is the inflection point between the bank face and the lake bed. It includes the bank face and the shore.

Figure 2. Profile view of lake shore illustrating three habitat zones when water level is average.

The HWL will normally be on the bank face (Fig. 3). Note that depending on where the HWL and the present water levels fall, the Bank Zone can overlap with the riparian and Littoral Zones. In Fig. 3, the Riparian Buffer Zone includes the upper part of the bank. When water levels are low, the lake bed is exposed (Fig. 3). Exposed Lake Bed should be assessed if the present water line is at least 3 feet horizontally out from the bank toe.

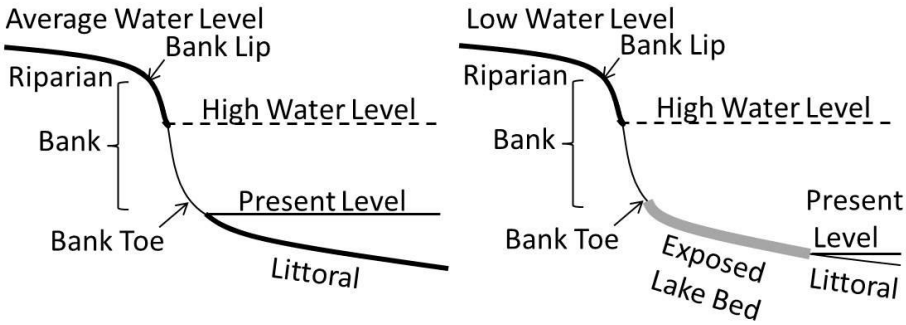


Figure 3. Habitat zones in relation to the High Water Level when the present water level is average (left) or low (right).

From a boat, navigate to the first parcel you will assess. Use landmarks and aerial photography from your map together with GPS coordinates and the rangefinder to define the parcel boundaries and the 35-foot setback. Go close to shore to view the parcel.

Riparian Buffer Zone

Percent Cover

Using your satellite imagery map and observations from the boat, visualize looking down on the Riparian Buffer Zone from the air. If a rain drop fell from the sky, what would it land on? Estimate the percent covered by each of the following in the Riparian Buffer Zone only:

1. Canopy - large trees at least ~16 feet tall (0-100%)

Ground layers (sum to 100%):

2. Shrubs and herbaceous plants - shrubs are woody plants with multiple stems or tree saplings approximately < 16 feet tall and herbaceous plants are grasses and forbs
3. Impervious surface – concrete, decking, boulders, stone, rip rap, rooftops, compacted gravel/soil, boats flipped over on shore
4. Manicured lawn
5. Agriculture - row crops, pasture, range, hay field
6. Other - duff, bedrock, gravel, bare soil, sand, mulch, etc.

Percent canopy cover can be up to 100% regardless of the other percent cover categories because tree canopies can overlap with the other categories. For example, tree branches may shade patio, lawn, and herbaceous plants. The sum of all "ground layers" (shrub/herbaceous plants, impervious surface, manicured lawn, agriculture, and other) must equal 100%. Shrubs and herbaceous plants may overlap and be difficult to distinguish. Estimate their combined percent cover and mark whether the estimate included shrubs and/or herbaceous plants. Check both boxes if both were present. Report percent covers in multiples of 5%. For example, if impervious surface only includes a couple of stairs on a 100-foot long parcel, report 5% cover.

Plants are only quantified in terms of their growth form, but not their taxonomic identity. Percent cover of non-native plants are quantified together with native plants. Species identification skills are not required to conduct this survey. Thus, a Riparian Buffer Zone with 100% cover of reed canary grass, an invasive, will appear the same as a buffer with 100% cover of native sedges. Species identification could be added for individual surveys if desired.

On some lakes, individual parcels could be very large, covering miles of shoreline. If the shoreline is completely undeveloped (i.e., no buildings, mowing, cleared vegetation, etc.), list 100% canopy cover and 100% shrub/herbaceous cover. If a lot of shoreline is covered by wetlands or prairie without trees, try to estimate the actual percent canopy cover (do not assign 100%). If there are signs of human disturbance (structures, cleared vegetation, etc.) in a small section of the entire parcel (e.g., 50 feet of shoreline on a 1600 foot long parcel), then you may assume the disturbed area covers 5% of the entire Riparian Buffer Zone (see example Parcel E on page 28).

Human Structures in the Riparian Buffer Zone

Count the number of structures that are present within the Riparian Buffer Zone of the parcel.

- Buildings (e.g., residence, shed, boathouse, garage, commercial building)
- Boats (generally flipped upside down on shore for storage)
- Fire pits (free standing or built in the ground)
- Other – include written description (e.g., retaining wall), but avoid counting small objects that are easily moved (e.g., toys or lawn chairs)

Runoff Concerns

Look for changes to the land that would increase runoff into the lake (see list below). Record whether the runoff concern occurs within the Riparian Buffer Zone ("Present in Riparian") or within the parcel but outside of the Riparian Buffer Zone ("Present out of Riparian"). If the runoff concern is present in the Riparian Buffer Zone, you do not need to search in detail outside of the Riparian Buffer Zone. You may still check both boxes if the concern occurs both in and out of the Riparian Buffer Zone, but this will not be reflected in the data entry form. When entering data to the spreadsheet, you will enter 0 if the item is absent, 1 if it is present only outside of the Riparian Buffer Zone, and 2 if it is present inside the Riparian Buffer Zone. There is not a separate code if the item is present both in and out of the Riparian Buffer Zone because the Riparian Buffer Zone is most proximate to the lake.

Record presence of:

- Point sources (e.g., culverts, drain pipes, rain gutters, sump pumps, gray water outflow)
- Channelized flow or gullies
- Stairways, trails or roads leading directly to the Bank Zone (top of the bank lip)
- Sloped lawn/soil (such that water runoff leads directly to the lake)
- Bare soil
- Sand/silt deposits
- Other – include written description

Bank Zone

Bank Modifications and Erosion

Estimate the length (to the nearest 10 feet) of the following items if present. Train your eye to recognize 10 foot increments along the shoreline. You may also use the recorded shoreline length of the parcel to aid length estimation.

- Vertical sea wall
- Rip rap
- Other erosion control structures (note what the material is under "Notes")
- Artificial beach
- Slumping banks or bank erosion > 1 foot vertical bank face
- Slumping banks or bank erosion < 1 foot vertical bank face

Littoral Zone

Human Structures

Count the number of human structures present within the Littoral Zone:

- Piers
- Boat lifts (count lifts with and without canopies the same)
- Swim rafts/water trampolines (Do not count rafts beyond ~50 feet out into the water from shore. Rafts may be placed up to 200 feet from shore.)
- Boat houses (over the water)
- Marinas
- Other – include written description

Aquatic Plants

Check the box if emergent and/or rooted floating aquatic plants are present within the Littoral Zone of the parcel. Plants growing only underwater (submergent) are not included in the survey because they may be difficult to observe. Check the box if there are obvious aquatic plant removal areas in the Littoral Zone of the parcel. Aquatic plant removal areas are generally demarcated by straight lines of cleared vegetation that are perpendicular to shore and adjacent to plant beds.

Exposed Lake Bed Zone

When lake levels are low and expose at least 3 horizontal feet of the lake bed (Fig. 3 and 4), this portion of the data sheet should be filled out. Otherwise, skip the Exposed Lake Bed Zone portion of the data sheet. Wisconsin case law grants an owner of riparian property the right to exclude members of the public from the Exposed Lake Bed abutting his property. Members of the public may only access Exposed Lake Bed adjacent to public land or to private land with the consent of the adjacent riparian landowner. Thus, do not step out of the boat and walk on the Exposed Lake Bed toward the HWL unless you have permission from the owner of the private abutting land. This means that the Riparian Buffer and Bank Zones cannot be accurately surveyed when the Exposed Lake Bed becomes very wide. In Fig. 4b, the observers would be too far away to assess the Riparian Buffer and Bank Zones. When lake levels are extremely low, only surveys of the Littoral and Exposed Lake Bed Zones are appropriate. The full survey should be postponed or repeated when water levels are higher.

Plants

Check the appropriate box if plants are growing on the Exposed Lake Bed. Use the same 3 plant growth forms as in the Riparian Buffer Zone: canopy, shrub, herbaceous. At left, the Exposed Lake Bed is sandy with herbaceous plants (Fig. 4a). At right, the Exposed Lake Bed is completely covered with Fasset's Loco Weed, an herbaceous plant (Fig. 4b).

Disturbances

Look for signs of disturbances to the Exposed Lake Bed and check the appropriate box. Specifically, look to see if plants were mowed or removed and look for signs of tilling or digging up the sediment.

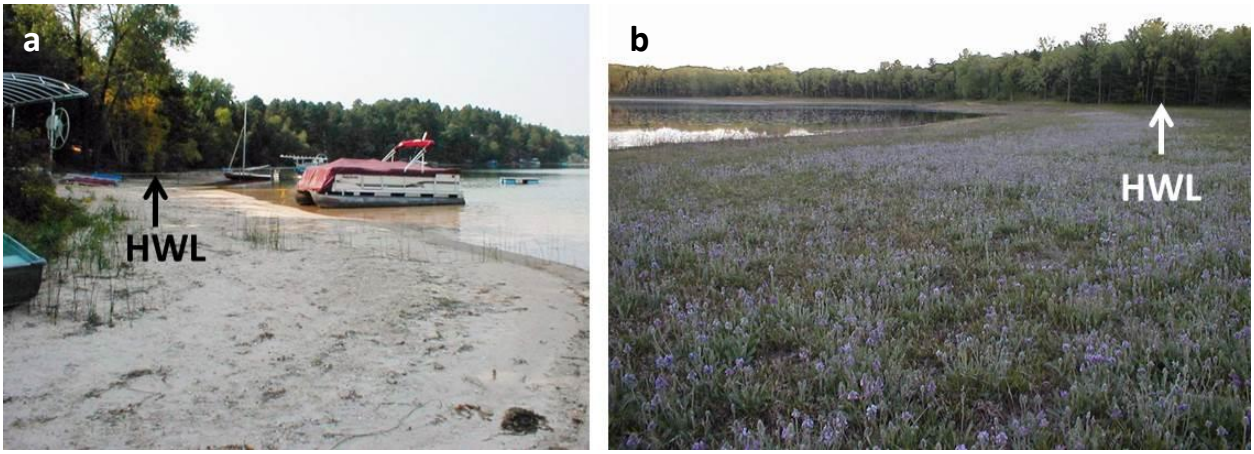


Figure 4. In both examples, the "Exposed Lake Bed" is the land between High Water Level and the present water level.

Coarse Woody Habitat Inventory (Loop 2)

Conduct the woody habitat protocol from a small boat or kayak, not a pontoon or large boat. Small boats can be maneuvered close enough to shore to see woody habitat. First, observe Secchi depth near shore. If the Secchi depth is less than 2 feet, this protocol should not be used because visual estimates of woody habitat will be unreliable.

Second, observe the current water level as compared to the High Water Level (HWL). Check the corresponding box if the current water level is below, at, or above the HWL. If water levels are low, the Riparian Buffer Zone could be tens of feet (or more) inland from the present waterline (Fig. 4 and 5). Coarse woody habitat below the HWL and above the present waterline should still be counted.

Figure 5. Wood stranded above water should be counted if below the HWL.

The woody habitat survey does not need to be associated with parcels. The boat driver should slowly drive the perimeter of the lake at the 2 foot depth contour with help from the observer, who shall periodically check water depth and find the 2 foot depth contour (use a yardstick, handheld depth finder, or marked wood calibration stick). If the Littoral Zone is relatively flat, then follow the 2 foot depth contour at the nearest point to shore. The observer should search for wood while wearing polarized sun glasses to improve visibility. The observer will mark a GPS waypoint for each piece of large wood.

This protocol only enumerates “large wood,” defined as greater than 4 inches in diameter somewhere along its length and at least 5 feet long. Only count wood that is between the HWL and the 2 foot depth contour. The large wood section must be in the water or below the HWL. Tree branches hanging over the water may be counted if the required size occurs below the HWL. If water levels are low, note that you will also be counting wood lying on the ground that is out of the water, but still below the HWL. Live branches and non-anchored logs count if they meet the other requirements. Live/dead wood standing vertically in the water and tree stumps with roots should be counted if they meet the size criteria. Do not count lumber (e.g., railroad ties, fish cribs, rip rap).

Coarse Woody Habitat Step by Step Instructions

1. Before searching for wood, measure the Secchi depth in deep water.
2. Record whether the current water level is below, at, or above the HWL.
3. Mark a GPS waypoint for each piece of large wood between the HWL and the 2 foot depth contour.

4. Give each piece of large wood a branchiness ranking:
   0 = no branches
   1 = a few branches
   2 = tree trunk has a full crown

Figure 6. From left to right, woody habitat without branches (0), with few branches (1), and with a full crown (2).

5. Touch Shore: Mark “1” if the log crosses the HWL (comes out of the water onto shore); mark “0” if it does not. Logs parallel to shore count if they touch the HWL.

Figure 7. Example of woody habitat connected to shore (top). If bog mats extend far out from shore, count as connected to shore when wood extends above water and touches the bog mat. Woody habitat parallel to shore may be counted if the log touches shore. In the bottom photo, the piece of wood is off shore and would not be counted as connected to shore.

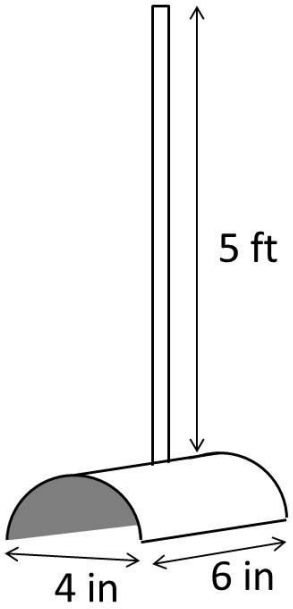
6. In Water: Mark “1” if at least 5 feet of log is currently underwater; mark “0” if the log is below the HWL, but less than 5 feet of the log is currently underwater.

Figure 8. This photo illustrates an example of trees hanging over the water. In this case, only the trunk closest to the water with inundated branches will be counted. It has few branches, touches shore, and is out of the water (Branch = 1, Touch Shore = 1, In Water = 0). The other trunks are too far above the water.

Estimating Diameter and Length of Coarse Woody Habitat

Coarse woody habitat greater than 4 inches diameter and 5 feet long that is in the water and/or below the HWL will be counted. First, the observers must familiarize themselves with wood of this size. Use the "wood calibration stick" to find trees on shore whose largest diameter is greater than or less than 4 inches diameter.

Bring the "wood calibration stick" on the boat. This is a 6-inch length of 4-inch inner diameter PVC pipe cut in half lengthwise and attached perpendicular to a 5-foot long pole. The pole is used to judge whether the piece of wood is at least 5 feet long and the PVC section is used to judge wood diameter at its widest point. If the PVC fits over the wood, the wood is too small to count. If it does not fit over the wood, it is large enough to count. One-foot intervals should be marked on the pole, which can then be used to measure the 2-foot depth contour.



Measure various sized pieces until you begin to recognize the size thresholds. Before you begin the survey, use your eye to identify "large wood" and then measure the length and diameter with the wood calibration stick.

- After you are correct on at least 5 consecutive pieces of wood, you may begin the survey.
- As you proceed with the survey, use the wood calibration stick to measure the diameter and length of 1 in every 20 pieces of wood as a quality assurance measure. The measurements do not need to be recorded.

Data Submittal

Photos

Photos should be saved on a DVD and mailed to the WDNR. The naming convention for each photo is as follows: WBIC_YYYYMMDD_photoid. Here, WBIC is the Water Body Identification Code for the lake, the date that the photo was taken is given with the 4-digit year, 2-digit month, and 2-digit day, and the photo id should be unique for each photo. A crosswalk table in Excel should also be included to place each photo in geographic space. This table should include 1 row for each photo and the following columns: WBIC, date (YYYYMMDD), photo id, parcel-id, latitude, and longitude. The photo id should be the same as is used in the name of the photo. The parcel-id that the photo represents should be listed (multiple photos might be necessary to fulfill a single parcel). The latitude and longitude in decimal degrees define the precise location where the photo was taken.

Parcel Habitat, Coarse Woody Habitat, and Quality Assurance

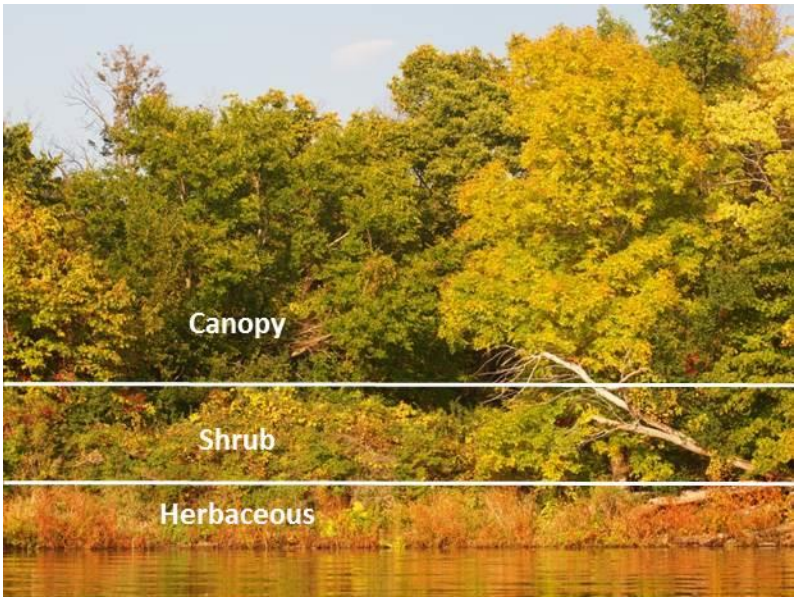
The parcel habitat, coarse woody habitat, and quality assurance data should be entered to a standard excel template (see “Parcel_Woody_Habitat_Data_Entry_Template.xlsx”) according to the instructions in the “read me” tab. Each lake will have its own file. Please email results to the Lake Monitoring Lead (Catherine.Hein@wisconsin.gov) or your regional lake biologist.

Definitions

Percent Cover – an estimation of the fraction of the plot that is dominated by each of a number of categories, such as lawn, impervious surface, and plants. The fraction is given as a percentage from 0 to 100 at 5% intervals.

Riparian Buffer Zone Definitions

Riparian Buffer Zone – land area from the High Water Level to 35 feet inland along the horizontal

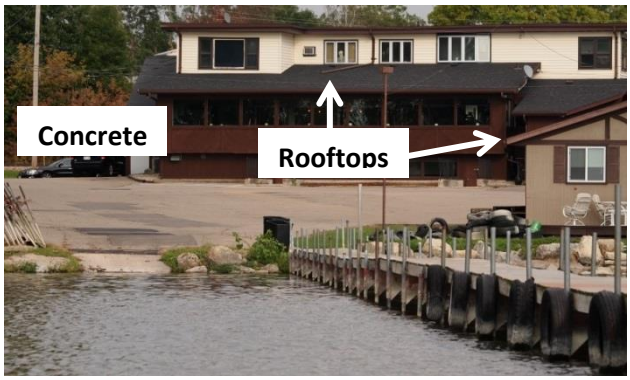


Canopy layer – area that is shaded by trees that are at least 16 feet tall

Shrub layer – woody plants with multiple stems and small trees less than 16 feet tall

Herbaceous plant layer – plants without woody stems. Grasses and sedges have slender leaves and inconspicuous flowers. Forbs are broad-leaved plants that often have showy flowers.

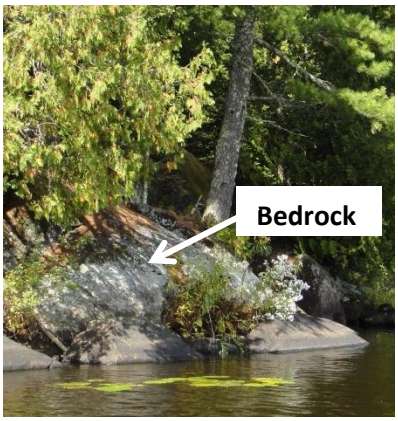
Impervious surface – an area that releases as runoff all or a majority of the precipitation that falls onto it (e.g. rooftops, sidewalks, driveways, parking lots, concrete, boulders, stone, decks, stairs, compacted gravel/soil, and boats flipped over on shore). Rocks used for rip rap also count as impervious surface.

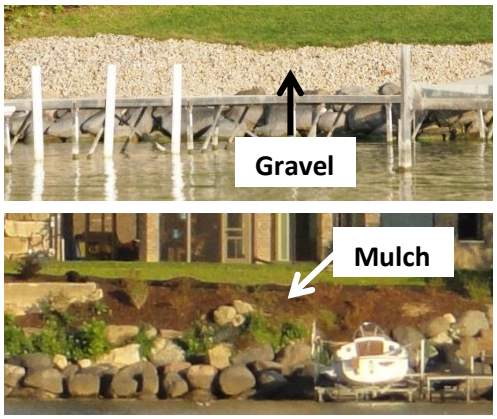


Rocks for rip rap →

Agriculture – agricultural fields planted in rows or grasslands used for grazing livestock

Manicured lawn – grass that is mowed short





Other Percent Cover – this category includes cover types that are not on the data sheet, such as bedrock, gravel, bare soil, sand, mulch, and dead plant material (duff)

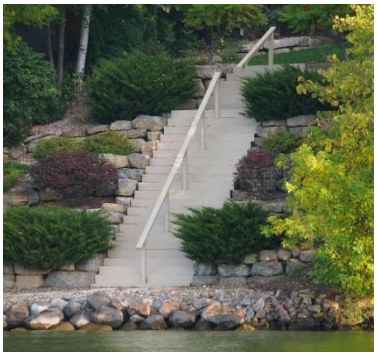
Building – any roofed structure (house, cabin, shed, boathouse, garage, commercial)

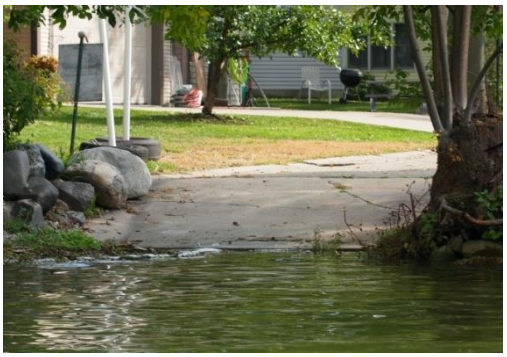
Fire pit – circular indentation in the ground or portable structure used for fires

Boats on shore – boats flipped upside down for storage in the Riparian Buffer Zone

Point Source – look for a pipe bringing water directly to the lake. This pipe could be directing stormwater, gray water, or other water sources to the lake.

Channelized water flow/gully – sharp indentation into the ground where water flows downhill and has eroded away the soil





Stair/trail/road to lake – stairs, dirt or paved trails, or roads that lead directly to the lake and would cause rainfall to flow into the water. Roads to the lake may be old, private boat landings.

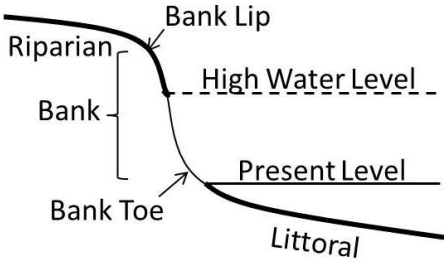
Lawn/Soil Sloping to Lake – the land slopes toward the lake and lacks natural vegetation that would prevent runoff/erosion (e.g., slope covered by lawn, bare soil, gravel, mulch)

Bare soil – unvegetated ground that could be eroded in a rain storm

Eroding, Slumping bank – obvious signs that soil on the bank is washing into the lake, location on the shoreline where the bank is lower than expected due to erosion

Sand/silt deposit – pile of fine sediments (< 2 mm diameter) that collected at a site due to erosion

Bank Zone Definitions

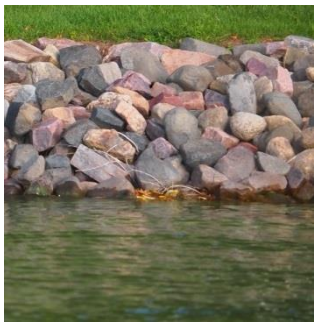


Bank Zone - The Bank Zone is variable in width, and is the region between the edge of the top-of-the-bank lip and the lake bed. The Bank Zone includes the bank face, high water level and the shore (or beach).

Bank Toe – the inflection point between the bank face and the lake bed

High Water Level (HWL) – the point on the bank or shore where the water is present often enough so that the lake or streambed begins to look different from the upland. Specifically, the HWL is the point on the bank or shore up to which the water, by its presence, wave action, or flow, leaves a distinct mark on the shore or bank. The mark may be indicated by erosion, destruction of or change in vegetation, or other easily recognizable characteristics. The HWL can be located through on-site studies of physical and biological conditions at the shoreline. The principal indicator is the change from water plants to land plants. In the area where the plants change, the investigator may also use indicators such as change in soil type, ridges, or other erosion marks or water stains on rocks, soils, trees, or structures. If none of these indicators are available in the immediate location, the elevation of the HWL may be found at another spot and transferred to that site in question (from NRCS 643A). The water level is below the HWL in the two sites pictured to the upper right (arrows point to the HWL).

Vertical Sea Wall – upright structure that is steeper than 1.5 feet vertical to one foot horizontal installed parallel to the shore to prevent the sliding or slumping of the land and to protect the adjacent upland from wave action. **Note:** Seawalls are commonly constructed of timber, rock (including gabions), concrete, steel or aluminum sheet piling and may incorporate biological components



Rip rap – rock or concrete piles used to armor shorelines and prevent erosion; this may also include natural cobbles and gravel that were clearly taken from the water and piled on the bank

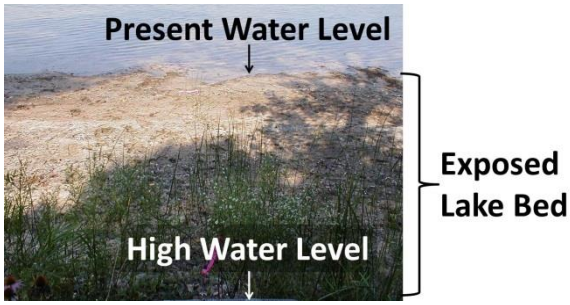
Other erosion control structures – any other type of erosion control structure on the shoreline; may include inert materials (rocks) at the bank toe and biological materials on the upper portion of the bank, non-treated wood, stakes and posts, jute netting, biologs, fiber rolls and mats, logs, and branches

Artificial beach– sand along the shoreline used to create a beach (versus shorelines that naturally have sand substrate). It may have been created by dumping sand along the bank or by scraping away top soil and vegetation to expose sand underneath.

Erosion >/< 1 ft. face – estimate the length (to the nearest 10 feet) of shoreline with eroding banks that are less than or greater than 1 foot vertical height. The picture to the left shows about 10 ft. of eroding bank face > 1 ft. tall.

Littoral Zone Definitions

Littoral Zone – water area from the present water line into the lake (~50 ft.), generally including the area near shore where aquatic plants and human structures are present in the water



Exposed Lake Bed – land area between the High Water Level and present water level (when water level is low)

Pier – structure leading out from shore into a body of water. One pier may have multiple mooring locations for boats. One pier should be counted for each access to shore. Count wharves, which are structures that run parallel to shore, as additional piers.

Boat lift and shelter – the lift stores a boat over and above the water. Some lifts have a canopy over the boat. Count together as 1.

Swim raft/water trampoline – floating structure that is anchored up to 200 ft. from shore. Count rafts within ~50 ft. from shore.

Boathouse – roofed structure over the water used to store boats

Marina – facility that provides secured moorings or dry storage for boats

Emergent aquatic plant – plants that live in the water and have leaves that extend above the water surface (e.g., bulrush, sedge, wild rice, arrowhead, cattails)

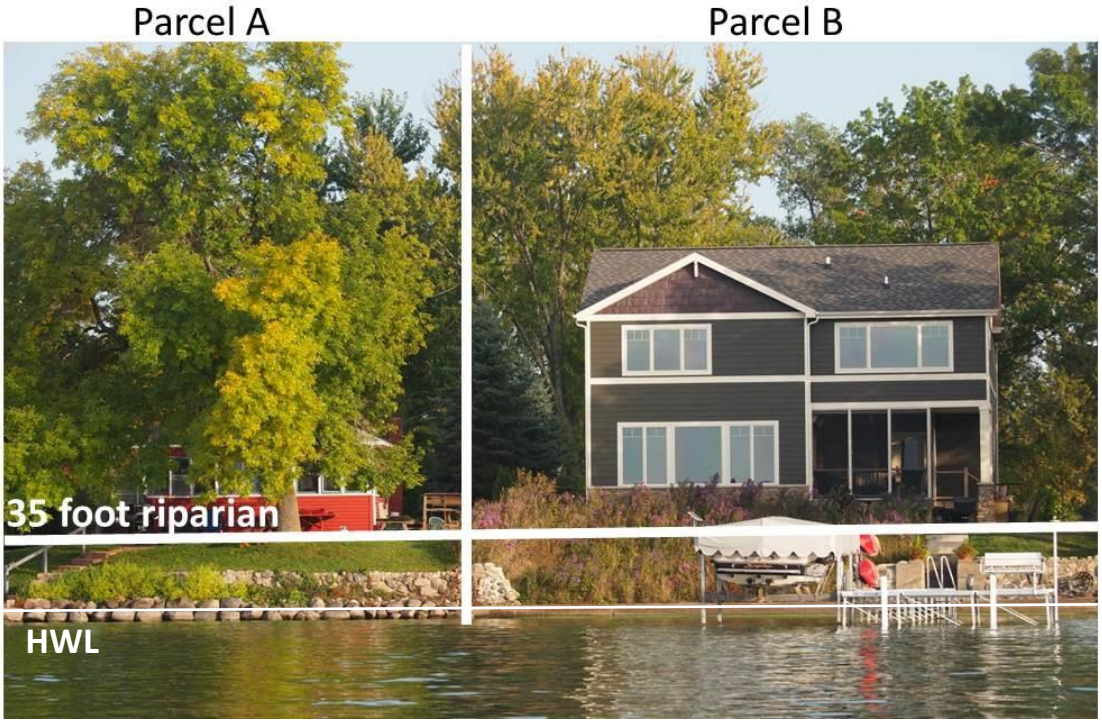
Floating aquatic plant – rooted plants with leaves that float on the water surface (e.g., white water lily)

Removed aquatic plants – littoral area where submergent or emergent aquatic plants have obviously been removed as evidenced by adjacent plant beds on both sides of the removal area. The removed area will often be along a straight line perpendicular to shore.

Coarse Woody Habitat – a piece of wood greater than 4 inches in diameter and 5 feet in length that is in the water or below the HWL. Live and dead wood standing vertically in the water should be counted if it is large enough. Tree stumps with roots should only be counted if they meet the size criteria.

Wood Calibration Stick – a 6 inch length of 4 inch inner diameter PVC pipe cut in half lengthwise attached perpendicular to a 5 foot long pole that is used to measure large wood in the water. One foot intervals should also be marked on the stick (to measure 2-foot depth).

Sample Parcel Assessments



The vegetation and shoreline erosion structures show a distinct boundary between Parcel A and B. The Riparian Buffer Zone is marked by the horizontal white line, but a rangefinder would be used to find the 35-foot inland distance in the field.

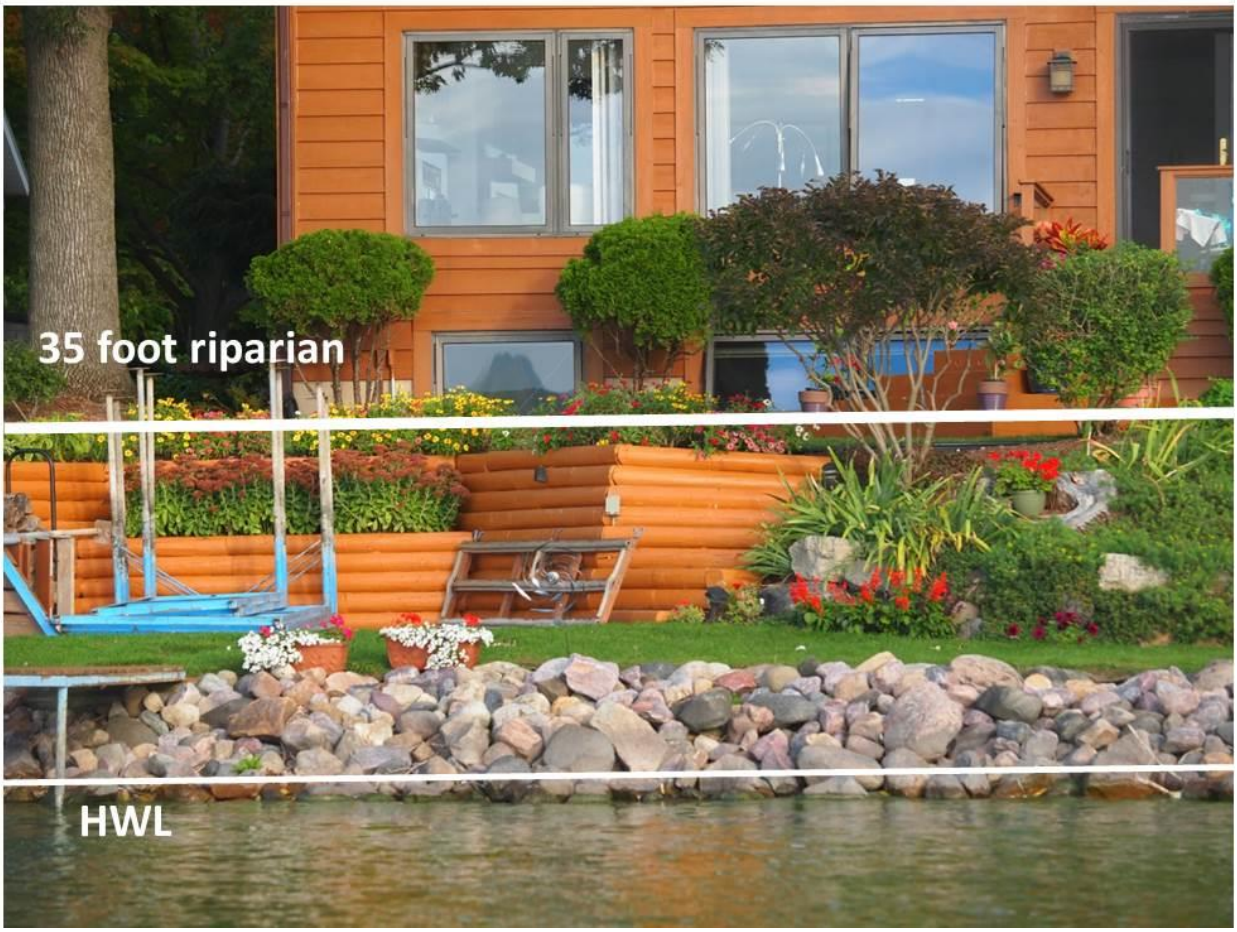
In Parcel A, the tree trunk is behind the Riparian Buffer Zone, but part of the canopy extends over the Riparian Buffer Zone (~10%). There are some herbaceous plants growing in the rip rap, but very few (5%). Mark herbaceous plants as present, but not shrubs. The rest of the parcel is made up of lawn and impervious surface (stairs and rip rap that extend landward from the water). Estimate impervious surface in the Riparian Buffer Zone as 15% and the remainder as lawn (100 – 5 – 15 = 80%). None of the "Human Structures" listed on the data sheet in the Riparian Buffer Zone or Littoral Zone boxes are present, so write "0" beside each item. There is sloped lawn present in the Riparian Buffer Zone, as well as a straight stairway to the lake that would deliver runoff during rain events, so check the appropriate boxes under Runoff Concerns. The entire Bank Zone is covered in rip rap; use the parcel shoreline length to record length of rip rap in feet. Aquatic plants are absent (leave blank).

There is no canopy cover in Parcel B. The majority of the parcel has been restored with native prairie plants (herbaceous cover). Approximately 5% is impervious surface (stairs and stone wall on the right), 10% is lawn, and the remaining 85% is herbaceous plants (no shrubs). There are no human structures in the Riparian Buffer Zone. There is 1 pier and 1 boat lift in the Littoral Zone. Under Runoff Concerns, sloped lawn and straight stair to lake are present in the Riparian Buffer Zone. There is a vertical sea wall along the entire length of the parcel. Aquatic plants are absent. The Exposed Lake Bed section does not apply.

Parcel C

Note that the HWL is slightly above the present waterline, so the sand and small grasses between the present waterline and HWL will not be a part of the percent cover estimation in the Riparian Buffer Zone. There are a lot of trees on the parcel, but some gaps near shore (90% canopy cover). The entire parcel except for the path leading to the water is covered by shrubs and herbaceous plants (mark as 95% cover and check both the shrub and herbaceous boxes). The remaining 5% cover is other (bare dirt on the path). There are no human structures in the Riparian Buffer Zone, but there is 1 pier in the Littoral Zone. There is a narrow path leading to the lake, which should be checked under “Present in Riparian” as “Stair/trail/road to lake” and “Bare soil”. Emergent plants are present. The Exposed Lake Bed Zone applies to this parcel because the width of the Exposed Lake Bed is at least 3 feet between the HWL and present water level. Herbaceous plants are present and there are no signs of disturbance.

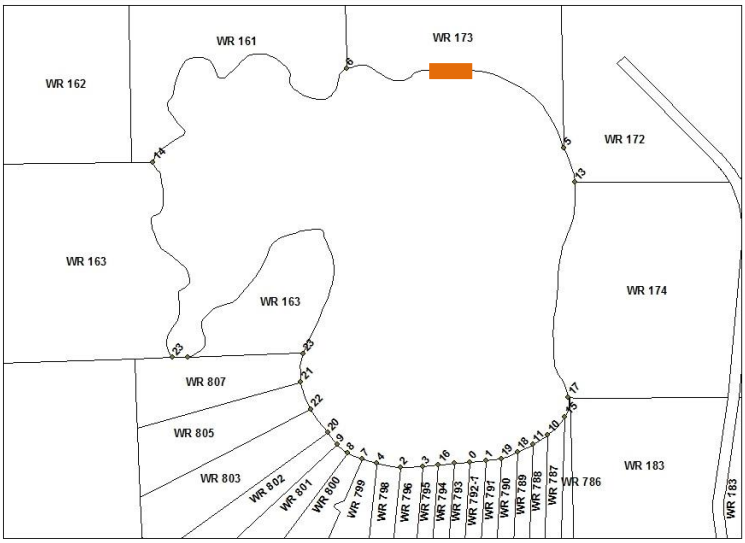
Parcel D



For instructional purposes, we will describe how to assess the portion of Parcel D pictured here. The house is just barely outside the Riparian Buffer Zone. Canopy cover is 0%. The garden area may be counted for shrub and herbaceous vegetation because it serves a structural function even though many of the species are ornamentals. Note the spaces between plants that are mulched; mulch will count as “other”. The top of the wooden boards that form the planter and the rip rap will count as impervious surface, but not the upside down pier section, which may only be stored there temporarily. Thus, the percent cover of shrub/herbaceous vegetation is 30%, impervious surface is 15%, lawn is 50%, and other is 5%. The garden planter may be counted as a human structure in the Riparian Buffer Zone under “Other”. There is 1 pier in the Littoral Zone. There are no runoff concerns. Rip rap covers the entire shoreline (approximately 20 feet in this photo). There are no aquatic plants and no visible plant removal areas. The Exposed Lake Bed Zone does not apply.

Parcel E

This is an example of state land that is natural, but shows signs of previous human disturbance. Parcels WR 163 – 183 in the map below are state land; the orange bar depicts the disturbed area in the photo above. There is an old forest road in the Riparian Buffer Zone. The area in the center of the photo lacks shrubs and trees, has sparse herbaceous vegetation, and large areas of bare soil with pine needles on top, but the majority of the 1600 feet of shoreline in parcel WR 173 has full coverage of herbaceous plants, shrubs, and trees. Assume that this disturbed area is 5% of the entire Riparian Buffer Zone in this parcel. Report 95% canopy cover, 95% shrub/herbaceous, and 5% other for the entire parcel. After "description", note that other percent cover is bare soil with pine needles. Runoff Concerns Present in Riparian include: "Lawn/soil sloping to lake" and "Bare soil". Human structures are absent in the Riparian Buffer and Littoral Zones. The Bank Zone is not modified. Emergent plants are present.



Time Estimate

This protocol is designed for a crew of 2 people in a small motor boat or, in some cases, a kayak. To help with planning, we approximate the time spent per monitoring activity. Time estimates represent the time that it takes a well-trained crew to complete a parcel. During training, the time to complete a parcel was approximately twice that reported here. Photos were taken on 13 lakes, the habitat assessment was done on 15 lakes, and the coarse woody habitat assessment was done on 5 lakes. The lakes range from very natural to highly developed and are spread throughout the state.

Table 1. Minimum and maximum time spent on each of the three parts of the protocol.

Protocol	Min	Max
Photos (minutes/mile of shoreline)	14	50
Parcel Assessment (minutes/parcel)	3.5	4
Coarse Woody Habitat (minutes/mile of shoreline)	29	120

Taking photos from a kayak added a substantial amount of time (max. in Table 1). This mode of transportation was required because the lake was so shallow. The time spent on the woody habitat inventory varied greatly as well. On most lakes, the time ranged from 29 to 50 minutes per mile, but one lake took 120 minutes per mile. This lake was stained and had very dense floating aquatic plants, making it hard to see and navigate. In this type of lake, the woody habitat inventory would be more efficient and accurate if conducted in early spring or late fall. The time spent managing data post-field work is not accounted for here. It takes approximately one hour to enter data from 35 parcels into Excel. However, data management effort will depend on whether data is captured on paper sheets or in a tablet computer. Eventually, data will be entered directly into the SWIMS database.

The total amount of time to complete the habitat survey on a lake depends largely on the length of shoreline and number of parcels. Green Lake (in Green Lake County) is one of the largest lakes in the state and will take at least two weeks to complete under the best conditions. Rock Lake (Jefferson County) is still quite large with a lot of parcels, and could be completed in less than a week. Small lakes with a lot of state land could be completed in a half day. Note that the time estimates in Table 2 do not account for travel time, set up, breaks, bad weather, etc.

Table 2. Examples of lakes that were sampled during summer of 2015. The total hours spent monitoring each lake was estimated using the minimum number of minutes per mile or parcel listed in Table 1.

Lake	Area (acre)	Shoreline length (mi)	Parcels	Total Hours Photos	Total Hours Parcels	Total Hours Wood	Total Hours
Green	7433	23.6	~1000	5.5	58.3	11.4	75
Rock	1364	11.2	341	2.6	17.5	6.5	27
Buffalo	105	2.1	26	0.5	1.5	1.0	3

This protocol will be a major undertaking on Wisconsin's largest lakes and flowages. Lake Chippewa (250 miles) and Turtle Flambeau flowage (209 miles) have the longest shorelines in the state and could take ~950 hours to complete all three aspects of the survey. However, this protocol could be accomplished quickly on smaller lakes, and most lakes in the state are small; 88% of the 1793 lakes with boat launches have <10 miles of shoreline (Fig. 9). Lakes with approximately 10 miles of shoreline should take approximately 2.5, 5, and 31 hours to complete the photo, woody habitat, and parcel assessments, respectively. This assumes the minimum time per mile or parcel in Table 1 and assumes that all parcels on a lake are 100 feet wide. The estimated time to complete the photo survey varies from < 10 minutes to 58 hours (Fig. 10), and the time to complete the woody habitat inventory varies from < 10 minutes to 120 hours (Fig. 11). It is harder to estimate total time on the parcel survey because the size of parcels can vary greatly. A lot of lakes have large parcels with state or federal land and will take less time than the estimate assuming 100 foot parcels around the entire lake.

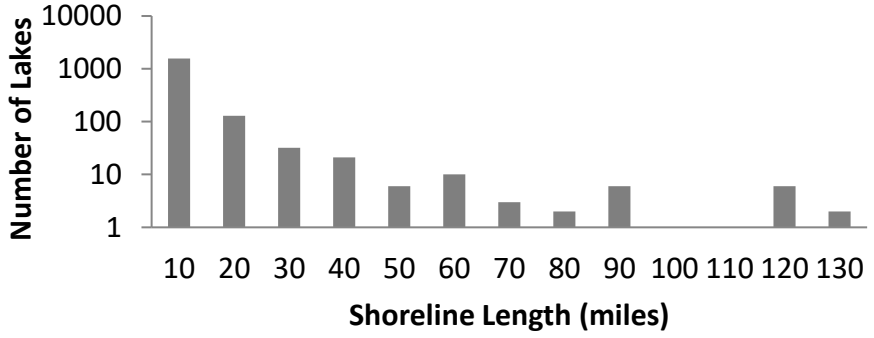


Figure 9. Frequency distribution of lake size for all lakes in the state with boat launches. Lake Chippewa and Turtle Flambeau Flowage are not included here.

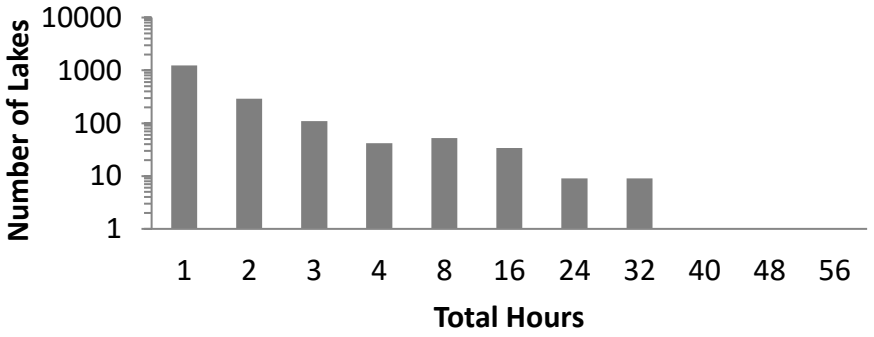


Figure 10. Total hours to complete the photo survey on lakes with boat launches given shoreline length. It will take 1 hour or less to complete the survey on 1244 lakes.

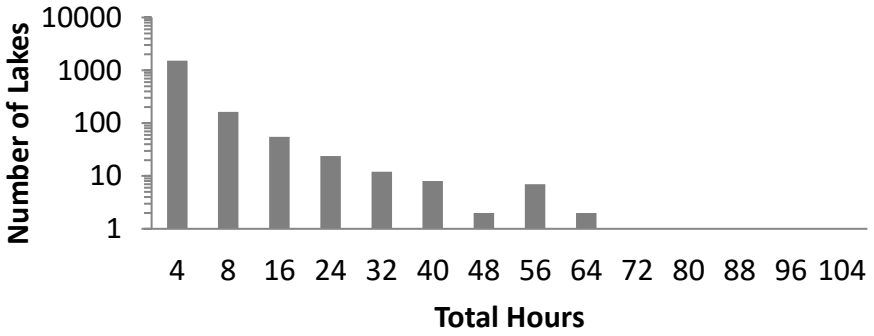


Figure 11. Total hours to complete the coarse woody habitat survey on lakes with boat launches given shoreline length. It will take 4 hours or less to complete the survey on 1518 lakes.

Data Sheets

Quality Assurance

Date _____ Lake name _____ WBIC_____
Observers_____

Present water level is ☐ Below ☐ At ☐ Above the High Water Level

Riparian Distance (landward)

Replicate	Estimated	Measured
1		
2		
3		

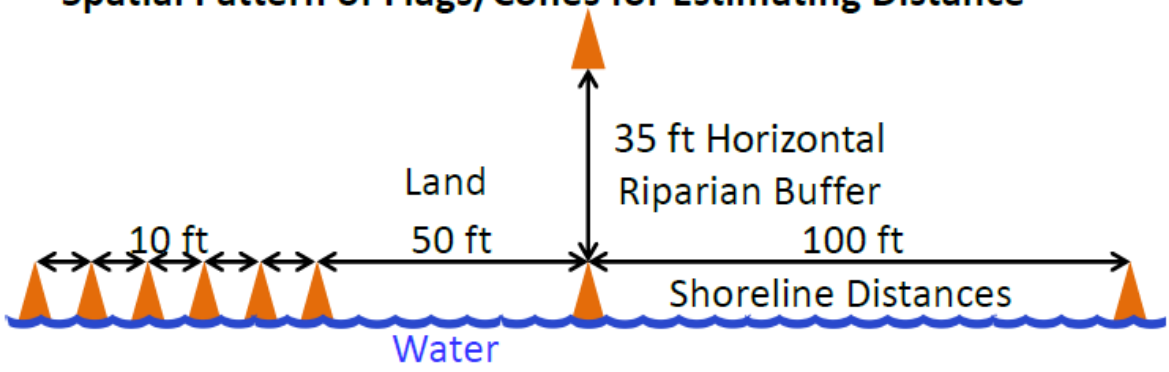
Shoreline Length

Replicate	Estimated	Measured
1		
2		
3		

Rangefinder Calibration

Replicate	Rangefinder	Tape Measure
1		
2		
3		

Spatial Pattern of Flags/Cones for Estimating Distance



Habitat Assessment Data Sheet (one per parcel)

Date _____ Lake name _____ WBIC_____
Parcel ID_____ Observers_____

RIPARIAN BUFFER ZONE

Percent Cover	Percent	
Canopy		(0-100)
Shrub ☐ Herbaceous ☐		
Shrub/Herbaceous		sum=100
Impervious surface		
Manicured lawn		
Agriculture		
Other (e.g. duff, soil, mulch)		

description:_____

Human Structures	Number
Buildings	
Boats on shore	
Fire pits	
Other	

description:_____

Runoff Concerns in Riparian or Entire Parcel	Present in Riparian	Present out of Riparian
Point source	☐	☐
Channelized water flow/gully	☐	☐
Stair/trail/road to lake	☐	☐
Lawn/soil sloping to lake	☐	☐
Bare soil	☐	☐
Sand/silt deposits	☐	☐
Other	☐	☐

description:_____

Notes:

BANK ZONE	Length (ft)
Vertical sea wall	
Rip rap	
Other erosion control structures	
Artificial beach	
Bank erosion > 1 ft face	
Bank erosion < 1 ft face	

LITTORAL ZONE

Human Structures	Number
Piers	
Boat lifts	
Swim rafts/water trampolines	
Boathouses (over water)	
Marinas	
Other	

description:_____

Aquatic Plants	Present
Emergents	☐
Floating	☐
Plant Removal	☐

If Applicable (low water level):
EXPOSED LAKE BED ZONE

Plants	Present
Canopy	☐
Shrubs	☐
Herbaceous	☐
Disturbed	
Plants (mowed or removed)	☐
Sediment (tilled or dug)	☐

Habitat Assessment Data Sheet (multiple parcels)

*can use if no exposed lake bed; describe "other" if you add an other category

LAKE NAME: **SHORELAND HABITAT ASSESSMENT** OBSERVERS:

WBIC: DATE:

Parcel ID					
RIPARIAN BUFFER ZONE					
Canopy (1-100 %)					
Shrub (check if present)					
Herbaceous (check if present)					
Shrub/Herbaceous (SUM to 100%)					
Impervious Surface (SUM to 100%)					
Manicured Lawn (SUM to 100%)					
Agriculture (SUM to 100%)					
Other (e.g. duff, soil, mulch) (SUM to 100%)					
Other description					
Human Structures *(number)*					
Buildings					
Boats on shore					
Fire pits					
Other: _____					
Runoff Concerns *(in/out of riparian zone)*					
Point Source					
Channelized Water flow/gully					
Stair/trail/road to lake					
Lawn/soil sloping to lake					
Bare Soil					
Sand/Silt deposits					
Other: _____					
BANK ZONE *(Length, ft)*					
Vertical Sea Wall					
Rip Rap					
Other erosion control structure: ___					
Artificial Beach					
Bank erosion >1ft face					
Bank erosion<1ft face					
LITTORAL ZONE *Human Structures (#)*					
Piers					
Boat Lifts					
Swim rafts/water trampolines					
Boathouses (over water)					
Marinas					
Other: _____					
Aquatic Plants *(check if present)*					
Floating					
Emergent					
Plant removal					

Coarse Woody Habitat Inventory Data Sheet

Date _____ Lake name _____ WBIC_____

Observers_____

Present water level is ☐ Below ☐ At ☐ Above the High Water Level Secchi depth _____ ft

ID	Branch	Touch Shore	In Water	ID	Branch	Touch Shore	In Water	ID	Branch	Touch Shore	In Water	ID	Branch	Touch Shore	In Water
1				26				51				76			
2				27				52				77			
3				28				53				78			
4				29				54				79			
5				30				55				80			
6				31				56				81			
7				32				57				82			
8				33				58				83			
9				34				59				84			
10				35				60				85			
11				36				61				86			
12				37				62				87			
13				38				63				88			
14				39				64				89			
15				40				65				90			
16				41				66				91			
17				42				67				92			
18				43				68				93			
19				44				69				94			
20				45				70				95			
21				46				71				96			
22				47				72				97			
23				48				73				98			
24				49				74				99			
25				50				75				100			

Branch: 0 = no branches, 1 = a few branches, 2 = full tree crown

Touch Shore: 0 = entirely below High Water Level (HWL), 1 = crosses HWL

In Water: 0 = less than 5 ft of log is currently underwater, 1 = at least 5 ft of log is currently underwater

Appendix A. Additional Parameters of Interest

There may be local reasons for including additional parameters into the minimum protocols described in this document. The following list gives a few examples that were included in past surveys. This list is not meant to be exhaustive.

Vegetation in Riparian Buffer

Average width of natural vegetation from water's edge landward

Human Structures in Riparian Buffer

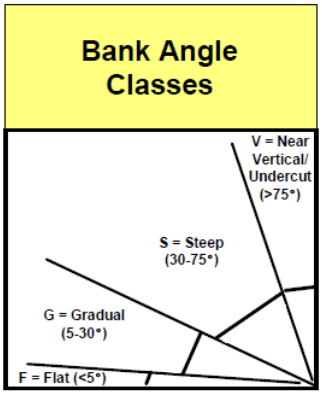
Boathouse – the number of boathouses on the lake could be quantified separately from buildings

Littoral Zone

Watercraft in the water – the number of watercraft in the water at piers and mooring buoys could be counted in addition to boat lifts if the lake group wants to find out the total number of watercraft at riparian lots. This count could be compared to counts from previous years and analyzed for a historical trend.

Bank Zone

Bank slope – this parameter could be documented with the use of GIS or by visually estimating categories of bank slope as in the National Lakes Assessment protocol



Aquatic Plants

Submergent Plants – submergent plants could be marked as present, absent, or unknown if water clarity was too low to judge.

Invasive Species

Percent cover of canopy, shrub, and herbaceous plants is quantified regardless of whether the species are native or invasive. In addition to estimating percent cover of each vegetation layer, percent cover of invasive species could be quantified separately. A checklist of invasive species could also be filled in for each parcel with special attention to riparian plant species.