Development of a Rapid Floristic Quality Assessment Methodology for Wisconsin Wetlands

Background and Draft Protocol

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Photo Credit: Pheasant Branch Conservancy herbaceous wetland, Summer 2022 by Sally Jarosz

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Contents

1. Introduction

The Wisconsin Department of Natural Resources (hereafter, "Department") has been developing floristic quality assessment (FQA) methodology to measure wetland condition or quality for over 20 years. Due to the intensive nature of the Department's existing FQA methodology, which requires every plant species be identified within each wetland assessment area (AA), it is considered to be a Level 3 (intensive) site assessment, as defined by the EPA. FQAs require that every plant within a wetland assessment area (AA) be identified to species, requiring the assessor to be familiar with over 1200 plant species. The level of expertise required has therefore limited the number of wetland assessments that can be completed due to the limited number of expert botanists employed by the Department.

Given this challenge, the Department undertook the effort to create a Level 2 (rapid) assessment, as defined by the EPA (EPA, 2022). Rapid floristic quality assessments (hereafter, "RFQA") may be utilized by those familiar with wetlands and common wetland plants but who are not trained as expert botanists. The objective of this endeavor was to create a tool that can be used by Department staff and external partners who may have only moderate botanical expertise and limited staff hours to complete a Level 3 assessment. Benefits include improving the Department's ability to procure timely regulatory decisions and expanding the Department's capacity to conduct routine wetland monitoring.

The Department is able to investigate the soundness and feasibility of an RFQA by utilizing the extensive database of full wetland floristic surveys collected by Department staff from a wide range of wetlands throughout Wisconsin. The Department's wetland FQA database includes approximately 1100 surveys from all ecoregions and conditions, from severely impacted to intact. During a review of several other state's RFQA methodologies, the Department was able to use this data to assess the benefits and drawbacks to a few different accepted RFQA methodologies and test each by manipulating subsets of wetland floristic data.

1.1. Existing FQA Methodologies

The Department's existing FQA methodology (hereafter "Full FQA") uses coefficients of conservatism (C-values) assigned to Wisconsin's vascular plant flora (Bernthal, 2003) as the basis for condition assessment. By identifying each plant in a wetland, botanists can calculate a mean conservatism score ("mean C" or $\bar{C}$) to the wetland. By adding each species' areal coverage within the AA, botanists can calculate a weighted mean coefficient of conservatism ("weighted mean C" or wC). These metrics, $\bar{C}$ and wC, can be compared to one of 30 community and ecoregion specific sets of numeric thresholds for condition developed for full wetland surveys (Hlina et al. 2015, Marti & Bernthal 2019). These metrics and numeric thresholds for condition form the basis of the Department's wetland bioassessment criteria – collectively called the "Wetland Floristic Quality Benchmarks for Wetland Monitoring and Assessment in Wisconsin" (hereafter "Full FQA Condition Benchmarks").

2. Development of a Rapid FQA Methodology

Our goal was to develop tool which would not require the user to identify every plant in a wetland to species level. At the same time, the tool was developed with the intention of maintaining consistency in concept, methodology, and result to our already developed full FQA methodology (Bernthal 2003; Trochlell, 2016).

The Department underwent two levels of testing to develop the RFQA: the first used the existing wetland FQA database of over 1,100 wetland surveys to manipulate floristic data in multiple ways to find a methodology that balanced ease of use and accuracy and the second was to field-test the tool across a range of wetland types and conditions.

2.1. Wetland FQA Database

Development of the RFQA methodology made use of pre-existing wetland floristic quality surveys completed between 2012 and 2022 by the Department and Lake Superior Research Institute staff (Hlina et al. 2015; Marti & Bernthal 2019). This database contains floristic data from 1,180 wetlands across a range of regions (Figure 1), wetland community types (Appendix B) and alteration levels (Figure 1). The essential data from each timed meander survey used to develop the RFQA were as follows:

1. Vascular plant species inventories
2. Areal cover values (1% to 100%) estimated visually as a percentage of the entire wetland AA.
3. Plant community condition score (1 – 6). A rating given by botanists in the field indicating where the wetland plant community falls on a continuum of anthropogenic alteration in relation to an intact example of that community from 1 (unaltered) to 6 (highly altered).
4. Overall Disturbance score (1 – 5). A rating given in the field indicating the level of anthropogenic alteration visible at the time of survey from 1(few with low severity) to 5 (multiple with high severity).
5. Cowardin Wetland Class determined from cover of trees, shrub, herbaceous, and aquatic vegetation from species inventories and WI Natural Community type assigned by surveyor.

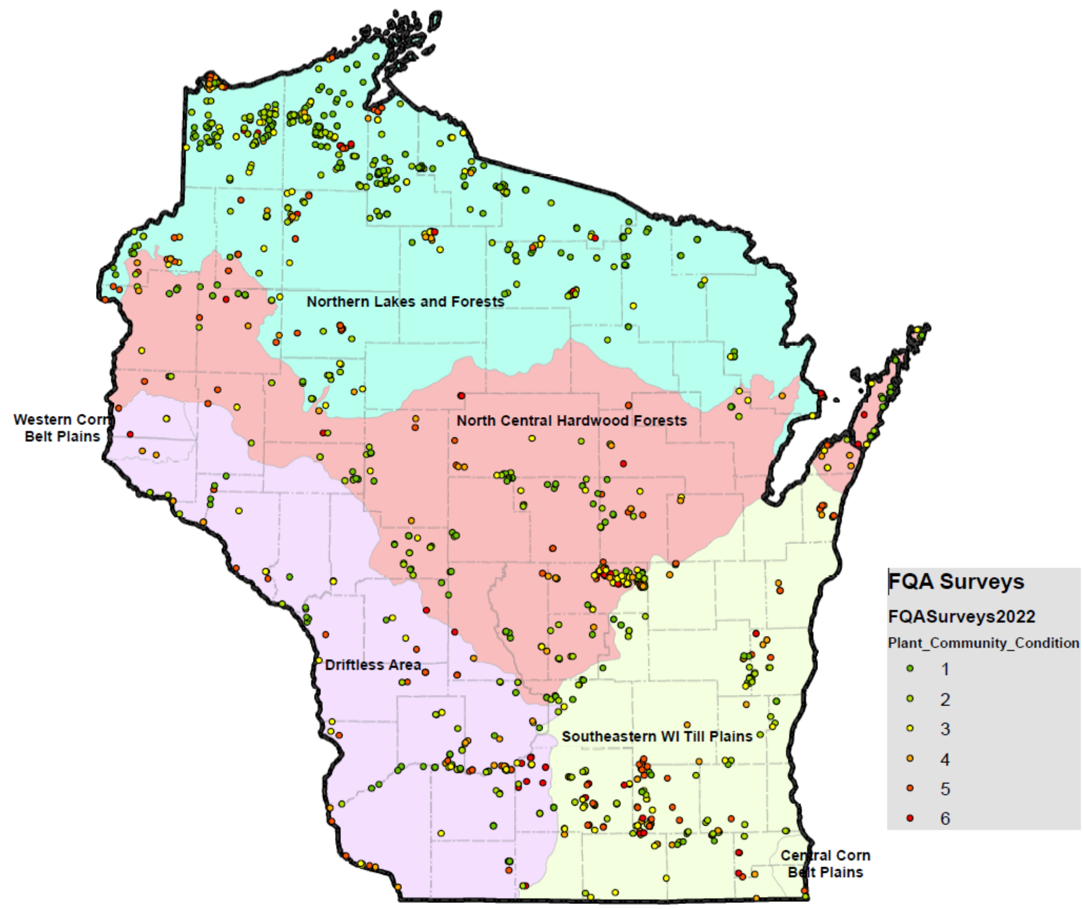

Figure 1. Wetland FQA survey locations (2012 -2019) with Plant Community Condition Score indicated by color from 1 (Green) = Unaltered to 6 (Red) = Highly altered.

2.2. Modifications to WI DNR's Full FQA Methodology

To meet the objectives for a RFQA four major modifications to the full FQA methodology were developed:

1. A dominants-only data collection protocol.
2. The use of broad, structure-based wetland classes in place of composition-based wetland community types.
3. The development of genus (or higher)-level C-values for select species groups,
4. Simplified, four-tier, numeric thresholds for floristic quality based on $w\overline{C}$ calculated using the above modifications.

2.2.1. Modification #1: Using Dominant Wetland Plants to Assess Condition

After review of multiple other RFQA protocols from other states, Department staff determined that a focus on the dominant (i.e., most abundant) plant species within a given wetland community might prove to be the simplest, for three reasons:

First, using only dominant plants will dramatically reduce the number of plant species a surveyor would need to identify. The number of species at low abundance in plant communities far outweighs the number that are common. For instance, floristic surveys of southern sedge meadows have found on average 50 species but of those, only 2 or 3 achieve areal cover amounts exceeding 20%.

Secondly, over time the Department's existing FQA methodology has relied increasingly on abundance-weighted metrics of conservatism to assess condition, especially cover-weighted mean conservatism (*wC*). Unlike FQI or wFQI, the *wC* metric is not affected by the size of the assessment area, allowing comparison of wetlands of diverse sizes. Also, weighting the metric by cover makes it far more indicative of the extent of non-native species invasion than simple mean C. The *wC* metric derives most of its numerical value from the C-value of the dominant plant species in a wetland. This metric has been shown to have a significant correlation (r^2 = 0.14 - 0.91; p-values 0.0-0.06) with measures of wetland stressors on most common wetland community types (Hlina et al. 2015; Marti & Bernthal 2019). This gave us confidence that a dominants-only approach could be effective.

Thirdly, as stated above, the Department's wetland assessment and monitoring program has already developed a large database of wetland floristic data from over 1,100 surveys completed using the timed meander survey methodology. This database allows us to simulate and optimize a dominants-only approach without having to complete hundreds of additional field surveys.

What do we call a "dominant" species?

Dominance is defined for the purposes of this methodology as high areal cover within a wetland community, regardless of whether the plant is dispersed or locally dominant or which stratum the plant is found within. Areal cover is measured using visual estimates across the entire wetland area and is expressed as a percent of the total area of the wetland.

How abundant should a species be within a wetland to be considered a dominant and be included in a rapid survey? Using existing full floristic survey data, we compared the effects of restricting surveys to only species with a minimum of 10% and 20% cover on the *wC* metric (Figures 2, 3, and 4).

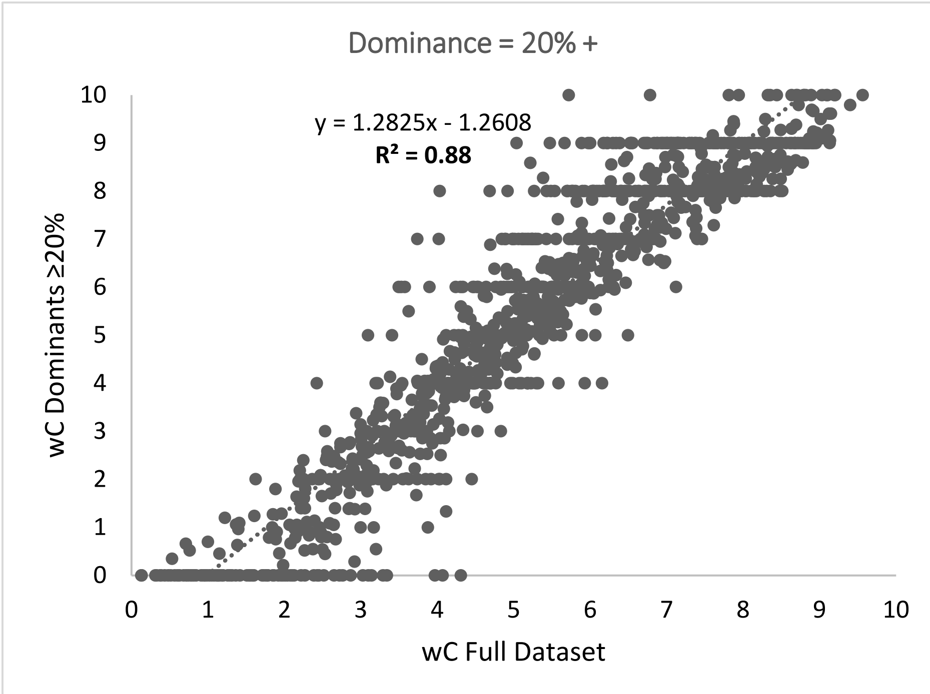

Figure 3. Dominance cut-off of 20%. Comparison of 1,161 wC values calculated from a full species list vs the same wetland wC calculated using only species with cover ≥ 20%.

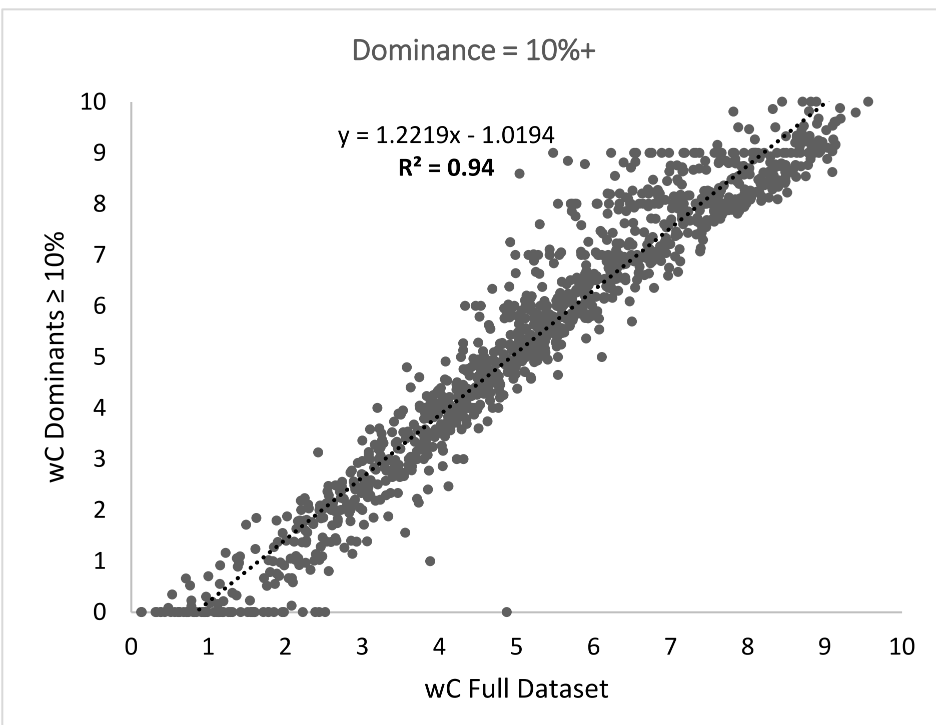

Figure 2. Dominance cut-off of 10%. Comparison of 1,161 wC values calculated from a full species list vs the same wetland wC calculated using only species with cover ≥ 10%.

Both 10% and 20% cut-offs produced results highly correlated to the *wC* derived from a full species list (R^2 = 0.88, 0.94; Figures 2 and 3). However, the proportion of *wC* values that differed dramatically from the *wC* value calculated from a full species list was considerably higher when species found at 20% or higher were used

(Figure 4). For instance, 81% of rapid-simulated *wC* results fell within 1 integer of the full FQA *wC* when 10% was used as a cut-off, but when 20% was used that proportion went down to only 64%. Because using a 10% minimum cut-off produced more reliably similar *wC* results from a full FQA survey and remains a relatively straightforward value to assess in the field we chose to use 10% as a working definition of a dominant species throughout our testing, data extraction and protocol development.

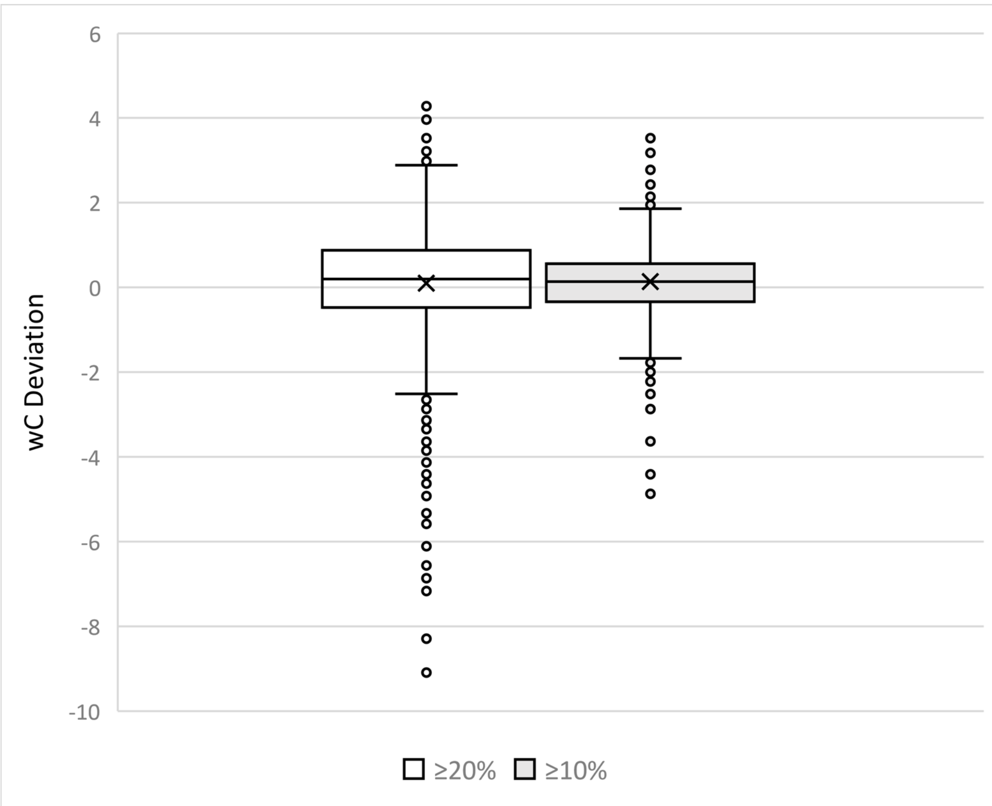

Figure 4. Deviation in wC values between full FQA surveys and simulated, dominants-only surveys when 20% areal cover and 10% areal cover minimums are used to define dominance.

However, this cut-off became less important as the protocol developed and we realized that only at the end of a meander survey can the surveyor know which species may qualify for this minimum 10% cut-off. In the meantime, the surveyor can only identify species that are locally dominant in the surveyor's current range of view. This may result in species with less than 10% cover being marked as "dominant" in the field form (Appendix A). In addition, assessing what constitutes 10% cover has a fair amount of variability between observers and should be thought of as more of a range i.e., 5% - 15%. Because the number of species in a mature wetland community that cover more than 1% areal cover is typically limited, we knew that even including some species in the 2% to 9% range would still meet our goal of drastically reducing the number of species required. This will be discussed more in the methodology section, below.

Restricting species to only those that occur at a dominant level (i.e., cover values ≥ 10%) reduced the number of potential species required to identify from over 1,200 to only 300 - a quarter of the original number. This modification was the most important factor in reducing the species list and making the RFQA user-friendly to non-expert botanists.

Identifying the common dominant plants in Wisconsin's wetlands

The Department's goal was to identify a list of species dominant in "typical" wetlands in Wisconsin, however, most surveys in our database were selected non-randomly and deliberately targeted by ecoregion, community type, and condition. The benefit of this sampling method is its effectiveness in capturing a broad spectrum of wetland floristic diversity in Wisconsin, (apart from aquatic wetland communities, (e.g., submergent marsh, floating leaf marsh) which were not included). However, high-quality, relatively undisturbed wetlands are over-represented in the database (Figure 5). To adjust we removed surveys labeled as reference-quality or were assigned a plant community condition score of "1" or "2", representing our most intact wetlands, with the assumption that reference-quality wetlands are less likely to be encountered by users of this tool. In general, we assumed wetlands on the landscape will follow a normal distribution in terms of condition (i.e., most wetlands will have "medium" condition rather than high or low) but included the lowest quality wetlands because many permitting decisions occur in altered landscapes on the edge of development. Because of these factors we envisioned the tool as best suited to the assessment of low and medium quality wetlands, intending to encourage the use of full FQA surveys for known high quality wetlands, while still being able to accurately identify a high-quality wetland as such.

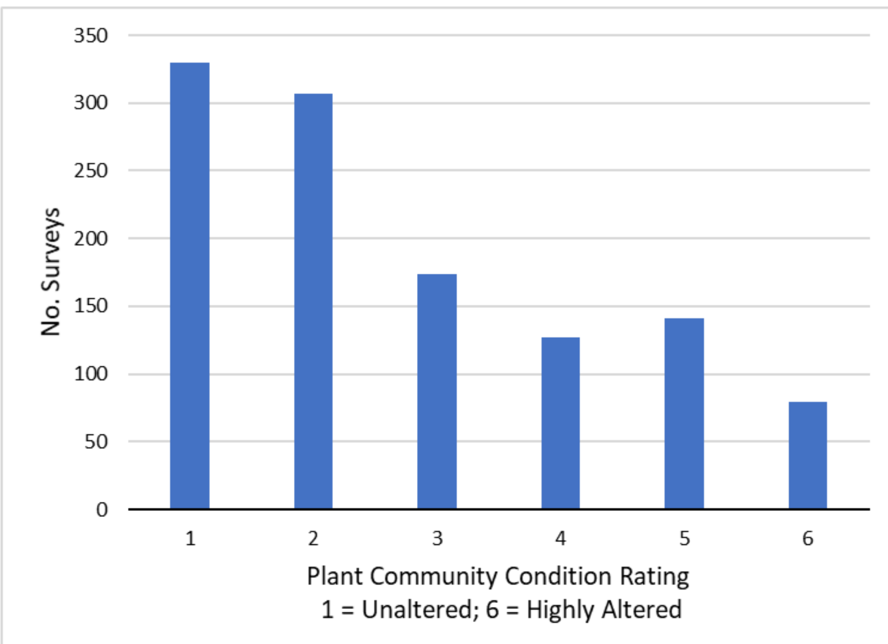

Figure 5. Distribution of Condition Scores of FQA Surveys from WI DNRs FQA Database. Surveys rated "1" or "2" were used in some analyses for protocol development. However, selection of common dominant species and calculation of group-level average C-values were restricted to wetlands rated "3" to "6".

Eliminating species that occur only in reference quality wetlands reduced the list of dominants (≥ 10%) from 300 to 225.

Using a modified importance value (IV) to rate commonness

To order species by their tendency to be encountered as a dominant plant we selected all species that appear in surveys at a minimum of 8% cover and calculated each species' relative frequency and relative cover among all non-reference quality surveys in a wetland class, Herbaceous (Emergent), Scrub-Shrub, and Forested (Cowardin et al., 1979; Federal Geographic Data Committee, 2013). While 8% is lower than what is typically considered to be a dominant species, we wanted to avoid inadvertently eliminating species that frequently appear as mid-to low-level dominants from 5 – 10% and allow for the imprecise nature of visual cover estimates.

Relative frequency and relative cover of the resulting dominant species were averaged to create an index of overall commonness similar in concept to Curtis & Macintosh's (1951) Importance Value (IV). The result was a list of dominant species ordered by IV for each of three wetland classes (Appendix C).

These three lists ranking species by their importance values were then used to guide the development of the following end products:

- RFQA data forms listing most commonly occurring dominant plant species.
- Genus- (or higher-) level C-values weighted by likelihood of being encountered; and
- A plant identification guide to dominant plants of Wisconsin wetlands (to be developed at a later date).

2.2.2. Modification #2: Use of Cowardin Wetland Classes to Structure the Tool

Wisconsin wetlands are diverse. Across the full spectrum of communities, they are host to over 250 dominant (≥ 10% cover) plant species. To make plant identification easier we looked for natural breaks in diversity to break up the large number of species and provide structure to the tool. While the full FQA protocol uses Wisconsin's Natural Community Classification (O'Connor, 2022), we thought the level of expertise required to use a composition-based classification might not be necessary for a rapid level assessment. Instead, we elected to use the wetland class system developed by Cowardin; a broad-level classification system within which the Natural Community Classification can fit (see Appendix B, Table 1). Cowardin Wetland Classes (Cowardin et al., 1979; Federal Geographic Data Committee, 2013) are easy to differentiate, do not require a user to identify plants to species, and are based on dominant vegetation structure, aligning well with a dominance-based tool. This classification divides wetlands into classes based on vegetation structure, with Forested, Scrub-Shrub, Emergent (Herbaceous), and Aquatic Bed being the most common. Categories use a 30% cover cut-off to differentiate one from another, with the taller vegetation type taking precedence over shorter vegetation. These classes are defined as follows:

Forested Wetlands: Trees at least 6m (20 ft) in height are the tallest life form and cover at least 30% of the wetland area.

Scrub-Shrub Wetlands: Woody plants less than 6m (20 ft) tall are the tallest life form and cover a minimum of 30% of the wetland area.

Herbaceous (Emergent) Wetlands: Rooted, herbaceous plants are the tallest life form with a minimum cover of 30%.

Aquatic Bed Wetlands: Plants that grow on or below the surface of the water are the tallest life form with at least 30% areal cover. This class of wetlands was not developed for use with the RFQA due to lack of data.

The Scrub-shrub class includes the common "**Shrub**" subtype dominated by tall shrubs such as *Alnus incana* (Tag alder) or *Salix petiolaris* (Meadow willow) and the "**Scrub**" subtype which are typically peatlands dominated by short-statured shrubs such *Chamaedaphne* (leatherleaf) in open bogs or stunted trees (e.g., muskeg). While these scrub communities may appear to be "open" herbaceous wetlands at first glance, if herbaceous cover is either shorter than the shrub cover or comprises less than 30% areal cover, scrub is the more appropriate designation.

Note also that the scrub-shrub class includes wetlands with combined tree and shrub cover greater than 30%, even if neither trees nor shrubs separately amount to 30% cover.

Cowardin Classes vs WI DNR Natural Community Classification

Table 1. Crosswalk of typical Wisconsin natural wetland communities falling under each Cowardin Palustrine (Wetland) Class. In the Cowardin Classification the tallest vegetation stratum with a minimum of 30% cover determines the Class.

Forested Class ***Trees >6m tall are the tallest life form and have 30% minimum cover.***	**Scrub-Shrub Class** ***Woody plants <6m tall are the tallest life form and have 30% minimum cover.***
Ruderal Swamp Forest	
Floodplain Forest	"Shrub" Subtype**:**
Southern Hardwood Swamp	Alder Thicket
Northern Hardwood Swamp	Shrub-Carr
Northern Wet-mesic Forest	Ruderal Shrub Swamp
Southern Tamarack Swamp	
Northern Tamarack Swamp	"Scrub" Subtype:
Black Spruce Swamp	Open Bog
White Pine-Red Maple Swamp	Muskeg
Herbaceous (Emergent) Class ***Rooted, emergent, herbaceous plants are the tallest life form and have 30% minimum cover.***	**Aquatic Bed Class** ***Plants that grow on or below the surface of the water are the tallest life form and have 30% minimum cover.***
Ruderal Wet Meadow	Submergent Marsh
Ruderal Marsh	Floating-leaf Marsh
Emergent Marsh	American Lotus-lily Marsh
Southern Sedge Meadow	Oligotrophic Marsh
Northern Sedge Meadow	
Wet Prairie	
Wet-Mesic Prairie	
Calcareous Fen	
Central Poor Fen	
Poor Fen	
Wild Rice Marsh	
Boreal Rich Fen	

The two classification systems do not always align as in Table 1, however. For instance, among our surveys a significant proportion of calcareous fens and sedge meadows had enough shrub growth to qualify as Scrub-Shrub wetlands and occasionally a wetland that matches a forested wetland in composition may fall under Scrub-Shrub if tree cover is just under 30% and the shrub layer is well developed. See Appendix B for the community classification of wetlands in Department's FQA database.

In addition to reference-quality wetlands, several, mostly rare wetland types present in Wisconsin are absent or not well represented in our database, including Wild Rice Marsh, Ephemeral Pond, Great Lakes Ridge and Swale, White-Pine Red Maple Swamp, Forested Seep, Bog Relict, Patterned Peatland, Great Lakes Shore Fen, Interdunal Wetland, Coastal Plain Marsh, Inland Beach, Moist Sandy Meadow, and Aquatic Bed Class wetlands: Submergent

Marsh, Oligotrophic Marsh, Floating-leaved Marsh, and American Lotus-lily Marsh. Because these were not included in the development of the tool, the RFQA may not be appropriate to use with these communities.

Splitting 225 dominant species into three Cowardin Classes reduces the number of species Assessors can expect to encounter in any single Cowardin Class to between 103 – 131. This will reduce the number of species appearing on Cowardin Class specific field forms making them easier to use.

2.2.3. Modification #3: Genus-Level Coefficients of Conservatism

The third modification to reduce the number of species and level of effort required to assess wetland condition was the development of genus- (or higher) level coefficients of conservatism (C-values). Because a complete species inventory is not a goal of a rapid assessment, we thought the judicious use of genus-level C-values could be effective in improving ease-of-use by not requiring identification of all species, especially within difficult groups. Genus-level identifications are not currently permitted in the full FQA survey methodology, which allows only vascular plant species that were assigned a C-value by a team of experts in 2001 (Bernthal, 2003) to be entered into the calculation of metrics.

Group-level C-values (Appendix C) were calculated using abundance-weighted averages by Cowardin class using only species within the genus that appeared in surveys at 8% cover or greater. We took into consideration three factors when calculating genus-level C-values:

- The disparity of C-values within the genus.
- The ease of identification of the group at the genus level vs species level; and
- The importance value (IV) of the group and the species within it.

Some plants are easy to identify at the genus-level and contain species with similar C-values, such as *Solidago* (goldenrods), making the use of a group average a safe choice. Other genera contained species with disparate C-values, introducing the risk of the result diverging significantly from that expected from a full FQA survey. Using IV-weighted averages allowed us to overcome some disparity in C-values within a group by matching more closely the C-value of the more commonly encountered species. However, when the genus had a high overall IV and equally common species within it with a high level of disparity, we did not consider it appropriate to use a genus-level identification. This was the case for *Salix* (willows) and *Fraxinus* (ashes). In the case of *Salix*, because the species within the genus are difficult to separate, we provide a genus-level C-value, but discourage its use when appearing at high cover in a wetland (50% or more).

The genus *Carex* was the largest and most significant genus in both number of species and IV in wetlands, especially in herbaceous class wetlands. While there was disparity in C-values across the genus, which ranged from 3 to 10, the most common dominants, *Carex stricta*, *Carex lacustris*, and *Carex utriculata*, had similar C-values, between 6 and 7, resulting in a weighted average C-value for the genus of 6.4 (see Herbaceous field form, Appendix A). Species with significantly lower C-values that can occasionally appear in wetlands at greater than 8% cover include *Carex granularis*, *C. pellita*, *C. trichocarpa*, *C. annectens*, and *C. vulpinoidea*. However, these species have considerably lower importance values and rarely dominate large wetland areas. Given the high level of difficulty involved in separating these species, we felt using a genus-level C-value for *Carex* is worth the risk of an inflated score on the rare occasions these species are highly prevalent.

We also recognized that sedge meadows dominated by wiregrass sedges (*Carex lasiocarpa*; C-value of 9 and *Carex oligosperma;* C-value of 10) will be undervalued if given a C-value of 6.4. While we considered a separate C-value for wiregrass sedges of 9.5, it was thought this may add too much complexity for two species that are generally encountered only in unaltered environments and would likely have accompanying species with high C-values to compensate. We also determined that in situations such as these, the resulting condition class would likely remain on the higher end and would therefore trigger the need for further study in regulatory situations.

In addition to creating averaged C-values at the genus level, in two cases weighted average C-values were calculated for species that look similar at a higher level than genus: wetland ferns, which come from several different families, and nettles, which fall in different genera but share a common family (Urticaceae). In the case of the Urticaceae family, we lumped most commonly-occurring species in this family with a grouped C-value but separated out *Urtica dioica* (stinging nettle) due to the disparity in c-value from the other common species in the family (see Shrub and Forested field forms, Appendix A).

A C-value for one non-vascular plant group was also added here, the moss genus *Sphagnum*. *Sphagnum* mosses are readily identifiable and associated with highly conservative wetland species, making the group an excellent indicator taxon. Because no C-value was assigned to Wisconsin *Sphagnum* species in the original 2001 effort we relied on a compilation of C-values for Great Lakes mosses by Kier Wefferling and others at UW-Green Bay Herbarium to find a reasonable C-value for this genus. Here we follow New Jersey's example in assigning a C-value of 7 to the genus (Bowman, 2017). This value may be revised in the future once work by UW-Green Bay Herbarium has been completed.

A total of 21 genus-level (or higher) C-values will be available to use on the Herbaceous Class Wetland form, 16 on the Shrub Class Form, and 16 on the Forested Class form.

It is important to note that the use of averaged, genus or higher-level C-values is optional in the rapid protocol. Users who are comfortable identifying all or some dominant plants to species level are invited to do so on forms and it may improve accuracy. However, genus-level identifications are expected to reduce survey time considerably and are expected – in most cases – to have a minimal cost to the accuracy of the final score. The following are situations to be aware of in which genus-level C-values may have reduced accuracy:

- Very high-quality wetlands such as fens, open bogs, and muskeg where genus-level C-values may be lower than C-values of species-level identifications.
- Unusual wetland community types, not well-captured in our database (see previous section for communities not included in the development of the RFQA); or
- Wetlands that fall near the border between two Cowardin wetland classes.

2.2.4. Modification #4: Statewide, All-community *wC* Thresholds for Rapid Data

The Department's full FQA methodology includes 5-tier condition benchmarks for *wC* and Mean C, calculated separately for 30 different community/ecoregion combinations. This high level of refinement provides users with an assessment of a wetland of interest specifically in relation to other wetlands of the same natural community type in the same ecoregion. By restricting comparison of scores to only wetlands of the same community type, the score is more likely to reflect anthropogenic alteration rather than other factors that influence plant conservatism such as adaptations to natural disturbance regimes (flooding, fire) which lowers plant conservatism or adaptations to environments with low nutrient availability or other stressors, which promotes plant conservatism. Using community-specific *wC* benchmarks effectively levels the playing field so that community types that tend to host tolerant species even in their most intact state (e.g., floodplain forests) can be assessed fairly, and communities that host conservative species (e.g., cedar swamps) are not over-rated even when in a degraded condition.

While we had wanted a rapid methodology to match the existing condition benchmarks for *wC* as much as possible, we knew it would be difficult to ensure that *wC* values calculated using only dominant plants identified by surveyors with less botanical experience would reliably fall within the same condition tier of the five that were developed for each community type. Secondly, we thought it appropriate that a rapid tool offer a simpler, broader, state-wide context of wetland plant conservatism which avoids the user having to identify wetland plant community type. While there are disadvantages to reverting to a one-size-fits-all assessment, there are also several advantages that we believe will complement Wisconsin's existing community-specific benchmarks for full FQA surveys. Besides simplicity, one important advantage of one-size-fits-all benchmarks is that it allows the recognition that not all wetland types are equal in their ability to support conservative plant species, in their association with high water quality and intact watersheds, development times or ability to be replaced via restoration. For more discussion on this topic see Section 4.

Setting numerical thresholds for rapid-derived floristic data

To determine reasonable cut-offs for *wC* that could distinguish Exceptional, High, Medium, and Low-quality wetland plant communities, we sorted all wetland surveys from the wetland FQA database into four plant conservatism bins, "Peatlands", "Conservative", "Moderate", and "Tolerant" based on the combination of criteria described in Table 2 below. Peatlands were set apart from the rest of the conservative group because they have highly specific ecological conditions required for their development that was considered incompatible with some of the more mesotrophic communities in the Conservative group.

While past floristic quality numerical thresholds have been set using only a rating of human alteration, we combined several factors to create our conservatism bins in addition to human alteration ratings. No single factor was reliably diagnostic.

- **WI Natural Community Type**. Wetlands of the same community often share traits like successional status, dependance on certain nutrient levels, and association with natural disturbance regimes.
- **Anthropogenic alteration**. Overall Disturbance score rates the level of anthropogenic stress to the wetland based on observations of disturbance factors in the wetland and buffer.
- **Percent non-native species cover.**
- **Previous record of restorability**. When the above factors were not decisive, restorability was used with the assumption that "Conservative" wetlands would be difficult and rarely restored and "Tolerant" wetlands would be easily and commonly restored.
- **Conservative plant diversity.** Ability to support a diversity (>~ 10 species) of conservative plants (C-values >6). This factor was used to separate tolerant communities from moderate communities when other factors were not decisive.

Restorability is defined as the likelihood of successfully restoring a wetland within a reasonable time frame, (~50 years) via re-establishment, i.e., restoration from a fully-drained state, typically by disabling ditches and/or tile from fields formerly plowed for annual crop production. Restorability is estimated based on a previous EPA-funded study of restoration outcomes 5 to 30 years post-restoration (Gibson & Jarosz, 2020). From the 106 restorations surveyed we found that 90% achieved (full) wC scores of 4.6 or less suggesting that plants with high conservatism are difficult to bring back even 30 years post restoration. In addition, certain dominant species appeared frequently, (reed canary grass, hybrid cattail, sandbar willow, box elder, Canada goldenrod) and others were less common (sedges, blue-joint grass, alder, bur-reed), and many were missing (black ash, Northern cedar, leatherleaf). These findings informed bin assignment and influenced RFQA thresholds, mainly by influencing the lower limits of the Conservative bin and the upper limits of the Tolerant bin.

Table 2. Attributes of surveyed wetlands used to define the four conservatism bins. Ranges of wC values from simulated RFQA data from these bins were used to set numerical thresholds for floristic quality.

Conservatism Bin	Peatlands	Conservative	Moderate	Tolerant
Characteristic Community Types	Open Bog Muskeg Poor Fen Black Spruce Swamp Central Poor Fen Boreal Rich Fen Northern Tamarack Swamp	Northern Wet-mesic Forest Northern Sedge Meadow Southern Sedge Meadow Calcareous Fen Southern Tamarack Swamp Northern Hardwood Swamp	Emergent Marsh Shrub-Carr Wet-mesic Prairie Wet Prairie Alder Thicket Floodplain Forest Southern Hardwood Swamp	Ruderal Marsh Ruderal Wet Meadow Ruderal Shrub Swamp Ruderal Forested Swamp
Description of common factors affecting plant conservatism.	Oligotrophic, highly stable, unimpacted to slightly impacted.	Weakly minerotrophic to mesotrophic, often ground water-dependent, unimpacted to slightly impacted.	Mesotrophic to eutrophic, mid-successional, naturally disturbance-related, or moderately impacted conservative wetlands with a mix of natives and introduced spp.	Eutrophic and/or highly altered, partially- drained or permanently flooded, dominated by introduced species or ruderal natives.
Overall Disturbance Ratings (1 -5)	1, 2, 3	1, 2 ,3	2, 3, 4	4, 5
Non-native cover range	<10% abs. cover. <6% rel. cover	<15% abs. cover. < 6% rel. cover	>15-55% abs. cover. < 35% >6% rel. cover	>55% abs. cover. > 35% rel. cover
Restoration probability from drained ag field in 50 years	Not known to be possible	Unlikely except in rare circumstances.	Possible	Likely
Typical C-values of flora (Middle 50%)	5 to 9	3 to 7	2 to 6	0 to 6
Characteristic Dominant Species	*Sphagnum* sp., Leatherleaf, Wiregrass sedges, Black spruce	Sedges, Tamarack, Cedar, Black Ash, Yellow birch	Maples, Green Ash, Alder, Willows, Blue-joint grass, Big blue stem	Reed Canary Grass, Cattails, Buckthorn, Box elder, Goldenrod, Sandbar willow

Once groups were determined, we used box plots of *wC* scores from rapid-simulated data for each group to set the thresholds (Figure 6): The Low-Medium threshold at the 80th percentile of Tolerant scores, the Medium-High threshold at the 80th percentile of Moderate scores, and the High-Exceptional threshold at the 80th percentile of Conservative scores. Thresholds were set with the recognition that overlap exists between adjacent groups and there is a risk that rapid *wC* scores will not always separate groups correctly. We considered placing thresholds at the midpoints between the 75th and 25th percentile of adjacent groups, but found that while similar, the 80th percentile of the lower group was both simpler and slightly biases the results in favor of over-estimating rather than under-estimating wetland quality.

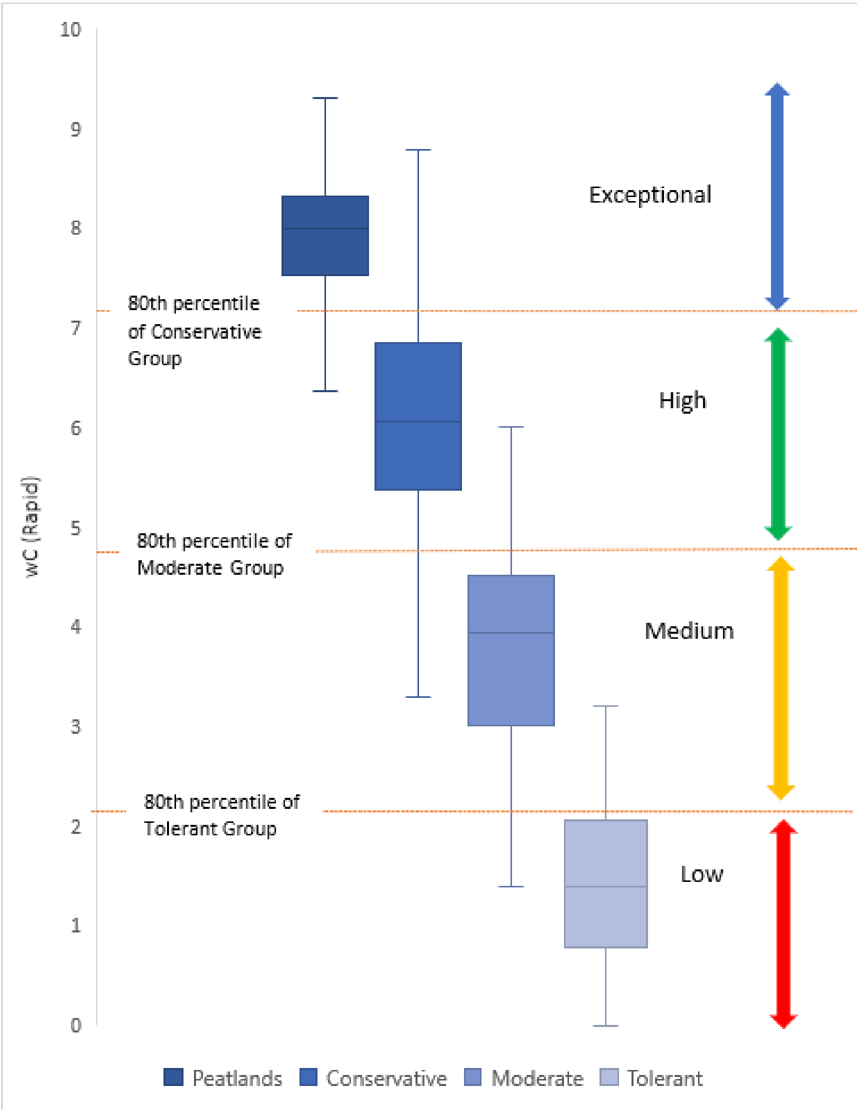

Figure 6. Rapid weighted mean c (wC) values for wetlands from four conservatism groups assigned using multiple tolerance metrics. Dotted red lines show where thresholds for floristic quality tiers were placed.

Table 3. RFQA weighted mean C score benchmarks for floristic quality.

Rapid *wC* Score	Floristic Quality Tier
7.1+	Exceptional
4.8 -7.0	High
2.1 -4.7	Medium
≤ 2.0	Low

2.3. Rapid FQA and the human disturbance gradient

Biological condition assessments were developed primarily to serve as a measure of human caused degradation. (EPA 2002). Because multiple factors are embedded within any scale based on plant C-values we thought it was important to estimate how much the RFQA *wC* might reflect wetland degradation as opposed to other factors.

We used the Overall Disturbance rating given to each survey in the wetland FQA database to estimate human alteration. This rating is determined in the field based on a Disturbance Factor Checklist, in which the surveyor indicates the number and severity of alterations observable in the wetland and the immediate buffer. A regression of Overall Disturbance score against simulated RFQA *wC* (Figure 7) found an inverse relationship of *wC* with disturbance (R^2 0.38, p = 0.00) indicating that disturbance is a weak but present factor influencing the RFQA wC value.

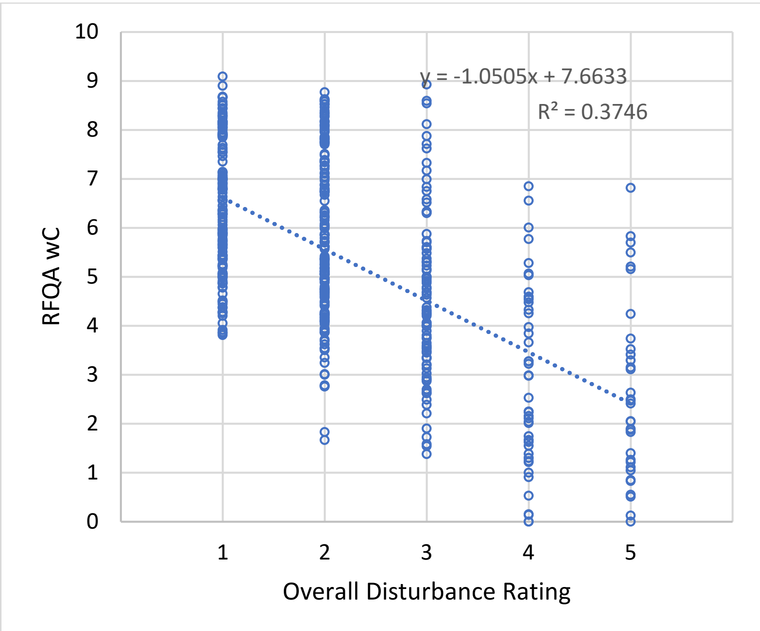

Figure 6. RFQA simulated wC results plotted against the Overall Disturbance Rating (1 = minimal stressors, 5 = multiple severe stressors) assigned to each wetland survey in the FQA database based on observations of alterations in the wetland and buffer.

For comparison, we looked at regressions of the Overall Disturbance rating with full *wC* previously calculated for specific community/ ecoregion combinations (Hlina et al., 2015; Marti & Bernthal, 2019). Significant R^2 values for 30 individual community/ecoregion combinations ranged from 0.14 to 0.85. The strength of the relationship between human alteration and RFQA *wC* therefore falls within the range found in previous work with the full FQA methodology to set numeric thresholds, though on the low end. While it seems clear that a relationship exists at broad levels, smaller differences in *wC* may be due to other factors.

What else is *wC* measuring, in addition to degradation? Plant conservatism is determined by several environmental factors that cause stress to plants and promote specialization. Plants with the highest C-values are adapted to conditions of low nutrient availability, persistently saturated soils, and long development times. These factors may be the result of differences in local natural history, but they are not irrelevant to wetland assessments due to the increasing difficulty of reproducing such environments in degraded watersheds with high nutrient availability and altered hydrology. In other words, wetlands hosting plants with high C-values are likely to be difficult to restore and this is valuable information when making decisions regarding potential impacts or prioritizing protection.

We refer to the single set of RFQA numeric thresholds as “Floristic Quality Tiers” to acknowledge that they describe floristic quality or plant conservatism more than wetland condition, and to distinguish them from the set of 30 community and ecoregion specific tiers developed for the full FQA methodology.

2.4. Simulating Rapid FQA Results from Full FQA Data

Simulations using pre-existing data from full FQA surveys were used throughout the development process and revealed where strengths and weaknesses existed in our dominants-only approach. We used both regressions and measures of absolute differences between dominants-only derived *wC* and full species list-derived calculations of *wC* to optimize the rapid protocol and gauge how close the results may be.

Early simulations tests found that a significant portion of surveys had only one or two species remaining after removing non-dominant species. We found this occurred most often in monotypes of reed canary grass and *Typha X glauca* which typically consisted of one species with 80% or more cover and the remaining with 3% or less cover. Surveys with lower numbers of dominants had higher discrepancies with full *wC* than surveys with more species. This led to modifying the survey protocol to include a minimum number of species regardless of areal coverage. Users will instead be asked to identify the top 3 to 5 most-dominant taxa they find in the wetland.

Once the protocol and genus-level C-values were developed we ran a final simulation that represents the closest approximation of how rapid modified data will differ from full FQA results. For this final simulation, floristic data from over 1,100 full timed meander wetland surveys were modified as follows:

1. Individual species entries for select taxa were replaced with one of 42 genus-level (or higher) taxa with averaged C-values as described above and listed in Appendix C.
2. Entries given a cover value of less than 8% were removed.
3. Surveys that did not meet the minimum number of dominant taxa criteria (3 for herbaceous wetlands, 4 for shrub wetlands, and 5 for forested wetlands) were eliminated; and
4. Reference quality wetlands were removed.

2.4.1 Results: How much can we expect RFQA *wC* results to match full FQA survey results?

Regressing simulated RFQA *wC* against full FQA *wC* resulted in an R^2 value of 0.91 (Figure 8) indicating a strong relationship with full survey results across the range of *wC* values. Many surveys were removed from our original dataset for this final simulation (reference-quality surveys and those that did not meet the minimum species requirements) because they did not contain data representative of the final product and intended use. However, the lowest R^2 value obtained before these surveys were eliminated was 0.87 indicating a robust relationship even when some surveys included fewer species and higher quality wetlands than what we expect when the protocol is put into use.

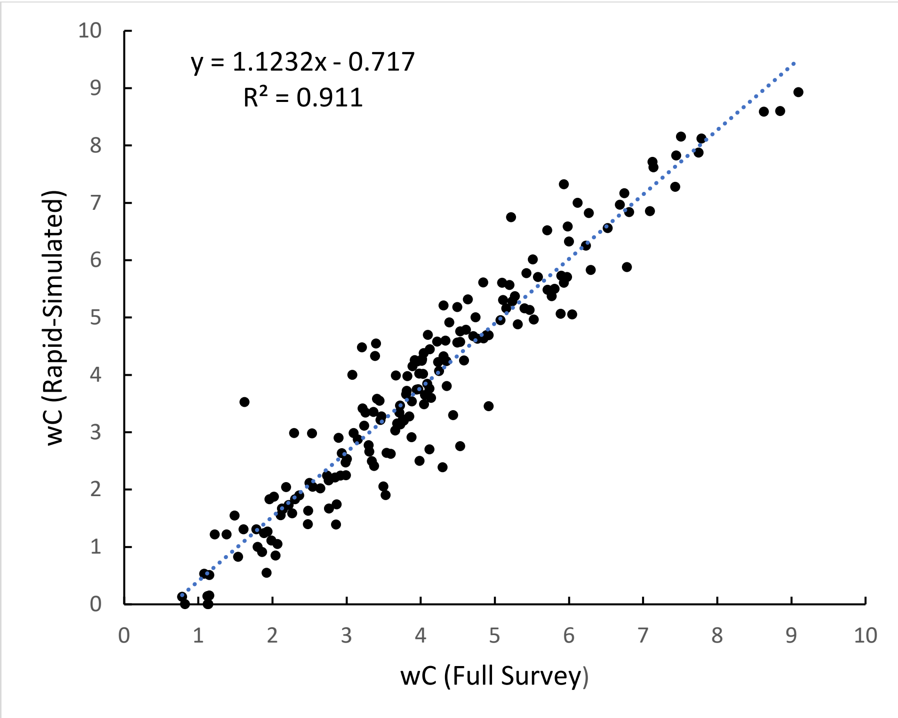

Figure 7. wC values from rapid-simulated data (dominants-only, with 46 genus-level or higher taxa substitutions for species-level plant entries regressed against wC calculated using a full species inventory. Does not include reference-quality wetlands.

Overall, the 95% confidence limits for agreement with full *wC* fell outside of agreed upon acceptable limits of +/- 1. Individual cases of rapid-modified data differed from full FQA surveys by as much as 1.9. Despite this, over half of surveys fell within +/- 0.5 of the full *wC* and from 80% to 94% fell within +/- 1 of the full *wC* result (Figure 9, Table 4). The biggest discrepancies in wC results were due to using a composite C-value for willow species in wetlands with high cover of sandbar willow (*Salix interior*) and pussy willow (*Salix discolor*), both with C-values of 2, considerably lower than the composite average of 4.9, suggesting the *Salix* composite C-value is too high when these species are present.

Also, plotting the difference between the rapid and full FQA against the average *wC* (Figure X) shows a pattern: Low values of *wC* (<2.5) tended to be under-estimated by the rapid modifications, while values between 6 and 8 tended to be over-estimated by the RFQA.

Table 4. Difference in wC values between simulated RFQA and full FQA. Shown are % of RFQA wC values differing by less than 0.5 and less than 1 for Herbaceous, Shrub, and Forested Class wetlands. 95% confidence intervals fell between -1.5 below and 1.0 above the full species wC result.

Difference from Full *wC*	Herb.	Shrub	Forested	Total
Within 0.5	50.0%	55.0%	63.4%	55.5%
Within 1.0	86.7%	80.0%	95.8%	87.0%
95% Confidence Intervals				-1.5 to +1.0

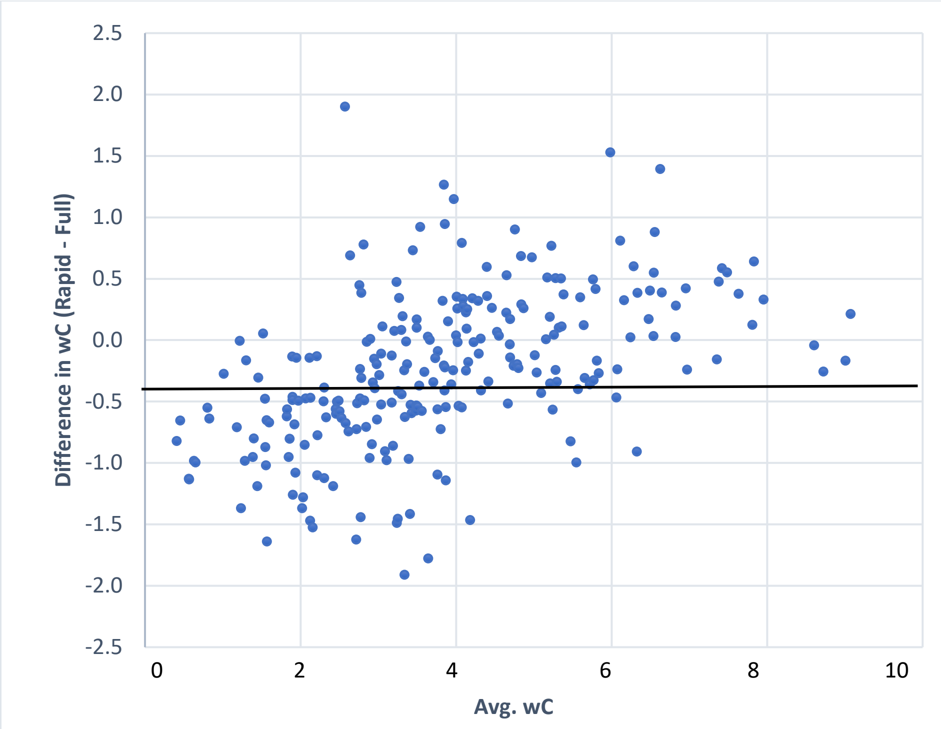

Figure 8. Difference between Rapid simulated wC and full survey wC plotted against the average of both wC scores. RFQA wC differences change from trending lower to trending higher than full FQA wC as average wC increases (until scores reach 8 or more.)

2.4.2 Conclusions from simulations

Because the level of agreement between rapid and full results from these simulations falls outside of acceptable limits, combined with the additional risk of misidentification that users with less botanical experience may introduce, we cannot recommend that users substitute rapid results for full *wC* results and apply them to the community and ecoregion-specific condition benchmarks developed for the full FQA methodology. Users should expect results of rapid surveys to lie within -1.5 to +1.0 of a full survey overall. However, these expected ranges can be adjusted based on the size of *wC*: results under 2.5 are more likely to underestimate a full FQA survey, results between 6 and 8 are more likely to overestimate *wC* from a full survey and we expect that *wC* values over 8 will tend to be under-estimated by rapid methods, especially when dominated by wiregrass sedges.

The use of the composite C-value for species in the genus *Salix* (willows) caused the biggest differences from full wC. The genus *Salix* is problematic for use with a rapid protocol because the genus has high cover and frequency in wetlands, there are multiple important dominant species in the genus (see Appendix C), individual species have disparate C-values, and species are difficult to distinguish. Due to this combination of qualities we decided to retain the composite C-value but encourage users to identify *Salix* to species whenever cover is above 50%.

While the level of agreement between the rapid and full wC results were less than what we hoped for, these results give us confidence that, within limits, a dominants-only protocol, with the use of select genus- or higher level plant identifications, produce reasonably unbiased FQA results compared to the full FQA methodology, provided separate benchmarks for condition, calculated specifically for RFQA data are used.

2.5. Field Testing

In summer of 2022, the Department solicited the assistance of eight Department wetland professionals ranging from novice to experienced botanists to test the draft RFQA protocol. Nineteen wetlands were surveyed, selected to target all Cowardin classes and a range of conditions. A total of 43 RFQA surveys were completed, and results compared to full FQA surveys that were completed either at the same time or within two years. Results are shown in Appendix D.

2.5.1 Field Testing Results: *wC* difference from full surveys

Rapid *wC* ranged from -1.1 to +1.1 of the *wC* derived from the full surveys, with 95% confidence intervals calculated at -1.2 to 1.1, a range marginally smaller than that calculated from the simulated data described in the previous section. Rapid and Full *wC* were highly correlated (R^2 = 0.92) across the range of *wC* values (0.6 to 6.2) from field sites (Figure 10).

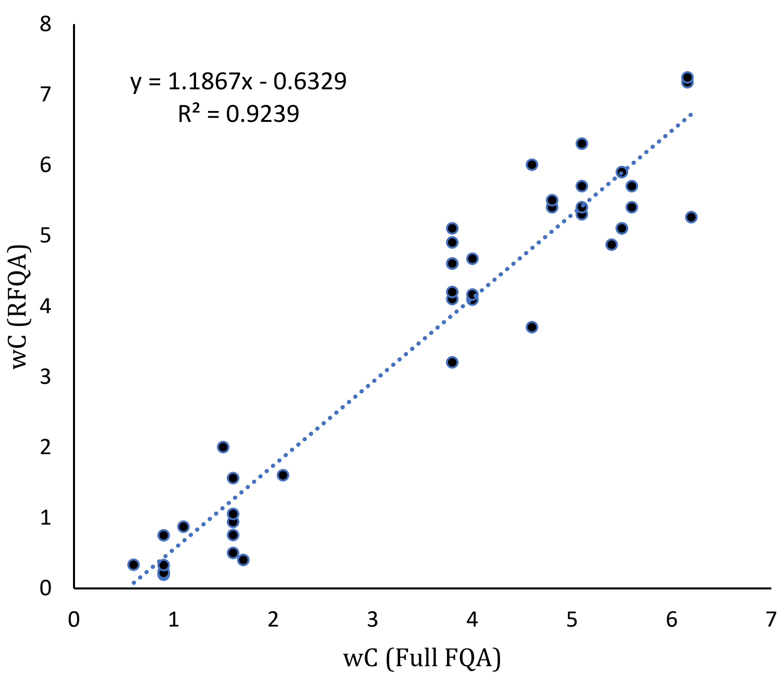

Figure 9. Regression of rapid wC values from 43 rapid field trials against wC from a full FQA survey of the same wetland. Points represents 19 different wetlands, 11 with same -day replicates by different observers.

However, when additional taxa ranging in cover from 3% -9% were added to the *wC* calculation, the correlation with the full survey *wC* tightened slightly (R^2 = 0.94 vs 0.92). Variability was reduced somewhat as well, with values clustering more tightly around zero (Figure 10).

2.5.2 Field Testing Results: Floristic quality category

From our selection of test wetlands, none resulted in a Rapid *wC* high enough to qualify as "Exceptional" using the thresholds shown in Table 3, however, 8 out of the 19 test sites qualified as "High" (Appendix D). Because the rapid benchmarks are not separated out by community type, we do not expect results to align with the 30 community and ecoregion specific benchmarks developed for full survey results in all cases. However, most did align: All "Medium" rapid results were "Fair" using community-specific benchmarks, and "Low" rapid results correlated with either "Poor" or "Very Poor" Benchmark scores. "High" surveys were the exception, with 5 resulting in only Fair condition from their full survey results and the remainder in Excellent condition. The community types of these mismatches were Cedar swamp, Northern Sedge Meadow, Calcareous Fen, and Northern Hardwood Swamp. Mismatches like this are expected with community types that tend to host many conservative species- the community may be moderately degraded but still retain more conservative species than many other wetlands in their intact state. The opposite should also be expected: even the best examples of naturally disturbance-related, mesotrophic communities such as Floodplain Forest, Alder Thicket, and Shrub-carr may never meet the "Exceptional" category. For instance, our field tests included three Excellent-condition Alder Thickets and Shrub-carrs, but they did not meet the criteria for "Exceptional" floristic quality using the RFQA classifications, a category likely to only be met in highly wet and oligotrophic environments.

2.5.3 Replicate Testing

Of our test wetlands, 11 were surveyed more than once by different observers on the same day. Standard deviations around the average *wC* of replicates ranged from 0.1 to 0.7. The largest variation in replicate *wC* came from a particularly heterogenous, patchy and diverse shrub wetland, in which *wC* varied by 1.7 between replicate rapid surveys by different observers beginning the survey from different start points. The two surveys with the highest standard deviations (0.6 and 0.7) were the only surveys which had two different floristic quality categories (High or Medium) depending on the replicate.

2.5.4 Testing a minimum species requirement

A question we explored with field testing was whether the minimum species requirements (the top 3, 4, or 5 depending on Cowardin Class; and all species ≥ 10% cover) were sufficient or if we should encourage additional observations. Because areal cover estimations occur only at the end of the survey, we found observers marked many taxa on forms that were locally abundant at some point along the meander but by the end of the survey did not meet the 10% cut-off. Encouraging users to enter more than the minimum species may come at the cost of extra survey effort and increase the variability in scores between observers, however, if it resulted in significant improvement in *wC* scores, it might be worth the cost.

Additional species observers entered on forms ranged from 1 to 11 taxa and were given final areal cover values between 1% and 9%. Total taxa per RFQA survey ranged from 3 to 14 (mean = 6.3) when additional taxa were included; in the minimum scenario total taxa selected ranged from 3 to 7 (mean = 4.5).

We looked at the effect on *wC* of both scenarios- restricting entry to the minimum number of taxa vs. including all species initially marked that were assigned a cover value of at least 3%. We found that the additional species improved the correlation between rapid and full *wC* (R^2 = 0.95 vs 0.92); and tightened the range of differences from full *wC* from 2.7 to 2.2 (Figure 11). The percentage of surveys falling within +/1 of the full FQA *wC* increased from 81% to 93% (Table 5). The 95% confidence intervals around the full *wC* value tightened as well, from [-1.4 to +1.5] to [-1.2 to +1.1].

Another concern, that adding additional species might decrease replicability due to the greater number of species occurring at covers less than 10%, and different observers choosing to report different species, turned out to not be an issue in our dataset: standard deviation between replicates was no greater or less when additional species were included.

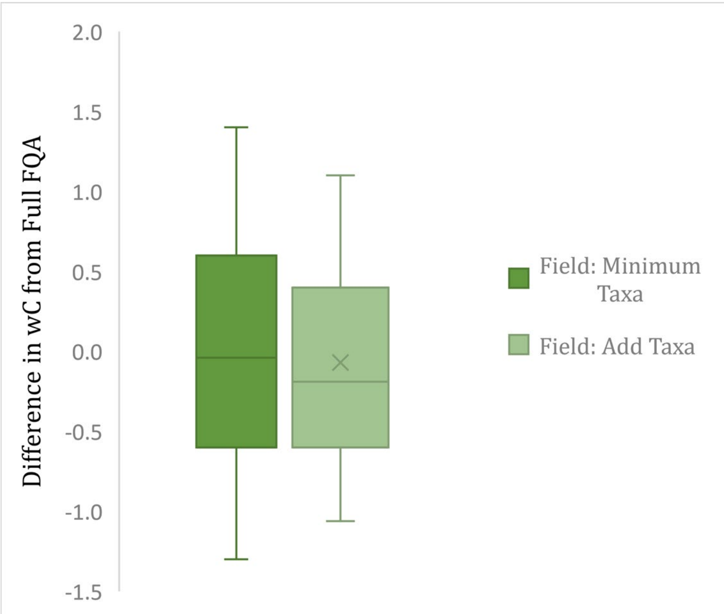

Figure 10. The distribution of differences in wC from field trials calculated using the minimum required number of taxa (left) and with additional taxa beyond the minimum required (right).

Table 5. Percentage of field RFQA trials (n = 43) that fell within +/- 0.5 and +/- 1.0 of full survey wC calculated using the minimum required taxa and with additional taxa beyond the minimum required. 95% confidence intervals around full wC are shown for both cases.

Difference from Full *wC*	Minimum Taxa	Additional Taxa
Within 0.5	34.9%	46.5%
Within 1.0	81.4%	93.0%
95% C.I.	-1.4 to +1.5	-1.2 to +1.1

2.5.5 Lessons learned from field testing

This step of testing the RFQA methodology and results was invaluable and confirmed the practicality and validity of this new methodology. We conclude the following from this exercise:

- Identifying the minimum number of taxa (top 3, 4, or 5 depending on wetland class) was sufficient in achieving a score that matched the full FQA *wC* within -1.4 to +1.5 of a full survey with 95% confidence and maintained a consistent relationship (R^2 = 92%) with full FQA scores across the range from low to moderately high values.
- Identifying one to ten additional taxa than the minimum required had minimal cost in terms of survey effort and improved the scores' similarity with full FQA results, with 93% of RFQA *wC* values falling within 1.0 of the full *wC*.
- Wetlands which are diverse and patchy on a large scale are considerably more difficult to assess areal cover within, and results may vary depending on the start point and meander path. These types of wetlands may require more time and a longer meander path to assess accurately.
- While all participants in field trials had some wetland plant experience, we found that not all had enough botanical knowledge and experience to make confident identifications across the range of

wetland types, even when genus-level identifications were used. Areal cover estimates, already known to be highly variable between observers, were even more variable than expected due to the wide range of experience among testers. While the rapid tool makes plant identification easier and shortens survey time, a moderate level of botanical knowledge and experience is nevertheless necessary to have confidence in the result.

3. Rapid FQA Survey Methods

3.1. Rapid FQA Survey Considerations

Before any RFQA surveys are completed in the field, the Assessor should familiarize themselves with the information contained within this section. The information below discusses how the tool should be utilized, how the Department has defined some of the key terms for use, and how to prepare prior to heading into the field to conduct a RFQA survey.

3.1.1 When NOT to Use the Rapid FQA

The RFQA tool, like any other commonly used field protocol, has limitations for when it can be used and when it should not be used. The tool was developed to make time-efficient, broad-level, quantitative floristic assessments accessible to wetland professionals who may not have advanced plant identification skills, or the time required to complete a full inventory. It is designed to work well for most wetland professionals familiar with common wetland plants in common wetland types. Assessors should become familiar with these limitations and consider using a the full FQA methodology in the following circumstances:

When a precise assessment of ecological condition is required

The RFQA will provide a fairly accurate assessment of condition based simply on what dominant plants are occurring in the community as Exceptional, High, Medium, or Low. Occasionally more nuanced scores or rankings are needed. In these situations, the RFQA methodology would not suffice, and a Full Timed Meander Survey is recommended.

When wetland condition relative to a specific community type or region is desired

The RFQA will only provide a condition rating relative to the full range of wetland types across the state. This means that a floodplain forest (which typically results in lower *wC*-values) in the south will be rated on the same scale as an open bog (which typically results in higher *wC*-values) in the north of the state. When a user is interested in assessing a wetland's condition relative only to other wetlands of the same community type or region, a full FQA survey must be completed, and results compared with a condition benchmark table specific to the wetland's ecoregion and natural community type.

When rare sensitive plant species are suspected to be present and important to capture

Usually rare, threatened, or endangered plant species do not occur at coverages greater than 10% areal cover and therefore might not be identified using this protocol. If identification of rare species is an important goal of a given survey or project, the RFQA should not be utilized.

In addition, some wetland communities such as calcareous fens and forested seeps are by nature poorly suited to a dominants-only assessment because they are known for hosting rare, conservative species within a matrix of more common and tolerant dominants. A RFQA is not expected to capture the value of these communities. If an Assessor suspects that a wetland in question may be one of these community types, a full floristic survey should be completed, or they should consult with an expert botanist if an evaluation of the wetland is needed.

When plant diversity is an important aspect of the plant community to capture

Plant species richness is an important aspect of ecosystem health that will not be captured using the RFQA. A full floristic survey should be used when plant diversity is important to better understand a wetland's functions, condition, and/or community type.

When the wetland has been disturbed or modified within the last 5 years

The flora of recently disturbed wetlands, such as farmed wetlands, restored wetlands, or recently exposed mudflats, can differ markedly from mature wetlands, especially in the first 4 years post-disturbance. These early successional communities may contain a high proportion of annuals that will disappear in subsequent years and may lack the long-lived perennials that will come to dominate these sites in coming years. Because such wetlands and their flora were not included in the development of this tool and furthermore the C-values of these early successional species have an untested relationship with wetland condition, neither the RFQA nor a full FQA is likely to result in a meaningful assessment of condition.

When a high level of precision and confidence in the assessment's conclusions is required

The RFQA bases its results on only a small number of plant taxa rather than the 25 to 100+ that are typically present in any given wetland community and there may be cases when the dominant plants provide a misleading picture of the overall health of the wetland. The RFQA also carries a risk of misidentification of plant species because its users may not have a high level of experience with wetland plant identification. In addition, the use of the optional genus-level plant identifications will also play a role in reducing the precision of the *wC* score when compared to a full FQA survey. Because of these factors the RFQA is a coarser-level and less precise assessment than the full FQA methodology.

Aquatic Bed Class wetlands

Aquatic Bed Class wetlands, Submergent Marsh, Oligotrophic Marsh, Floating-leaved Marsh, American Lotus-lily Marsh, and Wild Rice Marsh were not included in the development of the tool. These types generally require a boat and modified methods that include a rake to capture plant species. Furthermore, the C-values for the aquatic flora have been shown to be inflated relative to the C-values assigned to the rest of Wisconsin's flora. Until the relationship between the C-values for the aquatic flora and wetland condition are verified we do not recommend using the RFQA tool for these wetland types.

Upland Communities

The RFQA was developed solely for the use of wetland communities and should not be used to assess upland communities. If it is uncertain whether the assessment area is a jurisdictional wetland, at the very least the vegetation should be determined to be predominantly hydrophytic (FAC, FACW, or OBL) before proceeding.

3.1.2 When to Use the Rapid FQA with Discretion

The following are situations in which the RFQA should be utilized with caution:

High-Quality Wetlands

It is not a requirement of the RFQA that users know in advance the quality or type of wetlands they survey, and we fully support its use on most wetlands as a screening tool to identify high, medium, and low quality wetlands. However, users should be aware that there are several ways in which the use of the RFQA in high-quality wetlands carries a risk of undervaluing these communities. First, high-quality wetlands have a higher chance of hosting rare or sensitive species and exceptionally high diversity that would be missed in a dominants-only survey. Also, because the tool was optimized for use in the most commonly-occurring wetlands (which tend to be low-to medium-quality), using genus-level identifications in high-quality wetlands may result in a lower *wC* score than expected from a full FQA which may limit the tool from expressing the full range of upper-end *wC* value results. Because of these factors users should learn to recognize high quality communities (see below). In addition, the Department recommends that if a RFQA is completed in high-quality communities, that the Assessor identify as many dominant plants to species level as possible and identify additional known non-dominant plants on field forms. Known high-quality communities are better assessed by an experienced botanist using a full timed meander survey and users should consult experienced botanists when they suspect a wetland may be a high-quality community.

Tips for identifying high or exceptional quality wetland communities:

- Wetland AA is dominated by low ericaceous shrubs and/or stunted spruce or tamarack trees (e.g., a bog or muskeg).
- Wetland AA has significant cover by Sphagnum mosses.
- Wetland AA is dominated by large diameter cedar trees in northern Wisconsin.
- Wetland is dominated by wiregrass sedges (*Carex oligosperma* and/or *C. lasiocarpa*) or has abundant cotton grass (*Eriophorum spp*.).
- Wetland has areas of groundwater upwelling, indicated by areas of sparse, low vegetation in saturated soils, a raised peat dome, seeps, slope discharge, or the presence of fen indicator plants such as grass of Parnassus (*Parnassia glauca*), fen betony (*Pedicularis lanceolata*), shrubby cinquefoil (*Dasiphora fruticosa*), skunk cabbage (*Symplocarpus foetidus)*, or poison sumac (*Toxicodendron vernix*).

Rare wetland community types

Some wetland community types are not well supported by this tool due to lack of data or rarity. Users should expect that the dominant species of these types may not appear on field forms and should NOT use the provided genus-level identifications. These include ephemeral ponds, great lakes ridge and swales, white pine-red maple swamps, forested seeps, bog relicts, patterned peatlands, great lakes shore fens, interdunal wetlands, coastal plain marshes, inland beaches, and moist sandy meadows. Users are encouraged to make use of Natural Heritage Conservation's Key to Wetland Communities (O'Connor, 2022) when unusual wetland communities are encountered and follow-up with a full FQA survey.

Small Wetlands (<0.5 acres)

The RFQA was designed using data from wetlands with a minimum of 1 -2 acres in size. Small wetlands may be dominated by species that do not typically colonize large areas and therefore would not have been captured on field forms and included in genus-level C-values.

3.1.3 Regulatory Context

At any point, the Department or any other regulatory agency can dictate which survey method shall be used for wetland permit or exemption applications. This tool may be used for regulatory purposes, but it may not be right in all regulatory situations. The Department may require a permittee to utilize a full timed-meander survey (or other suitable survey methodology) instead of or in addition to the RFQA tool.

3.1.4 Aerial Image Review

This tool was not developed or tested to be used from aerial or drone imagery. The tool was only tested for situations when a wetland professional is on the ground meandering through the AA or able to visually assess the area in person. However, aerial images can be utilized in conjunction with the in-person AA assessment and to help with establishing the boundaries of an AA.

3.1.5 Assessor Experience Requirements

Assessors need at minimum one full growing season of experience identifying Midwestern wetland plants from a wide range of community types, including herbaceous, shrub, and forested wetlands prior to conducting a RFQA survey. In addition to knowing the most common wetland herb, shrub, and tree species, users should know how to distinguish between several higher-order taxonomic groups such as: grasses, sedges in the genus *Carex,* goldenrods, asters, willows, nettles, bur-reeds, buckthorns, and dogwoods. Utilization of the RFQA tool is not recommended without this level of experience. Use of the RFQA for regulatory purposes will only be permitted when the wetland evaluator(s) can show that these requirements have been met and may require confirmation by the Department.

The RFQA simplifies plant identification by providing approximately 73 of the most common wetland plant species or groups on forms. However, because wetlands are highly variable, it is not possible to provide a complete list that would anticipate every possible wetland plant species. Therefore, Assessors should always expect to encounter one or more dominant species that is not found on the RFQA plant lists and be prepared to identify plants in the field using field guides and collect any unknown dominant species for later identification. Instructions for how to handle these situations is found in Section 3.3.1, below.

3.1.6 When to conduct survey – seasonality limitations

The ideal date range for botanical surveys in Wisconsin is from June 1st to September 15th, when vegetation is at its optimal growth. However, Assessors who are comfortable doing so may extend this period to the full growing season, typically April 15 through October 15 in Wisconsin, although varying in each region. One of the benefits of this tool is that the Assessor is not always required to make species-level identifications making plant ID without the presence of fruiting or flowering structures easier in some cases. However, the tool is intended to only be used on living vegetation, not standing dead or thatch plants.

3.2. Assessment Area Planning

The RFQA requires Assessors to conduct a single survey on each Assessment Area (AA). Assessment areas must be of a single wetland type (i.e., Forest, Shrub, or Herbaceous) following the Cowardin classification system. There is a corresponding RFQA field form (see Appendix A) for each of these three community types. It is not required that surveyors delineate wetland plant communities beyond the structural type but doing so is recommended to break up large areas or to distinguish areas with clearly different groups of dominant plants.

Community identification can be estimated using recent aerial imagery, drone photography (if available), and wetland mapping (either Wisconsin Wetland Inventory or National Wetland Inventory layers) available on the Department's Surface Water Data Viewer. This desktop analysis can provide an initial idea of how many AAs may need to be created on a given site, but this should be confirmed in the field (see Section 3.4.1, below).

3.2.1 Identifying Wetland Types

Each AA should be limited to one of the following structural types using the Cowardin wetland classification (Federal Geographic Data Committee, 2013) and the corresponding RFQA Field Form should be used to collect plant data. In the Cowardin classification **the tallest vegetation stratum with a minimum of 30% cover determines the Class** (Table 6)**.**

Table 6. Cowardin Palustrine Classes

Forested Class (PFO) ***Mature trees >6m tall are the tallest life form with 30% minimum cover.***
Scrub-Shrub Class (PSS) ***Woody plants <6m tall are the tallest life form with 30% minimum cover. Or combined cover of trees and shrubs is ≥30% cover.***
Herbaceous Class (PEM) ***Rooted, emergent, herbaceous plants are the tallest life form with 30% minimum cover.***

Note that the Scrub-Shrub Class (PSS) may contain communities not always thought of as "shrub" wetlands such as those in which neither trees nor shrubs separately comprise 30% cover but in combination they do. This class also includes scrub wetlands which may appear "open" but are dominated by low shrubs such as Leather-leaf (*Chamaedaphne calyculata*), Labrador tea (*Rhododendron groenlandicum*), shrubby cinquefoil (*Dasiphora fruticosa*), or Sweetgale (*Myrica gale*). Keep in mind that even when a wetland has abundant low shrubs, these shrubs still must be the tallest life form with a minimum 30% cover to be included in the PSS class.

3.2.2 Assessment Area Size Limitations

While there are no restrictions on the size of a single AA, the following are some guidelines.

Small Assessment Areas:

AAs less than 0.5 acres in size may require modifications to the protocol due to scale issues. For instance, if a wetland is very small a single tree covering more than 30% of the AA qualifies as a forested wetland. Also, very small areas may have dominant plants that are not on the data forms because they do not typically spread over large areas. Therefore greater care may be needed to identify species.

Large Assessment Areas:

This protocol recommends an AA size of approximately 5 acres or less per single RFQA survey for ideal accuracy. When AAs are larger than 5 acres, it becomes difficult to visually verify the entire limits of the assessment area. While it is not expected that Assessors will cover the entire AA on foot (unless the AA is less than an acre), Assessors are expected to be able to visually verify how far the vegetation type being assessed extends and ensure that the vegetation along the meander path is representative of the whole AA. The ability of the Assessor to visually verify homogeneity depends on visibility in the field but may be extended with high quality aerial or LiDAR imagery.

While 5 acres is recommended as a rule of thumb, applying a single RFQA survey to larger areas is allowable when the vegetation is homogenous and the RFQA meander is representative of the remainder of the area. Aerial photo documentation and LiDAR imagery can be used to show that areas outside of the meander track have the same floristic composition as the areas traversed during the meander. Google Earth imagery can also be used in the field to help assess the extent of homogeneity when imagery is of sufficiently high resolution, recently updated, and plant types are easy to distinguish.

Alternatively, any break points in plant composition, hydrology, expected condition, or other factors of interest could be used to break up a large AA into smaller units, and a separate RFQA survey performed for each area. Completing RFQA surveys of a single large wetland from multiple access points is another approach that can be used to verify the homogeneity of large wetlands.

Proposed Regulatory Impact Areas:

If a wetland is being evaluated for regulatory purposes (in the planning phases of a proposed wetland impact permit), the AA survey location should include the entirety of the proposed impact zone and adjoining wetland areas around the impact zone, if access is available. Multiple AA unites may be necessary if the impact zone includes multiple vegetation community types.

Privately-Owned Riparian Wetlands Observed by Boats:

If a wetland or portion of a wetland is observable from a public waterway (e.g., from a boat), the portion of the wetland that is visible can be assessed using this protocol if the vegetation is identifiable. This tool should not be used if the dominant species are not identifiable from the riparian vantage point. Clearly indicate that the survey was conducted visually by boat in the "AA notes" section of the form.

3.3. Equipment Needed

The bare minimum the Assessor should take with them are the RFQA field forms, plant identification guides, and a way to calculate location (e.g., a smart phone is suitable to provide start coordinates).

Recommended equipment:

- RFQA Field Forms, in hardcopy (Appendix A) or digital form (available online).
- GPS or smart phone for recording meander track and start coordinates.
- Plant ID guides.
- Plastic bags in case it is necessary to collect a plant for later identification.
- Other necessary field gear for outdoor conditions (I.e., muck boots, rain gear, etc.).

3.3.1 Forms

The field forms can be used either in printed, hard-copy form or an electronic form – available on the Department's Wetland Monitoring and Assessment website. It is recommended that printed forms are then transcribed into the electronic form so that floristic metrics are auto calculated appropriately. Department staff should send all completed forms to the wetland monitoring and assessment team for inclusion in a centralized database. External partners can also submit RFQA data to the Department.

There are three RFQA field forms depending on the type of wetland being assessed – there is one form for herbaceous communities (PEM), one for shrub wetlands (PSS), and one for forested communities (PFO).

Each field form is divided into sections detailed below:

RFQA Survey Information: This section is located at the top of the form in a peach color. Below is a list of information the Assessor shall include for each survey.

- Assessment Area (AA) Name: The name should reference the location of the AA and numerical numbering system that makes sense, especially if a single location will include more than one AA.
- Date of the RFQA Assessment: Survey dates should be limited to the growing season when dominant plants are identifiable. The survey should be completed in a single day.
- AA Notes: This can include how the AA was defined in the field, the size of the AA, notes about AA access, the length of time it took to complete the survey, etc.

- Location of the Start of the Meander Path: Record the Latitude and Longitude coordinates of the survey start point within the AA.
- Name of the Assessor(s): List the name of all qualified Assessors present for the RFQA survey.
- NHC Wetland Type (if known): The specific Department Bureau of Natural Heritage Conservation's wetland classification (O'Connor, 2022).

Survey Results: The second section of the form includes the auto-calculated floristic metrics. These sections will auto-fill every time the Assessor identifies a dominant plant/group and enters the areal coverage of a given species. When adding a new dominant species in the "WRITE IN ADDITIONAL DOMINANT SPECIES HERE" section, the Assessor will need to enter scientific name, common name, and c-value in addition to dominance and final percent area coverage.

The following metrics are auto calculated:

- RFQA Mean C: This is the average C-value of all selected species without being weighted by each species coverage of the AA.
- Dominant Species Count: This is the total number of species or grouped taxa identified as "Dominant" on the form.
- RFQA Weighted Mean C: This is the average C-value of all selected species, weighted by its area coverage with the AA. This is the score that should be utilized when giving the wetland AA a rank (see Table 8).
- Total Calculated Cover: This is the total sum of areal cover of all identified species or group taxa. Typical values are 80% to over 100%.

Instructions: This section will be slightly different depending on the form but describes how many species or species groups should be identified at a minimum. The forms are color coded with the Herbaceous form (PEM) being shown as blue, the shrub form (PSS) as green, and the forested form (PFO) as purple.

Plants: The fourth section of the field form includes common dominants for the Cowardin class based on over 1,100 floristic surveys. Each plant species or group includes the Latin name as well as the most-utilized common name. Plant taxa are organized by growth form, including 1) Trees, 2) shrubs, 3) grasses, 4) graminoids (includes sedges, cattails, bulrushes and other grass-like species, 5) forb species, and 6) other species (such as aquatic plants, vines, and ferns).

Near the bottom of each form is an area to enter additional dominant plant species that were not included in the list of commonly-occurring dominants above. When a dominant species is encountered that is not included in the form, it should be added to this section.

Comments: This section should be utilized to note various observations, comments, or follow-up items. Suggestions for inclusion are:

- If the AA was defined by something other than a pre-established polygon or clear community boundary, describe how the boundary of the AA was determined.
- If the AA was divided or combined, note an attached map showing this detail or discuss why the division or combination was made.
- If a large wetland was divided into sub-sections, note how many and which other surveys are part of the larger wetland complex (suggest numbering the surveys "1 of 5", "2 of 5", etc.).
- If wildlife observations were made, note what species and/or the number of animals of each species were observed.

- If an unknown dominant was collected for further documentation, describe the species (e.g. "Unknown 1: small heart-leaved forb, collected").
- Make note if the wetland is exceptionally diverse or contains other unique characteristics.
- If the Assessor observes a known threatened, endangered, or special concern species, make a note to communicate this find (and associated photo documentation) with the Bureau of Natural Heritage's observation forms.
- If a regulated invasive species is identified, make a note to communicate this find (and associated photo documentation and sample collection) through the Department's Invasive Species report forms.

3.3.2. Recommended plant ID guides/tools

The Department plans to create a companion identification guide that is made to be utilized along-side the RFQA field forms which should be available on the Department website. The guide will be laid out in a similar organizational structure – divided into graminoids, forbs, shrubs, trees, and other species sections.

Assessors are also encouraged to utilize other midwestern-based vegetation field guides to improve identification accuracy such as the Online Virtual Flora of Wisconsin and Michigan Flora on the internet, and hardcopy books with illustrations or photos such as:

- Wildflowers of Wisconsin and the Great Lakes Region: A Comprehensive Field Guide (Black & Judziewicz, 2009),
- Wetland Plants of the Upper Midwest: A Full Color Field Guide to the Aquatic and Wetland Plants of Michigan, Minnesota, and Wisconsin. (Chadde, 2022).
- Trees and Shrubs of Minnesota (Smith, 2008)
- Wetland Plants and Plant Communities of Minnesota and Wisconsin (Eggers and Reed, 2015) This resource is also available online.

3.3.3. Location Tools

The Assessor should have a way to establish starting meander coordinates in latitude and longitude, decimal degrees preferred. This can be accomplished with a GPS or a smart phone that can provide coordinates. Starting coordinates should be recorded at the top of each AA form. Collecting the starting latitude and longitude is required but tracking a meander path is not a requirement (although is highly recommended).

3.3.4. Aerial Imagery Tools, Maps

Recent aerial imagery can be helpful while in the field, preferably on a smart phone or tablet that has the capability of showing the Assessor's current location. The tool developers found the use of ArcGIS Field Maps and Google Earth useful but other phone/tablet applications are available. These apps can indicate where in the AA you are currently standing, and the extent of the vegetation type if the aerial imagery is of high quality. Another useful aid is to be able to measure AA sizes while in the field to determine if an inclusionary wetland is above or below the maximum threshold of 0.25 acres or to determine the estimated size of the AA. Printed hard copy maps using current aerial imagery may also prove helpful.

3.4. Field Methodology

3.4.1 Defining Assessment Areas

Once on-site, the Assessor should first confirm that the previously-planned AA is accurate and make any required adjustments based on field conditions. Once the AA(s) is(are) confirmed, the Assessor should complete one RFQA per AA. There may be multiple surveys completed within a single wetland complex or area of interest.

Homogeneity Requirements

The AA must at minimum consist of a single wetland structural type (Table 6). However, in addition to Cowardin class, it is recommended that a single AA have a relatively homogenous composition, i.e., that dominant species are consistent throughout the AA. This is not always required, especially when the area is small, and is not always possible when the scale of patchiness is large, but when there are noticeable breaks in composition splitting will result in higher resolution and accuracy of floristic quality results. In addition, RFQA meander surveys are easier and faster to complete in areas of homogenous vegetation.

The following scenarios of dividing a single wetland structural type into sub-AA units are optional and may be utilized to better understand a heterogenous wetland AA but are not required. Depending on the purpose of the assessment, these subdivisions may or may not make sense.

Example 1*: There is a contiguous, primarily-herbaceous wetland with a small, forested wetland pocket. The whole wetland complex totals 20 acres and the forested pocket only makes up 0.2 acres. In this example, a single RFQA AA is required since the forested pocket makes up less than 0.25 acres in total. See Figure 12.*

Example 2*: There is a contiguous, primarily-herbaceous wetland with a small, forested wetland pocket. The whole wetland complex totals 20 acres and the forested pocket makes up 2.0 acres. In this example, two separate RFQA surveys should be completed since the forested pocket makes up greater than 0.25 acres in total. RFQA AA #1 would be the herbaceous wetland and RFQA AA #2 would be the forested pocket. See Figure 13.*

Small inclusions of other structural types are often encountered within the context of a larger wetland type. In these cases, use a 0.25 acre size cut-off as a rule of thumb to help guide the decision to split or include. If the smaller wetland area is approximately 0.25 acres (900 m^2) or less in size it can be included in the larger wetland class (see Example 1, Figure 12). If the wetland of a different structural type is larger than 900m^2, that wetland pocket should be excluded from the original FQA survey; the Assessor should establish a second AA for the pocket wetland and conduct a second RFQA survey (see Example 2, Figure 13).

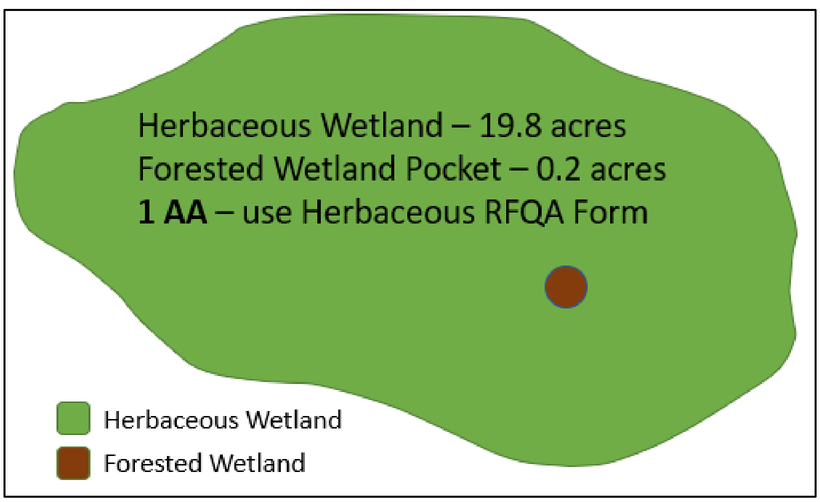

Figure 11. AA Homogeneity Example 1

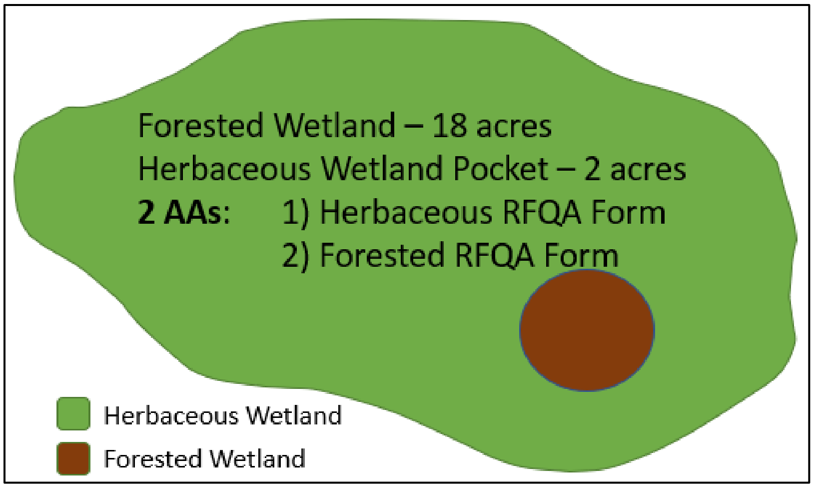

Figure 12. AA Homogeneity Example 2

Guidelines for Dividing AAs of one Structural Type into Smaller Units

Once the structural types have been determined, the AA may be further divided in the following situations:

- The presence of clear breaks in plant composition and/or hydrologic conditions (Examples 3 and 4, Figures 14 and 15)
- Large wetlands (≥ 5 acres). Even if clear breaks are not apparent large wetlands should be broken up to verify homogeneity. Exceptions can be made for larger wetlands that are clearly homogeneous or when accessibility is an issue (Example 5).

Example 3*: If there is one contiguous herbaceous wetland but half of the wetland is emergent marsh along the fringe of a lake and the other half is at a higher elevation and is more of a wet prairie – this AA would ideally be divided into two separate AAs and a RFQA would be conducted separately in each of the two distinct herbaceous wetland communities. See Figure 14.*

Example 4*: If a single contiguous wetland is being invaded, the highly invaded portion could be separated from the un-invaded portion of the wetland. This division is not required but is recommended to achieve the most informative results. See Figure 15.*

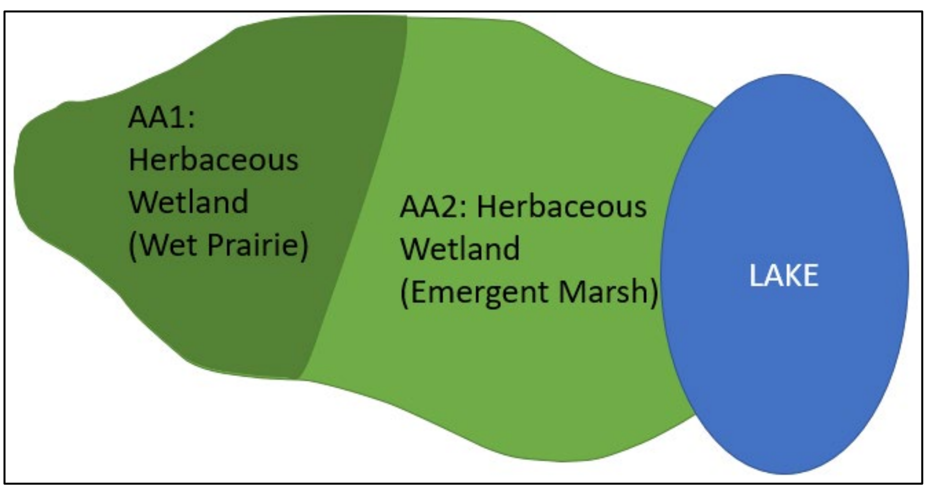

Figure 13. AA Division Example 3

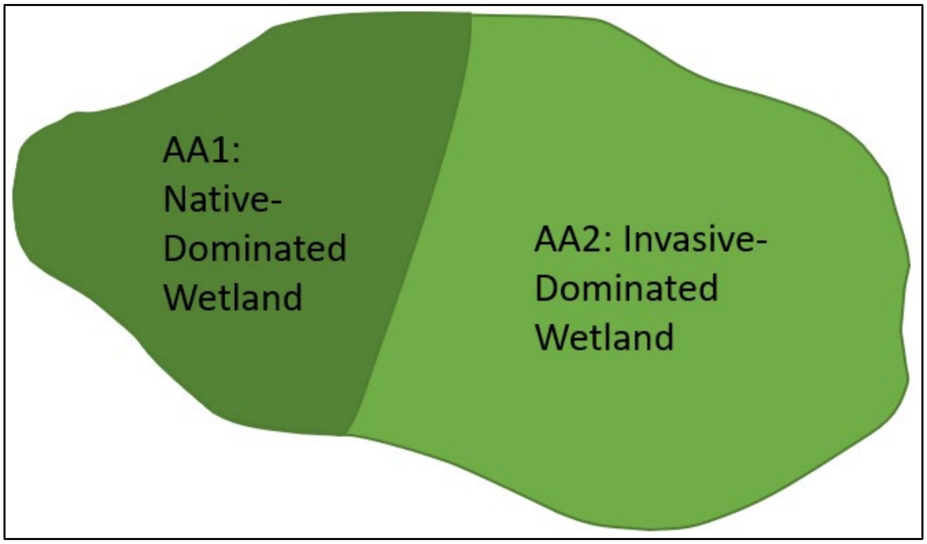

Figure 14. AA Division Example 4

> ***Example 5****: If a single, contiguous floodplain forest stretches along a river system and is 50 acres, the wetland should be divided into smaller units with a single RFQA survey conducted within each unit.*

Combining Similar, Nearby Wetlands into a Single AA

Wetlands often occur in a matrix of different community types – to account for this natural occurrence and to reduce survey effort, there are a few situations when wetlands which are physically separated but appear to have nearly identical vegetation can be combined into a single AA. These combinations can occur only when the AA's are of the same structural type (herbaceous, shrub, or forested), are of similar vegetative composition, similar hydrologic conditions, and are physically situated nearby (and can be meandered within the same sampling event).

> ***Example 6****: If two similar wetlands are divided by a stand of a different type of wetland, but are of similar HGM type and composition, a single survey can be completed for both of these wetlands. Best professional judgement can be used to determine if a given wetland is of similar condition and composition to combine into a single RFQA AA. In this example, two forested wetlands (FW1 and FW2) are of similar composition and hydrologic condition and can be combined into a single RFQA AA; FW3 is somewhat different and should have a separate RFQA survey completed. See Figure 16.*

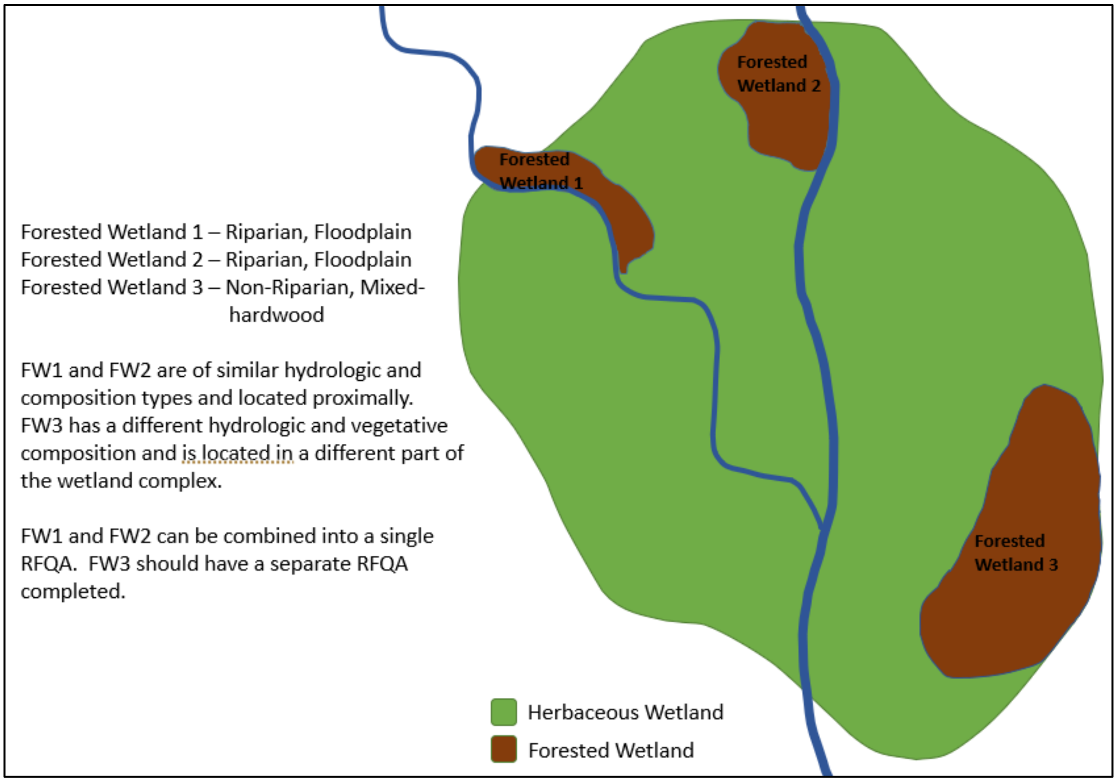

Figure 15. AA Combination Example 6

3.4.2. Collecting RFQA Plant Data

Locate the Start Point

Once the boundaries of the AA are determined, a representative location within the AA should be selected as the meander start point. This location ideally should be located away from the edge of the AA or within a central portion of the AA, if accessible (see Figure 17).

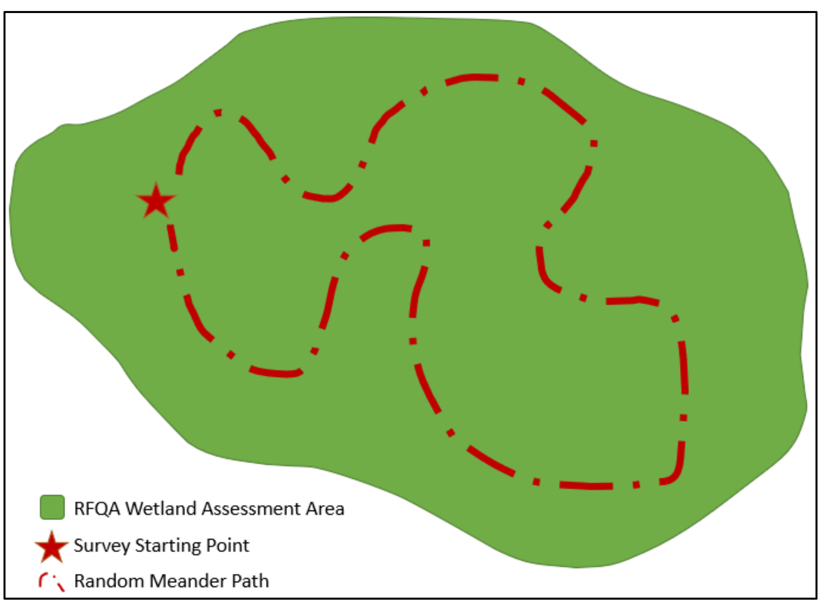

Figure 16. Typical AA starting point and meander path.

At the start point, the Assessor should choose the RFQA Field Form appropriate to the Cowardin Class of the AA and begin filling out the top of the form, including the coordinates of the start point in decimal degrees.

Identify Dominant Plants

The Assessor can then begin identifying plants from the tree, shrub, and herbaceous layer that appear to dominate (cover at least 10% of the total visible area) and mark these plant taxa as "Dominant" on the RFQA form. Because it can be difficult to gauge 10% areal cover, another approach could be to identify the top 3 -5 most abundant plant taxa in any given area.

Any observed plants not on the list can be added at the bottom under the "Write In Additional Dominant Species Here" Section. Also, Assessors confident of an identification at the species-level can ignore the genus or group-level identification option on the form and write the species name in this section – this will result in a more accurate final RFQA *wC* score. Unknown plants should be given a temporary name in the "Comments" section and collected for later identification.

To assist with identifying what 10% cover looks like, the back of each field form (Appendix A) includes a figure showing what multiple coverage classes could look like (Oldham, et. al., 2000).

Note that, when in doubt, it is encouraged to err on the side of over-reporting potential dominant taxa rather than under-reporting. Once more of the wetland has been observed, not all of these taxa will still be dominant, however, even taxa assigned a cover only between 3 – 9% can be included in the survey and are expected to improve the final score.

Meandering the wetland

The Assessor should continue moving through the wetland within representative areas and staying away from edges. While meandering the Assessor should be seeking out new dominant taxa and keeping in mind the abundance of the taxa already identified to help estimate areal cover for these plants at the end of the survey.

Minimum Number of Dominants

Surveyors are asked to record (at minimum) all dominant species over 10% areal cover occurring within the AA. However, in some cases, especially when invasive species are present the wetland is structured so that there is only 1 species that exceeds 10% cover. To overcome this potential problem, the RFQA includes a minimum taxa requirement for each survey, 3 for herbaceous wetlands, 4 for shrub wetlands, and 5 for forested wetlands (Table 7). In some wetlands meeting this requirement means including species with less than 10% cover in the survey. The total number of dominants identified and selected will be indicated on the form.

Table 7. The minimum number of dominant plant species or groups that should be included in a RFQA form by wetland type.

Wetland Type	Minimum # Dominant Taxa
Herbaceous (PEM)	3
Shrub (PSS)	4
Forested (PFO)	5

Ending the Meander

The survey can end once the Assessor is satisfied no additional dominant taxa at 10 % minimum cover will be encountered AND the minimum taxa requirements (see Table 7) have been met.

When visibility is poor and the Assessor is not sure if more dominant taxa lie ahead, the use of aerial imagery, such as Google Earth, is recommended to check for signatures of possible changes in composition. When imagery shows different signatures, it is recommended that the Assessor travel to those areas to assess dominant species.

A typical RFQA survey will take no more than 15 minutes to complete (not counting time spent consulting identification guides). However, the duration of a survey is dependent on size of the AA, accessibility, ease of meandering the site, visibility, and heterogeneity of the wetland community.

All species or species groups that the Assessor determines may be occurring at a dominant level, should be indicated under the "Dominant" column by selecting "Dominant" from the dropdown (see Figure 18 below).

	A	B	C	D	E	H	I	J	K	L
1	**WISCONSIN RAPID FQA CALCULATOR: SHRUB/SCRUB WETLANDS**					**Trees ≥ 6ft tall comprise < 30% cover; combined cover of trees and shrubs ≥ 30% cover.**				
2	**Assessment Area (AA) Name: Shrub Wetland EXAMPLE 1**						**Date: 7/1/2023**			
3	**AA Notes:**					**Location of Start of Meander**	**Start Lat: 43.07538**			
4						**Path:**	**Start Long: -89.38032**			
5	**Name of Assessor(s): Jane Doe**					**NHC Wetland Type (if known):**				
6	**SURVEY RESULTS:**									
7	RFQA Mean C:	3.5				**RFQA Weighted Mean C:**	**0.0**			
8	Dominant Species Count:	6				Total Cover of Dominants:	0			
9	***INSTRUCTIONS: Select at minimum the top 4 most-dominant plant taxa including ALL taxa with 10% or greater areal cover. Species not appearing on list can be written in space provided at bottom. Stop meander when when no new dominant taxa are apparent. Estimate areal cover for marked taxa.***									
10						**Trees:**				
11	Scientific Name	Common Name	C-Value	Dominant	Final % Cover	Scientific Name	Common Name	C-Value	Dominant	Final % Cover
12	*Acer spp. (Maples only)*	Native maples	4			*Larix laricina*	Tamarack	8		
13	*Acer negundo*	Box elder	0			*Populus spp.*	Aspen/Cottonwood	2		
14	*Fraxinus nigra*	Black ash	8			*Salix* *Native trees only	Native tree willows	4		
15	*Fraxinus pennsylvanica*	Green ash	2			*Salix X fragilis*	Crack willow	0		
16						**Shrubs:**				
17	Scientific Name	Common Name	C-Value	Dominant	Final % Cover	Scientific Name	Common Name	C-Value	Dominant	Final % Cover
18	*Alnus incana*	Speckled alder	4	Dominant		*Rubus spp.*	Raspberry/Dewberries	3.2		
19	*Betula pumila*	Bog birch	7			*Spiraea spp.*	Spiraeas	4.3	Dominant	
20	*Chamaedaphne calyculata*	Leatherleaf	9			*Salix spp.* *ID to sp.-level if possible	Willows (shrubs)	5.2		
21	*Cornus spp.*	Dogwoods	3	Dominant		....*Salix discolor*	....Pussy willow	2		
22	*Frangula/Rhamnus spp.*	Buckthorns (Non-native)	0			....*Salix interior*	....Sandbar willow	2		
23	*Ilex verticillata*	Winterberry	7			....*Salix petiolaris*	....Meadow willow	6		
24	*Lonicera spp.*	Honeysuckles (Non-native)	0							
25						**Graminoids:**				
26	Scientific Name	Common Name	C-Value	Dominant	Final % Cover	Scientific Name	Common Name	C-Value	Dominant	Final % Cover
27	*Calamagrostis canadensis*	Blue-joint grass	5	Dominant		*Phalaris arundinacea*	Reed canary grass	0	Dominant	
28	*Carex spp. (PSS)*	Sedges (Shrub Wetlands)	6.3	Dominant		*Poa spp .* ** Non-natives only	Non-native bluegrasses	0		
29	*Glyceria striata*	Fowl manna grass	4			*Typha spp.*	All Cattails	0.3		
30	*Leersia oryzoides*	Rice cut grass	3							

Figure 17. Excerpt of a sample RFQA form showing a survey after the initial meander but before coverages are assigned. Dominant species highlighted here in yellow.

Estimating Areal Cover

Once dominants have been identified the Assessor should estimate the percent cover of each identified dominant by assigning a number from 1% to 100% based on what percent area of the AA the taxa covers (see Figure 19). The coverage amount should be typed into the "Final % Cover" Column in the field form. Note that it is normal for total cover amounts to exceed 100%; this is especially common in wetlands with multiple stratums such as shrub wetlands or forested wetlands, or any wetland where vegetation is dense and overlapping. A cover estimate table can prove helpful when assigning coverages.

	A	B	C	D	E	H	I	J	K	L
1	**WISCONSIN RAPID FQA CALCULATOR: SHRUB/SCRUB WETLANDS**					**Trees ≥ 6ft tall comprise < 30% cover; combined cover of trees and shrubs ≥ 30% cover.**				
2	**Assessment Area (AA) Name: Shrub Wetland EXAMPLE 1**						**Date: 7/1/2023**			
3	**AA Notes:**					**Location of Start of Meander**	**Start Lat: 43.07538**			
4						**Path:**	**Start Long: -89.38032**			
5	**Name of Assessor(s): Jane Doe**					**NHC Wetland Type (if known):**				
6	**SURVEY RESULTS:**									
7	RFQA Mean C:	3.5				**RFQA Weighted Mean C:**	**3.4**			
8	Dominant Species Count:	6				Total Cover of Dominants:	96			
9	***INSTRUCTIONS: Select at minimum the top 4 most-dominant plant taxa including ALL taxa with 10% or greater areal cover. Species not appearing on list can be written in space provided at bottom. Stop meander when when no new dominant taxa are apparent. Estimate areal cover for marked taxa.***									
10						**Trees:**				
11	Scientific Name	Common Name	C-Value	Dominant	Final % Cover	Scientific Name	Common Name	C-Value	Dominant	Final % Cover
12	*Acer spp. (Maples only)*	Native maples	4			*Larix laricina*	Tamarack	8		
13	*Acer negundo*	Box elder	0			*Populus spp.*	Aspen/Cottonwood	2		
14	*Fraxinus nigra*	Black ash	8			*Salix* *Native trees only	Native tree willows	4		
15	*Fraxinus pennsylvanica*	Green ash	2			*Salix X fragilis*	Crack willow	0		
16						**Shrubs:**				
17	Scientific Name	Common Name	C-Value	Dominant	Final % Cover	Scientific Name	Common Name	C-Value	Dominant	Final % Cover
18	*Alnus incana*	Speckled alder	4	Dominant	45	*Rubus spp.*	Raspberry/Dewberries	3.2		
19	*Betula pumila*	Bog birch	7			*Spiraea spp.*	Spiraeas	4.3	Dominant	10
20	*Chamaedaphne calyculata*	Leatherleaf	9			*Salix spp.* *ID to sp.-level if possible	Willows (shrubs)	5.2		
21	*Cornus spp.*	Dogwoods	3	Dominant	10	....*Salix discolor*	....Pussy willow	2		
22	*Frangula/Rhamnus spp.*	Buckthorns (Non-native)	0			....*Salix interior*	....Sandbar willow	2		
23	*Ilex verticillata*	Winterberry	7			....*Salix petiolaris*	....Meadow willow	6		
24	*Lonicera spp.*	Honeysuckles (Non-native)	0							
25						**Graminoids:**				
26	Scientific Name	Common Name	C-Value	Dominant	Final % Cover	Scientific Name	Common Name	C-Value	Dominant	Final % Cover
27	*Calamagrostis canadensis*	Blue-joint grass	5	Dominant	8	*Phalaris arundinacea*	Reed canary grass	0	Dominant	8
28	*Carex spp. (PSS)*	Sedges (Shrub Wetlands)	6.3	Dominant	15	*Poa spp.* ** Non-natives only	Non-native bluegrasses	0		
29	*Glyceria striata*	Fowl manna grass	4			*Typha spp.*	All Cattails	0.3		
30	*Leersia oryzoides*	Rice cut grass	3							

Figure 18. Excerpt of Sample RFQA form showing a survey after the final percent coverages are assigned. Dominant species highlighted here in yellow. Note that RFQA Weighted Mean C is 3.4.

Including more taxa than the minimum

Once areal cover is assigned to each taxa marked as dominant it is often the case that more taxa have been marked than were necessary given the stated minimum requirements. These additional entries should remain in the calculation since as a rule, additional species will improve the weighted mean C score and therefore will result in a more accurate final score. That said, the protocol is intended to save time compared to a full FQA survey by not requiring minor species be identified. Therefore, The Department does not recommend spending extra time capturing all species encountered – only those that appeared potentially dominant at one point in the meander survey and may have final coverages between 3% - 9%.

Additional species not on the list

Users should expect at any time to encounter dominant species not listed on forms. The list of species provided on the field forms are the most commonly occurring dominant plant species or group identified by the Department, but they do not list all possible species that may be encountered. If an Assessor encounters a plant occurring at a dominant level that is NOT already listed on the corresponding form, the Assessor shall utilize one of the provided blank spaces at the bottom of the form under the heading "Write in Additional Dominant Species Here" by writing in the Latin name, common name, accepted c-value, selecting "Dominant" from the drop-down box, and entering the coverage of the species. Additional blanks may be added, as needed. Officially-recognized c-values can be found on [Wisconsin's Floristic Quality Assessment Calculator]() or by contacting the Department.

Separating out grouped species

If the Assessor has the expertise and can identify a plant down to species level, then the Assessor can utilize one of the blank spots at the bottom of the form to call out a specific species that is otherwise included in a grouped species. This is most appropriate when the plant encountered may have a c-value that differs from the weighted average c-value included in the form. It is also possible to divide the total cover of a plant group, e.g. ferns, between those known to species-level, e.g. sensitive fern, and those known only to the group level (Example 7).

> ***Example 7****: If an herbaceous wetland AA has 20% coverage of* Carex pellita *and another 20% coverage of other* Carex *species (for a total of 40% cover by* Carex *plants), the Assessor can check the "*Carex spp.*" box and enter 20% for the coverage and then utilize the blank space to enter:*
> "Carex pellita – Broad-leaved woolly sedge – 4 – 20%".
> *See Figure 20, below.*

				Gramin
Scientific Name	Common Name	C-Value	Dominant	Final % Cover
Bolboschoenus fluviatilis	River bulrush	6		
Calamagrostis canadensis	Blue-joint grass	5		
Carex spp. (PEM)	Sedges (Herbaceous Wetlands)	6.4	Dominant	20
Juncus spp.	Rushes	4		
Leersia oryzoides	Rice cut grass	3		
Phalaris arundinacea	Reed canary grass	0		
Phleum pratense	Timothy	0		
Phragmites australis	Common reed grass	0		
WRITE IN ADDITIONAL DOMINANT SPECIES HERE:				
Scientific Name		C-Value	Dominant	Final % Cover
Carex pellita	Broad-leaved woolly sedge	4	Dominant	20

Figure 19. Example form entry showing how to add additional species in the extra spaces provided (see Example 7).

There are certain circumstances where identification to species level may be beneficial. Alternatively, the Assessor can instead perform a Level 1 timed meander survey instead of the Level 2 RFQA survey to provide a more-accurate floristic metric result.

Combining separate surveys for reporting

If multiple surveys were completed on AAs that were later determined to be similar enough to combine into a single AA, an acreage-weighted average of the surveys can be calculated as the final *wC* for the entire area. A similar approach can be used when there is a need for site-level reporting; however, in this case results should be provided for both individual AAs and as a site average.

3.4.3. Floristic Quality Categories

Once data entry into the Excel version of the RFQA Field Form has been completed, and the RFQA weighted mean C (*wC*) has auto-calculated, consult Table 8 to determine a Floristic Quality Category.

Table 8. Floristic Quality Tiers based on RFQA wC results.

RFQA ***wC***	Floristic Quality Tier	Description	Restorability*
7.1+	Exceptional	Unimpacted to mildly impacted, highly nutrient-poor and stable, flora almost exclusively specialists, minimal to zero non-natives.	None currently known.
4.8 -7.0	High	Unimpacted to mildly impacted, at least somewhat nutrient-poor, flora has significant coverage by habitat specialists, non-natives may be present in small amounts.	Unlikely but possible in certain circumstances.**
2.1 -4.7	Medium	Moderately impacted, or mesotrophic to eutrophic; may have significant displacement of conservative species by non-natives or consist almost exclusively of native generalists.	Very possible, may require management.
<2.1	Low	Highly impacted, eutrophic, at least 3/4 of wetland has been displaced by non-natives, or consists entirely of ruderal natives.	Likely, especially in surface water dominated wetlands in agricultural watersheds, or when restoration is incomplete.

*Assumes the method of restoration is via re-establishment (i.e., from a fully-drained state) and is based on surveys of 106 wetland restorations up to 30 years old (See Gibson & Jarosz (2020) for full report).
** Scores up to 6.4 are known from oligotrophic, calcareous, or groundwater dominated areas.

RFQA surveys will result in 4 possible floristic quality categories based on *wC*: Exceptional, High, Medium, and Low. RFQA results should be thought of as conservatism relative to all wetlands across the Wisconsin landscape, rather than condition in relation to a specific wetland community type in a specific ecoregion (for this analysis, a Timed Meander Survey is recommended with the resulting score being evaluated using Wisconsin's Wetland Floristic Condition Benchmarks; Trochlell, 2016).

3.4.4. Summary of RFQA data collection protocol

Once the boundaries of the AA have been determined, data collection can begin. Data collection should result in a list of all dominant plant taxa present within the AA with accompanying areal estimates of cover.

Step 1: Select a field form based on wetland type (Herbaceous, Shrub, or Forested) and complete top portion of form (Assessor name, date, AA name, etc).

Step 2: Locate a start point in a representative area within the AA, away from the edge. Record your latitude and longitude and start your meander track (optional).

Step 3. Begin identifying and recording plant taxa that appear most abundant by cover in the tree, shrub, and herb layer by marking the appropriate taxonomic group as "Dominant" on the form. If a dominant species is not on the form, it can be written in the blanks at the bottom of each form. If the species is unknown, enter a descriptor, e.g., "hairy opposite", in the blank provided and collect for later identification.

Step 4: Begin meandering through the wetland seeking out and recording all new locally dominant taxa observed.

Step 5: Stop the survey when you have: a) visually scanned most of the AA or a representative area of the AA, b) you are no longer finding new dominant taxa, and c) you are satisfied you have captured all taxa dominating at least 10% of the AA. The survey should take approximately 15 minutes; however, some wetlands may take longer. Stop the meander track (if using).

Step 6: Assign areal cover estimates to each taxa identified as a dominant by writing in a number from 1% to 100% under the “Final & Cover” columns.

Step 7: Determine if you have met the minimum number of taxa required for the wetland type. The top 3, 4, or 5 most-abundant taxa (depending on Cowardin class), including all taxa with 10% or more areal cover.

4. Final thoughts

4.1. Rapid FQA Goals Met

The RFQA tool was designed to be able to assess the quality of a wetland quickly and easily. Surveyors need only to identify dominant vegetation within an established AA. From the over 1,200 plant species found in Wisconsin wetlands, the RFQA has identified 73 plant species or genera/groups commonly encountered as dominants to select on field-forms, from which a conservatism metric (wC) can be calculated. Field tests found that users identified 5 or 6 plant taxa on average per survey and 15 -20 minutes was a typical survey time. Most test surveys required the Assessor to write-in at least one plant species that was not listed on the form as a common dominant; this serves as a reminder that wetlands are too diverse and variable to reduce to only 73 taxa and users should always be prepared to identify a plant or two in the field or collect for later identification.

While the RFQA is intended to be used by professionals with only a moderate level of botanical experience, the tool is also designed to be flexible: users with more botanical knowledge can identify all dominant plants to species if they choose, while users with less experience can rely on genus-level plant identification options and collect more samples for later verification.

Since the goal of this effort was to create a Rapid FQA tool that was easier to use than the full FQA methodology and would allow for additional users to assess wetland quality while maintaining a high level of condition assessment accuracy, we feel these goals have been met. Once some final internal testing has been completed, this new rapid assessment will improve the Department’s capacity to monitor and assess wetlands with current staffing and provide external partners with a valuable tool to assist in their wetland efforts, as well.

4.2. Interpreting Rapid FQA Results

RFQA surveys use the average conservatism of dominant plant species to place a wetland in one of four floristic quality categories: Exceptional, High, Medium, or Low. Because the thresholds for these categories were determined using multiple of the inter-related factors that vary with plant conservatism, (human-caused degradation, nutrient availability, and restorability) these factors all must be considered when interpreting these results. Table 8 includes a narrative description of each tier and includes some of the stronger factors determining plant conservatism in wetlands.

4.2.1. RFQA Floristic Quality Tiers vs Community-Specific Condition Categories

Using a single floristic quality scale for all wetlands regardless of community type and ecoregion can in some ways be thought of as reflecting “absolute” plant conservatism rather than plant conservatism relative to other wetlands of the same community in the same ecoregion (as is calculated with the full FQA methodology). This requires a shift in interpretation and use which has both advantages and disadvantages. RFQA floristic quality tiers describe broad floristic quality across the full continuum from the most altered and eutrophic (e.g., reed canary grass meadow in southeastern Wisconsin) to the most intact and nutrient-poor (e.g., an open bog in northern Wisconsin). The benefits of this include putting an assessed wetland in a broader scale of plant conservatism which allows for wetland community type itself to change as anthropogenic alteration increases in severity and the recognition that not all community types have an equal likelihood of being replaced via restoration.

There are disadvantages as well: as discussed in Section 2.3, by not controlling for the set of factors that determine community type, differences in RFQA *wC* scores cannot be attributed to human caused degradation (as opposed to variation in natural history) with as much confidence. Also, there are situations in which floristic quality relative to community type is of greater value, e.g., assessing the restoration of a specific community type, or identifying high-quality examples of a particular community type in an area.

There is a risk that some wetlands may be under-valued using this single scale: for instance, an excellent example of an Alder Thicket or Floodplain Forest may be assessed as only “Medium” with the RFQA rankings. Wetlands that are associated with natural disturbance regimes or are considered early to mid-successional will be more likely to be undervalued in this system. On the other hand, more conservative and oligotrophic wetlands such as Cedar Swamps, Open Bogs, or Muskegs will almost always have wC in the “High” or “Exceptional” range but may be actively experiencing degradation. Another risk is that a “Low” RFQA result may be the only remaining example of a Calcareous Fen, Wet-mesic Prairie, or Floodplain Forest in the watershed and therefore undervalues the ecological importance of that wetland.

Not all community types have an equal chance of falling within each of the RFQA tiers: many community types are not capable of reaching the “Exceptional” category. Wetlands qualifying as “Exceptional” are likely to be intact examples of highly oligotrophic communities such as Open Bog, Black Spruce Swamps, or Cedar Swamps. At the other extreme, not all communities can qualify as “Low” and still meet the definition for that community type in Wisconsin’s Natural Community Classification. These include peatlands, Cedar Swamps, and Northern Hardwood Forests. However, all communities for which we have a full range of examples in the Department’s wetland FQA database can meet “High” Floristic Quality and most, except for a few peatland types, can meet the Medium category.

Users suspecting the community type is rare in the area, however degraded, or if users have other reasons to want to assess wetland condition relative to others of the same natural community type and ecoregion should use the full FQA methodology and consult the appropriate condition benchmark table (Hlina et al., 2015, Marti & Bernthal, 2019). While it is possible to consult these tables with only RFQA *wC* results in hand for an estimate of community and ecoregion specific condition, keep in mind that we found that the RFQA *wC* results can differ by as much as +/- 1.5 from full survey wC. Therefore, a range of condition categories is likely to be the best approximation that can be made with RFQA results.

4.3. Appropriate Uses of the Rapid FQA

The RFQA should be useful and effective in any situation where there is a need to screen for wetland floristic quality, especially situations that call for a quick determination or where wetlands are too abundant for intensive surveys given limited time and resources.

Examples of situations that may occur include site visits for projects that may be impacting wetlands where Department staff may need to communicate wetland quality type with an applicant to assist with planning purposes. This decision may be made prior to the completion of a full functional assessment (such as a WRAM). This tool can also be utilized to help with Department regulatory decisions. Wisconsin state statutes specifically reference certain vegetation community types as more strictly regulated than others, and the determination of these community types necessitates that onsite vegetation data be surveyed.

Biologists or land managers monitoring or assessing wetland resources will find that the RFQA can allow more information to be gathered using less time and resources. Wetlands can be assessed across larger areas and the results used to guide future actions, including identifying which wetlands should be targeted for more intensive floristic surveys.

For scenarios described previously in Section 3.1, the RFQA tool may not be an appropriate tool to survey the wetland vegetation community if the community would likely rate in the high or exceptional quality categories. As stated above, the Department suggests the usage of the full FQA in these situations – that methodology is available on the Department website.

4.4. Next steps

The RFQA can and should be re-visited on a regular basis to modify grouped species C-values based on more floristic data or to include additional species on the forms and remove species that are not being encountered frequently. Finally, the methodology may be modified slightly, as needed, to clarify and simplify the protocol to improve its usability.

The Department intends to utilize this protocol on a provisional basis for at least a few months in additional regions and wetland types throughout the state before formalizing the protocol and making it available on the Department website. Once the Department has determined this protocol is suitable for public use, the methods section and field forms will be posted to the Department website here: https://dnr.wisconsin.gov/topic/wetlands/methods.html.

In addition, the Department has identified the need for a companion field guide of commonly occurring dominant wetland plants of Wisconsin. Department staff hope to complete a publicly-available PDF document that could be used alongside the field forms to further describe the common wetland dominants included in the field form. Ideally this document would also highlight common "look-alikes" and call attention to identifying characteristics of common wetland dominants. Once created, this document would be linked to the field forms and to the Department website.

Lastly, the Department will need to create a database to capture RFQA results from internal and possibly external Assessors. While the RFQA data is similar in nature to the full FQA data, there are key differences as described above and we have determined it is important to keep the results separated to make sure the data is appropriately utilized. Once a database is created to capture these results, the data can be used to inform future wetland monitoring and assessment decisions, watershed planning purposes, regulatory purposes, and other needs, as appropriate.

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6. Appendices

Appendix A: Rapid FQA Field Forms

Appendix B: Wisconsin FQA Database Surveys sed for RFQA Analysis

Appendix C: RFQA Plant List and Composite C-Values for Genus-level Plant ID

Appendix D: Field Testing Results

Appendix A: Rapid FQA Field Forms

Appendix B: Wisconsin FQA Database Surveys Used for Rapid FQA Analysis

Natural Community Classification and Cowardin Classification of surveys in WI DNR's Wetland FQA Database with number of surveys shown.

Herbaceous (Emergent) Class		Scrub-Shrub Class		Forested Class	
Southern Sedge Meadow	92	Alder Thicket	116	Black Spruce Swamp	84
Emergent Marsh	84	Shrub-Carr	105	Northern Hardwood Swamp	79
Northern Sedge Meadow	61	Open Bog	69	Northern Wet-mesic Forest	75
Ruderal Wet Meadow	42	Muskeg	63	Floodplain Forest	58
Ruderal Marsh	29	Northern Sedge Meadow	18	Southern Hardwood Swamp	27
Calcareous Fen	24	Emergent Marsh	12	Northern Tamarack Swamp	17
Wet-Mesic Prairie	22	Ruderal Shrub Swamp	11	Ruderal Swamp Forest	7
Central Poor Fen	21	Southern Sedge Meadow	10	Southern Tamarack Swamp	2
Poor Fen	10	Calcareous Fen	8	Boreal Rich Fen	1
Boreal Rich Fen	8	Black Spruce Swamp	4	Sand prairie	1
Wet Prairie	4	Poor Fen	4	White Pine-Red Maple Swamp	1
Open Bog	3	Wet Prairie	3		
Wild Rice Marsh	1	Wet-Mesic Prairie	3		
Sand prairie	1	Northern Hardwood Swamp	2		
		Central Poor Fen	1		
		Northern Tamarack Swamp	1		
		Ruderal Wet Meadow	1		

Appendix C: Rapid FQA Plant List and Composite C-Values for Genus-level Plant ID

Common dominant plants of Wisconsin wetlands ordered by importance value (IV). A separate list is provided for each Cowardin Palustrine class (Herbaceous (PEM), Shrub-Scrub (PSS), and Forested (PFO)). Similar species are grouped at the genus level (or higher in the case of ferns and nettles) and given a composite C-value based on the IV-weighted average C-value of species in the group. RFQA taxa with Cowardin class in parentheses indicates the group and associated C-value should only be used in the indicated Cowardin Class.

RFQA Plant List for Herbaceous (Emergent) Wetlands (PEM)

RFQA TAXON	Common Name	Grouped Species	C-Value	Composite C-Value	IV	Composite IV
Phalaris arundinacea	**Reed canary grass**			**0**		40.7
***Carex* spp. (PEM)**	**Sedges**	*Carex stricta*	7	**6.4**	14.3	35.3
		Carex lacustris	6		7.1	
		Carex utriculata	7		3.5	
		Carex trichocarpa	4		3.3	
		Carex lasiocarpa	9		2.1	
		Carex pellita	4		1.4	
		Carex aquatilis	7		0.8	
		Carex granularis	3		0.7	
		Carex haydenii	8		0.6	
		Carex annectens	4		0.6	
		Carex oligosperma	10		0.5	
		Carex sartwellii	7		0.3	
		Carex vulpinoidea	2		0.3	
***Typha* spp.**	**Cattails**	*Typha X glauca*	0	**0.3**	13.6	29.3
		Typha latifolia	1		8.2	
		Typha angustifolia	0		7.5	
Calamagrostis canadensis	**Blue-joint grass**			**5**		9.3
***Solidago* spp. (PEM)**	**Goldenrods**	*Solidago canadensis*	1	**1.5**	5.1	6.9
		Solidago gigantea	3		1.8	
***Lemna* spp.**	**Duckweeds**	*Lemna turionifera*	2	**2.4**	5.6	6.7
		Lemna minor	4		0.7	
		Lemna trisulca	6		0.4	
Bolboschoenus fluviatilis	**River bulrush**			**6**		3.8
***Sparganium* spp.**	**Bur-reeds**	*Sparganium emersum*	8	**5.3**	0.3	3.1
		Sparganium eurycarpum	5		2.8	
***Helianthus* spp.**	**Sunflowers**	*Helianthus grosseserratus*	2	**2.2**	2.3	2.6
		Helianthus giganteus	4		0.3	
Eutrochium maculatum	**Spotted joe-pye-weed**			**4**		2.5

Phragmites australis	Common reed grass	*Phragmites australis ssp. americanus*	1	**0.5**	1.2	2.4
		Phragmites australis ssp. australis	0		1.2	
Poa pratensis	Kentucky bluegrass	*Poa pratensis*		**0**		2.4
Symphyotrichum spp. (PEM)	Asters	*Symphyotrichum firmum*	6	**5.6**	1.6	2.2
		Symphyotrichum lanceolatum	4		0.3	
		Symphyotrichum puniceum	5		0.3	
Impatiens capensis	Orange jewelweed			**2**		2.1
Persicaria spp.	Smartweeds/Tearthumb	*Persicaria amphibia*	5	**5.1**	1.8	2.1
		Persicaria sagittata	6		0.3	
Sagittaria spp.	Arrowhead	*Sagittaria latifolia*	3	**3.9**	1.7	2.0
		Sagittaria rigida	8		0.3	
Scirpus spp.	Wool-grass	*Scirpus atrovirens*	3	**3.8**	0.3	1.6
		Scirpus cyperinus	4		1.3	
Salix spp. (PEM)	Willows (Native shrubs)	*Salix discolor*	2	**2.9**	0.3	1.5
		Salix interior	2		0.9	
		Salix petiolaris	6		0.3	
Leersia oryzoides	Rice cut grass			**3**		1.5
Equisetum fluviatile	River horsetail			**7**		1.4
Spiraea spp.	Spiraeas	*Spiraea alba*	4	**4.4**	0.9	1.3
		Spiraea tomentosa	6		0.3	
Juncus spp.	Rushes	*Juncus dudleyi*	4	**4**	0.9	1.3
		Juncus effusus	4		0.4	
Fern spp. (PEM)	Ferns	*Thelypteris palustris*	7	**5.2**	0.6	1.2
		Onoclea sensibilis	5		0.3	
		Pteridium aquilinum	2		0.3	
Cornus spp.	Dogwoods	*Cornus amomum*	4	**2.7**	0.3	1.2
		Cornus foemina	2		0.6	
		Cornus sericea	3		0.3	
Urtica dioica	Stinging nettle	*Urtica dioica*		**1**		1.2
Utricularia spp.	Bladderworts	*Utricularia intermedia*	9	**8.3**	0.7	1.1
		Utricularia vulgaris	7		0.4	
Schoenoplectus spp.	Bulrushes	*Schoenoplectus acutus*	6	**5.4**	0.8	1.1
		Schoenoplectus tabernaemontani	4		0.3	
Urticaceae spp. (Except Urtica dioica) (PEM)	Nettles (Except Stinging nettle)	*Pilea fontana*		**7**		0.9
Thalictrum dasycarpum	Purple meadow-rue			**4**		0.9
Spartina pectinata	Prairie cord grass			**5**		0.9
Equisetum arvense	Field horsetail			**1**		0.9
Lythrum salicaria	Purple loosestrife			**0**		0.6

RFQA Plant List for Shrub Wetlands (PSS)						
RFQA Taxon	**Common Name**	**Species**	**C-Value**	**Composite C-Value**	**IV**	**Composite IV**
Salix spp. (PSS)	**Willows (Shrubs)**	***Salix petiolaris****	6	**4.9**	22.3	**32.8**
		Salix discolor*	2		5.0	
		Salix interior*	2		4.2	
		Salix bebbiana	7		0.7	
		Salix pyrifolia	7		0.5	
		Salix eriocephala	4		0.4	
Alnus incana	**Tag alder**			**4**		**33.2**
Phalaris arundinacea	**Reed canary grass**			**0**		**26.5**
Carex spp. (PSS)	**Sedges**	*Carex stricta*	7	**6.5**	9.0	**24.2**
		Carex lacustris	6		7.5	
		Carex crinita	6		1.2	
		Carex trichocarpa	7		1.0	
		Carex trisperma	9		0.8	
		Carex utriculata	7		0.8	
		Carex lasiocarpa	9		0.7	
		Carex pellita	4		0.4	
		Carex stipata	2		0.4	
		Carex brunnescens	7		0.4	
		Carex canescens	8		0.4	
		Carex gracillima	5		0.4	
		Carex rostrata	10		0.4	
		Carex annectens	4		0.4	
		Carex bebbii	4		0.4	
		Carex bromoides	8		0.4	
Cornus spp.	**Dogwoods**	*Cornus amomum*	4	**3.0**	3.2	**18.0**
		Cornus foemina	2		4.6	
		Cornus sericea	3		9.5	
Frangula/Rhamnus spp.	**Buckthorns (non-native)**	*Frangula alnus*	0	**0**	11.9	**16.6**
		Rhamnus cathartica	0		4.7	
Calamagrostis canadensis	**Bluejoint grass**			**5**		**13.2**
Solidago spp.	**Goldenrods**	*Solidago canadensis*	1	**2.3**	1.6	**5.1**
		Solidago gigantea	3		3.1	
		Solidago riddellii	7		0.4	
Impatiens capensis	**Orange jewelweed**			**2**		**4.1**
Fern spp. (PSS)	**Ferns**	*Athyrium filix-femina*	5	**5**	0.4	**3.5**
		Matteuccia struthiopteris	5		0.8	
		Onoclea sensibilis	5		1.9	

		Osmundastrum cinnamomeum	5		0.4	
Urticaceae spp. (PSS) (Except Urtica dioica)	**Nettles (Except Stinging nettle)**	*Pilea fontana*	7	**5.2**	1.1	**3.1**
		Pilea pumila	3		1.0	
		Boehmeria cylindrica	6		0.7	
		Laportea canadensis	4		0.3	
Glyceria striata	**Fowl Manna Grass**			**4**		**2.9**
Lonicera spp. (Non-Native)	**Honeysuckles (Non-native)**	*Lonicera morrowii*	0	**0**	2.0	**2.4**
		Lonicera tatarica	0		0.4	
Spiraea spp.	**Spiraeas**	*Spiraea alba*	4	**4.4**	2.1	**2.4**
		Spiraea tomentosa	6		0.4	
Betula pumila	**Bog birch**			**7**		**2.3**
Salix spp. (Trees)	**Willows (Native trees)**	*Salix amygdaloides*	4	**4**	1.3	**2.3**
		Salix eriocephala	4		0.4	
		Salix nigra	4		0.6	
Rubus spp.	**Raspberry/ Dewberries**	*Rubus hispidus*	4	**3.2**	0.4	**2.2**
		Rubus idaeus ssp. strigosus	3		1.8	
Poa pratensis	**Kentucky blue grass**			**0**		**1.9**
Typha spp.	**Cat-tails**	*Typha angustifolia*	0	**0.3**	0.7	**1.5**
		Typha latifolia	1		0.8	
Ilex verticillata	**Winterberry**			**7**		**1.2**
Symplocarpus foetidus	**Skunk cabbage**			**8**		**1.2**
Chamaedaphne calyculata	**Leatherleaf**			**9**		**1.2**
Leersia oryzoides	**Rice Cut Grass**			**3**		**1.1**
Symphyotrichum/ Doellingeria	**Asters**			**5**		**1.1**
Urtica dioica	**Stinging nettle**	*Urtica dioica*	1	**1**	0.9	**0.9**

RFQA Plant List for Forested Wetlands (PFO)						
RAPID FQA TAXON	**Common Name**	**Species**	**C-Value**	**Composite C-Value**	**IV**	**Composite IV**
Acer spp.	**Maples**	*Acer saccharinum*	2	**2.3**	15.9	24.1
		Acer rubrum	3		6.1	
		Acer X freemanii	3		2.0	
Phalaris arundinacea	**Reed canary grass**			0		19.6
Fraxinus nigra	**Black ash**			8		17.5
Urticaceae spp. (Except Urtica dioica) (PFO)	**Nettles (Except Stinging nettle)**	*Laportea canadensis*	4	**4.3**	6.4	15.6
		Pilea pumila	3		5.0	
		Boehmeria cylindrica	6		2.6	
		Pilea fontana	7		1.6	
Fraxinus pennsylvanica	**Green ash**			2		15.6
Larix laricina	**Tamarack**			8		13.8
Frangula/Rhamnus	**Buckthorns (Non-native)**	*Frangula alnus*	0	**0**	7.3	12.6
		Rhamnus cathartica	0		6.5	
Thuja occidentalis	**Northern white-cedar**			9		11.8
Carex spp. (PFO)	**Sedges**	*Carex bromoides*	8	**7.3**	0.9	8.7
		Carex brunnescens	7		0.5	
		Carex canescens	8		0.4	
		Carex cristatella	4		0.4	
		Carex lacustris	6		1.5	
		Carex leptalea	9		0.9	
		Carex pellita	4		0.4	
		Carex stricta	7		1.0	
		Carex trisperma	9		1.8	
Impatiens capensis	**Orange jewelweed**			**2**		6.2
Picea mariana	**Black spruce**			**8**		6.2
Alnus incana	**Tag alder**			**4**		6.5
Fern spp. (PFO)	**Ferns**	*Osmundastrum cinnamomeum*	5	**6.5**	3.6	6.1
		Cystopteris bulbifera	8		0.7	
		Onoclea sensibilis	5		0.7	
		Athyrium filix-femina	5		0.3	
		Osmunda regalis	7		0.3	
		Matteuccia struthiopteris	5		0.3	
Lysimachia nummularia	**Moneywort**			**0**		6.0
Quercus spp.	**Oaks**	*Quercus bicolor*	7	**5.9**	2.3	4.9
		Quercus macrocarpa	5		1.9	
		Quercus rubra	5		0.7	
Acer negundo	**Box elder**			**0**		4.5
Ulmus spp.	**Elm spp.**	*Ulmus americana*	3	**3.2**	3.6	4.3
		Ulmus rubra	4		0.7	

Glyceria striata	**Fowl manna grass**			**4**		3.7
Pinus strobus	**Eastern white pine**			**5**		3.7
Populus spp.	**Aspen/Cottonwood**	*Populus deltoides*	2	**2.1**	1.5	3.3
		Populus grandidentata	3		0.3	
		Populus tremuloides	2		1.4	
Symplocarpus foetidus	**Skunk-cabbage**			**8**		3.1
Rubus spp.	**Blackberry/Raspberry spp.**	*Rubus idaeus ssp. strigosus*	3	**2.7**	1.5	3.2
		Rubus allegheniensis	2		0.7	
	Dewberries	*Rubus hispidus*	4	**4.9**	0.7	
		Rubus pubescens	7		0.3	
Lonicera spp. (non-native)	**Non-Native Honeysuckle**	*Lonicera morrowii*	0	**0**	1.4	2.8
		Lonicera tatarica	0		0.3	
		Lonicera X bella	0		1.1	
Betula alleghaniensis	**Yellow birch**			**7**		2.5
Tilia americana	**American linden**			**5**		2.5
Ilex verticillata	**Winterberry**			**7**		2.3
Abies balsamea	**Balsam fir**			**5**		2.1
Zanthoxylum americanum	**Common prickly-ash**			**3**		2.1
Calamagrostis canadensis	**Blue-joint grass**			**5**		1.8
Betula papyrifera	**Paper birch**			**3**		1.7
Solidago spp. (PFO)	**Goldenrods**	*Solidago gigantea*	3	**2.6**	1.3	1.6
		Solidago canadensis	1		0.3	
Tsuga canadensis	**Northern hemlock**			**8**		1.5
Symphyotrichum spp. (PFO)	**Asters (Forested Wetlands)**	*Symphyotrichum lateriflorum*	3	**5**	0.3	1.1
		Symphyotrichum ontarionis	6		0.7	
Urtica dioica	**Stinging nettle**	*Urtica dioica*		1	1.1	1.1
Betula nigra	**River birch**			**6**		1.1
Leersia spp.	**Rice cutgrass/ white grass**	*Leersia oryzoides*	3	**3.6**	0.7	1.1
		Leersia virginica	5		0.3	1.1
Poa pratensis	**Kentucky bluegrass**			**0**		1.0

Appendix D: Field Testing Results

Wetland AA Name	Class	n*	Mean RAPID *wC*	FULL *wC*	Rapid Category	Full Category	Full Survey Community	*wC* Difference (Rapid - Full)	Rapid *wC* SD
Jenni & Kyle RWF	FOREST	1	0.3	0.6	LOW	Very Poor	Floodplain Forest	-0.3	NA
LostCrk NWMF	FOREST	2	6.8	6.2	HIGH	Fair	Cedar Swamp	0.7	0.1
Pheasant Branch -E	FOREST	2	0.5	0.9	LOW	Very Poor	Floodplain Forest	-0.4	0.3
Pheasant Branch -T	FOREST	5	1.0	1.6	LOW	Very Poor	Floodplain Forest	-0.6	0.3
SE079	FOREST	2	4.4	4.6	HIGH/MEDIUM	Fair	N. Hardwood Swamp	-0.2	0.6
BullGus1	HERB	2	5.5	4.8	HIGH	Fair	N. Sedge Meadow	0.7	0.1
BullGus3	HERB	2	5.4	5.1	HIGH	Fair	N. Sedge Meadow	0.3	0.1
Jenni & Kyle-WMP	HERB	1	2.0	1.5	LOW	Very Poor	Wet-mesic Prairie	0.5	NA
MSLA007	HERB	2	5.2	5.6	HIGH	Fair	Calcareous Fen	-0.4	0.4
Pheasant Branch-A	HERB	3	3.8	4.0	MEDIUM	Fair	S. Sedge Meadow	-0.2	0.2
Pheasant Branch-N	HERB	1	1.3	1.7	LOW	Poor	S. Sedge Meadow	-0.4	NA
Pheasant Branch-UV	HERB	4	0.2	0.9	LOW	Very Poor	S. Sedge Meadow	-0.7	0.1
DeadPikeAT	SHRUB	1	5.0	5.4	HIGH	Excellent	Alder Thicket	-0.4	NA
DeadPikeSC	SHRUB	1	5.3	6.2	HIGH	Excellent	Shrub-carr	-1.0	NA
Jenni & Kyle SC1	SHRUB	1	1.6	2.1	LOW	Very Poor	Shrub-carr	-0.5	NA
Jenni & Kyle SC2	SHRUB	1	0.8	1.1	LOW	Very Poor	Shrub-carr	-0.3	NA
Pheasant Branch-F	SHRUB	7	4.1	3.8	HIGH/MEDIUM	Fair	Shrub-carr	0.3	0.7
SE131	SHRUB	3	5.5	5.5	HIGH	Excellent	Shrub-carr	0.0	0.5
SE176	SHRUB	2	5.8	5.1	HIGH	Fair	N. Hardwood Swamp	0.7	0.1

*Number of rapid survey replicates conducted of the same AA.