Guidance for Delineating Invasive Aquatic Plants

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Objective

The primary purpose of this document is to provide guidance on how to delineate areas where invasive plants occur for management purposes. This document is intended for DNR Invasive Species Specialists and external partners who also conduct aquatic plant surveys.

For information on invasive species early-detection monitoring see DNR AIS Early Detection and Baseline Monitoring Guidance.

Introduction

Delineations are a type of plant survey that gathers information on the geographic location, boundaries, environmental conditions, and the relative abundance of invasive aquatic plants and the native aquatic plant species that co-occur with them. They can be done on a whole lake basis or within a targeted area within a basin. They can be used to identify areas of vegetation either targeted for management or identified for protection and are necessary when considering the relative risks and benefits of invasive aquatic plant management. Delineations can also be useful in monitoring the changes in the relative abundance and species composition of the delineated areas over time but do not take the place of other plant surveys such as point-intercept surveys. The output from a delineation survey is a map showing the delineated plant stands and a table of associated information.

Delineations are done when applying for a DNR Invasive Aquatic Plant Management (IAPM) permit. If a contractor or lake group completes a delineation to identify areas for management, the permit process is often times expedited and a DNR inspection may be waived.

Definitions

Polygon: a map feature, drawn in a GIS mapping program based on waypoint and boat track data collected during a field delineation survey. A polygon describes the area of a plant stand to be controlled or protected/buffered from management activities.

Stand: a distinct area of vegetation in a lake or wetland. Stands are mapped as polygons based on the target species' and associated native plants' presence (or absence) and relative abundance.

Target Species: the plant species (invasive or native) identified as the primary concern for the delineation.

Treatment: management activities used to control an invasive plant species generally through mechanical, chemical, or biological means. **MN DNR permits are required in most instances.**

Waypoint: a survey/sampling point taken with a GPS unit where plant observations are recorded.

Planning the Survey

Timing of survey

The distribution and abundance of plants can change dramatically throughout the growing season and from year to year. For this reason, delineations are generally performed early in the season in which management has been planned for the target plant. Delineations should be done when the target aquatic plant is actively growing and observable. To schedule early season delineations (typically applies to curly-leaf pondweed), communication with lake residents/users can be helpful as they may have knowledge of when plants are present.

Check weather conditions prior to scheduling a delineation survey. Because visual observations of the target plants are extremely useful when locating them, the surveys should be done under low to moderate wind conditions (less than 12 mi/h) and are best done on calm sunny days. When planning a field delineation take into account not only the expected wind speed, but also the direction of the wind, and the wind fetch expected in the areas you will be working. Protected areas with little fetch can be surveyed under conditions of higher wind speed, while areas with a long fetch for the wind will best be surveyed when the wind is calm.

Existing data

Existing data should be reviewed and may be helpful to have in the field when doing a delineation survey. Data can be brought either as paper records or uploaded into a GPS unit prior to the field delineation. Potential existing data to review include:

- Delineation polygons and waypoints from previous surveys.
- Bathymetric maps and/or lake shoreline map.
- Other point locations where the target plant(s) have been located, for example from previous surveys or from your local invasive species specialist.

Equipment

The technology available to delineate the boundaries and measure the area of invasive aquatic plant stands is constantly evolving. Current practices employ the use of handheld GPS units and paper to collect field data followed with post-survey map processing using a GIS software such as ArcMap. Recently, invasive species mapping has focused on such tools as EDDMapS or Collector for ArcGIS applications that report point and polygon locations of species occurrences to a central database using smartphones or tablets.

Regardless of the methods used, a delineation survey should be done with a device that can record both waypoints and a track of the survey path. Associated data can be recorded on paper forms, electronically, or using a combination of the two. *Appendix 1* has a list of equipment that is useful to have on hand for delineation surveys. An example field form is shown in *Appendix 2*.

Conducting the Survey

Delineation of a target plant occurs through field observations generally made via three methods. These methods are usually combined during a delineation survey and include 1) visual observations, 2) SONAR (depth finder) observations, and 3) thrown rake observations. The ability to visually identify the boundaries of submersed plant stands varies with water clarity, depth, wind, plant height, and plant cover. If water clarity is limited, a surveyor must use a sampling rake or other below-water sampling device to identify plants. Two metal rake heads tied together and attached to a rope can be thrown and dragged along the lake bottom (see Figures 1 and 2). For a delineation survey, the rake should be thrown in areas where the surveyor thinks the target plants occur. Care should be taken to find the furthest extent of target plant beds for areas delineated for treatment. SONAR can assist in locating below water plant stands, but the species composition must be verified by a sampling rake.

When a plant stand is visible from the surface it can be useful to drive the boat around the plant stand and use the boat track itself to create the boundary of the polygon. This delineation technique can also be used to map areas of matted invasive species that may be targeted for treatment, or areas of native plants (such as water lilies) that should be excluded from treatment.

The extent which the lake is surveyed may be dependent on the management goals. For example, if management is being proposed in only a portion of the lake, then a lakewide delineation may not be necessary and could target specific areas (i.e. historically managed sites). However, if the goal is to provide a complete record of all possible locations of the target plant (i.e. infestation extent) then a full lake delineation is more appropriate.

Figure 1. A two-sided metal rake for sampling aquatic plants. This sampling rake was made by welding two rake heads together. It can also be constructed by tying two rake heads together with zip ties.

Figure 2. Throwing the sampling rake.

Navigating to each waypoint

Whether mapping with a hand-held or boat-mounted GPS unit or using Collector for ArcGIS on an iPad, surveyors must collect a series of waypoints, boat tracks, and notes to identify the plant species associated with each delineated plant stand. In order to have the most complete information, surveyors should follow these steps:

1. Record the track of the boat with a GPS receiver.
2. Beginning at one end of the first area to delineate, run transects (paths) perpendicular from shore lakeward, using a zig-zag pattern (see Figure 3 below).

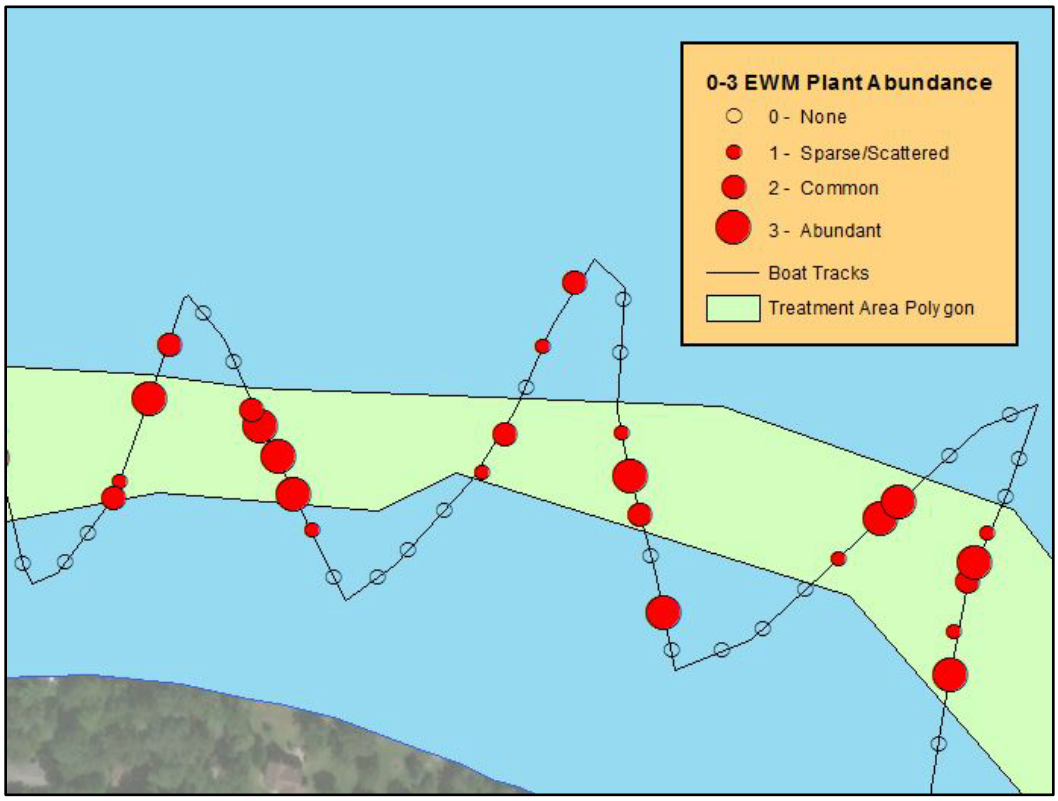

Figure 3. Example of delineation process. Polygon indicates a proposed invasive plant treatment area, solid black line indicates the boat track, and waypoints indicate the target plant abundance observations.

3. Along the transect route stop and record data and a waypoint location either at regular intervals or when conditions such as water depth or the abundance or presence of target plants change. If the target area is narrow, make the intervals short and vice versa. Waypoint locations are not pre-established for a delineation survey. As a general rule, allow for waypoints to occur every 10-25 meters apart on small lakes (100-400 acres), 35 meters on medium lakes (400-1000 acres) and 50 meters on large lakes (1000+ acres). The total number of survey waypoints will vary depending on the size of survey area, extent of infestation, and whether the stands are monocultures or are composed of a diverse mix of plant species.

4. At each waypoint, minimally record:
   - **Target plant relative abundance,** observed either by a sampling rake or visually. The relative abundance ranking is based on the number of plants or percent plant coverage observed at a sampling point. MN DNR Invasive Species Program uses a quantitative ranking of zero to three based on rake coverage (see Table 1 below).

     Table 1. Rake coverage or fullness can be used in conjunction with visual observations to estimate the target plant abundance on a zero to three scale. A zero ranking indicates no target plants were retrieved or observed in a sample.

Abundance Ranking	Rake Coverage	Description
1		Sparse; plants covering <25% of the rake head
2		Common; plants covering 25%-75% of the rake head
3		Abundant; plants covering >75% of the rake head

   - **Water depth** (preferably in feet unless otherwise noted). Water depth is an important observation when calculating water volumes for treatment or for determining plant height to the water's surface. Plant height may also be estimated or measured directly.

5. As sampling progresses to deeper depths, stop when the target invasive plant species is no longer visibly evident or recovered on the rake. If not visibly apparent, go back halfway to the last point with invasive plants present and sample in order to verify the edges of the invasive plant stand.
6. Repeat this process until the entire littoral zone or targeted area has been delineated.
7. Invasive plant treatment areas or native plant beds that are to be avoided (e.g. water lilies) may be created as polygons in the field (e.g. using the ArcCollector application or via boat tracks) or created back at the office using a GIS software to edit polygons and create a final treatment map for IAPM permit applications (see section on Processing field survey data).

Record lakewide data

Before completing the survey, include the following lakewide information:

- The **date**, **site/lake name**, **county**, and **surveyor name(s)**. If surveyors are not DNR staff, include their organization.
- **Water temperature:** Record one to three observations of water temperature below surface at dispersed locations around the lake; also record the GPS location and the depth of the temperature reading. Some observers record temperatures from different depths: surface, mid depth, and near lake bottom.
- **Water clarity:** Record at least one observation and GPS location of Secchi disk transparency during the survey.
- **Weather and conditions** of your survey day as well as any other notes that may be helpful to your delineation assessment.

Additional considerations: native observations and stand density (optional)

In some situations surveyors may record observations of native plants that co-occur with the target invasive. Certain native plant species may be affected by management actions and there may be interest in documenting them. In order to minimize non-target damage, other natives such as emergent or floating-leaf species may be delineated as plant stands or beds rather than individual point observations (see Figure 4 below).

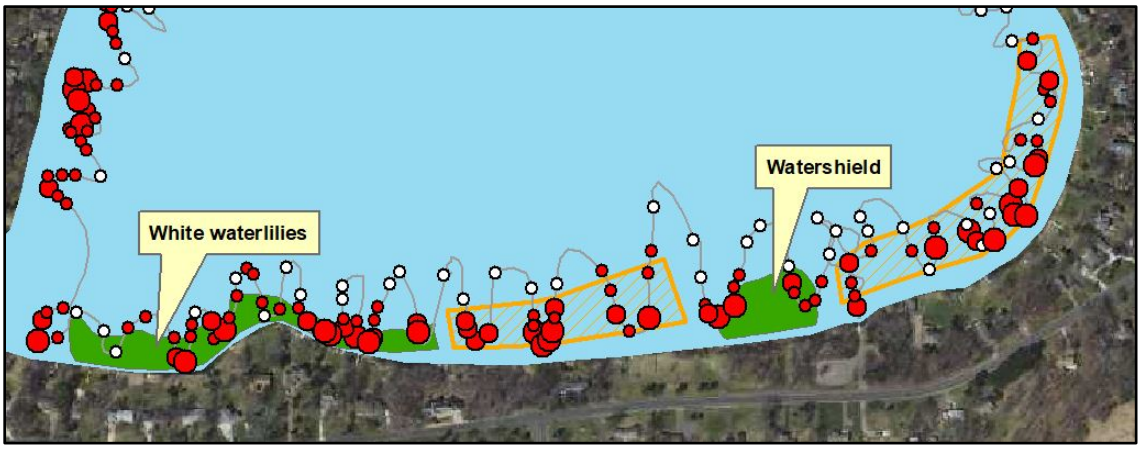

Figure 4. Example of delineating native plant observations for areas of management avoidance. Polygons outlined in orange represent proposed treatment areas. Green polygons show areas of white waterlilies and watershield (floating-leaf native plants).

Surveyors may also choose to assign a qualitative stand density rating for each invasive plant delineated area (see Table 2 below). **Stand density** is an overall abundance ranking for a target species or native plants within a larger plant stand. It is a useful measure when there is uniform growth of the target

species within a distinct area. Stand density can be used to determine if management is called for in water bodies where the target plant is widespread. Stand density can also be used as an assessment tool by comparing stand densities over time such as before and after management. Surveyors can sample random points within the stand by rake toss and use the average rake-collected relative abundance of the target plant (on a scale of 0-3) to characterize stand density.

Table 2. Example of a qualitative stand density rating scale. Rake coverage or visual observations can be used to estimate the overall plant stand abundance of the target invasive or native plant assemblage within a polygon.

Stand Density Rating	Description
Matted / Monotypic	The target species is the only species in the stand and the plants are near or at the surface.
Dominant	The target species dominates the stand with very few occurrences of other species.
Moderate / common	The stand is a mix of species, with the target species comprising about 50% of the plant cover.
Scattered	The target species is present, but it is not the most common. Other species comprise the majority of the stand.
Sparse	The target species is fairly uncommon to rarely found in the stand.

Processing Field Survey Data

The next step in the delineation process is to create polygons (i.e. treatment polygons) from the boat tracks and waypoint observations. If the delineation is being done by a third party as part of an Invasive Aquatic Plant Management (IAPM) permit application or grant application requirement, processed data should be submitted to the DNR including GIS files and associated invasive/native plant data (as a tabular electronic spreadsheet) so that a map can be recreated and a field visit done if needed.

Making the map

Once field data has been collected, post-processing of data generally occurs with a desktop computer using a GIS mapping program such as ArcMap or Google Earth. The first step is to import the waypoints and boat tracks into the mapping program, along with the associated information from each waypoint (such as relative abundance of the target invasive species). That information can be used to create delineated polygons (i.e. treatment polygons or native species stands for avoidance). The final map should have the boat tracks, the waypoints, and the delineated polygons (if applicable). See Figure 5 below for a completed delineation map.

If the delineation map is to be used to guide treatment with herbicides only contiguous stands of invasive vegetation that are targeted for treatment should be mapped as polygons. Isolated plant

occurrences, and areas that are not targeted for treatment should be mapped as points and not delineated with polygons for treatment.

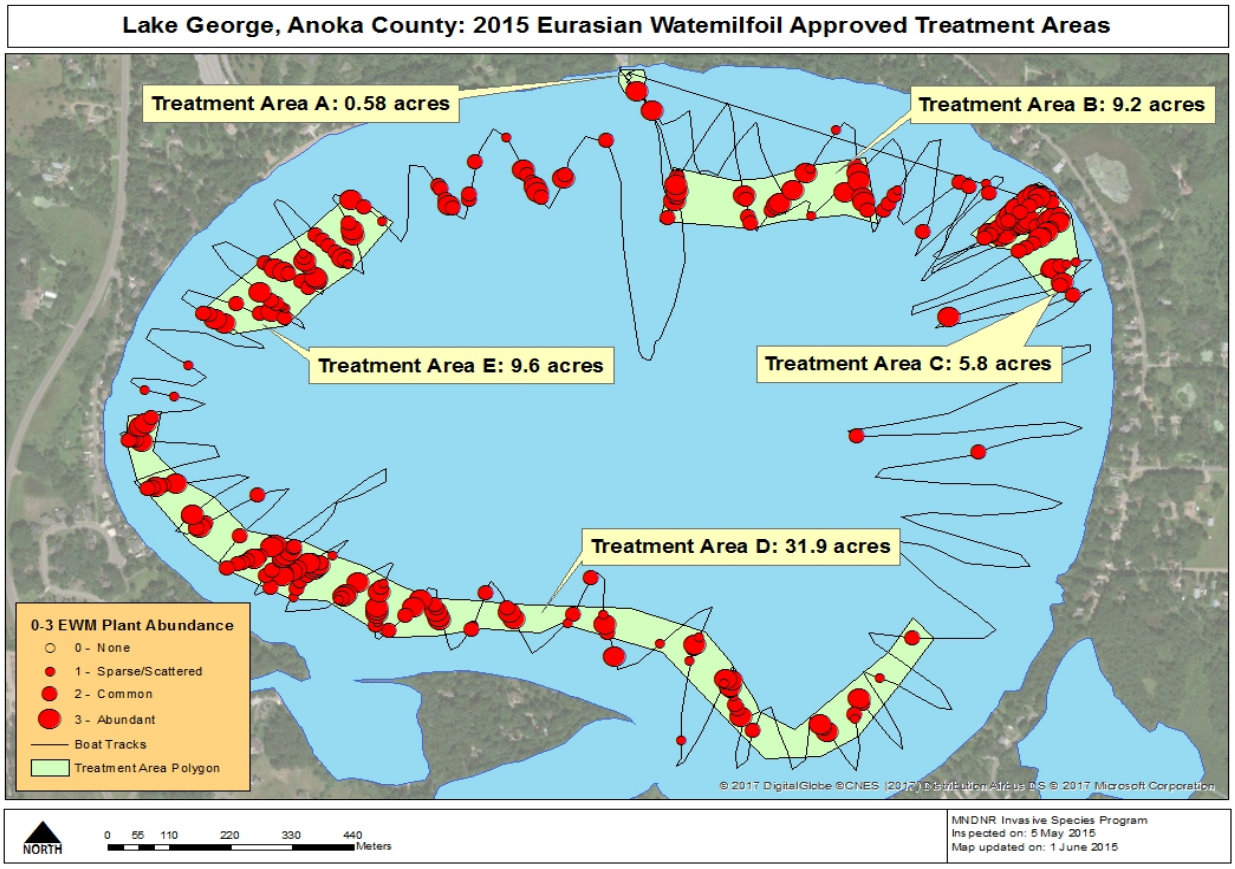

Figure 5. Example of a delineation map with proposed treatment polygons for Eurasian watermilfoil. Points courtesy of Anoka Conservation District. Green polygons indicate Eurasian watermilfoil stand. Black line indicates boat track.

Appendix 1

Equipment Checklist

Basic

_____ Data sheets on waterproof paper (Rite-in-the-rain®) or electronic data collection device

_____ Clipboard, pencils, permanent marker (Sharpie®)

_____GPS Unit with historical data/polygons (if available) uploaded

_____ Polarized sunglasses

_____ Lake access point / map

_____ Bathymetric map of lake (either on rite in the rain paper or loaded onto GPS device)

_____ Double sided rake on rope

_____ Plastic bags/collection containers

_____ Digital camera

_____ Boat / canoe

_____ Depth Pole or SONAR depth finder

_____ Life Jackets [one each wearable plus one throwable]

_____ Secchi disk

Optional

_____ Plant ID books / AIS identification sheets

_____ Sorting trays for plants and invertebrates (white or light color)

_____ Hand lens

_____ Chest waders (for working in wetlands)

_____ View tube, or underwater camera

_____ Duck pole (push pole for getting into shallow areas)

Appendix 2

Example field data recording sheet for delineation surveys

Invasive Species Lake Survey Field Sheet

Date: _____ DNR Staff: _____

Lake: _____ Other Staff / Organizations: _____

County: _____ Secchi Depth: _____ Waypoint Secchi Taken: _____

DOW # _____ Water temp: _____ Air temp: _____

Time on water _____ Time off Water _____ Weather: _____

Plant abundance ranking for all species observed: 3 = abundant (75 -100%), 2= common (25 - 50%), 1 = sparse (< 25%), blank = not observed.

			Target Species				Other Taxa							Notes
Waypoint	Depth	no veg - too deep	E. watermilfoil	Curly-leaf pondweed	other invasive	other invasive	Coontail	Elodea canadensis						