Qualitative Yellow Iris (*Iris pseudacorus*) and Purple Loosestrife (*Lythrum salicaria*) Shoreline Surveys, and August Warm-water Macrophyte Point-intercept Survey Upper St. Croix River and Ox Creek Slough (WBIC: 2601400 and 2744100) Douglas County, Wisconsin

Purple loosestrife - Upper St. Croix Lake Outlet 8/16/16

Dense Northern wild rice north of Cut-Away Dam (8/16/16)

Project Initiated by: Friends of the St. Croix Headwaters and the Wisconsin Department of Natural Resources

Yellow iris cluster north of Cut-Away Dam 8/25/16

Surveys Conducted by and Report Prepared by:

Endangered Resource Services, LLC
Matthew S. Berg, Research Biologist
St. Croix Falls, Wisconsin
June 20, August 16, and August 25, 2016

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INTRODUCTION:

The St. Croix River (WBIC 2601400) begins at the outlet on the south side of Upper St. Croix Lake (WBIC 2747300) in central Douglas County, Wisconsin in the Town of Solon Springs. Below the lake outlet, the river meanders past Cut-Away Bridge before joining with the Ox Creek Slough (WBIC 2744100). At this point, it becomes "lake-lake" as it widens to 150-300 meters across and shows no visible flow before narrowing sharply, becoming riverine, and flowing rapidly for approximately 1.5 miles before emptying into the St. Croix Flowage. Collectively, the river and slough combines to form an approximately 263-acre waterbody (Figure 1). Most of the area is very shallow with a mean depth of only 3.6ft and a maximum depth of 10ft just below the Cut-Away Bridge. The bottom is predominately thick organic muck with areas of sand and rock located in the central river channel, at the Ox Creek Inlet, and scattered along the shore.

Figure 1: Upper St. Croix Watershed Aerial Photo

BACKGROUND AND STUDY RATIONALE:

Yellow iris (*Iris pseudacorus*) and Purple loosestrife (*Lythrum salicaria*) are highly invasive exotic species that pose a significant threat to Wisconsin's native wetland plant communities. Although Purple loosestrife has been present in northwest Wisconsin for decades including along the shores of Upper St. Croix Lake and along the St. Croix River between the lake and the St. Croix Flowage, Yellow iris is a relatively new invader that was recorded as a visual at only two points during our original point-intercept surveys in this area in 2009 and 2010. Because Yellow iris has apparently been spreading rapidly since its introduction and because the populations of Galerucella beetles (*Galerucella* spp.) that have been released to control Purple loosestrife in the past seemed to have crashed, the Friends of the St. Croix Headwaters (FOTSCH) and the Wisconsin Department of Natural Resources (WDNR) requested shoreline surveys for each of these species on the St. Croix River between the lake and the flowage in 2016. The also requested a follow-up to the original 2009 point-intercept macrophyte survey. However, due to time and budget constraints, this survey was reduced to only include those points between Upper St. Croix Lake and the Cutaway Dam. The primary goal of these surveys was to develop management strategies to control the spread of these invasive species with a secondary goal of comparing how vegetation in this stretch of river may have changed since the original August 2009 survey. This report is the summary analysis of these three field surveys conducted on June 20 and August 16 and 25, 2016.

METHODS:

Yellow Iris and Purple Loosestrife Shoreline Surveys:

As the goal of these surveys was to simply document the rough distribution of these species along the river, we made no attempt to quantify the density of plants and simply noted if plants were growing near any of 552 point-intercept survey points that were established by Michelle Nault (WDNR) in 2009 (Appendix I). The Yellow iris survey occurred on June 20th when plants were in bloom and most likely to be detected. This time was also chosen as Amy Elliot (UW-Superior) was coordinating a removal effort and wanted locations prior to the June 27-30 removal effort. Because Purple loosestrife's peak blooming period is in August, we returned on August 25th to complete this survey.

August Warm-water Full Point-intercept Macrophyte Survey:

Of the 552 points in the original 2009 survey grid, 97 occurred between the Upper St. Croix Lake Outlet and Cut-Away Dam, and we used these same points during the 2016 survey (Appendix I). Prior to beginning the August point-intercept survey, we canoed upstream and conducted a general survey of the area to regain familiarity with the species present (Appendix II). All plants found were identified (Voss 1996, Boreman et al. 1997; Chadde 2002; Crow and Hellquist 2009; Skawinski 2014), and a data sheet was built from the species present. We located each survey point with a GPS (Garmin 76CSX), recorded a depth reading with a metered pole rake, and took a rake sample. All plants on the rake, as well as any that were dislodged by the rake, were identified and assigned a rake fullness value of 1-3 as an estimation of abundance (Figure 2). We also recorded visual sightings of all plants within six feet of the sample point not found in the rake. In addition to a rake rating for each species, a total rake fullness rating was also noted. Substrate (bottom) type was assigned at each site where the bottom was visible or it could be reliably determined using the rake.

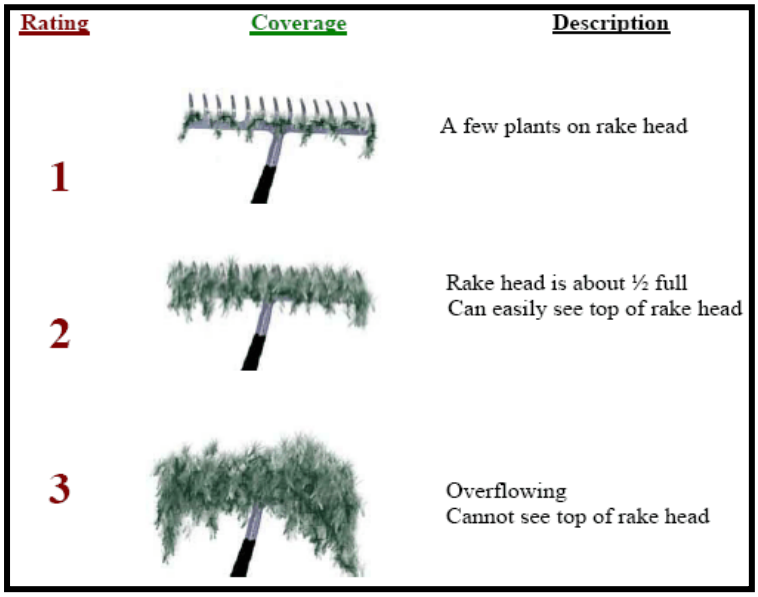


Figure 2: Rake Fullness Ratings (UWEX 2010)

DATA ANALYSIS:

We entered all data collected into the standard APM spreadsheet (Appendix II) (UWEX 2010). From this, we calculated the following:

Total number of sites visited: This included the total number of points on that were accessible to be surveyed by canoe.

Total number of sites with vegetation: These included all sites where we found vegetation after doing a rake sample. For example, if 20% of all sample sites have vegetation, it suggests that 20% of the lake has plant coverage.

Total number of sites shallower than the maximum depth of plants: This is the number of sites that are in the littoral zone. Because not all sites that are within the littoral zone actually have vegetation, we use this value to estimate how prevalent vegetation is throughout the littoral zone. For example, if 60% of the sites shallower than the maximum depth of plants have vegetation, then we estimate that 60% of the littoral zone has plants.

Frequency of occurrence: The frequency of all plants (or individual species) is generally reported as a percentage of occurrences within the littoral zone. It can also be reported as a percentage of occurrences at sample points with vegetation.

Frequency of occurrence example:

Plant A is sampled at 70 out of 700 total littoral points = 70/700 = .10 = 10%
This means that Plant A's frequency of occurrence = 10% when considering the entire littoral zone.

Plant A is sampled at 70 out of 350 total points with vegetation = 70/350 = .20 = 20%
This means that Plant A's frequency of occurrence = 20% when only considering the sites in the littoral zone that have vegetation.

From these frequencies, we can estimate how common each species was at depths where plants were able to grow, and at points where plants actually were growing. Note the second value will be greater as not all the points (in this example, only ½) had plants growing at them.

Simpson's Diversity Index: A diversity index allows the entire plant community at one location to be compared to the entire plant community at another location. It also allows the plant community at a single location to be compared over time thus allowing a measure of community degradation or restoration at that site. With Simpson's Diversity Index, the index value represents the probability that two individual plants (randomly selected) will be different species. The index values range from 0 -1 where 0 indicates that all the plants sampled are the same species to 1 where none of the plants sampled are the same species. The greater the index value, the higher the diversity in a given location. Although many natural variables like lake size, depth, dissolved minerals, water clarity, mean temperature, etc. can affect diversity, in general, a more diverse lake indicates a healthier ecosystem. Perhaps most importantly, plant communities with high diversity also tend to be **more resistant** to invasion by exotic species.

Maximum depth of plants: This indicates the deepest point that vegetation was sampled. In clear lakes, plants may be found at depths of over 20ft, while in stained or turbid locations, they may only be found in a few feet of water. While some species can tolerate very low light conditions, others are only found near the surface. In general, the diversity of the plant community decreases with increased depth.

Mean and median depth of plants: The mean depth of plants indicates the average depth in the water column where plants were sampled. Because a few samples in deep water can skew this data, median depth is also calculated. This tells us that half of the plants sampled were in water shallower than this value, and half were in water deeper than this value.

Number of sites sampled using rope/pole rake: This indicates which rake type was used to take a sample. In shallower areas, we use a 10ft pole rake for sampling.

Average number of species per site: This value is reported using four different considerations. 1) **shallower than maximum depth of plants** indicates the average number of plant species at all sites in the littoral zone. 2) **vegetative sites only** indicate the average number of plants at all sites where plants were found. 3) **native species shallower than maximum depth of plants** and 4) **native species at vegetative sites only** excludes exotic species from consideration.

Species richness: This value indicates the number of different plant species found in and directly adjacent to the water. Species richness alone only counts those plants found in the rake survey. The other two values include those seen at a sample point during the survey but not found in the rake, and those that were only seen during the initial boat survey or inter-point. **Note: Per DNR protocol, filamentous algae, freshwater sponges, aquatic moss and the aquatic liverworts *Riccia fluitans* and *Ricciocarpus natans* are excluded from these totals.**

Average rake fullness: This value is the average rake fullness of all species in the rake. It only takes into account those sites with vegetation (Table 1).

Relative frequency: This value shows a species' frequency relative to all other species. It is expressed as a percentage, and the total of all species' relative frequency will add up to 100%. Organizing species from highest to lowest relative frequency value gives us an idea of which species are most important within the macrophyte community (Tables 2 and 3).

Relative frequency example:

Suppose that we sample 100 points and found 5 species of plants with the following results:

Plant A was located at 70 sites. Its frequency of occurrence is thus 70/100 = 70%
Plant B was located at 50 sites. Its frequency of occurrence is thus 50/100 = 50%
Plant C was located at 20 sites. Its frequency of occurrence is thus 20/100 = 20%
Plant D was located at 10 sites. Its frequency of occurrence is thus 10/100 = 10%

To calculate an individual species' relative frequency, we divide the number of sites a plant is sampled at by the total number of times all plants were sampled. In our example that would be 150 samples (70+50+20+10).

Plant A = 70/150 = .4667 or 46.67%
Plant B = 50/150 = .3333 or 33.33%
Plant C = 20/150 = .1333 or 13.33%
Plant D = 10/150 = .0667 or 6.67%

This value tells us that 46.67% of all plants sampled were Plant A.

Floristic Quality Index (FQI): This index measures the impact of human development on aquatic plants. The 124 species in the index are assigned a Coefficient of Conservatism (C) which ranges from 1-10. The higher the value assigned, the more likely the plant is to be negatively impacted by human activities relating to water quality or habitat modifications. Plants with low values are tolerant of human habitat modifications, and they often exploit these changes to the point where they may crowd out other species. The FQI is calculated by averaging the conservatism value for each native index species found in the lake during the point-intercept survey**, and multiplying it by the square root of the total number of plant species (N) in the lake ($FQI=(\Sigma(c1+c2+c3+\ldots cn)/N)*\sqrt{N}$). Statistically speaking, the higher the index value, the healthier the lake's macrophyte community is assumed to be. Nichols (1999) identified four eco-regions in Wisconsin: Northern Lakes and Forests, North Central Hardwood Forests, Driftless Area and Southeastern Wisconsin Till Plain. He recommended making comparisons of lakes within ecoregions to determine the target lake's relative diversity and health. The Upper St. Croix River is located in the Northern Lakes and Forests Ecoregion (Tables 4 and 5).

**** Species that were only recorded as visuals or during the boat survey, and species found in the rake that are not included in the index are excluded from FQI analysis.**

Comparison to Past Surveys: We compared data from the same 97 points in both the 2009 and 2016 point-intercept surveys (Figure 12) (Tables 2 and 3) to see if there were any significant changes in the area's vegetation. Using the Chi-square analysis on the WDNR Pre/Post survey worksheet, differences were considered significant at $p<.05$, moderately significant at $p<.01$ and highly significant at $p<.005$ (UWEX 2010). It should be noted that when comparing the point-intercept surveys, we used the number of littoral points with plants (93 in 2009/97 in 2016).

RESULTS:

Yellow Iris Shoreline Survey:

Our June survey found that Yellow iris was essentially continuous from the lake outlet to Cut-Away Dam, and continued to be regularly encountered all the way to the confluence with the Ox Creek Slough (Figure 3). From here, plants became much less common, and, anecdotally anyway, occurred at much lower densities (Figure 4) (Appendix III). In total, we recorded Yellow iris adjacent to 214 shoreline points.

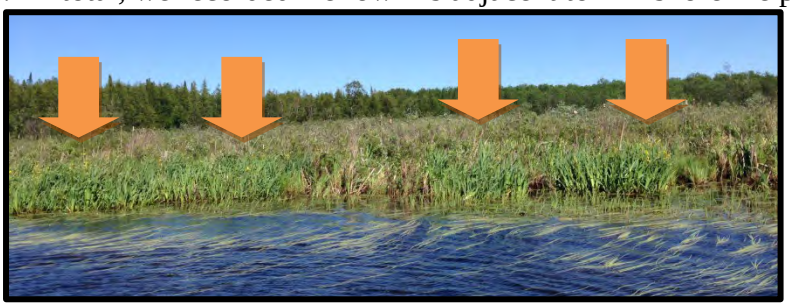


Figure 3: Yellow Iris Near the Upper St. Croix Lake Outlet – 6/20/16

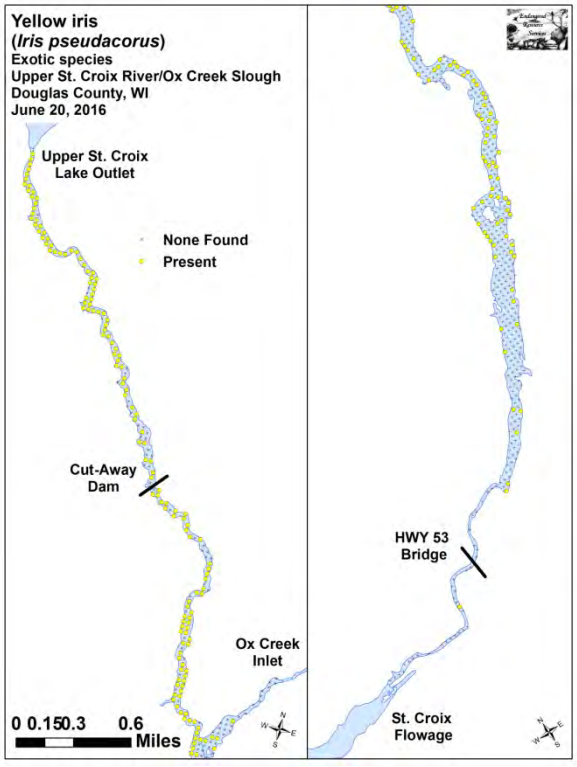


Figure 4: Yellow Iris Shoreline Distribution – 6/20/16

Purple Loosestrife Shoreline Survey:

Similarly, our August survey found high levels of Purple loosestrife near the lake outlet in what was essentially a large monotypic bed (Figure 5). Although levels decreased as we proceeded towards Cut-Away Dam, monotypic beds of various sizes were still common throughout this stretch (Figure 6). From here, plants became patchier, but unlike Yellow iris which become much less common below the Ox Creek Slough, Purple loosestrife continued to be present in almost all general shoreline areas; especially along the largely uninhabited western shoreline of the "lake" area (Figure 7) (Appendix III). In total, we recorded Purple loosestrife adjacent to 341 shoreline points.

Figure 5: Purple Loosestrife at the Upper St. Croix Lake Outlet – 8/16/16

Figure 6: Purple Loosestrife Just North of Cut-Away Dam – 8/16/16

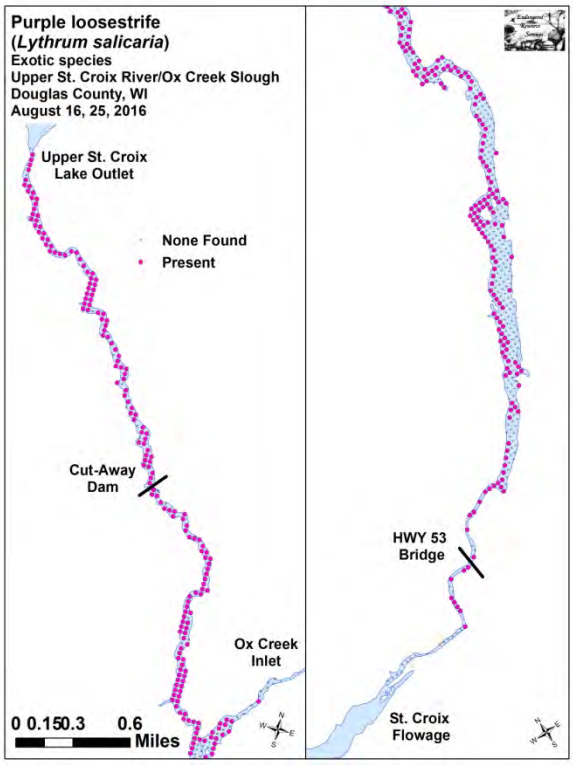


Figure 7: Purple Loosestrife Shoreline Distribution – 8/16, 25/16

August Warm-water Full Point-intercept Macrophyte Survey:

The Upper St. Croix River to Cut-Away Dam survey grid contained 97 points. Three of these points were in a shallow wet sedge meadow adjacent to the river channel. Because we lacked proficiency in identifying sedges in 2009, we chose to ignore them during that survey. However, in 2016, we opted to include these points. The upper river is generally a shallow (<5ft) ribbon that slowly meanders from the Upper St. Croix Lake Outlet to the Cut-Away Bridge. Thick organic muck lines the margins of the majority of this stretch with only a few areas having enough current to produce scoured rock. Collectively, these conditions extrapolated to 96.9% of the bottom being covered in muck and 3.1% have gravel or rock. (Figure 8) (Table 1) (Appendix IV).

In both 2009 and 2016, we found plants growing to 5.0ft (Table 2) (Figure 9). In 2016, we found plants at all survey points, and this was similar to 2009 when plants were present at all but one point (Appendix V). Plant diversity was very high in 2016 with a Simpson Index value of 0.92 – up slightly from 0.91 in 2009. Species richness was moderately high with 47 species found in the rake (up from 36 in 2009). This total increased to 50 when including visuals and 52 when adding in species only seen inter-point. Mean native species richness at sites with native vegetation also increased from 4.40/site in 2009 to 4.61/site in 2016 (Figure 10). Total rake fullness experienced a decline from a very high 2.71 in 2009 to a high 2.49 in 2016 (Figure 11) (Appendix V).

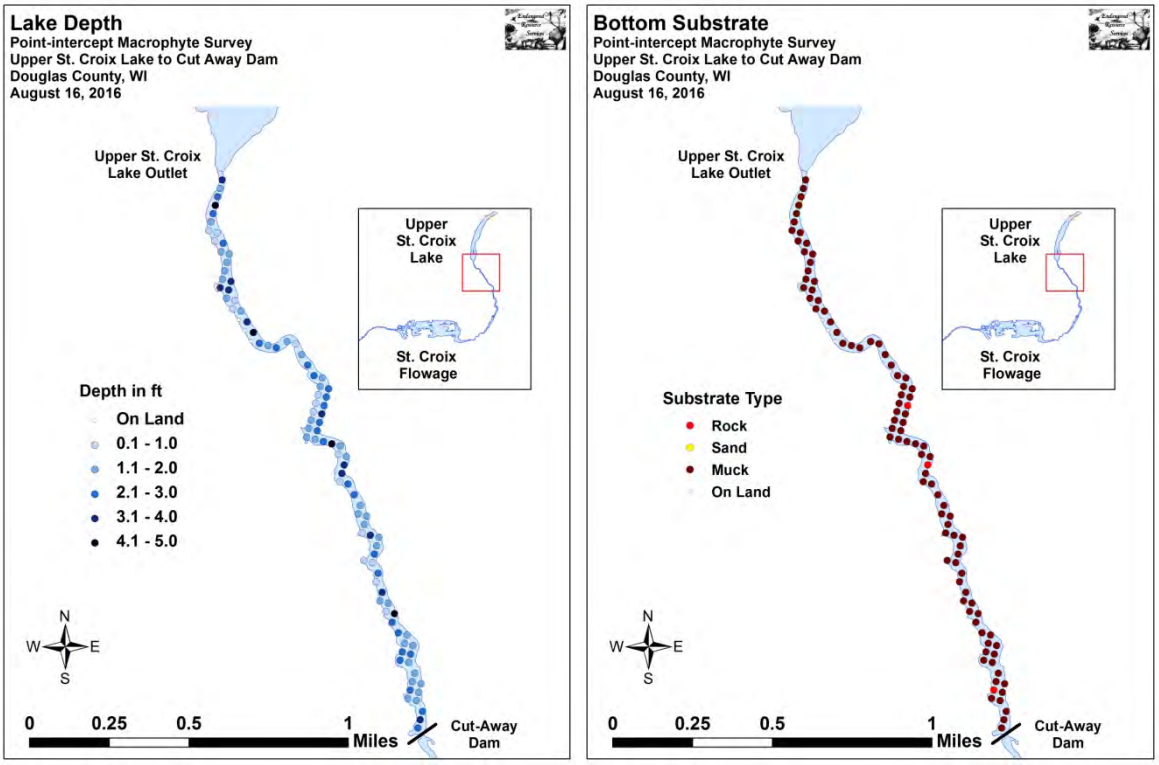


Figure 8: Depth and Bottom Substrate

Table 1: Aquatic Macrophyte P/I Survey Summary Statistics St. Croix River from the Upper St. Croix Lake Outlet to Cut-Away Dam, Douglas County August 10-12, 2009 and August 16, 2016

Summary Statistics:	2009	2016
Total number of points sampled	94	97
Total number of sites with vegetation	93	97
Total number of sites shallower than the maximum depth of plants	94	97
Frequency of occurrence at sites shallower than maximum depth of plants	98.9	100
Simpson Diversity Index	0.91	0.92
Maximum depth of plants (ft)	5.0	5.0
Mean depth of plants (ft)	2.2	2.5
Median depth of plants (ft)	2.0	2.5
Average number of all species per site (shallower than max depth)	4.39	4.72
Average number of all species per site (veg. sites only)	4.44	4.72
Average number of native species per site (shallower than max depth)	4.35	4.61
Average number of native species per site (sites with native veg. only)	4.40	4.61
Species richness	36	47
Species richness (including visuals)	41	50
Species richness (including visuals and boat survey)	****	52
Mean rake fullness (veg. sites only)	2.71	2.49

**** We did not keep a separate list of boat survey plants by region in 2009 so this total is unknowable.

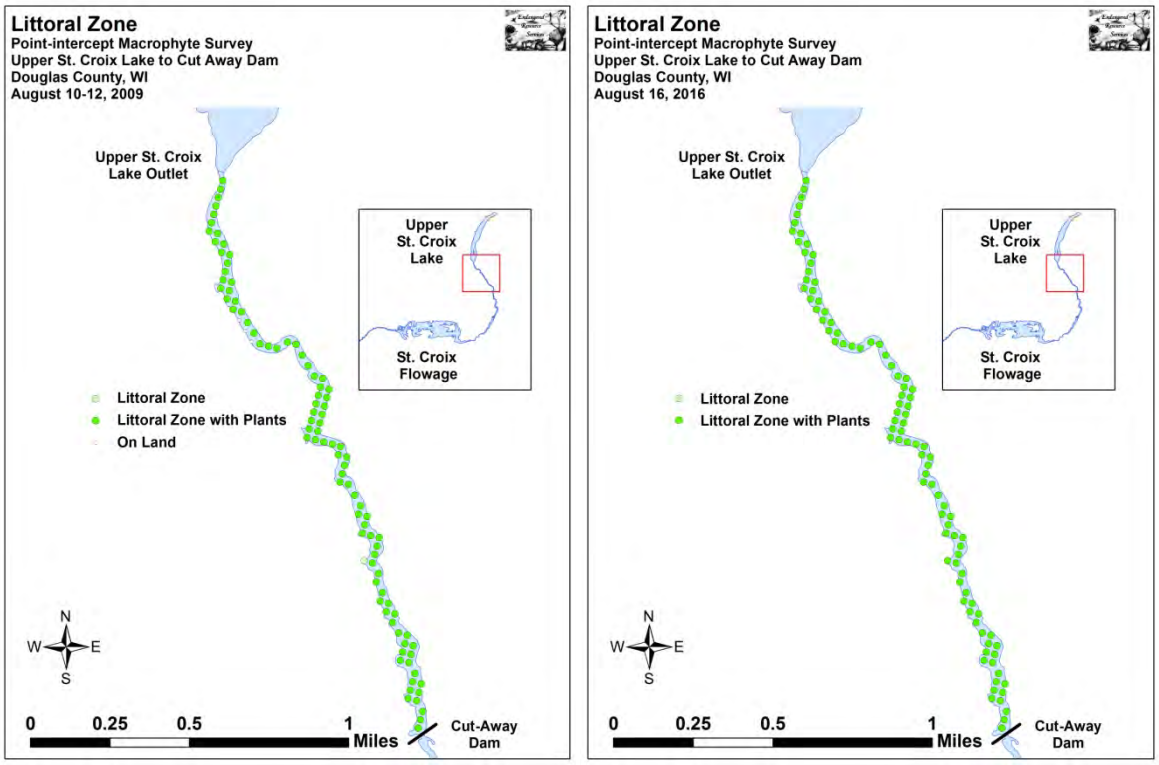


Figure 9: 2009 and 2016 Littoral Zone

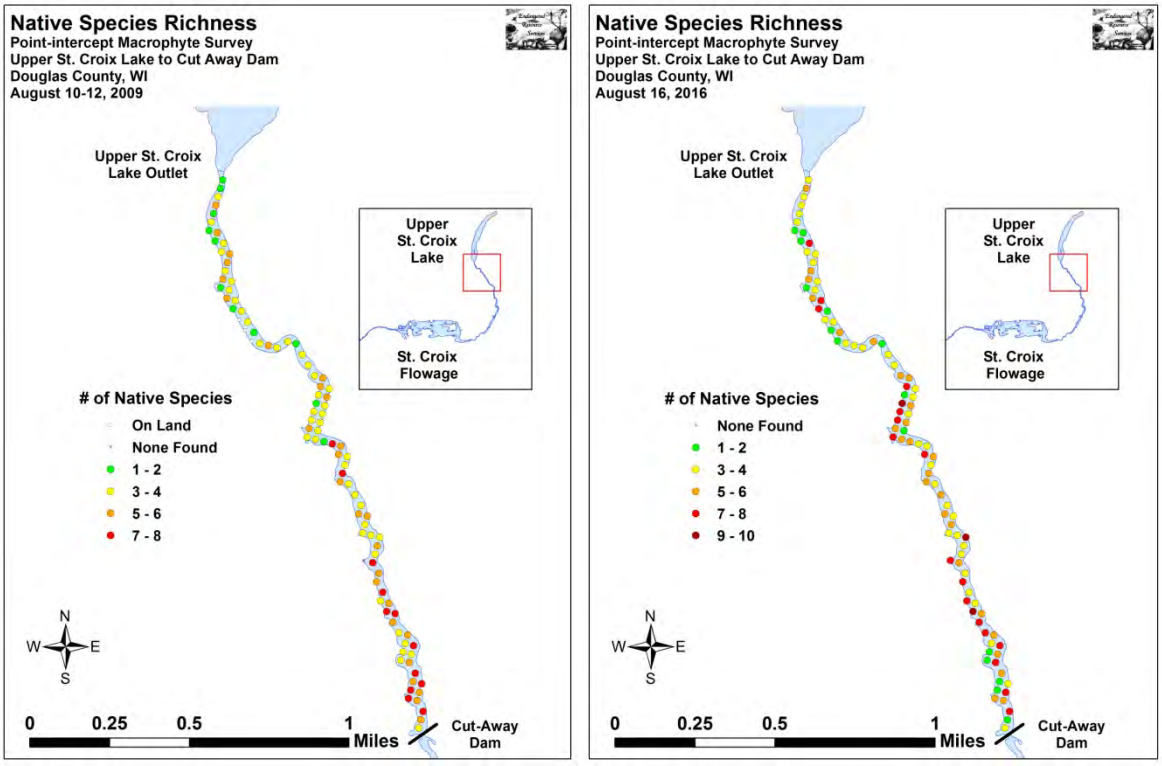


Figure 10: 2009 and 2016 Native Species Richness

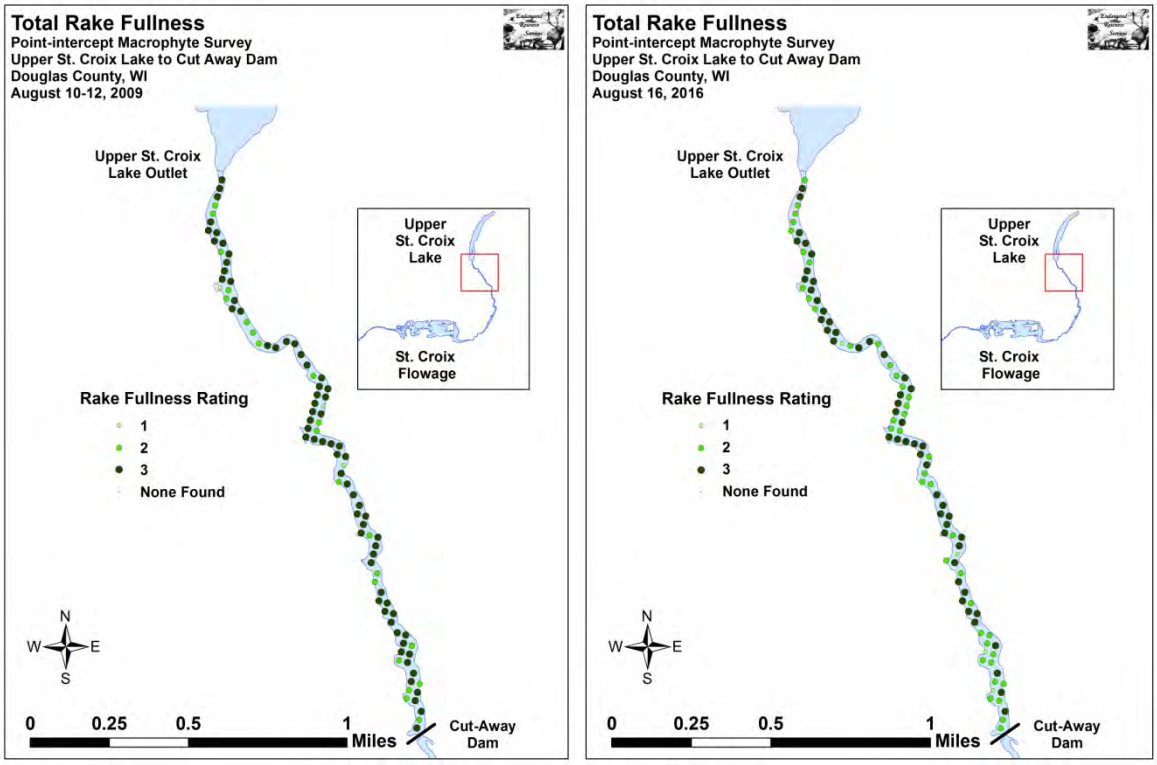


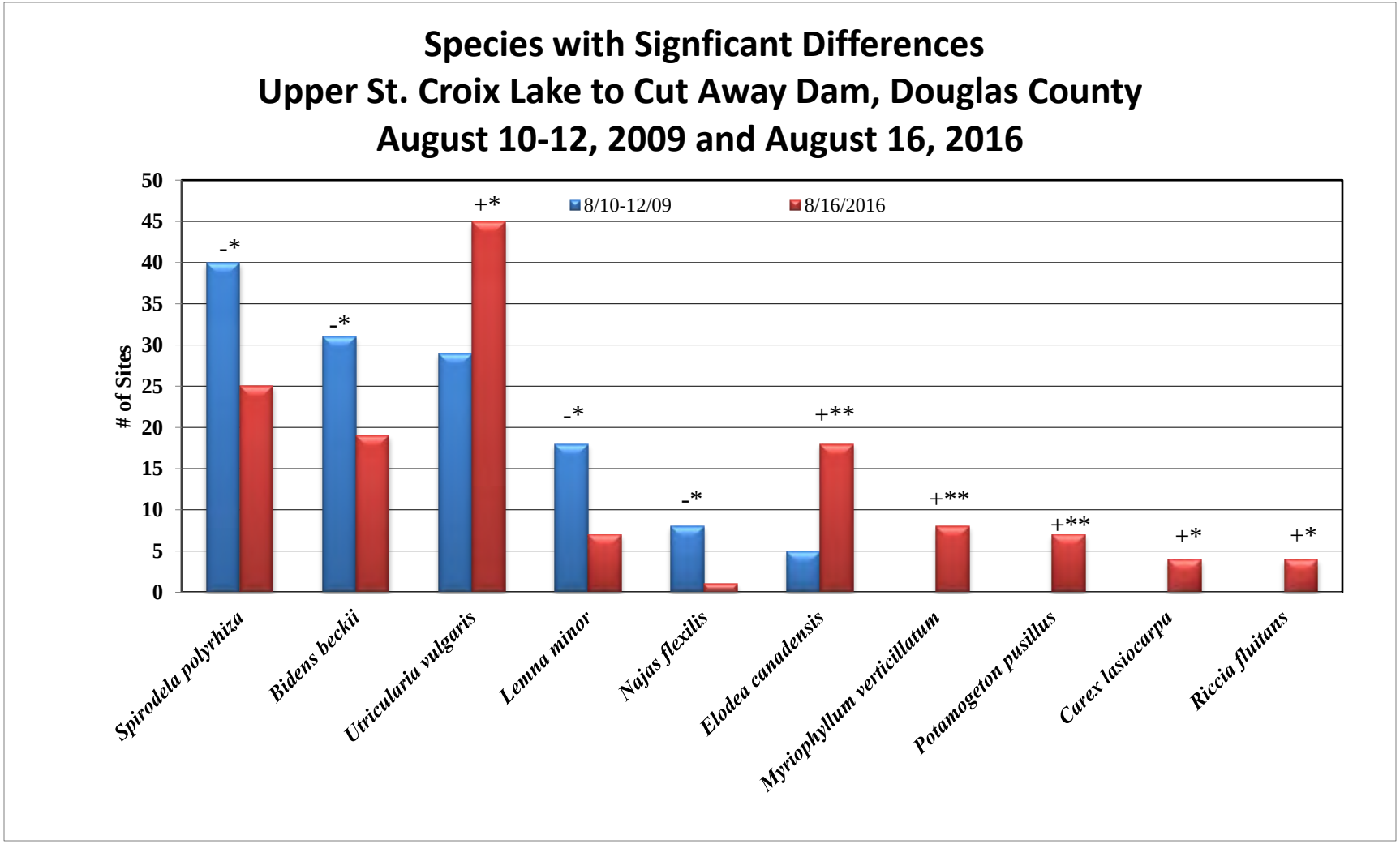
Figure 11: 2009 and 2016 Total Rake Fullness

Comparison of Native Macrophyte Species in 2009 and 2016:

In August 2009, Northern wild rice (*Zizania palustris*), White water lily (*Nymphaea odorata*), Large duckweed (*Spirodela polyrhiza*), and Coontail (*Ceratophyllum demersum*), were the most common macrophyte species (Table 2). They were present at 87.10%, 56.99%, 43.01%, and 40.86% of survey points with vegetation respectively and accounted for 51.33% of the total relative frequency. Water marigold (*Bidens beckii*) (7.51), Common bladderwort (*Utricularia vulgaris*) (7.02), Forked duckweed (*Lemna trisulca*) (5.08), and Small duckweed (*Lemna minor*) (4.36) were the only other species with relative frequencies over 4.0 (Maps for all species found in August 2009 are located in Appendix VI).

The August 2016 survey identified Northern wild rice, White water lily, Common bladderwort, and Coontail as the common macrophyte species. We found them at 85.57%, 50.52%, 46.39%, and 38.14% of sites with vegetation (Table 3), and they accounted for 46.72% of the total relative frequency. Large duckweed (5.46), Water stargrass (*Heteranthera dubia*) (4.80), and Water marigold (4.15) also had relative frequencies over 4.0 (Maps for all species found in August 2016 can be found in Appendixes VII).

From 2009 to 2016, 10 species showed significant changes in distribution (Figure 12). Common waterweed (*Elodea canadensis*), Whorled water milfoil (*Myriophyllum verticillatum*), and Small pondweed (*Potamogeton pusillus*) experienced moderately significant increases; and Common bladderwort, Narrow-leaved woolly sedge (*Carex lasiocarpa*), and Slender riccia (*Riccia fluitans*) showed significant increases. Conversely, Large duckweed, Water marigold, Small duckweed, and Slender naiad (*Najas flexilis*) showed significant declines.



Significant differences = * $p < .05$, ** $p < .01$, *** $p < .005$

Figure 12: Macrophytes Showing Significant Changes from 2009-2016

Table 2: Frequencies and Mean Rake Sample of Aquatic Macrophytes
St. Croix River from the Upper St. Croix Lake Outlet to Cut-Away Dam, Douglas County
August 10-12, 2009

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake	Visual Sight.
Zizania palustris	Northern wild rice	81	19.61	87.10	86.17	2.42	3
Nymphaea odorata	White water lily	53	12.83	56.99	56.38	1.64	5
Spirodela polyrhiza	Large duckweed	40	9.69	43.01	42.55	1.38	0
Ceratophyllum demersum	Coontail	38	9.20	40.86	40.43	1.16	0
Bidens beckii	Water marigold	31	7.51	33.33	32.98	1.81	1
Utricularia vulgaris	Common bladderwort	29	7.02	31.18	30.85	1.38	7
Lemna trisulca	Forked duckweed	21	5.08	22.58	22.34	1.33	0
Lemna minor	Small duckweed	18	4.36	19.35	19.15	1.00	0
	Filamentous algae	15	*	16.13	15.96	1.87	0
Heteranthera dubia	Water star-grass	12	2.91	12.90	12.77	1.33	1
Myriophyllum sibiricum	Northern water-milfoil	9	2.18	9.68	9.57	1.00	2
Potamogeton zosteriformis	Flat-stem pondweed	9	2.18	9.68	9.57	1.33	2
Najas flexilis	Slender naiad	8	1.94	8.60	8.51	1.50	0
Typha latifolia	Broad-leaved cattail	7	1.69	7.53	7.45	1.43	2
Elodea canadensis	Common waterweed	5	1.21	5.38	5.32	1.40	0
Nuphar variegata	Spatterdock	5	1.21	5.38	5.32	1.20	2
Sparganium emersum	Short-stemmed bur-reed	5	1.21	5.38	5.32	1.20	2
Vallisneria americana	Wild celery	5	1.21	5.38	5.32	1.00	0
Lythrum salicaria	Purple loosestrife	4	0.97	4.30	4.26	2.50	2
Schoenoplectus tabernaemontani	Softstem bulrush	4	0.97	4.30	4.26	2.00	0
Potamogeton amplifolius	Large-leaf pondweed	3	0.73	3.23	3.19	1.00	1
Potamogeton epihydrus	Ribbon-leaf pondweed	3	0.73	3.23	3.19	1.00	1
Stuckenia pectinata	Sago pondweed	3	0.73	3.23	3.19	1.67	1

* Excluded from relative frequency analysis

Table 2 (cont'd): Frequencies and Mean Rake Sample of Aquatic Macrophytes St. Croix River from the Upper St. Croix Lake Outlet to Cut-Away Dam, Douglas County August 10-12, 2009

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake	Visual Sight.
Carex comosa	Bottle brush sedge	2	0.48	2.15	2.13	1.00	1
Chara sp.	Muskgrass	2	0.48	2.15	2.13	2.00	0
Eleocharis palustris	Creeping spikerush	2	0.48	2.15	2.13	2.50	0
Leersia oryzoides	Rice cut grass	2	0.48	2.15	2.13	1.50	0
Potamogeton natans	Floating-leaf pondweed	2	0.48	2.15	2.13	2.00	1
Potamogeton richardsonii	Clasping-leaf pondweed	2	0.48	2.15	2.13	1.00	2
Carex utriculata	Common yellow lake sedge	1	0.24	1.08	1.06	3.00	0
Cicuta bulbifera	Bulb-bearing water hemlock	1	0.24	1.08	1.06	2.00	0
Potamogeton robbinsii	Fern pondweed	1	0.24	1.08	1.06	3.00	0
Ranunculus aquatilis	White water crowfoot	1	0.24	1.08	1.06	2.00	0
Sagittaria latifolia	Common arrowhead	1	0.24	1.08	1.06	1.00	1
Sagittaria rigida	Sessile-fruited arrowhead	1	0.24	1.08	1.06	1.00	2
Sparganium eurycarpum	Common bur-reed	1	0.24	1.08	1.06	1.00	0
Utricularia minor	Small bladderwort	1	0.24	1.08	1.06	1.00	0
Equisetum fluviatile	Water horsetail	**	**	**	**	**	2
Iris pseudacorus	Yellow iris	**	**	**	**	**	2
Potamogeton gramineus	Variable pondweed	**	**	**	**	**	1
Potamogeton pusillus	Small pondweed	**	**	**	**	**	1
Potamogeton spirillus	Spiral-fruited pondweed	**	**	**	**	**	2

** Visual only

Table 3: Frequencies and Mean Rake Sample of Aquatic Macrophytes
St. Croix River from the Upper St. Croix Lake Outlet to Cut-Away Dam, Douglas County
August 16, 2016

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake	Visual Sight.
Zizania palustris	Northern wild rice	83	18.12	85.57	85.57	2.00	5
Nymphaea odorata	White water lily	49	10.70	50.52	50.52	1.53	7
Utricularia vulgaris	Common bladderwort	45	9.83	46.39	46.39	1.33	8
Ceratophyllum demersum	Coontail	37	8.08	38.14	38.14	1.16	5
Spirodela polyrhiza	Large duckweed	25	5.46	25.77	25.77	1.04	2
Heteranthera dubia	Water star-grass	22	4.80	22.68	22.68	1.41	9
Bidens beckii	Water marigold	19	4.15	19.59	19.59	1.16	2
Elodea canadensis	Common waterweed	18	3.93	18.56	18.56	1.22	4
Lemna trisulca	Forked duckweed	18	3.93	18.56	18.56	1.17	0
Potamogeton zosteriformis	Flat-stem pondweed	18	3.93	18.56	18.56	1.61	2
Nuphar variegata	Spatterdock	13	2.84	13.40	13.40	1.15	5
	Filamentous algae	11	*	11.34	11.34	1.09	0
Lythrum salicaria	Purple loosestrife	9	1.97	9.28	9.28	1.44	2
Myriophyllum verticillatum	Whorled water milfoil	8	1.75	8.25	8.25	1.63	0
Lemna minor	Small duckweed	7	1.53	7.22	7.22	1.14	0
Potamogeton pusillus	Small pondweed	7	1.53	7.22	7.22	1.29	1
Sparganium emersum	Short-stemmed bur-reed	7	1.53	7.22	7.22	1.29	3
Typha latifolia	Broad-leaved cattail	7	1.53	7.22	7.22	1.43	4
Myriophyllum sibiricum	Northern water-milfoil	6	1.31	6.19	6.19	1.00	2
Potamogeton natans	Floating-leaf pondweed	5	1.09	5.15	5.15	1.20	3
Carex lasiocarpa	Narrow-leaved woolly sedge	4	0.87	4.12	4.12	2.50	0
Riccia fluitans	Slender riccia	4	*	4.12	4.12	1.00	1
Sagittaria rigida	Sessile-fruited arrowhead	4	0.87	4.12	4.12	1.00	4
Schoenoplectus tabernaemontani	Softstem bulrush	4	0.87	4.12	4.12	1.25	3

* Excluded from relative frequency analysis

Table 3 (cont'd): Frequencies and Mean Rake Sample of Aquatic Macrophytes
St. Croix River from the Upper St. Croix Lake Outlet to Cut-Away Dam, Douglas County
August 16, 2016

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake	Visual Sight.
Stuckenia pectinata	Sago pondweed	4	0.87	4.12	4.12	1.50	0
Potamogeton richardsonii	Clasping-leaf pondweed	3	0.66	3.09	3.09	1.00	1
Sparganium fluctuans	Floating-leaf bur-reed	3	0.66	3.09	3.09	1.00	2
Vallisneria americana	Wild celery	3	0.66	3.09	3.09	1.33	2
Carex comosa	Bottle brush sedge	2	0.44	2.06	2.06	2.00	1
Carex stricta	Tussock sedge	2	0.44	2.06	2.06	2.50	3
Chara sp.	Muskgrass	2	0.44	2.06	2.06	1.50	0
Eleocharis palustris	Creeping spikerush	2	0.44	2.06	2.06	1.00	2
Iris pseudacorus	Yellow Iris	2	0.44	2.06	2.06	2.00	1
Potamogeton epihydrus	Ribbon-leaf pondweed	2	0.44	2.06	2.06	1.50	2
Potamogeton obtusifolius	Blunt-leaf pondweed	2	0.44	2.06	2.06	1.50	0
Sagittaria latifolia	Common arrowhead	2	0.44	2.06	2.06	1.50	1
Utricularia minor	Small bladderwort	2	0.44	2.06	2.06	1.00	0
Carex pseudocyperus	False bristly sedge	1	0.22	1.03	1.03	1.00	0
Comarum palustre	Marsh cinquefoil	1	0.22	1.03	1.03	1.00	0
Equisetum fluviatile	Water horsetail	1	0.22	1.03	1.03	1.00	0
Najas flexilis	Slender naiad	1	0.22	1.03	1.03	1.00	1
Potamogeton alpinus	Alpine pondweed	1	0.22	1.03	1.03	2.00	0
Potamogeton amplifolius	Large-leaf pondweed	1	0.22	1.03	1.03	1.00	1
Potamogeton gramineus	Variable pondweed	1	0.22	1.03	1.03	1.00	0
Potamogeton robbinsii	Fern pondweed	1	0.22	1.03	1.03	1.00	1
Ranunculus aquatilis	White water crowfoot	1	0.22	1.03	1.03	1.00	0
Sparganium eurycarpum	Common bur-reed	1	0.22	1.03	1.03	1.00	1
Typha X glauca	Hybrid Cattail	1	0.22	1.03	1.03	3.00	1
Utricularia intermedia	Flat-leaf bladderwort	1	0.22	1.03	1.03	1.00	0

Table 3 (cont'd): Frequencies and Mean Rake Sample of Aquatic Macrophytes
St. Croix River from the Upper St. Croix Lake Outlet to Cut-Away Dam, Douglas County
August 16, 2016

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake	Visual Sight.
Calla palustris	Water calla	**	**	**	**	**	1
Cicuta bulbifera	Bulb-bearing water hemlock	**	**	**	**	**	1
Potamogeton spirillus	Spiral-fruited pondweed	**	**	**	**	**	1
Phragmites australis var. amer.	Common reed	***	***	***	***	***	***
Scirpus cyperinus	Woolgrass	***	***	***	***	***	***

** Visual Only *** Boat Survey Only

Northern wild rice was the most common species north of Cut-Away Dam in both 2009 and 2016. Its distribution was nearly unchanged being found at 81 sites in 2009 and 83 sites in 2016 (Figure 13). It did, however, experience a decline in mean rake fullness from 2.42 in 2009 to 2.00 in 2016. Despite this decline, there were many areas that would have provided exception human harvest potential (Figure 14).

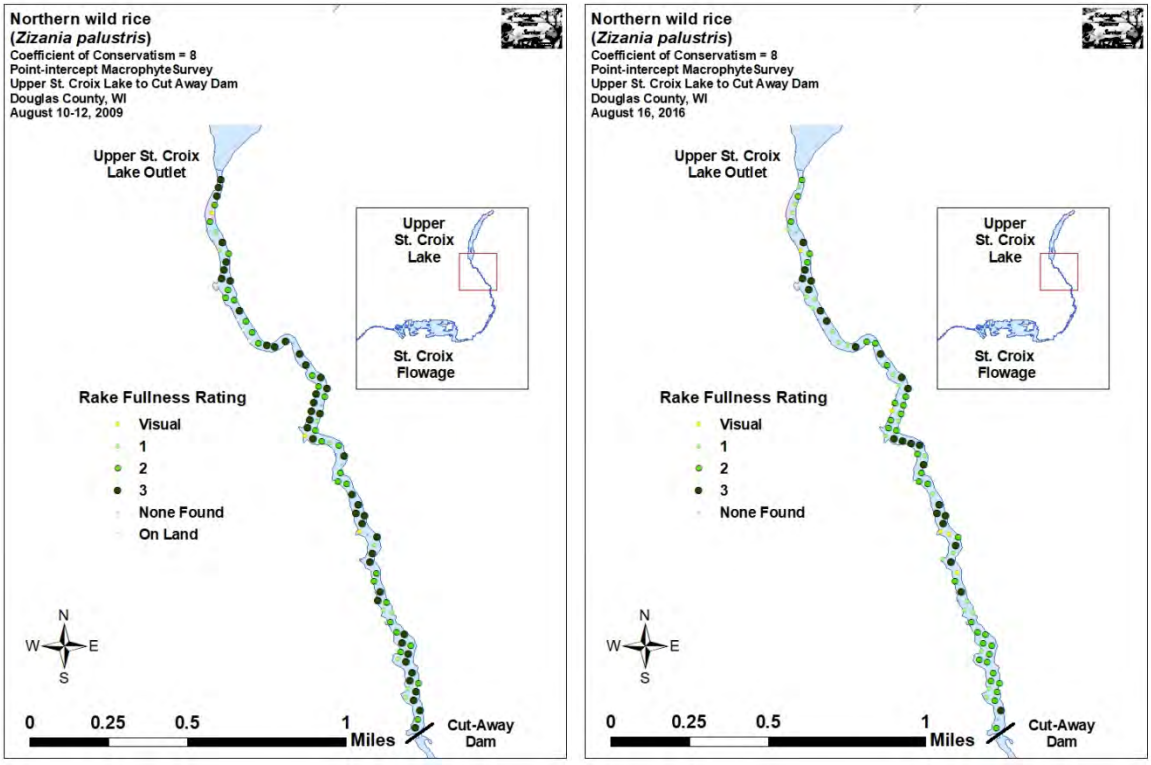


Figure 13: 2009 and 2016 Northern Wild Rice Density and Distribution

Figure 14: Dense Northern Wild Rice North of Cut-Away Dam - 8/16/16

White water lily, the second most common species in both 2009 and 2016, was also little changed (Figure 15). Present at 53 points with a mean rake fullness of 1.63 in 2009, it declined slightly to 49 points with a mean rake of 1.53.

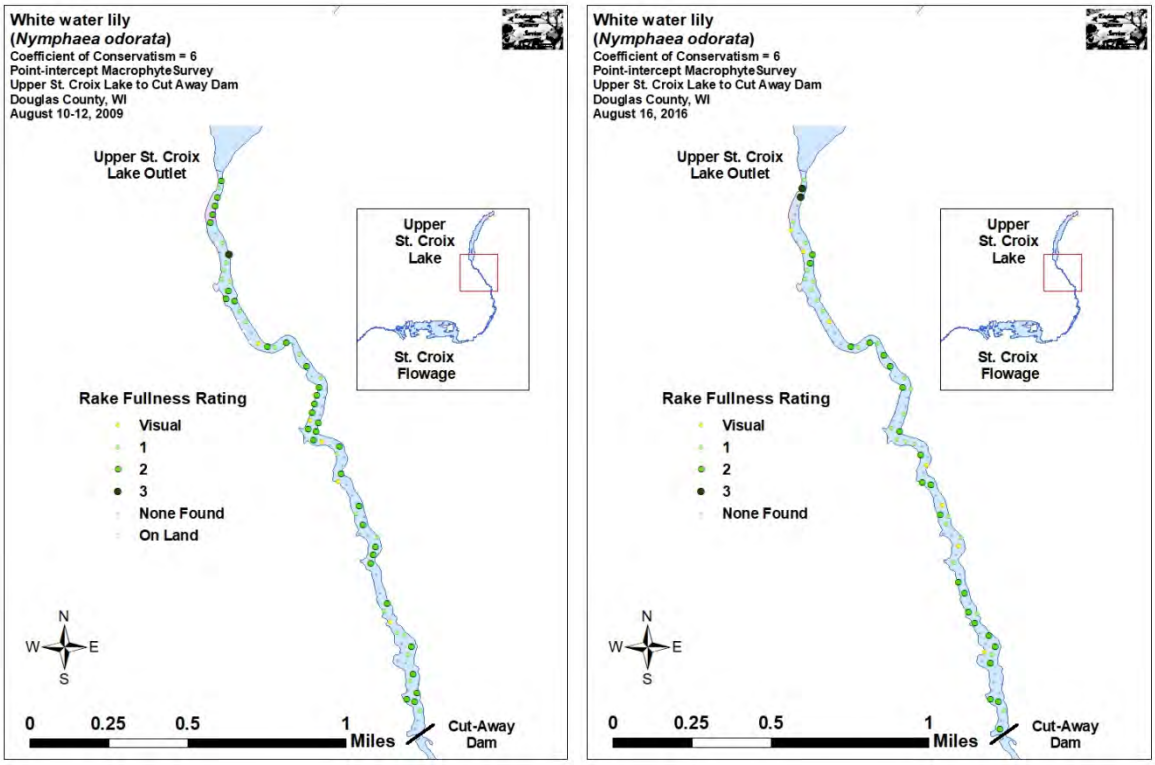


Figure 15: 2009 and 2016 White Water Lily Density and Distribution

Comparison of Floristic Quality Indexes in 2009 and 2016:

In 2009, we identified a total of 32 **native index species** in the rake during the point-intercept survey (Table 4). They produced a mean Coefficient of Conservatism of 5.8 and a Floristic Quality Index of 33.1.

Table 4: Floristic Quality Index of Aquatic Macrophytes St. Croix River from the Upper St. Croix Lake Outlet to Cut-Away Dam, Douglas County August 10-12, 2009

Species	Common Name	C
Bidens beckii	Water marigold	8
Carex comosa	Bottle brush sedge	5
Ceratophyllum demersum	Coontail	3
Chara sp.	Muskgrass	7
Eleocharis palustris	Creeping spikerush	6
Elodea canadensis	Common waterweed	3
Heteranthera dubia	Water star-grass	6
Lemna minor	Small duckweed	4
Lemna trisulca	Forked duckweed	6
Myriophyllum sibiricum	Northern water-milfoil	6
Najas flexilis	Slender naiad	6
Nuphar variegata	Spatterdock	6
Nymphaea odorata	White water lily	6
Potamogeton amplifolius	Large-leaf pondweed	7
Potamogeton epihydrus	Ribbon-leaf pondweed	8
Potamogeton natans	Floating-leaf pondweed	5
Potamogeton richardsonii	Clasping-leaf pondweed	5
Potamogeton robbinsii	Fern pondweed	8
Potamogeton zosteriformis	Flat-stem pondweed	6
Ranunculus aquatilis	White water crowfoot	8
Sagittaria latifolia	Common arrowhead	3
Sagittaria rigida	Sessile-fruited arrowhead	8
Schoenoplectus tabernaemontani	Softstem bulrush	4
Sparganium emersum	Short-stemmed bur-reed	8
Sparganium eurycarpum	Common bur-reed	5
Spirodela polyrhiza	Large duckweed	5
Stuckenia pectinata	Sago pondweed	3
Typha latifolia	Broad-leaved cattail	1
Utricularia minor	Small bladderwort	10
Utricularia vulgaris	Common bladderwort	7
Vallisneria americana	Wild celery	6
Zizania palustris	Northern wild rice	8
N		**33**
Mean C		**5.8**
FQI		**33.1**

In 2016, we identified a total of 42 **native index plants** in the rake during the point-intercept survey. They produced a mean Coefficient of Conservatism of 6.2 and a Floristic Quality Index of 40.3 (Table 5). Nichols (1999) reported an average mean C for the Northern Lakes and Forest Region of 6.7 putting this part of the St. Croix River slightly below average for this part of the state. The FQI was, however, much above the mean FQI of 24.3 for the Northern Lakes and Forest Region (Nichols 1999).

Table 5: Floristic Quality Index of Aquatic Macrophytes St. Croix River from the Upper St. Croix Lake Outlet to Cut-Away Dam, Douglas County August 16, 2016

Species	Common Name	C
Bidens beckii	Water marigold	8
Carex comosa	Bottle brush sedge	5
Ceratophyllum demersum	Coontail	3
Chara sp.	Muskgrass	7
Eleocharis palustris	Creeping spikerush	6
Elodea canadensis	Common waterweed	3
Equisetum fluviatile	Water horsetail	7
Heteranthera dubia	Water star-grass	6
Lemna minor	Small duckweed	4
Lemna trisulca	Forked duckweed	6
Myriophyllum sibiricum	Northern water-milfoil	6
Myriophyllum verticillatum	Whorled water-milfoil	8
Najas flexilis	Slender naiad	6
Nuphar variegata	Spatterdock	6
Nymphaea odorata	White water lily	6
Potamogeton alpinus	Alpine pondweed	9
Potamogeton amplifolius	Large-leaf pondweed	7
Potamogeton epihydrus	Ribbon-leaf pondweed	8
Potamogeton gramineus	Variable pondweed	7
Potamogeton natans	Floating-leaf pondweed	5
Potamogeton obtusifolius	Blunt-leaf pondweed	9
Potamogeton pusillus	Small pondweed	7
Potamogeton richardsonii	Clasping-leaf pondweed	5
Potamogeton robbinsii	Fern pondweed	8
Potamogeton zosteriformis	Flat-stem pondweed	6
Ranunculus aquatilis	White water crowfoot	8
Riccia fluitans	Slender riccia	7
Sagittaria latifolia	Common arrowhead	3
Sagittaria rigida	Sessile-fruited arrowhead	8
Schoenoplectus tabernaemontani	Softstem bulrush	4
Sparganium emersum	Short-stemmed bur-reed	8
Sparganium eurycarpum	Common bur-reed	5
Sparganium fluctuans	Floating-leaf bur-reed	10
Spirodela polyrhiza	Large duckweed	5
Stuckenia pectinata	Sago pondweed	3
Typha latifolia	Broad-leaved cattail	1

Table 5 (cont'): Floristic Quality Index of Aquatic Macrophytes St. Croix River from the Upper St. Croix Lake Outlet to Cut-Away Dam, Douglas County August 16, 2016

Species	Common Name	C
Typha X *glauca*	Hybrid cattail	1
Utricularia intermedia	Flat-leaf bladderwort	9
Utricularia minor	Small bladderwort	10
Utricularia vulgaris	Common bladderwort	7
Vallisneria americana	Wild celery	6
Zizania palustris	Northern wild rice	8
N		**42**
Mean C		**6.2**
FQI		**40.3**

Comparison of Exotic Plant Species in 2009 and 2016:

In 2009, Yellow iris was reported as a visual at just two points (Figure 16). After significant efforts to remove plants in June 2016, we found it in the rake at two points during the August survey with an additional visual sighting (Figure 17). Despite this seemingly positive news, large numbers of plants still survive throughout the area.

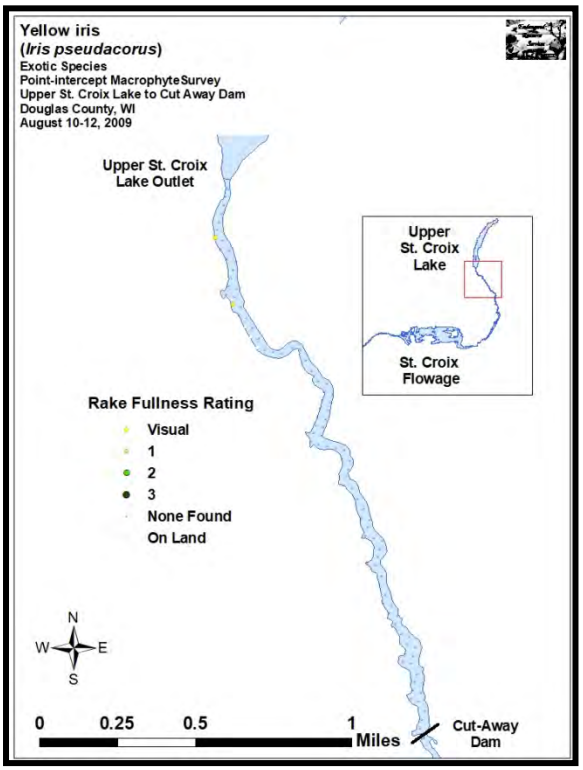


Figure 16: Yellow Iris Density and Distribution - 8/10-12/09

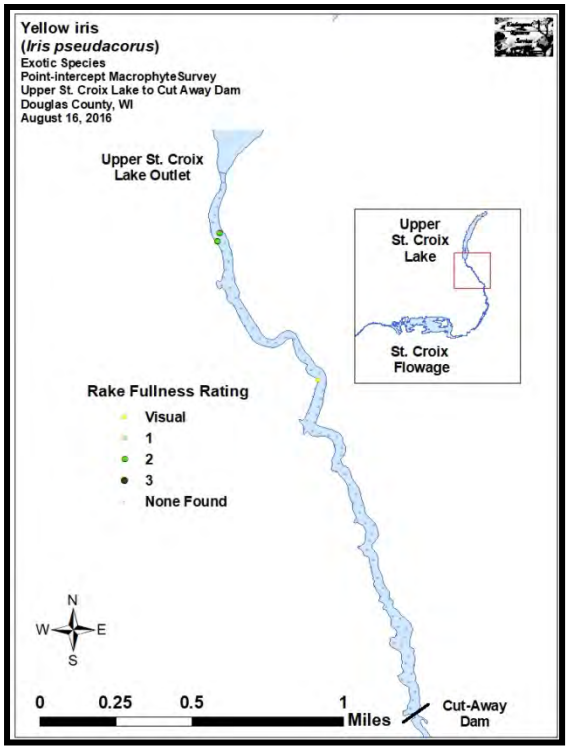


Figure 17: Yellow Iris Density and Distribution - 8/16/16

The 2009 survey found Purple loosestrife at four points with two additional visual sightings (Figure 18). In 2016, we found loosestrife at nine points with two additional sightings (Figure 19). Most plants showed little to no evidence of beetle herbivory.

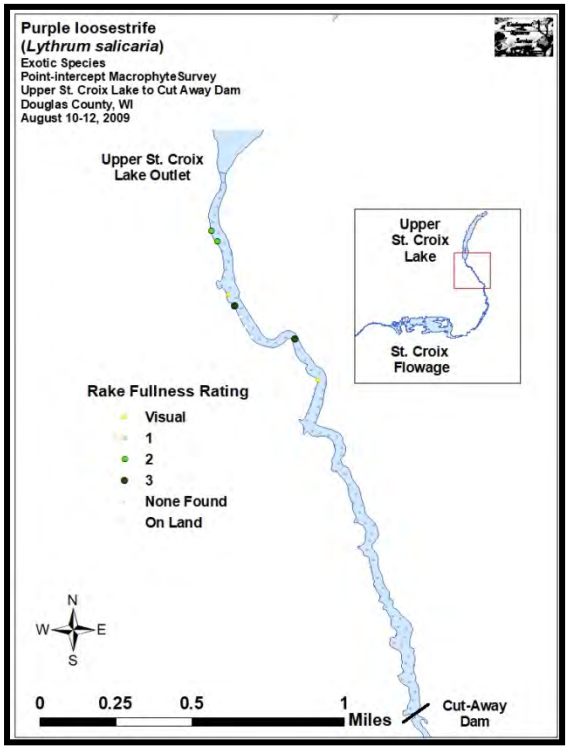


Figure 18: Purple Loosestrife Density and Distribution - 8/10-12/09

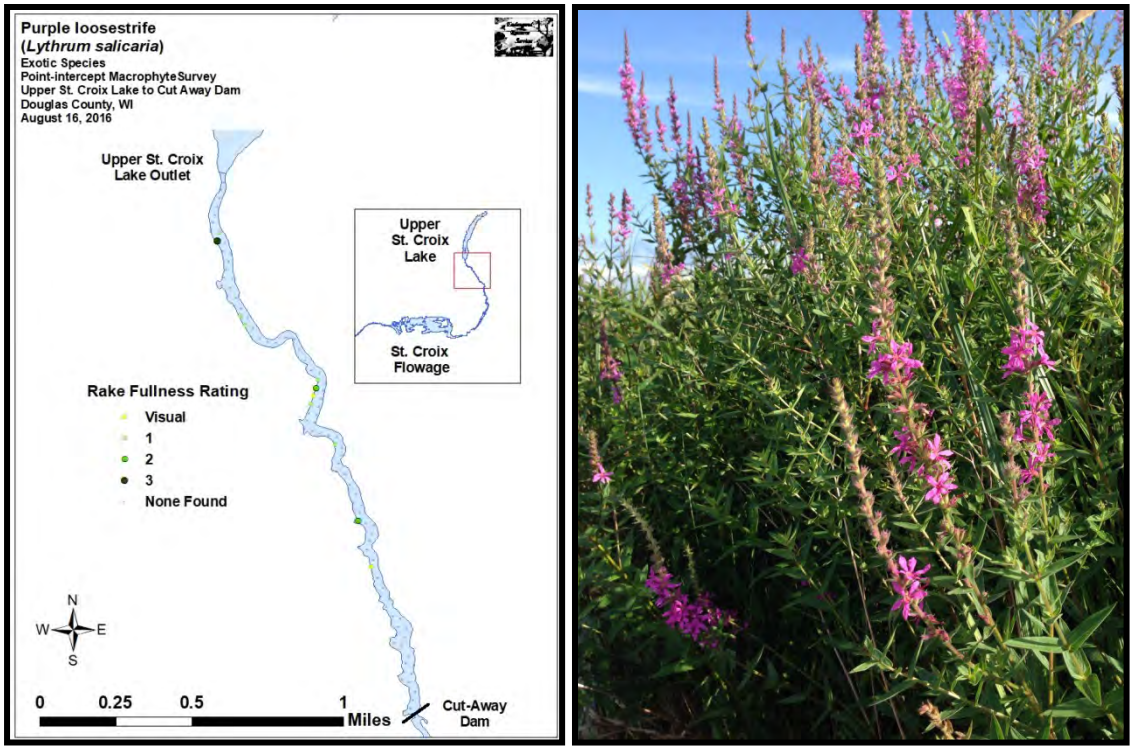


Figure 19: Purple Loosestrife Density and Distribution - 8/16/16

DISCUSSION AND CONSIDERATIONS FOR MANAGEMENT:

Yellow Iris:

The presence and apparent rapid spread of Yellow iris in the Upper St. Croix Watershed is troubling. Because no biological control agents currently exist for Yellow iris, manual removal is likely the only current management strategy. Volunteers will continue to be needed along uninhabited areas of the upper river, but in the "lake" region, we STRONGLY encourage residents to eliminate plants on their property before a minor problem becomes a significant one. June is the best time to look for this iris as the bright yellow fleur-de-lis are most common at this time. At other times of the year when it is not in bloom, its leaves could be confused with Northern blue flag (*Iris versicolor*) – a native and non-invasive species.

Purple Loosestrife:

For whatever reason, the Galerucella beetle population appears to have crashed. Because there are so many plants established, manual removal is likely going to be difficult to impossible on the biggest beds. Because of this, it is likely necessary to continue to raise and release beetles and hope their population can recover to the point it can bring the loosestrife back into check. Along residences where plants might be few in number, property owners are encouraged to remove any loosestrife plants they find, bag them to prevent seed dispersal, and dispose of them well away from the lake or any other wetland. August and September are the best times to do this as the bright fuchsia candle-shaped flower spikes are easily seen. Because the plants have an extensive root system, care should be taken to remove the entire plant as even small root fragments can survive and produce new plants the following year.

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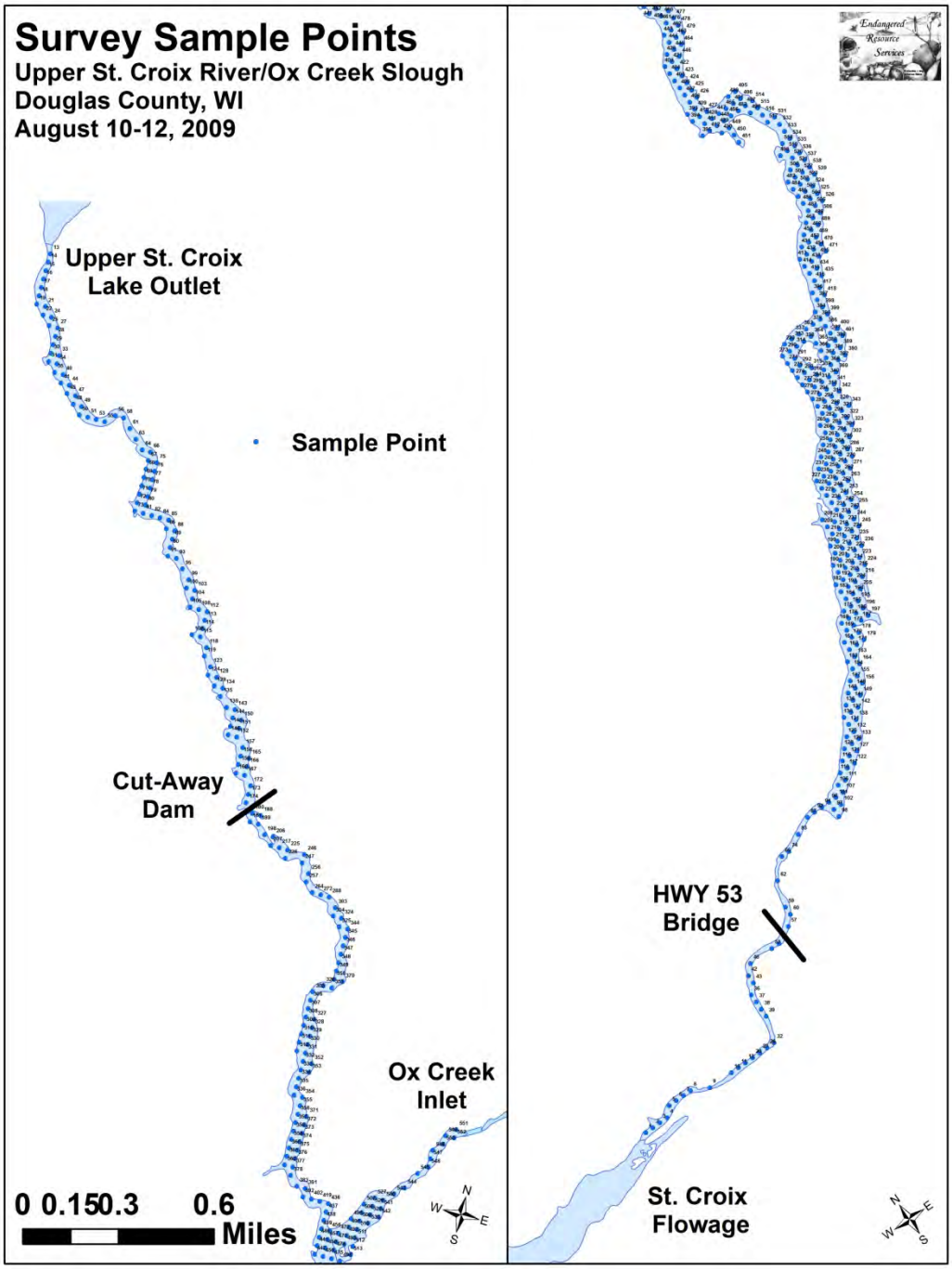
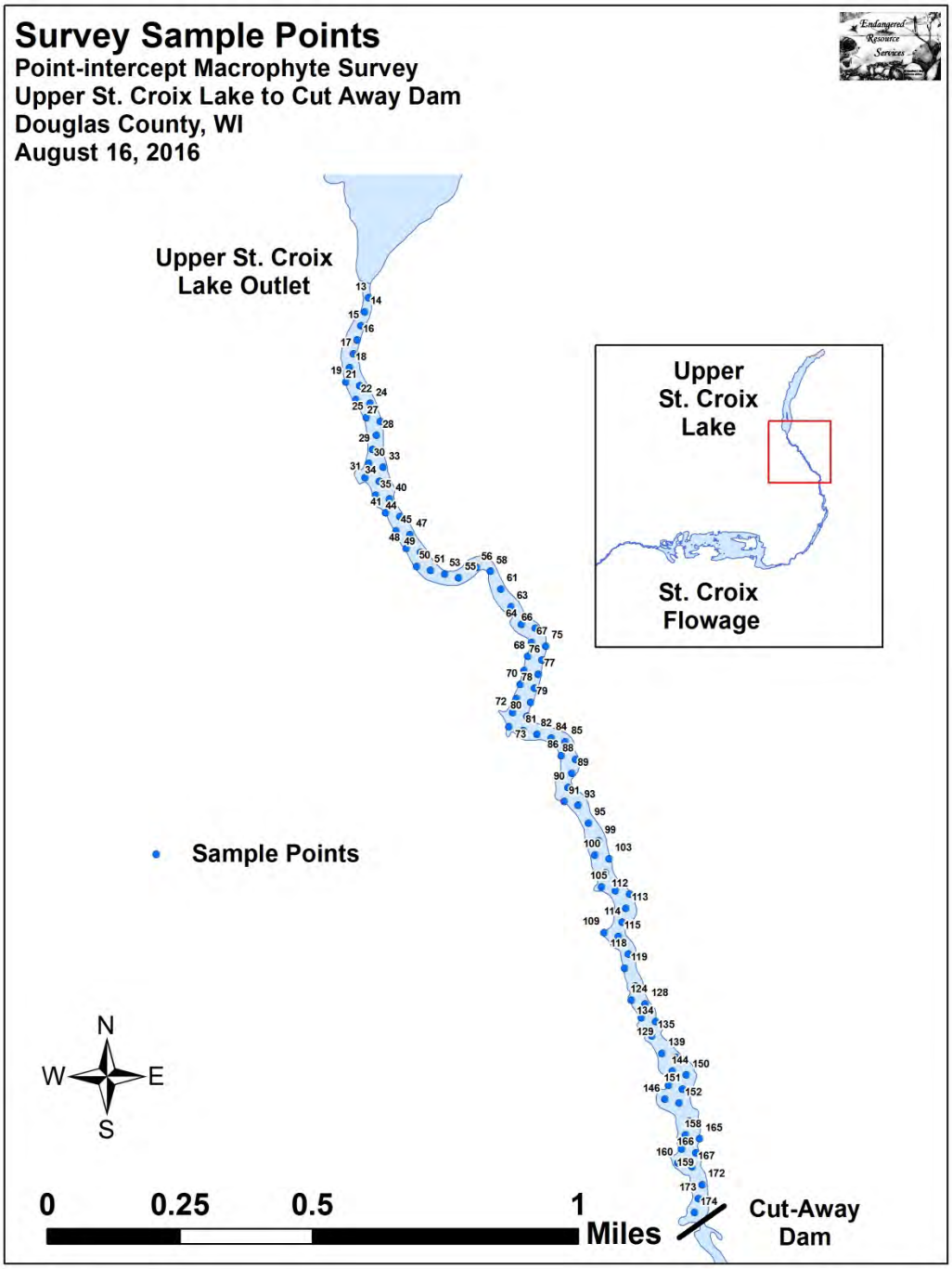
Appendix I: Survey Sample Points Maps


Survey Sample Points
Upper St. Croix River/Ox Creek Slough
Douglas County, WI
August 10-12, 2009
Upper St. Croix
Lake Outlet
Sample Point
Cut-Away
Dam
Ox Creek
Inlet
0 0.150.3 0.6
Miles
N
W
E
S
HWY 53
Bridge
St. Croix
Flowage
N
E
W
S


Survey Sample Points
Point-intercept Macrophyte Survey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
Endangered Resource Services
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Sample Points
N
W
E
S
0
0.25
0.5
1
Miles
Cut-Away Dam

Appendix II: Boat and Vegetative Survey Data Sheets

Boat Survey	
Lake Name	
County	
WBIC	
Date of Survey	
(mm/dd/yy)	
workers	
Nearest Point	**Species seen, habitat information**

Observers for this lake: names and hours worked by each:																										
Lake:									WBIC									County						Date:	
Site #	Depth (ft)	Muck (M), Sand (S), Rock (R)	Rake pole (P) or rake rope (R)	Total Rake Fullness	EWM	CLP	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1																									
2																									
3																									
4																									
5																									
6																									
7																									
8																									
9																									
10																									
11																									
12																									
13																									
14																									
15																									
16																									
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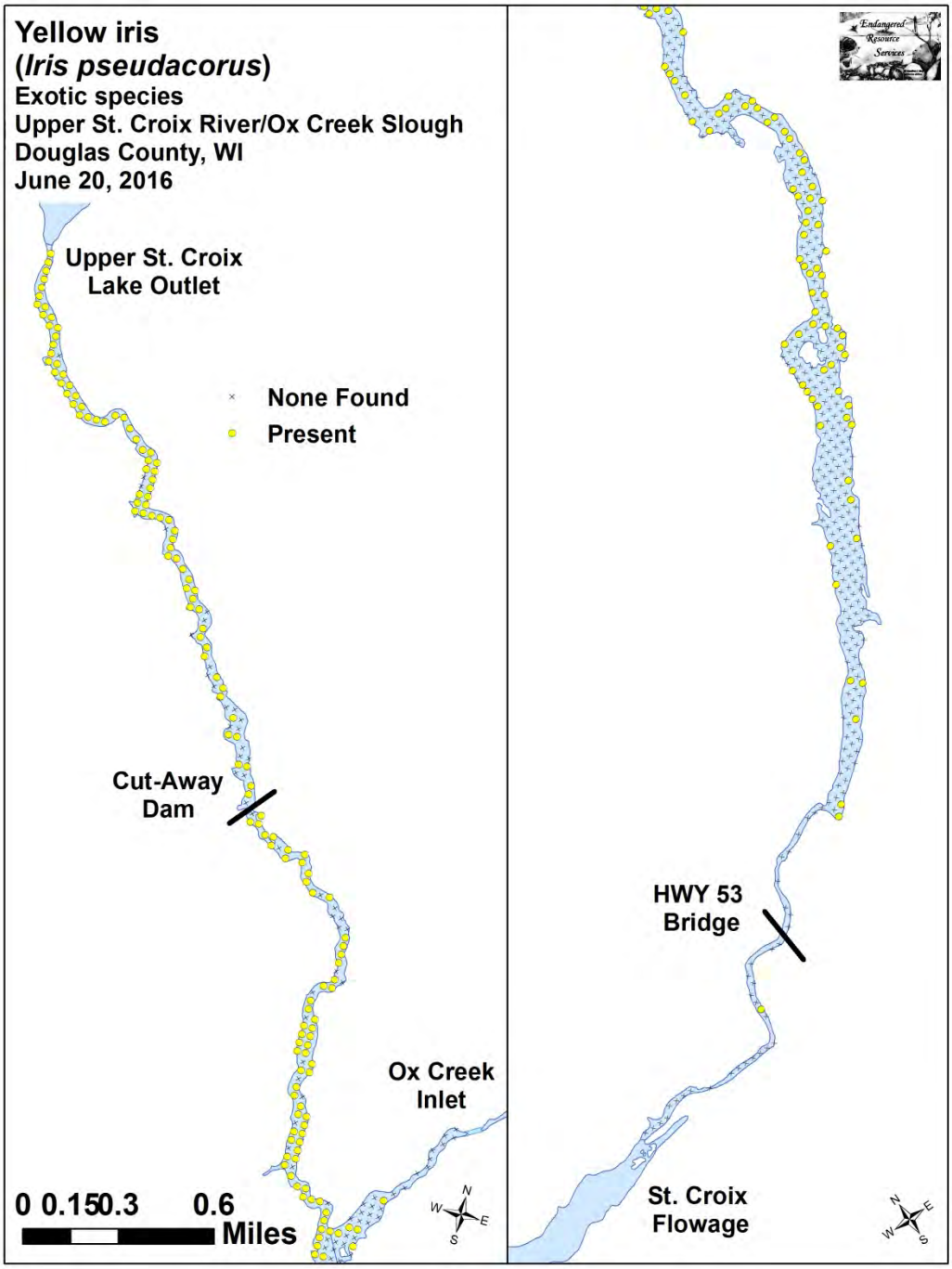
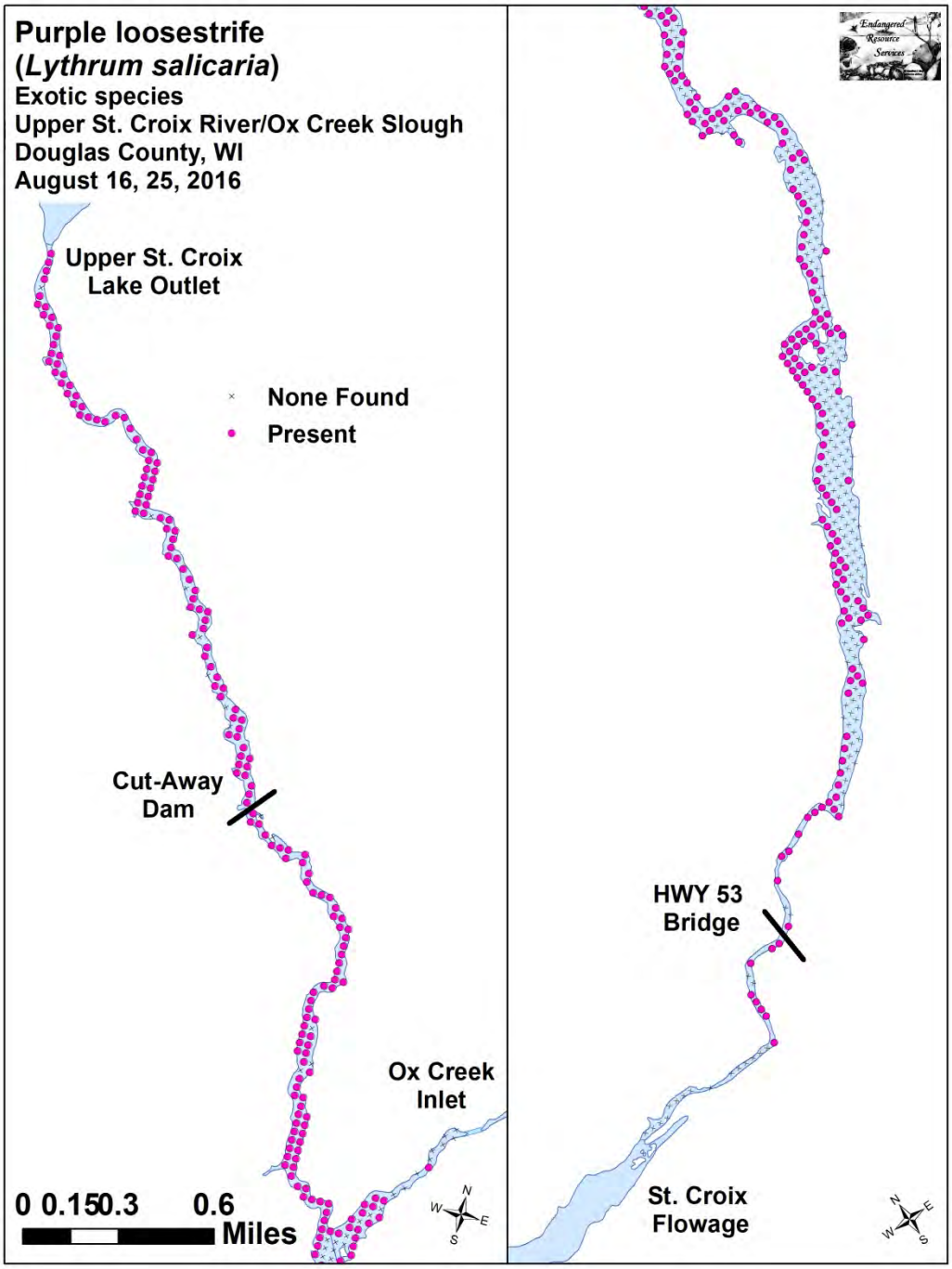
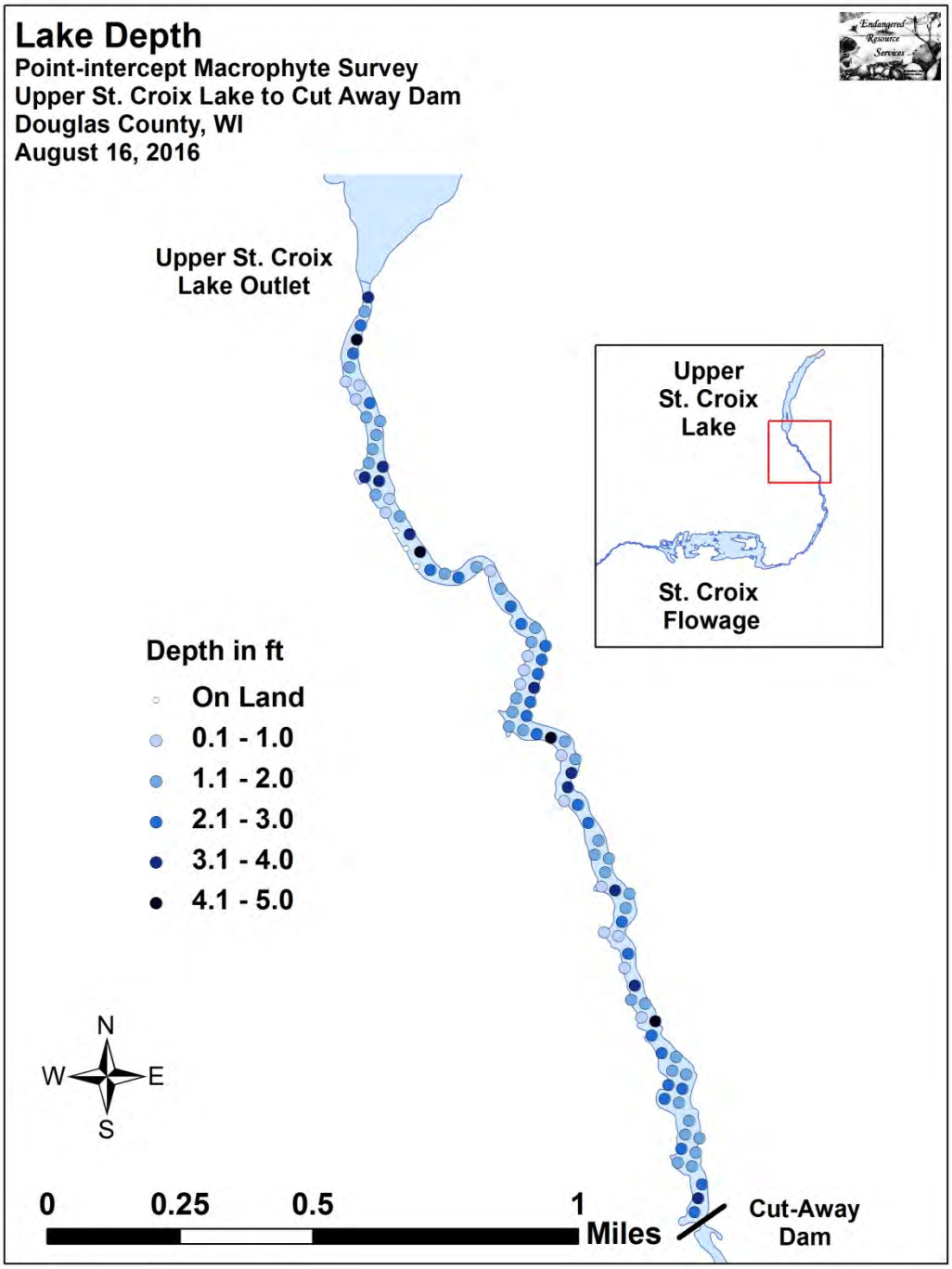
19																									
20																									

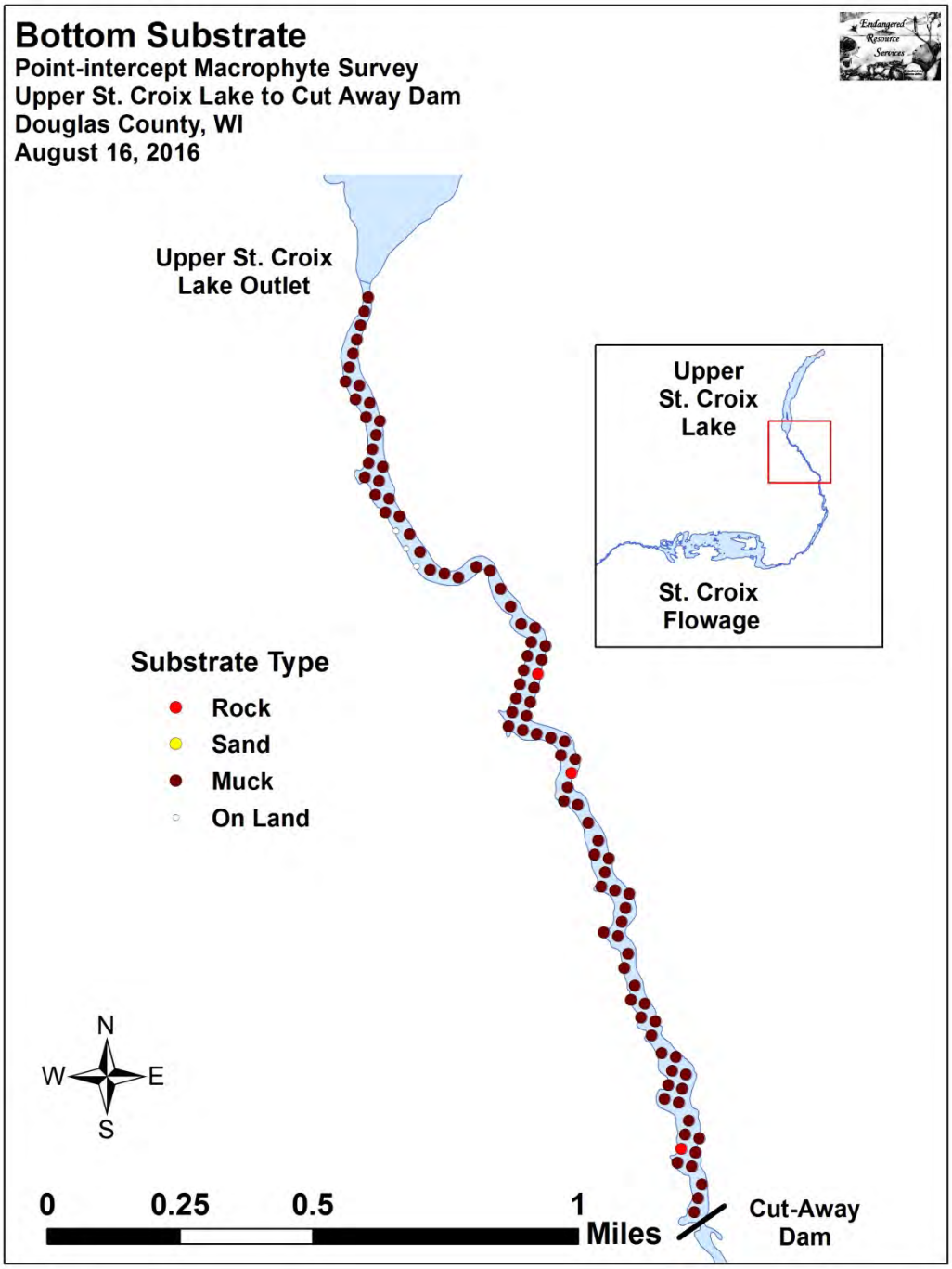
Appendix III: Yellow Iris and Purple Loosestrife Shoreline Survey Maps


Yellow iris
(Iris pseudacorus)
Exotic species
Upper St. Croix River/Ox Creek Slough
Douglas County, WI
June 20, 2016
Upper St. Croix
Lake Outlet
None Found
Present
Cut-Away
Dam
Ox Creek
Inlet
0 0.150.3 0.6
Miles
HWY 53
Bridge
St. Croix
Flowage

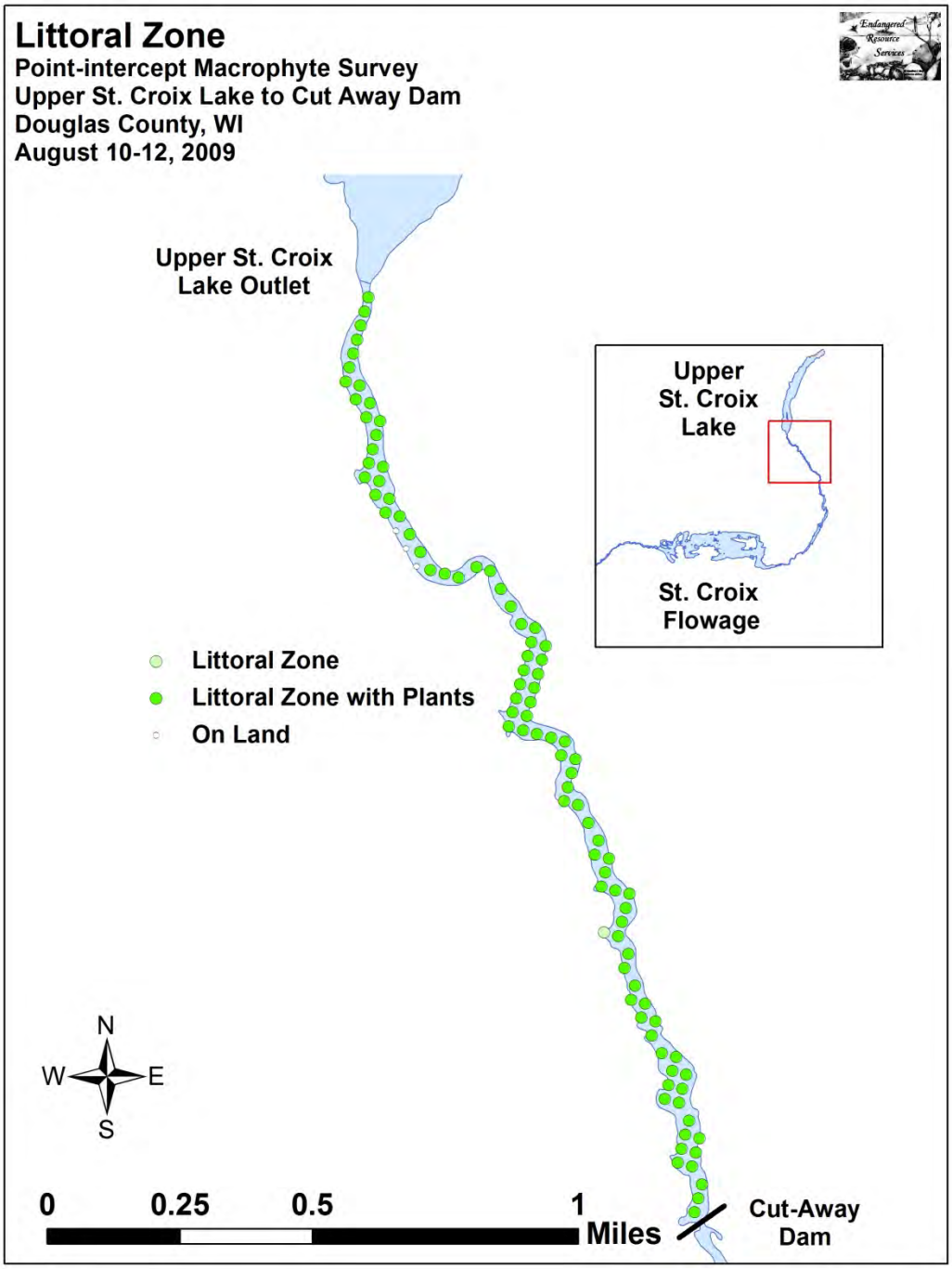

Purple loosestrife
(Lythrum salicaria)
Exotic species
Upper St. Croix River/Ox Creek Slough
Douglas County, WI
August 16, 25, 2016
Upper St. Croix
Lake Outlet
None Found
Present
Cut-Away
Dam
Ox Creek
Inlet
0 0.150.3 0.6
Miles
HWY 53
Bridge
St. Croix
Flowage

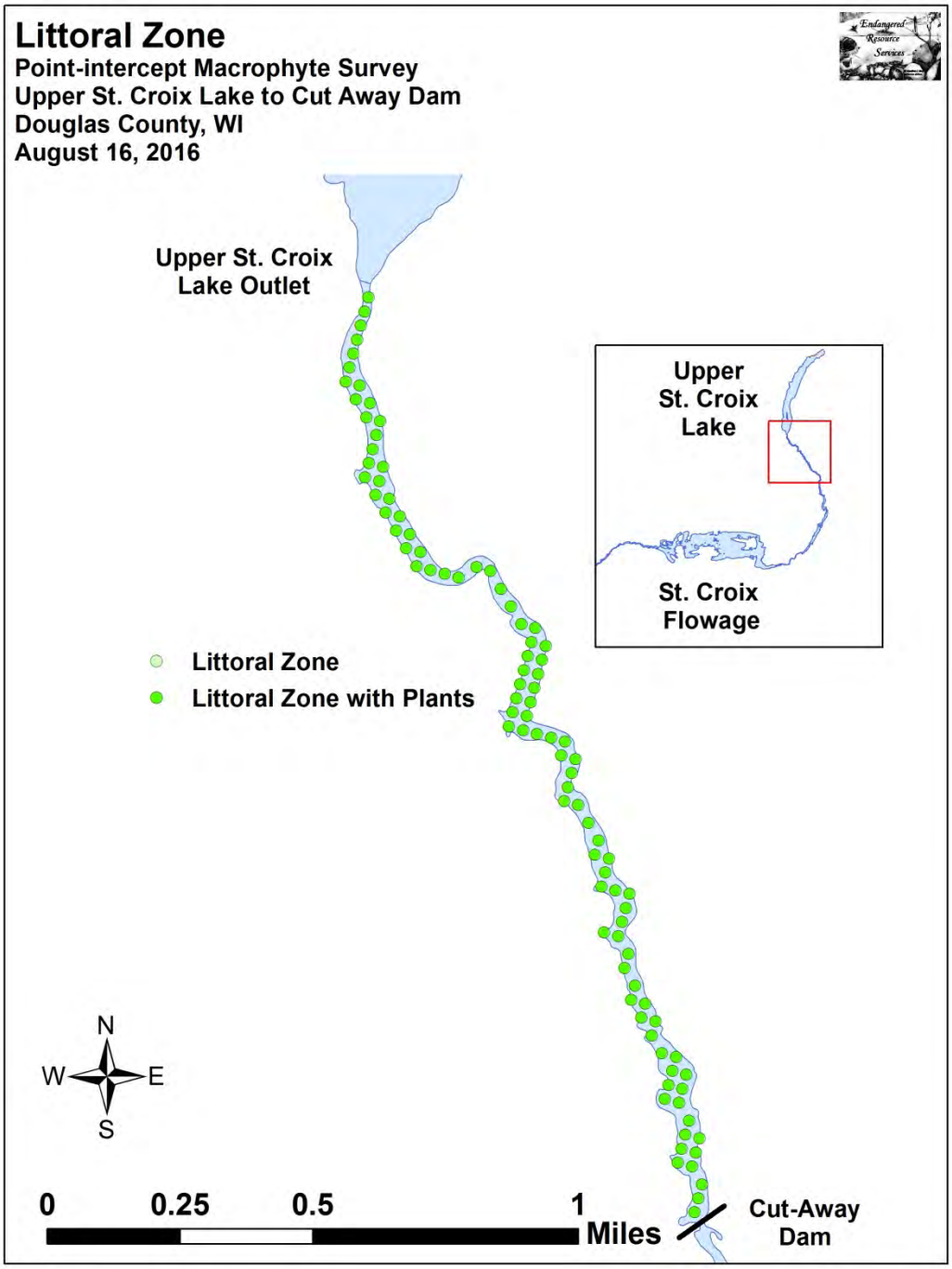
Appendix IV: Habitat Variable Maps

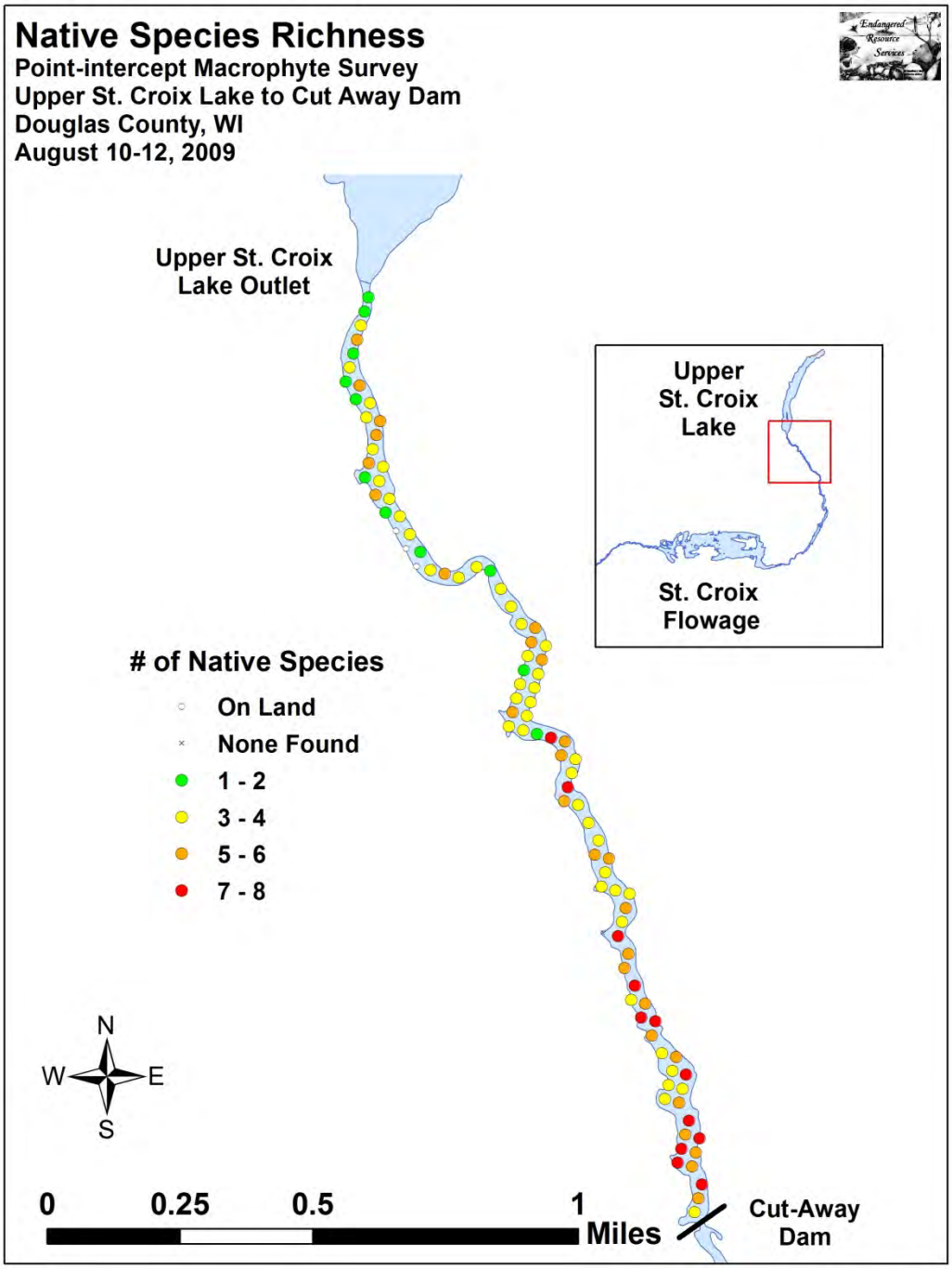

Lake Depth
Point-intercept Macrophyte Survey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
Endangered Resource Services
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Depth in ft
On Land
0.1 - 1.0
1.1 - 2.0
2.1 - 3.0
3.1 - 4.0
4.1 - 5.0
N
W
E
S
0
0.25
0.5
1
Miles
Cut-Away Dam

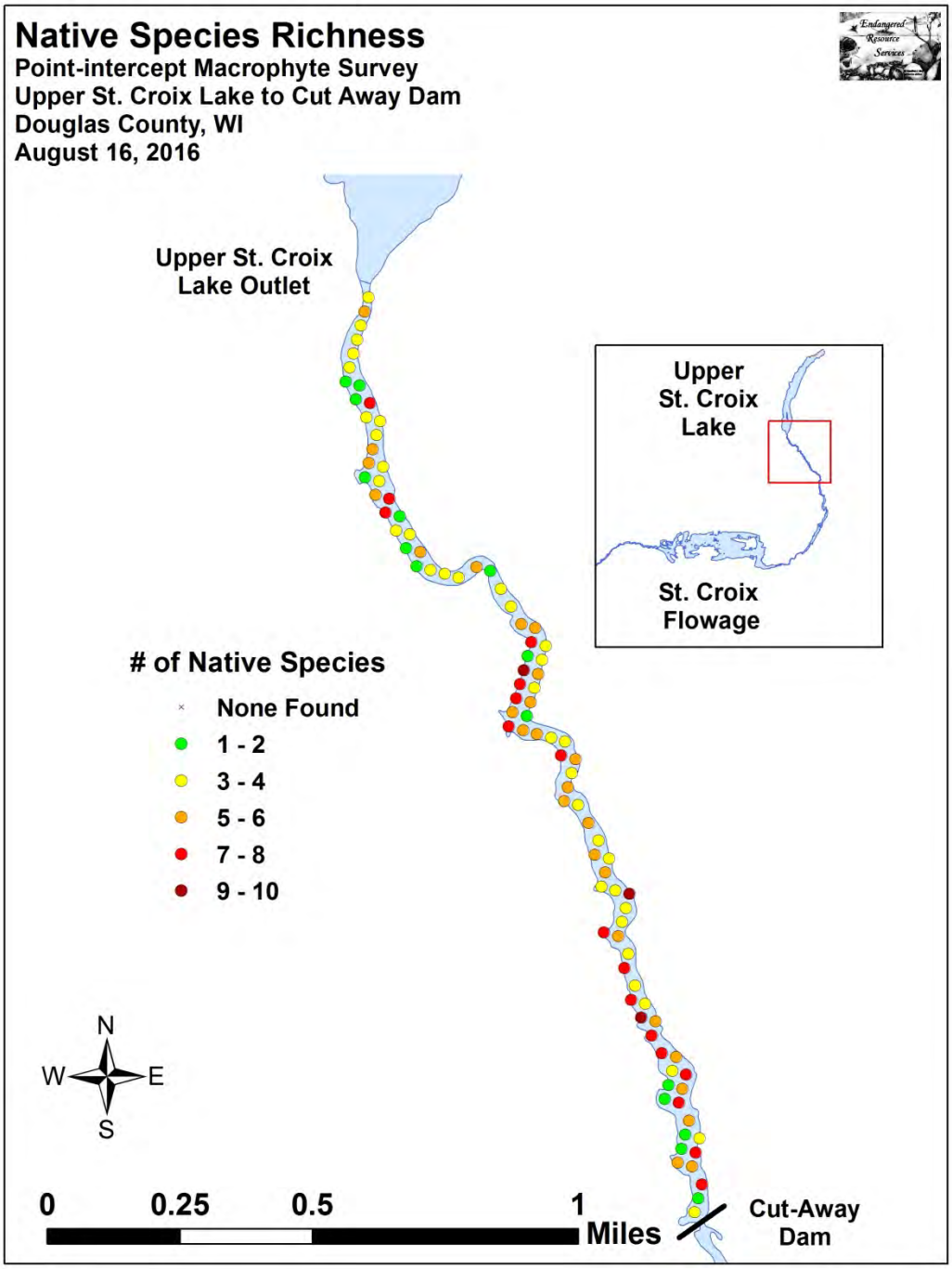

Bottom Substrate
Point-intercept Macrophyte Survey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Substrate Type
Rock
Sand
Muck
On Land
N
W
E
S
0
0.25
0.5
1
Miles
Cut-Away Dam

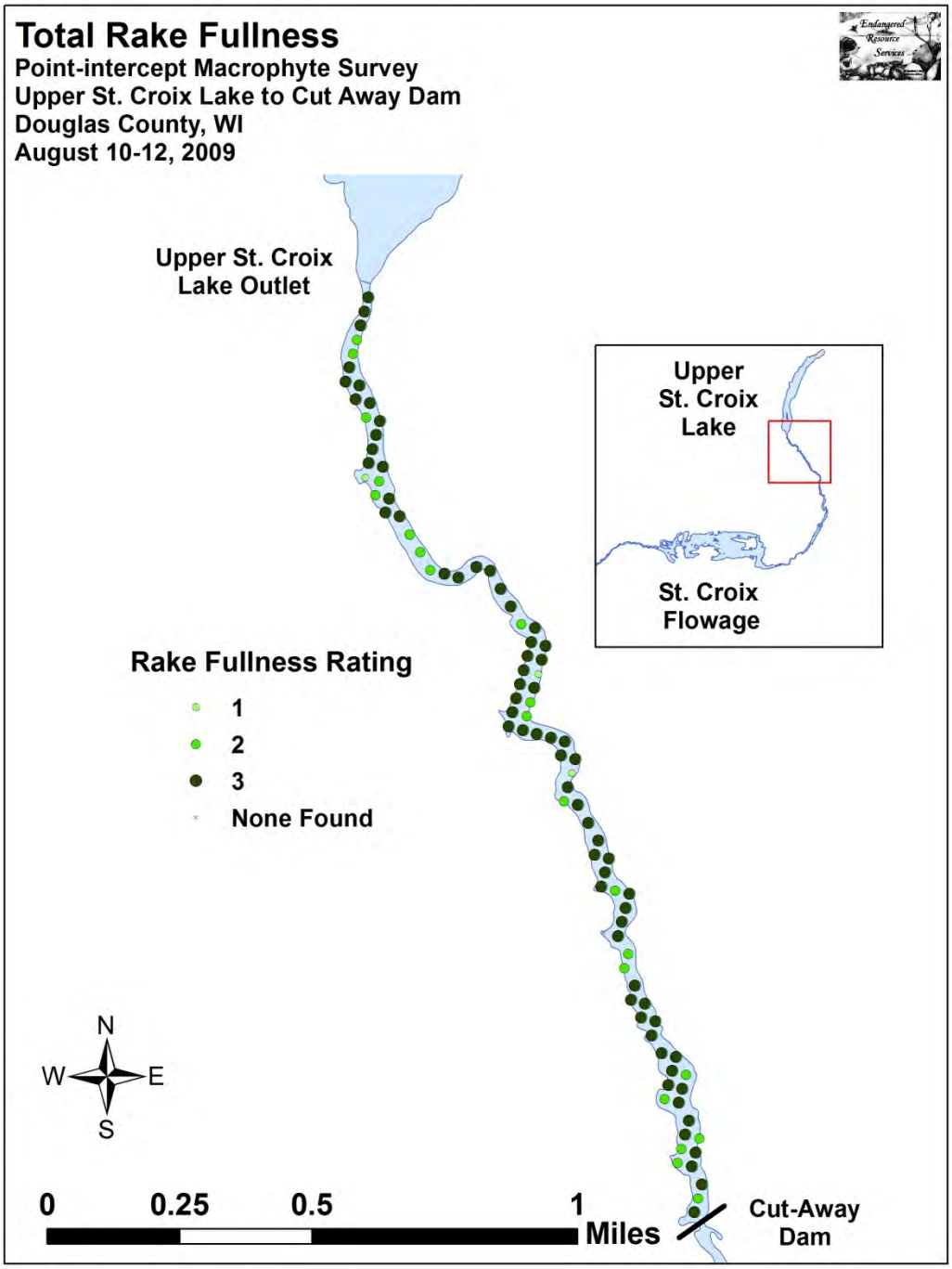
Appendix V: 2009 and 2016 Littoral Zone, Native Species Richness and Total Rake Fullness Maps

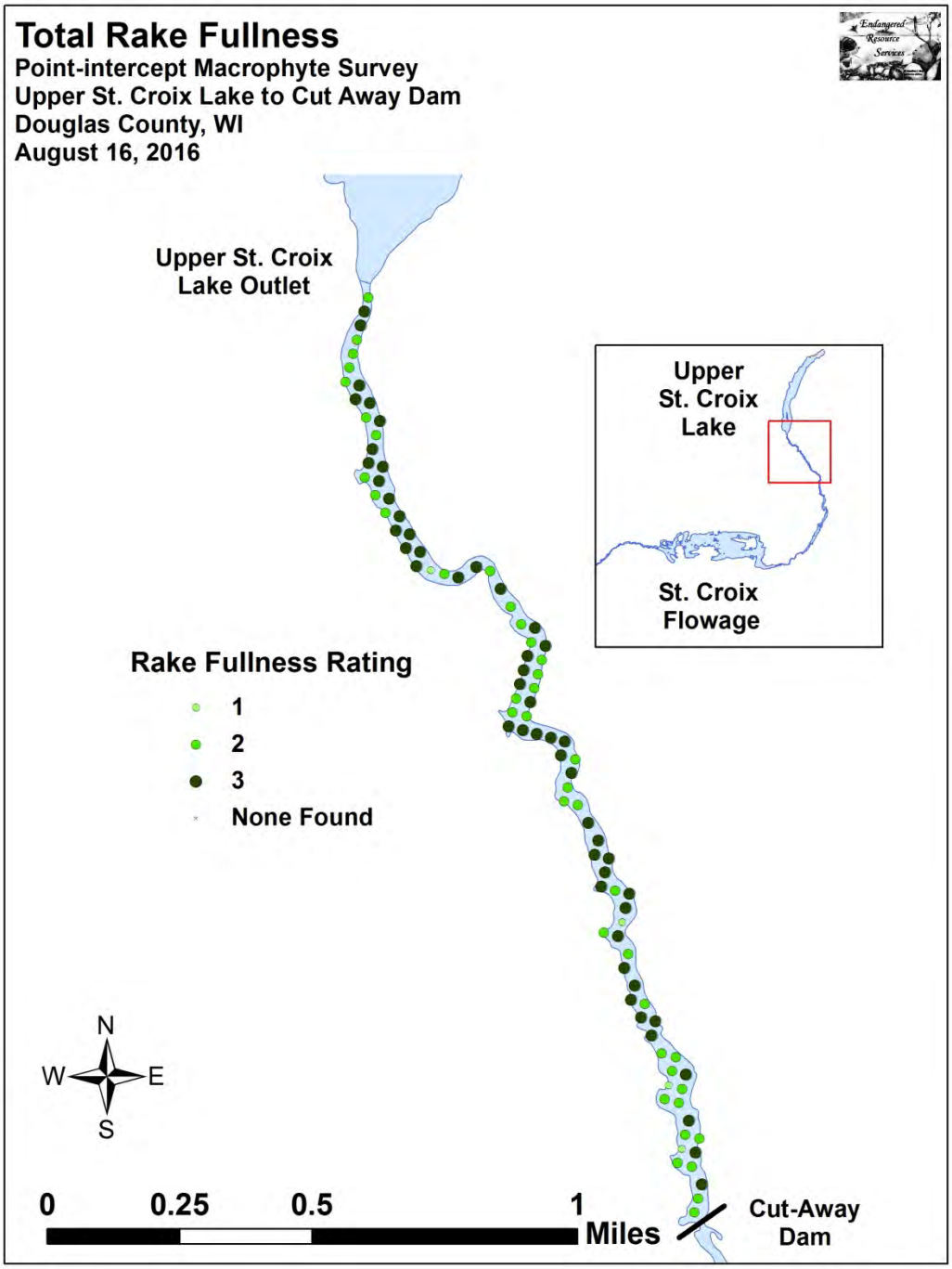

Littoral Zone
Point-intercept Macrophyte Survey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Endangered Resource Services
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Littoral Zone
Littoral Zone with Plants
On Land
N
W
E
S
0
0.25
0.5
1
Miles
Cut-Away Dam


Littoral Zone
Point-intercept Macrophyte Survey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Littoral Zone
Littoral Zone with Plants
N
W
E
S
0
0.25
0.5
1
Miles
Cut-Away Dam

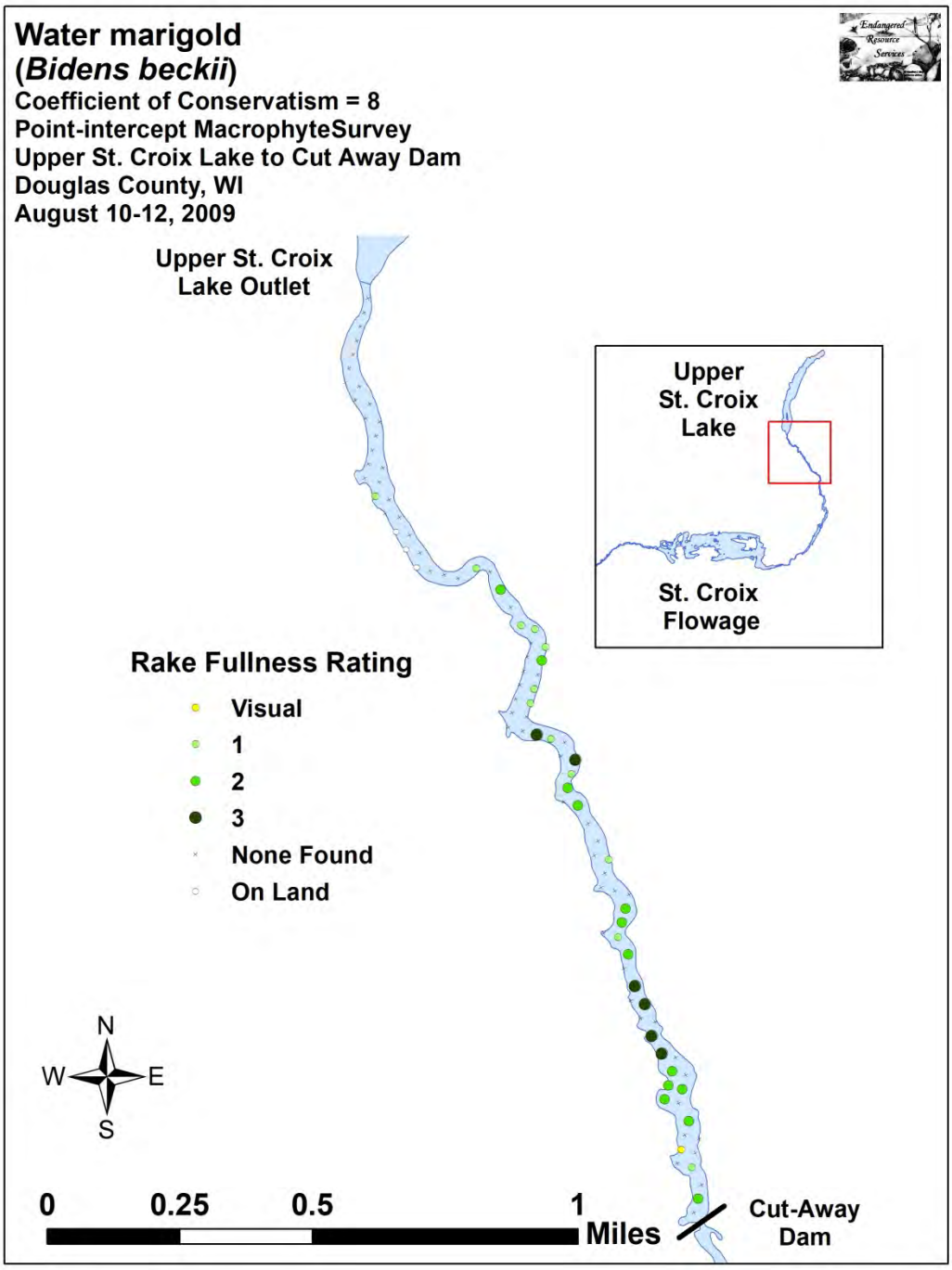

Native Species Richness
Point-intercept Macrophyte Survey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Endangered Resource Services
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
# of Native Species
On Land
None Found
1 - 2
3 - 4
5 - 6
7 - 8
N
W
E
S
0
0.25
0.5
1
Miles
Cut-Away Dam

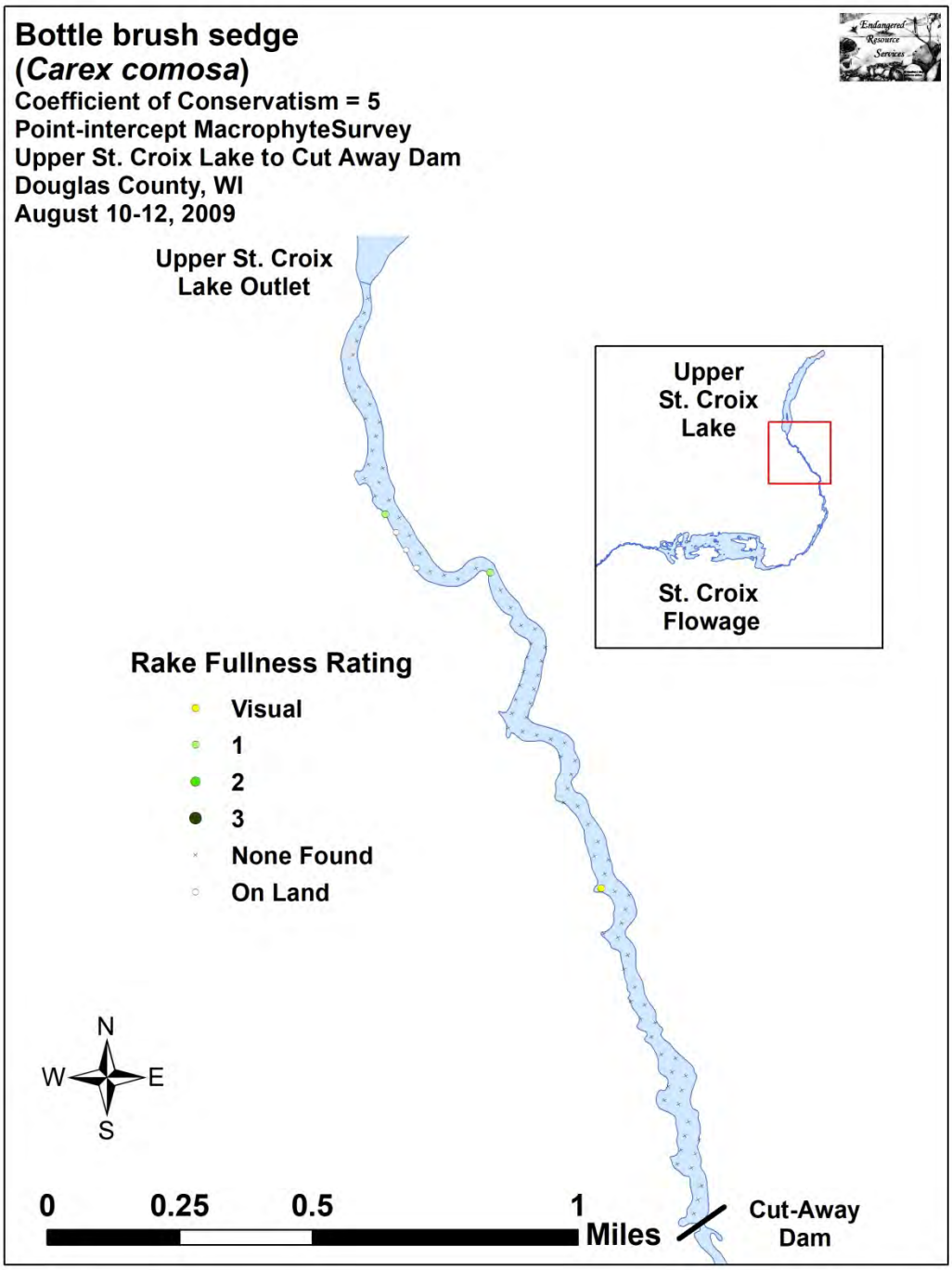

Native Species Richness
Point-intercept Macrophyte Survey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
Endangered Resource Services
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
# of Native Species
None Found
1 - 2
3 - 4
5 - 6
7 - 8
9 - 10
N
W
E
S
0
0.25
0.5
1
Miles
Cut-Away Dam

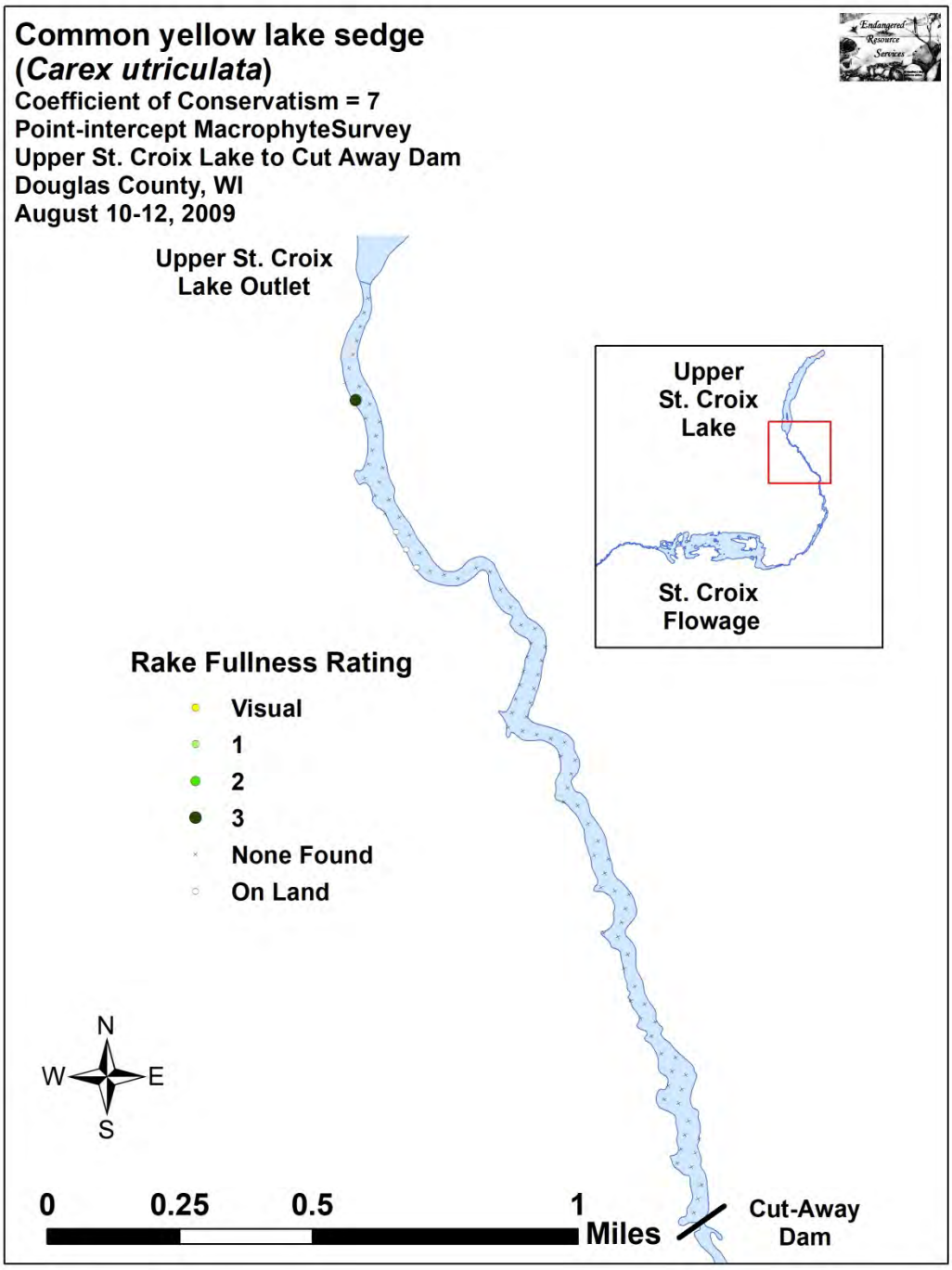

Total Rake Fullness
Point-intercept Macrophyte Survey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Endangered Resource Services
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles
Cut-Away Dam

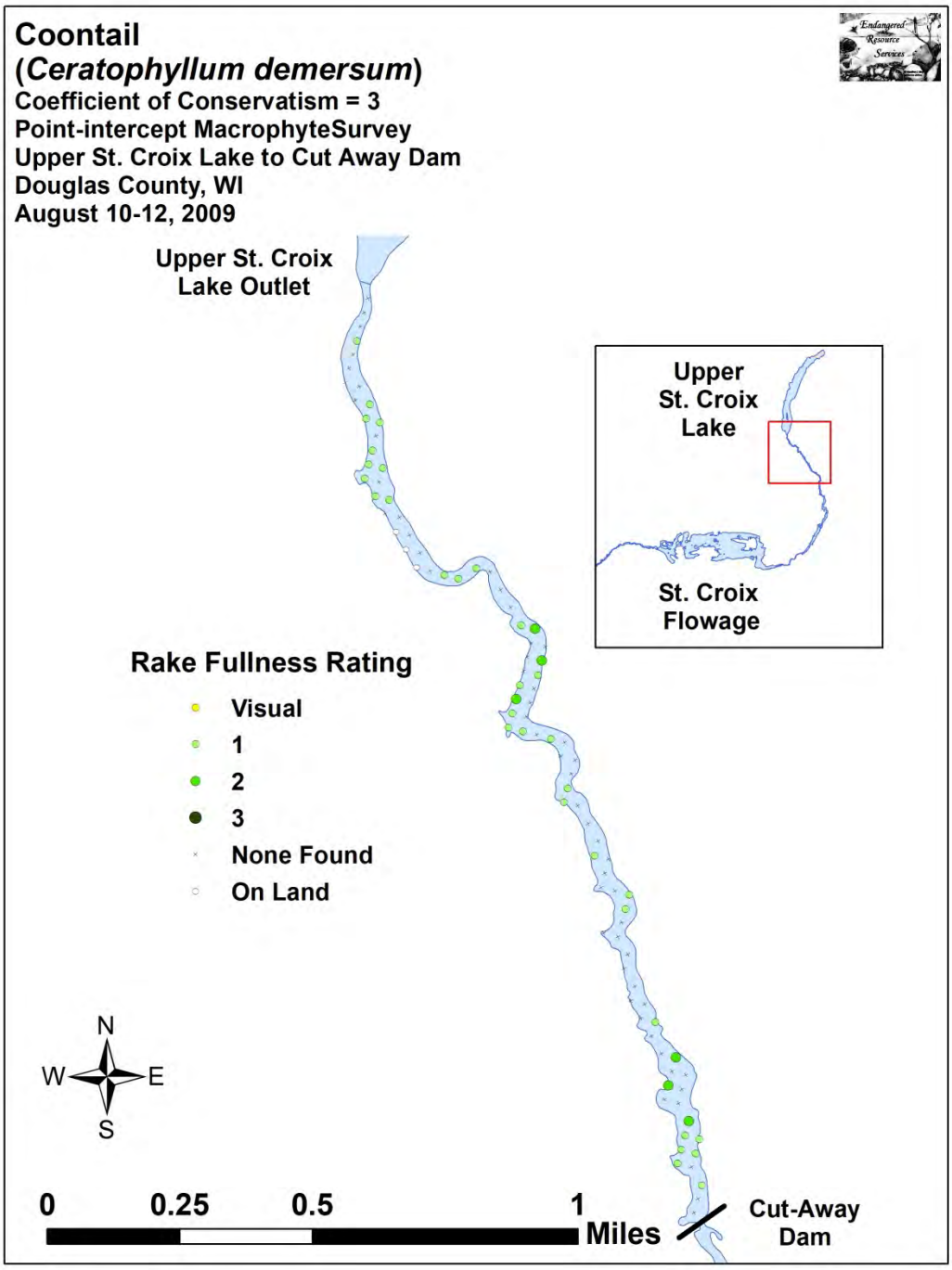

Total Rake Fullness
Point-intercept Macrophyte Survey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
Endangered Resource Services
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
1
2
3
None Found
N
W
E
S
0
0.25
0.5
1
Miles
Cut-Away Dam

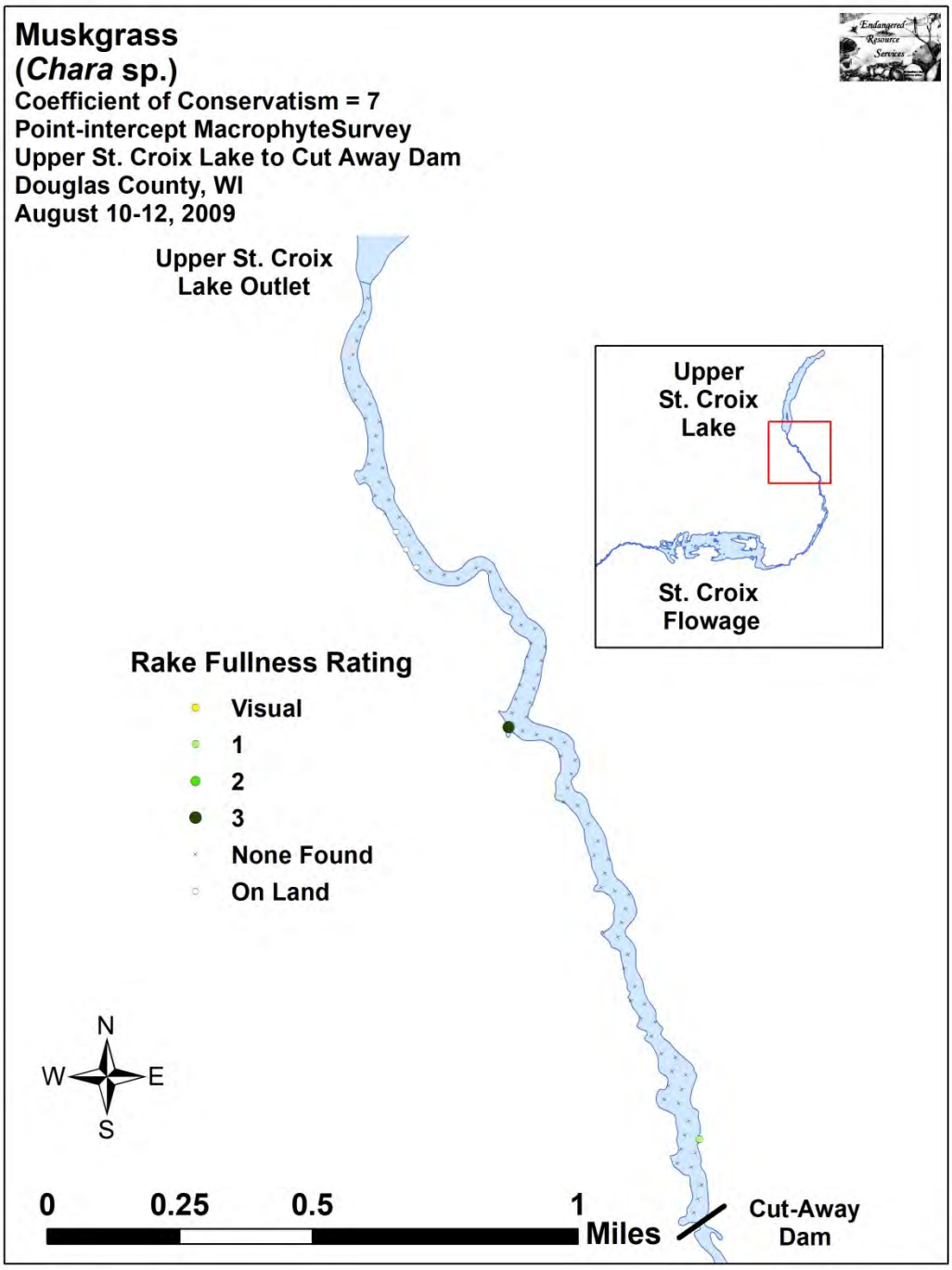
Appendix VI: August 2009 Species Density and Distribution Maps

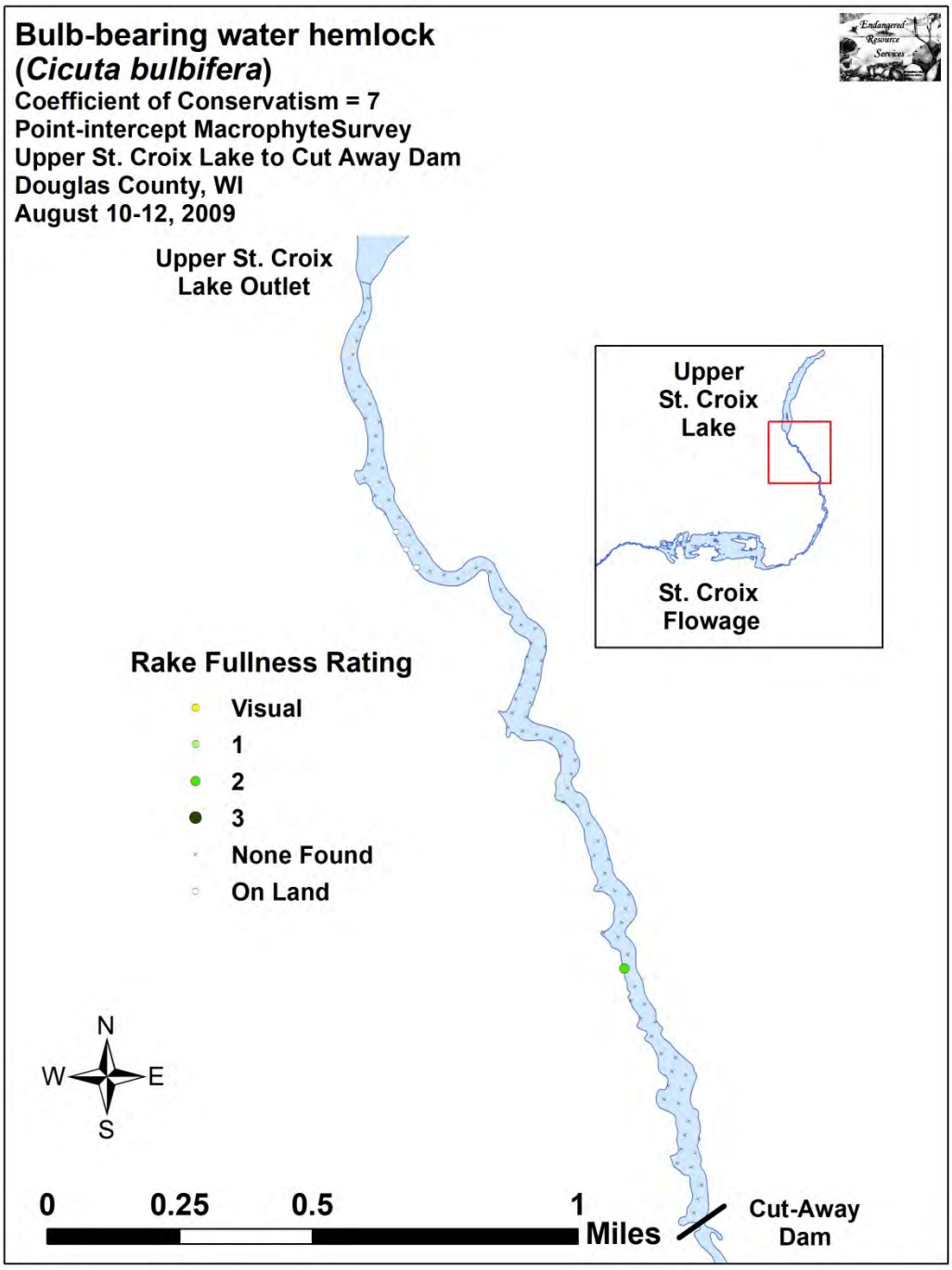

Water marigold
(Bidens beckii)
Coefficient of Conservatism = 8
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
1
2
3
None Found
On Land
N
W
E
S
0
0.25
0.5
1
Miles
Cut-Away Dam

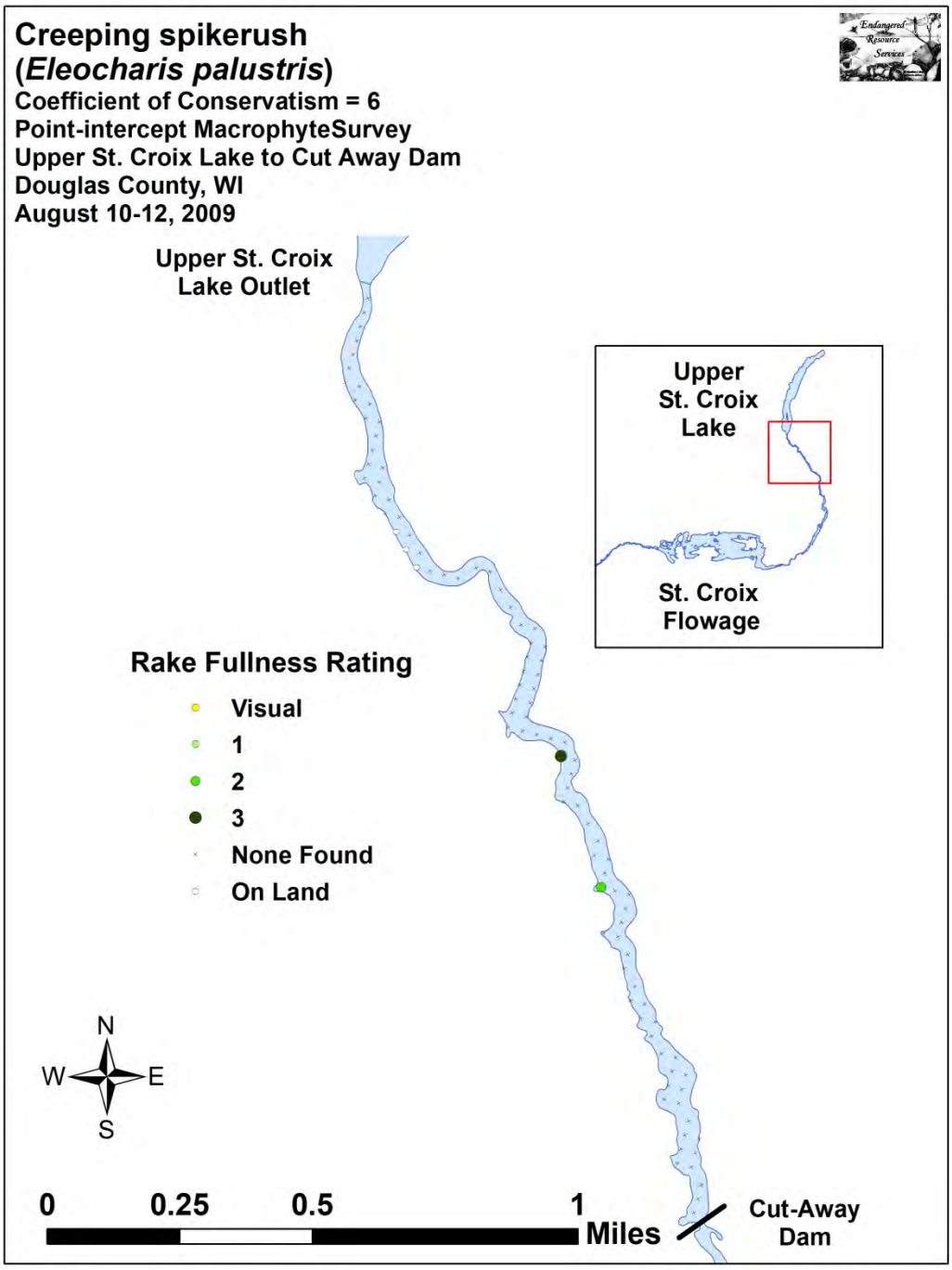

Bottle brush sedge
(Carex comosa)
Coefficient of Conservatism = 5
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
1
2
3
None Found
On Land
N
W
E
S
0
0.25
0.5
1
Miles
Cut-Away Dam

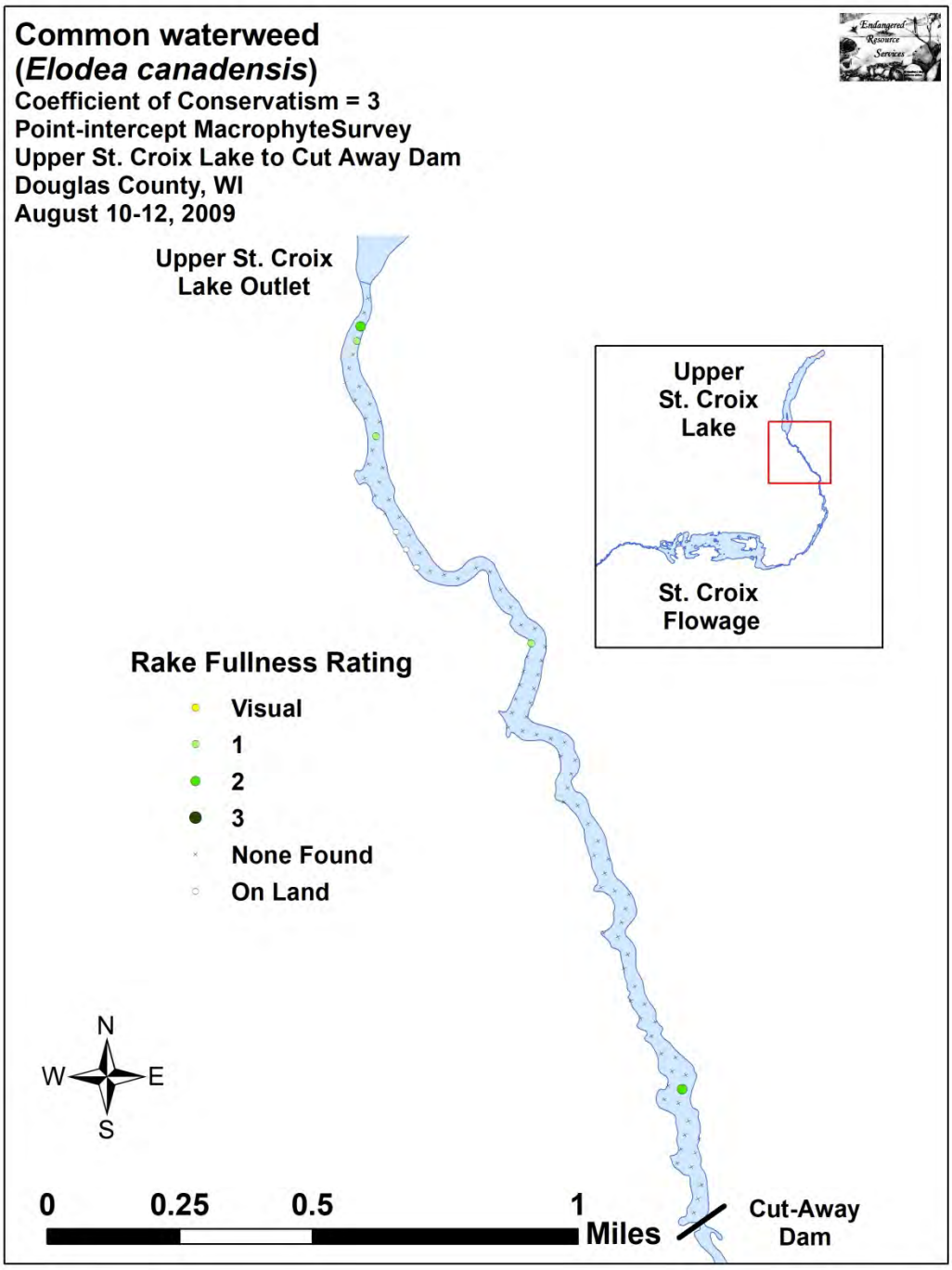

Common yellow lake sedge
(Carex utriculata)
Coefficient of Conservatism = 7
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
1
2
3
None Found
On Land
N
W
E
S
0
0.25
0.5
1
Miles
Cut-Away Dam

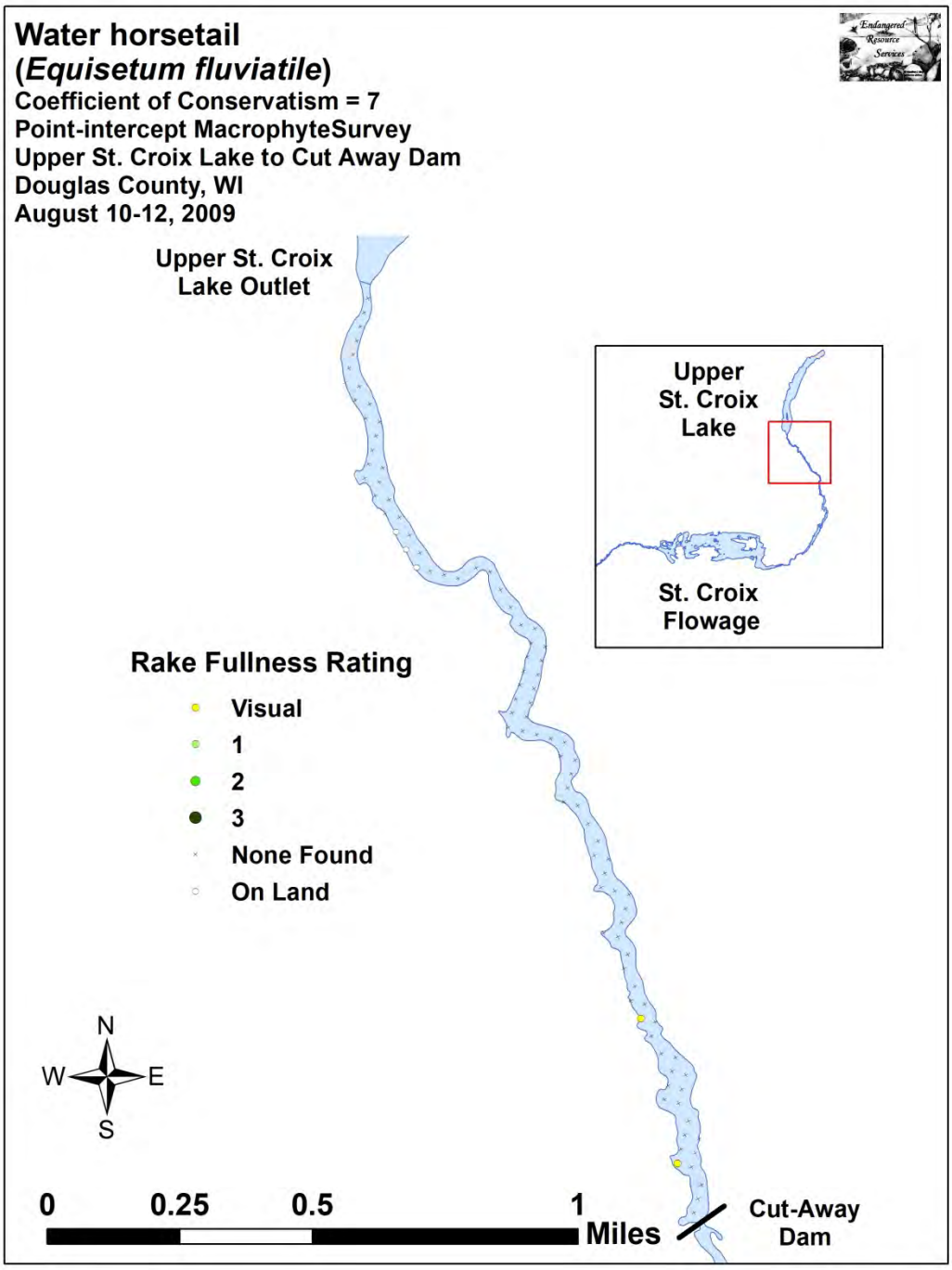

Coontail
(Ceratophyllum demersum)
Coefficient of Conservatism = 3
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
1
2
3
None Found
On Land
N
W
E
S
0
0.25
0.5
1
Miles
Cut-Away Dam

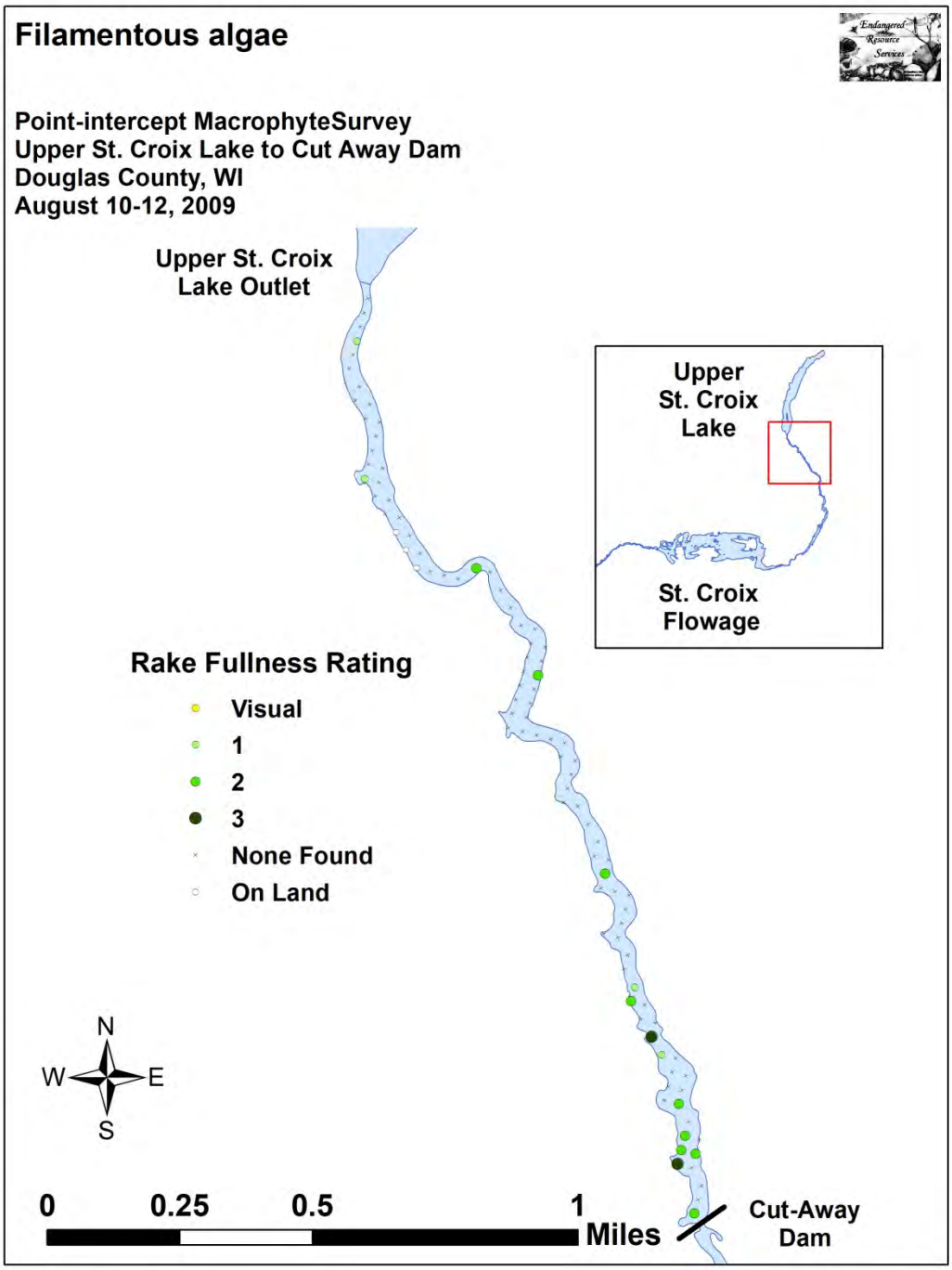

Muskgrass
(Chara sp.)
Coefficient of Conservatism = 7
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
1
2
3
None Found
On Land
N
W
E
S
0
0.25
0.5
1
Miles
Cut-Away Dam

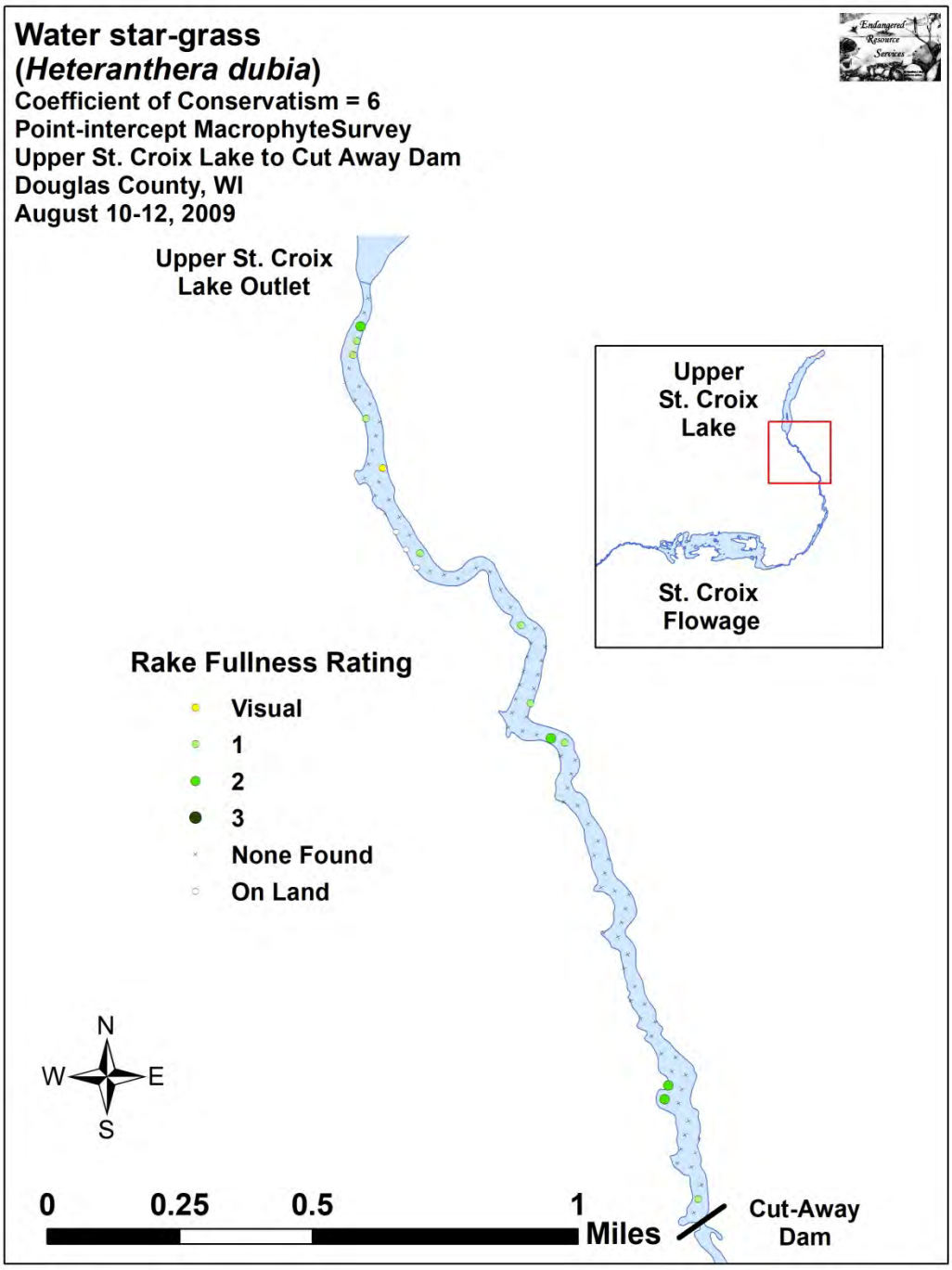

Bulb-bearing water hemlock
(Cicuta bulbifera)
Coefficient of Conservatism = 7
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
1
2
3
None Found
On Land
N
W
E
S
0
0.25
0.5
1
Miles
Cut-Away Dam

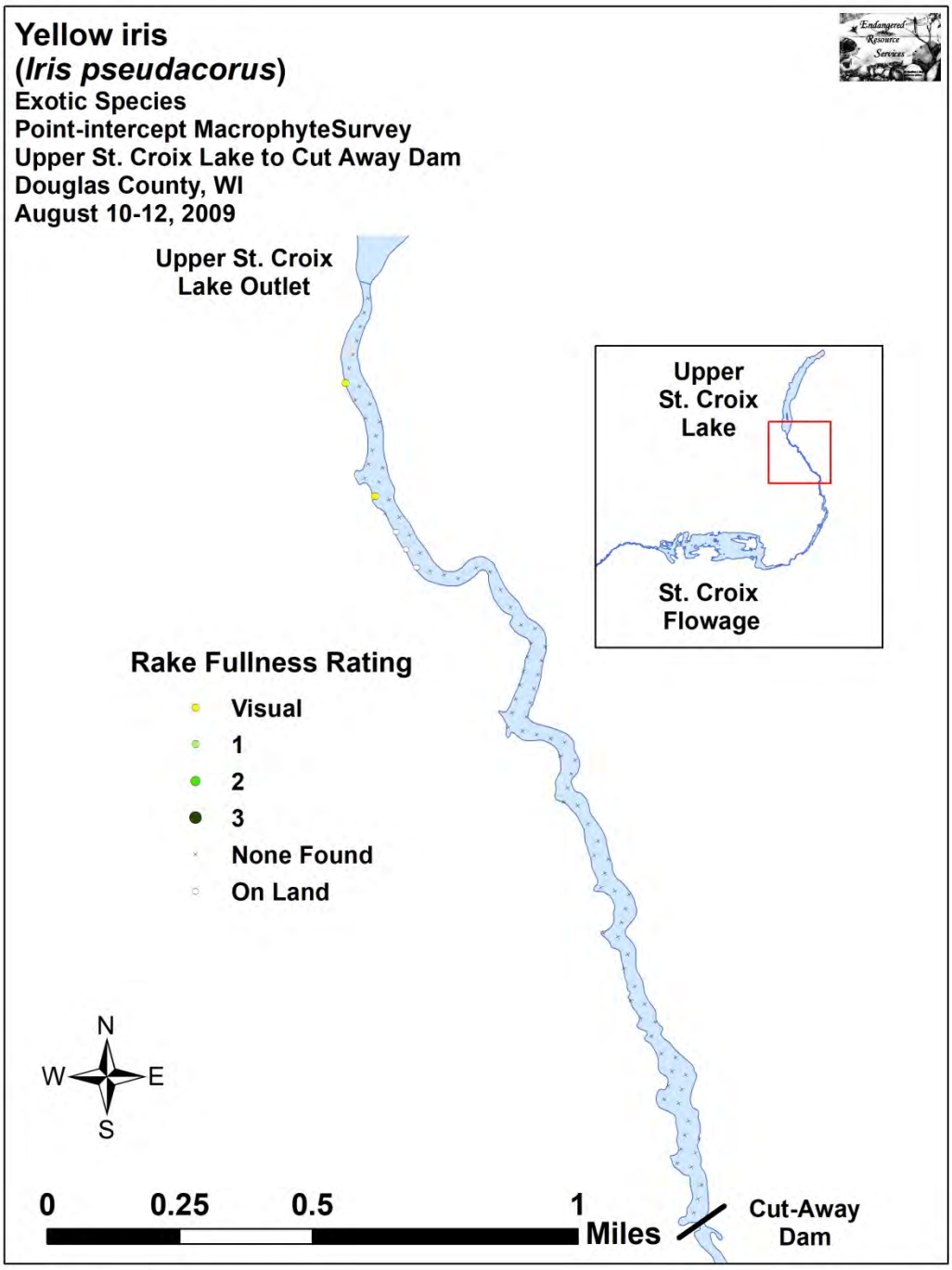

Creeping spikerush
(Eleocharis palustris)
Coefficient of Conservatism = 6
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
1
2
3
None Found
On Land
N
W
E
S
0
0.25
0.5
1
Miles
Cut-Away Dam

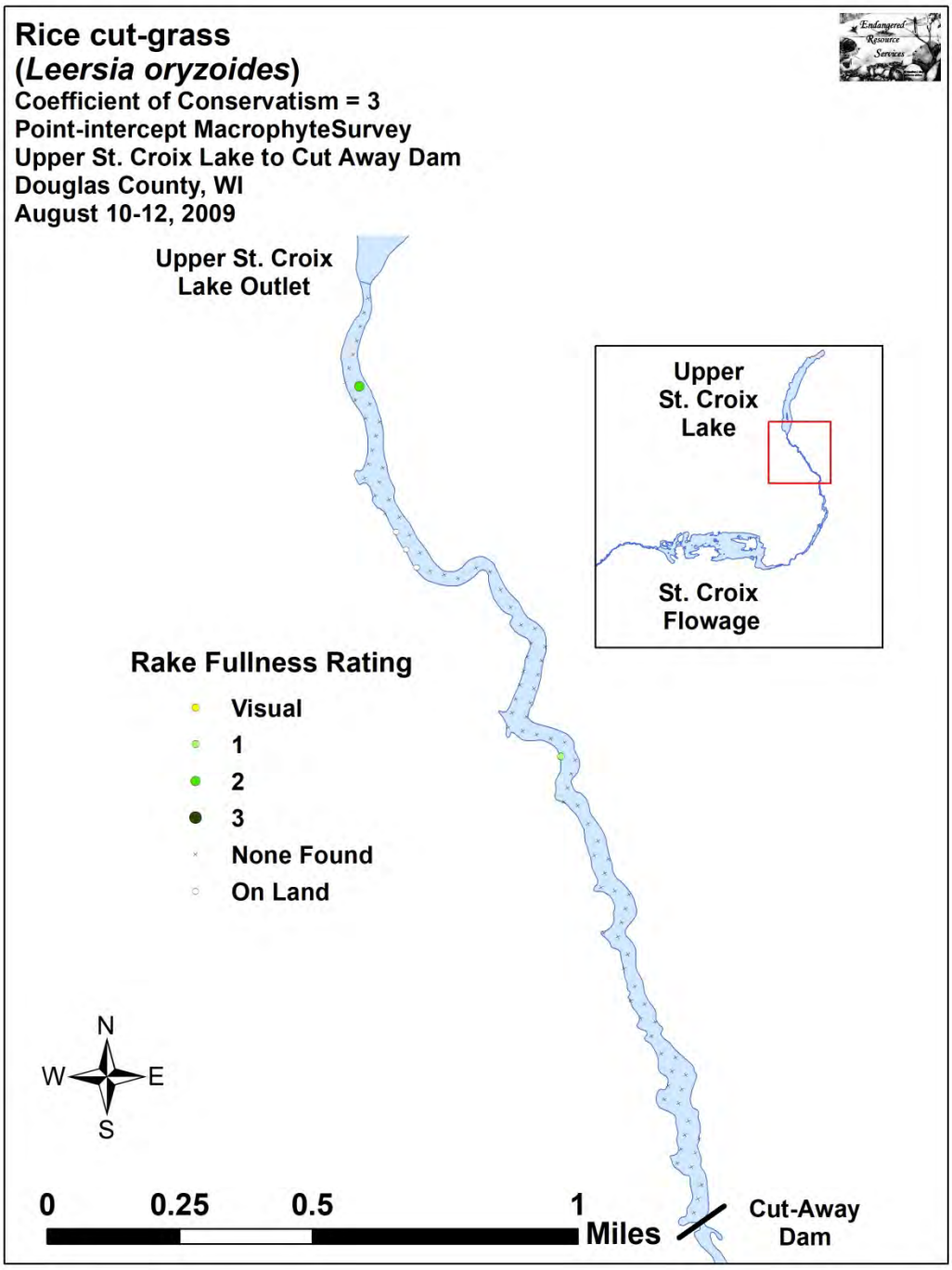

Common waterweed
(Elodea canadensis)
Coefficient of Conservatism = 3
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
1
2
3
None Found
On Land
N
W
E
S
0
0.25
0.5
1
Miles
Cut-Away Dam

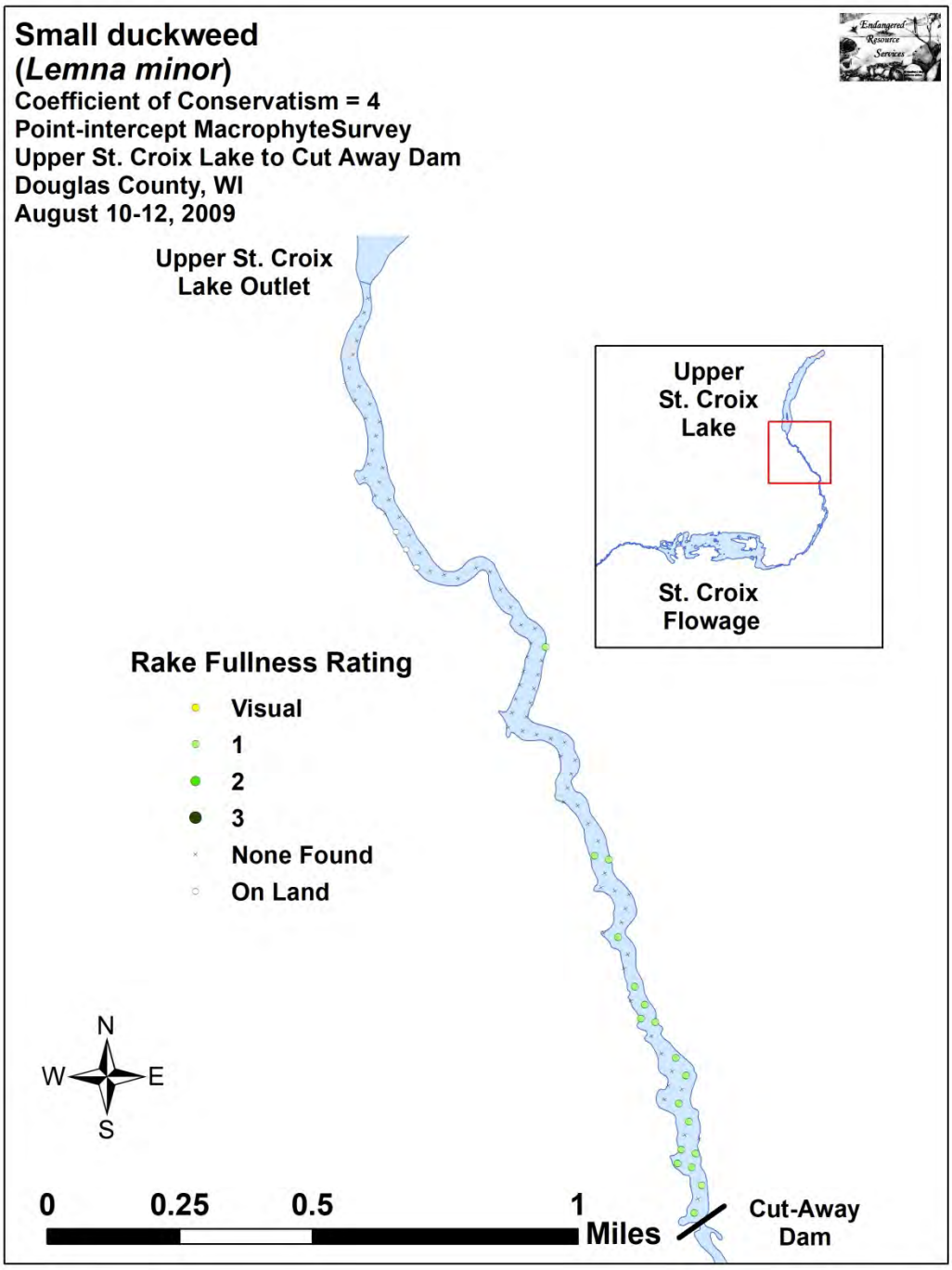

Water horsetail
(Equisetum fluviatile)
Coefficient of Conservatism = 7
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
1
2
3
None Found
On Land
N
W
E
S
0
0.25
0.5
1
Miles
Cut-Away Dam

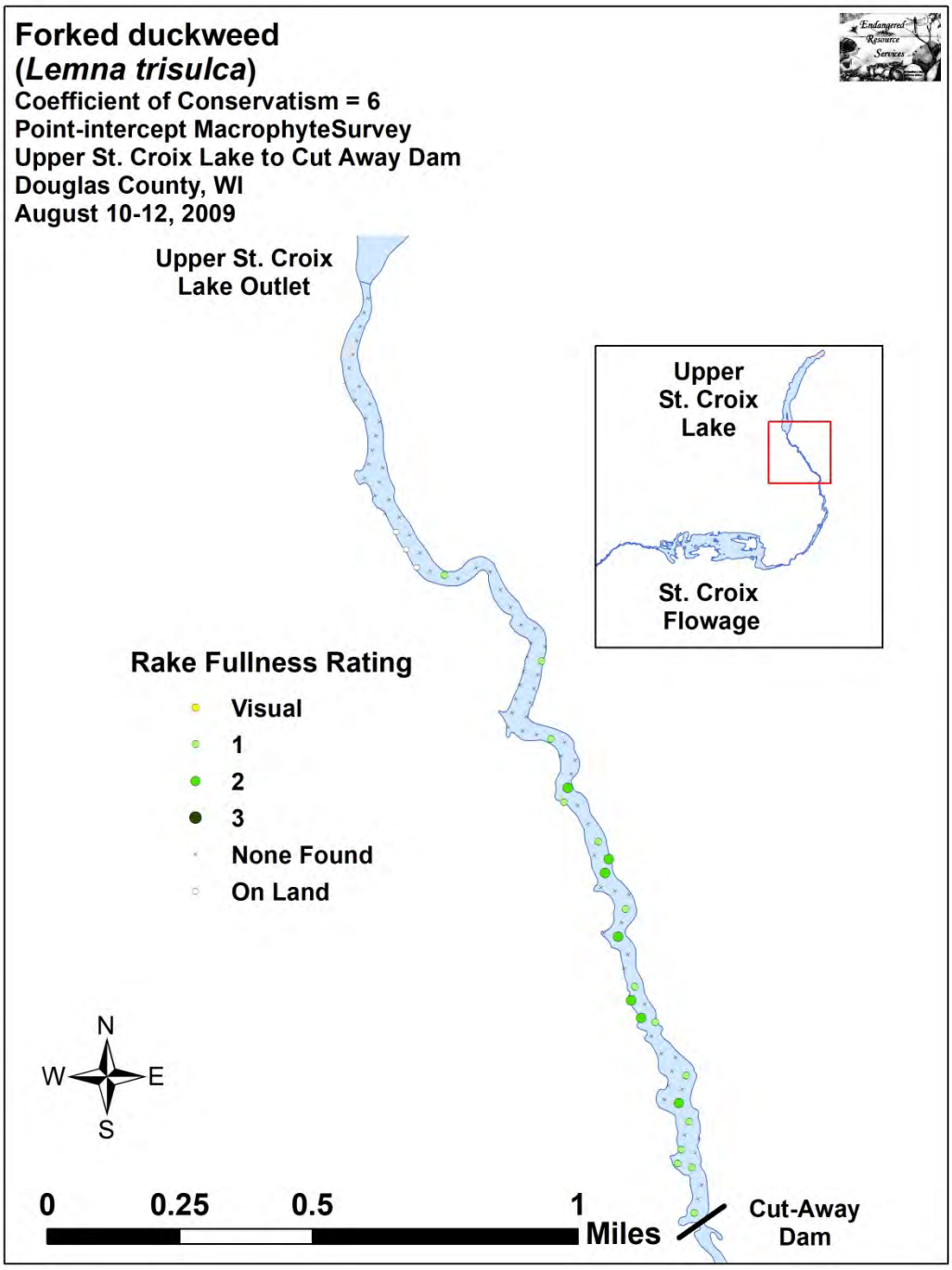

Filamentous algae
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
1
2
3
None Found
On Land
N
W
E
S
0
0.25
0.5
1
Miles
Cut-Away Dam

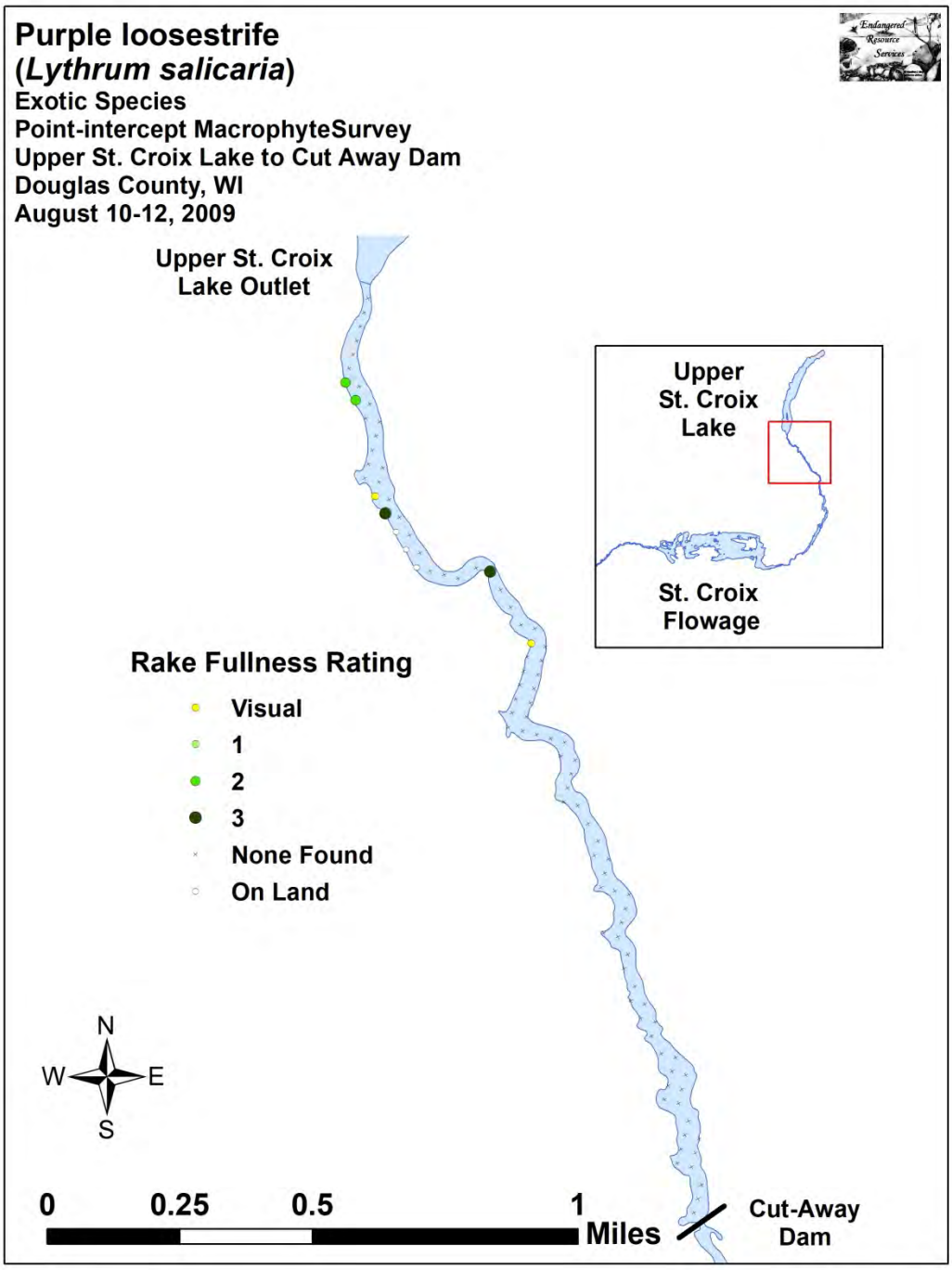

Water star-grass
(Heteranthera dubia)
Coefficient of Conservatism = 6
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
1
2
3
None Found
On Land
N
W
E
S
0
0.25
0.5
1
Miles
Cut-Away Dam

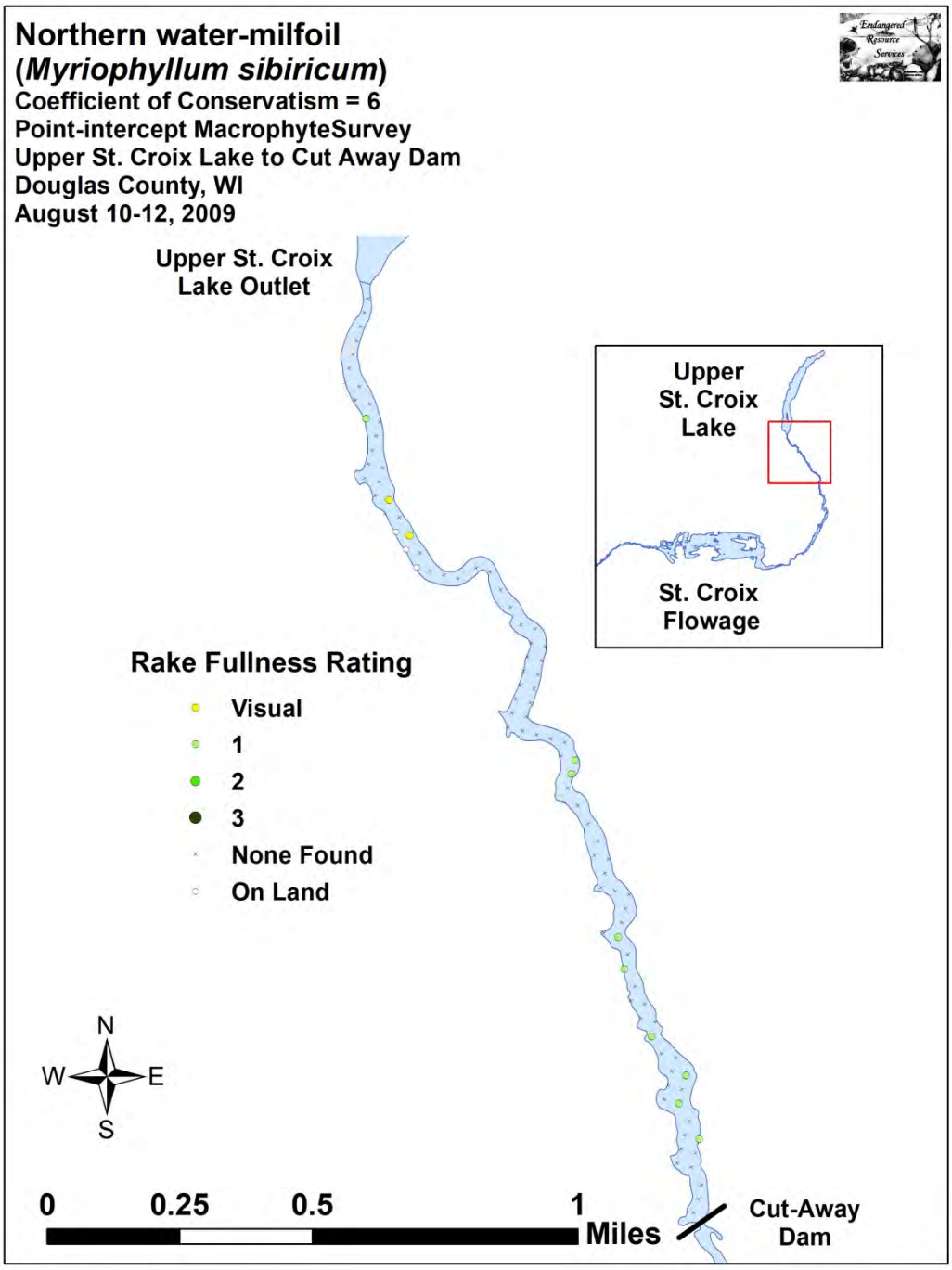

Yellow iris
(Iris pseudacorus)
Exotic Species
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
1
2
3
None Found
On Land
N
W
E
S
0
0.25
0.5
1
Miles
Cut-Away Dam

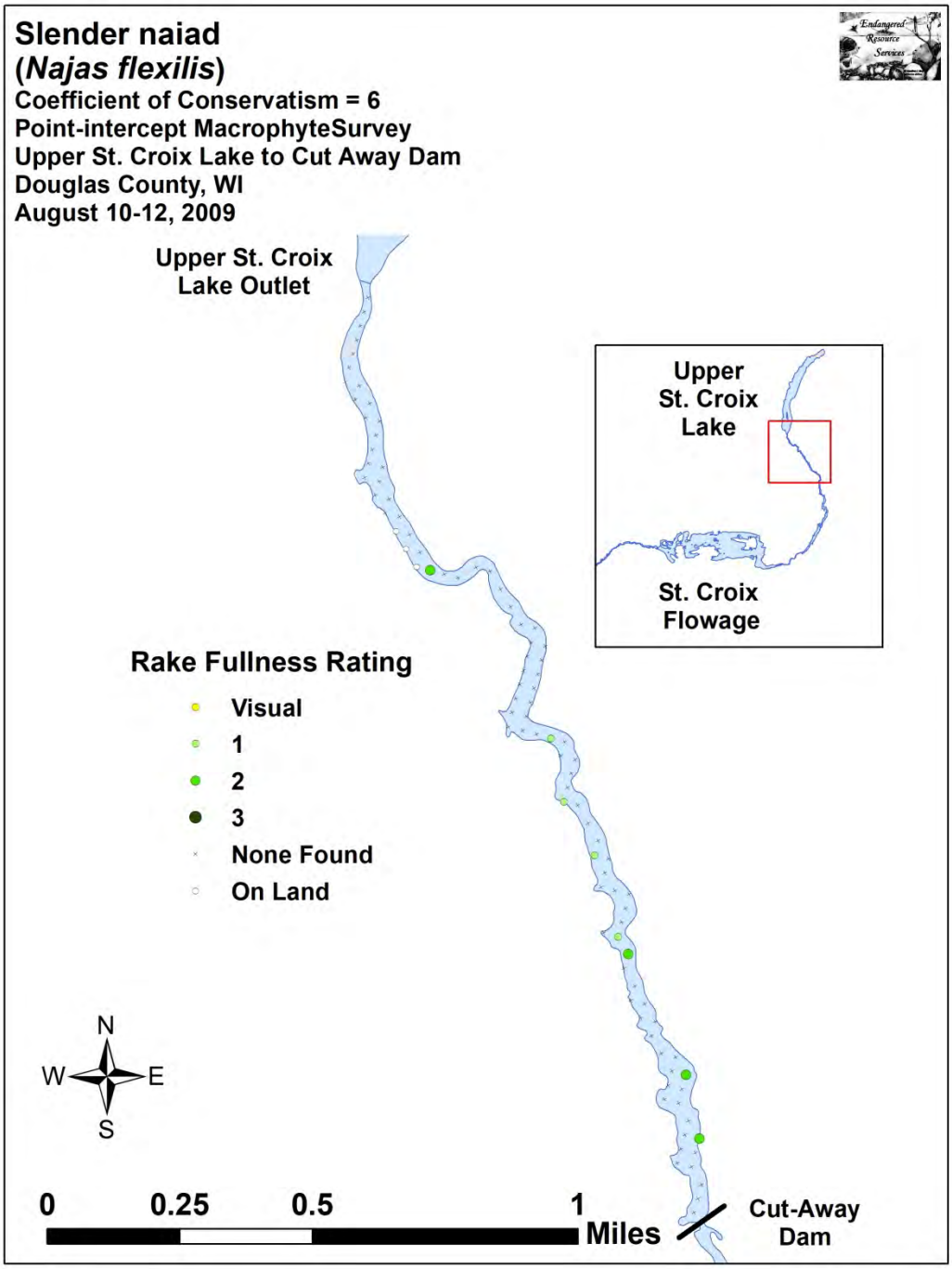

Rice cut-grass
(Leersia oryzoides)
Coefficient of Conservatism = 3
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
1
2
3
None Found
On Land
N
W
E
S
0
0.25
0.5
1
Miles
Cut-Away Dam

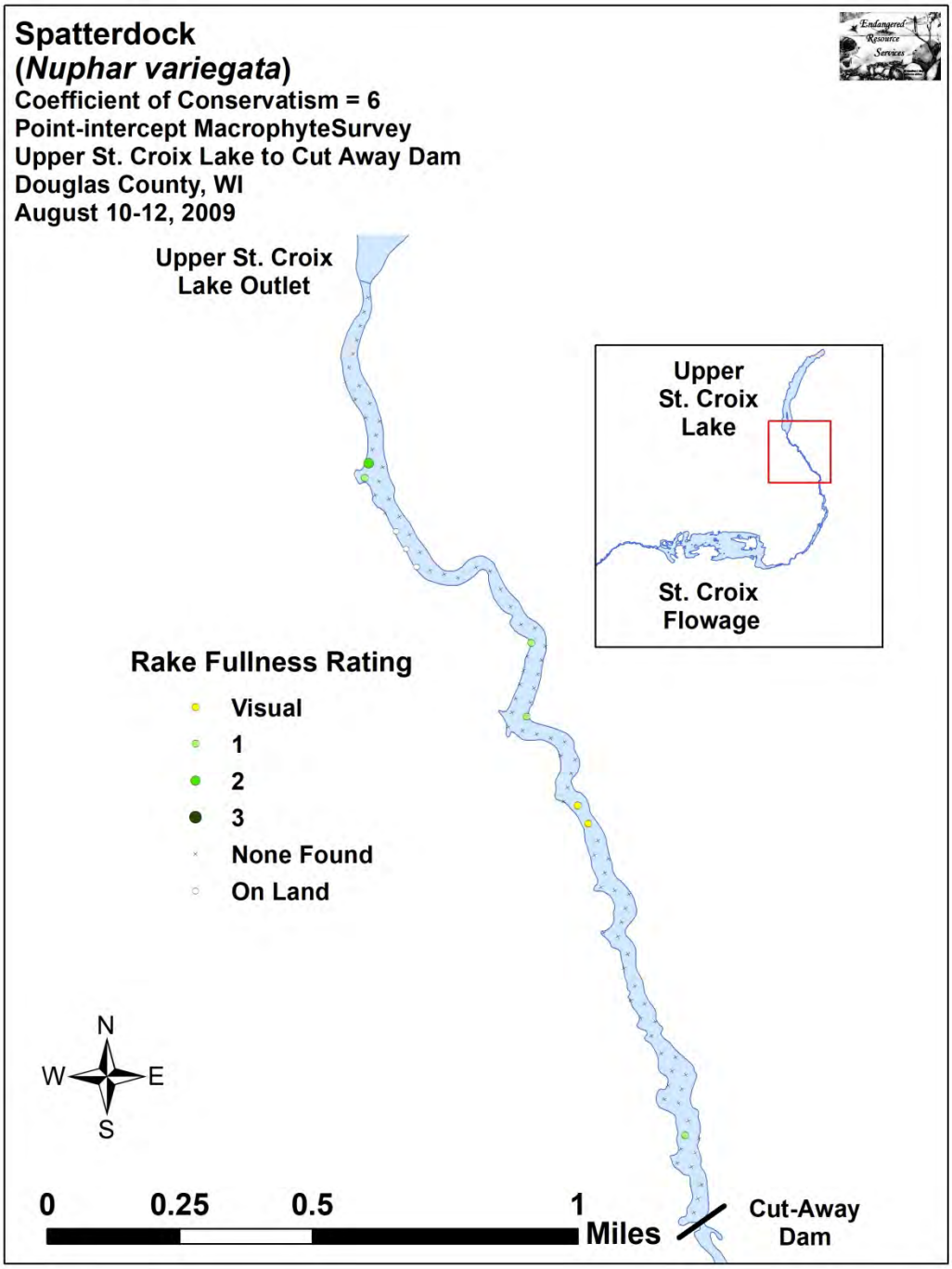

Small duckweed
(Lemna minor)
Coefficient of Conservatism = 4
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
1
2
3
None Found
On Land
N
W
E
S
0
0.25
0.5
1
Miles
Cut-Away Dam

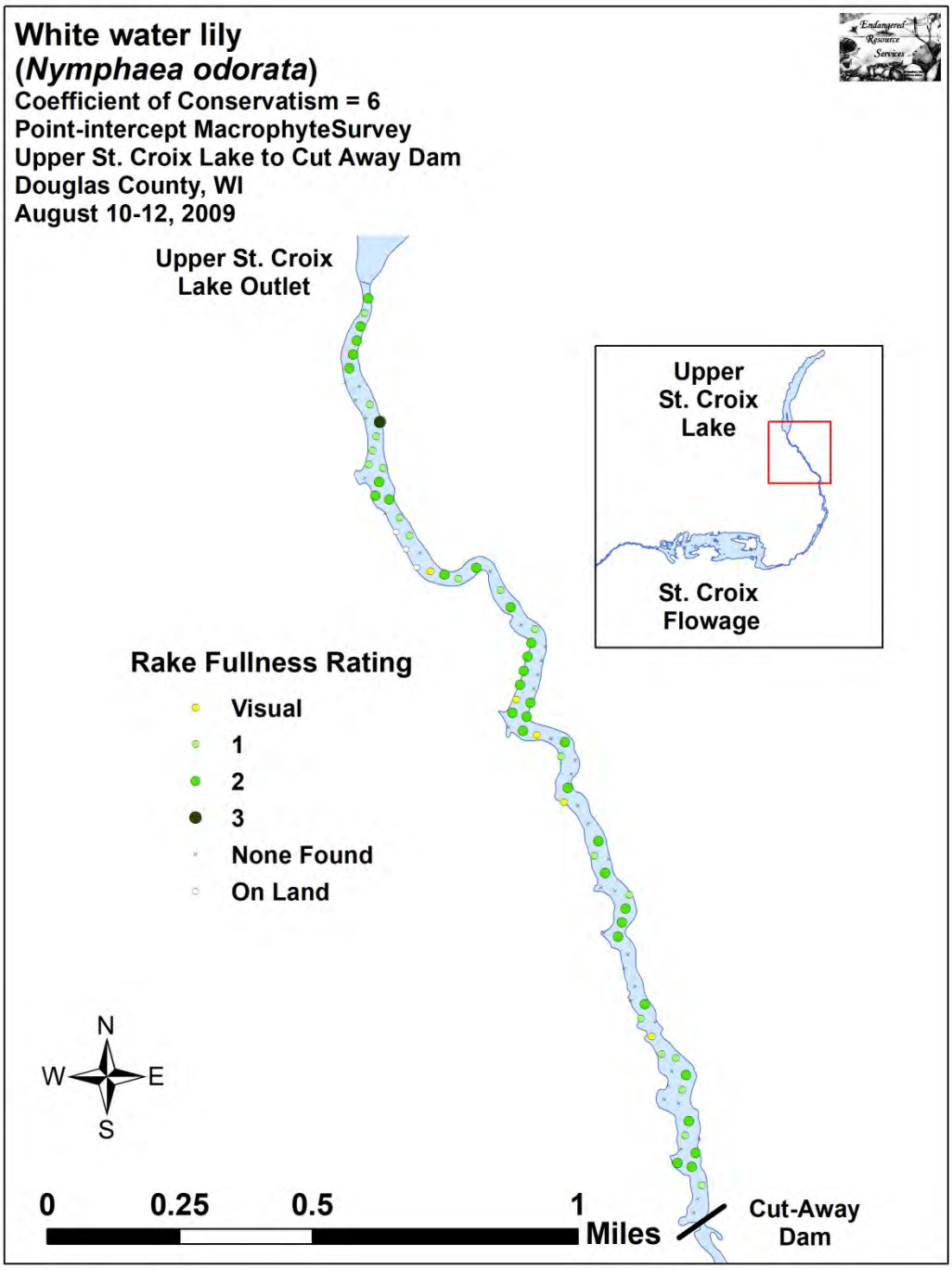

Forked duckweed
(Lemna trisulca)
Coefficient of Conservatism = 6
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
1
2
3
None Found
On Land
N
W
E
S
0
0.25
0.5
1
Miles
Cut-Away Dam

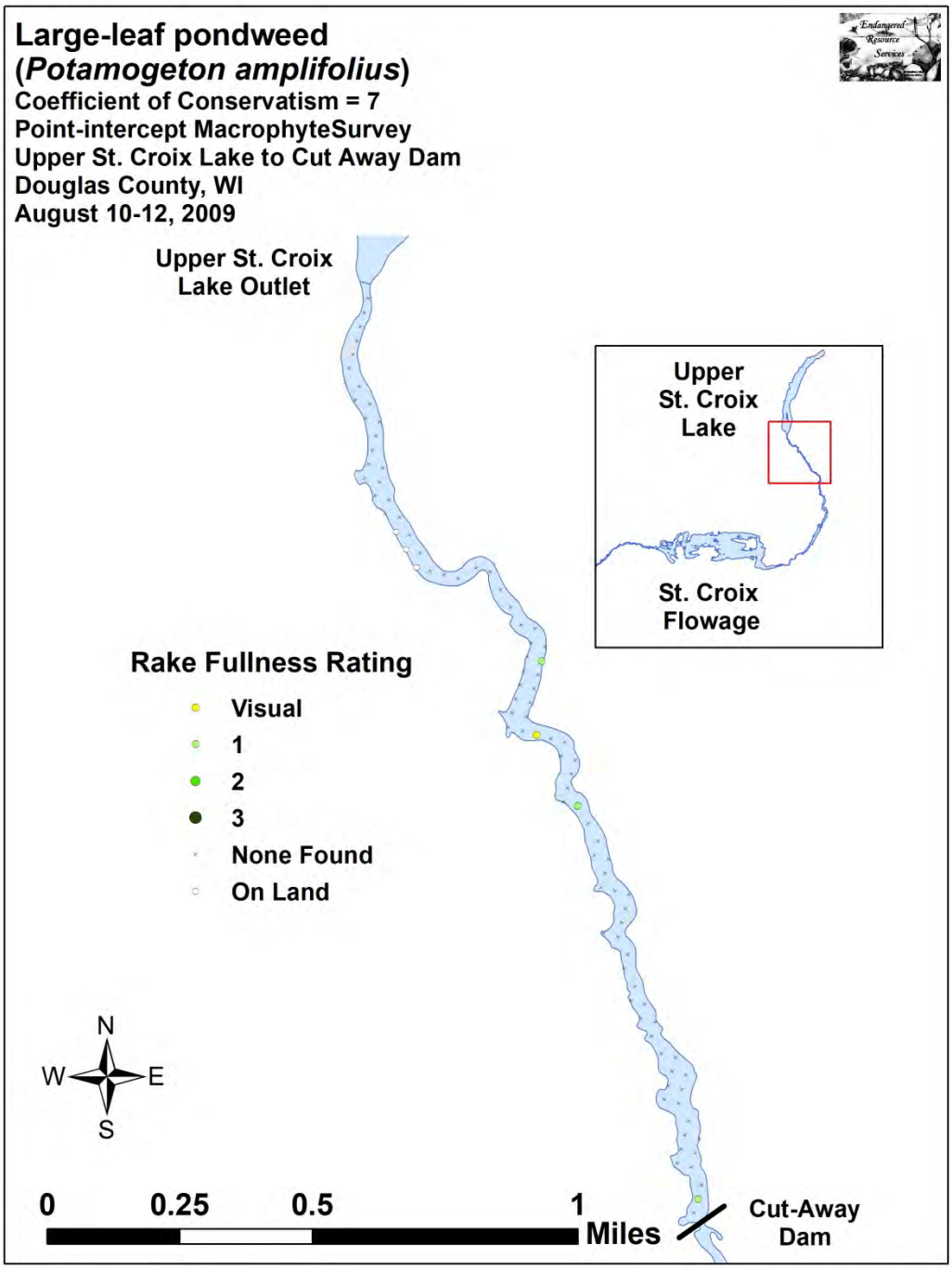

Purple loosestrife
(Lythrum salicaria)
Exotic Species
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
1
2
3
None Found
On Land
N
W
E
S
0
0.25
0.5
1
Miles
Cut-Away Dam

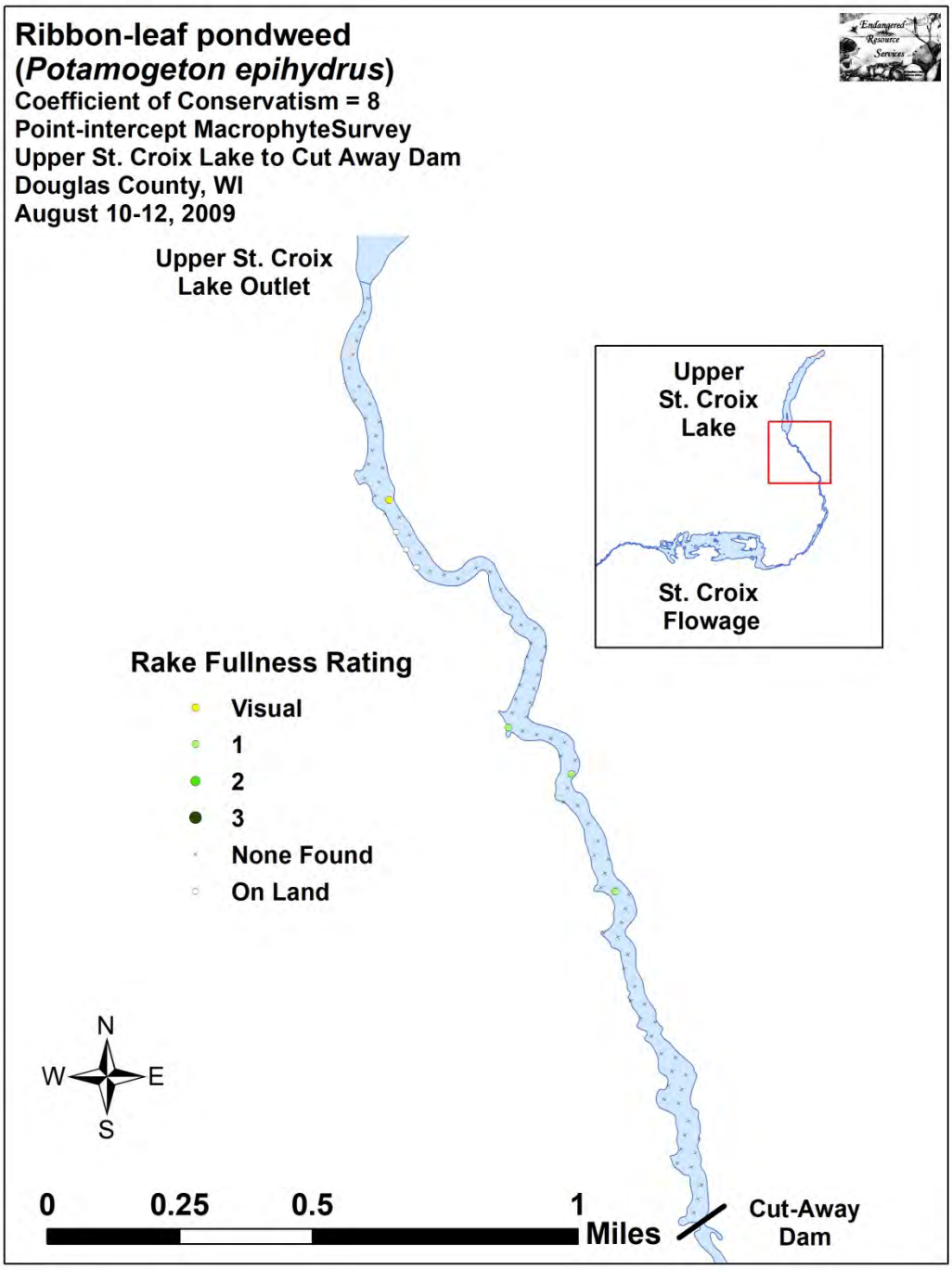

Northern water-milfoil
(Myriophyllum sibiricum)
Coefficient of Conservatism = 6
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
1
2
3
None Found
On Land
N
W
E
S
0
0.25
0.5
1
Miles
Cut-Away Dam

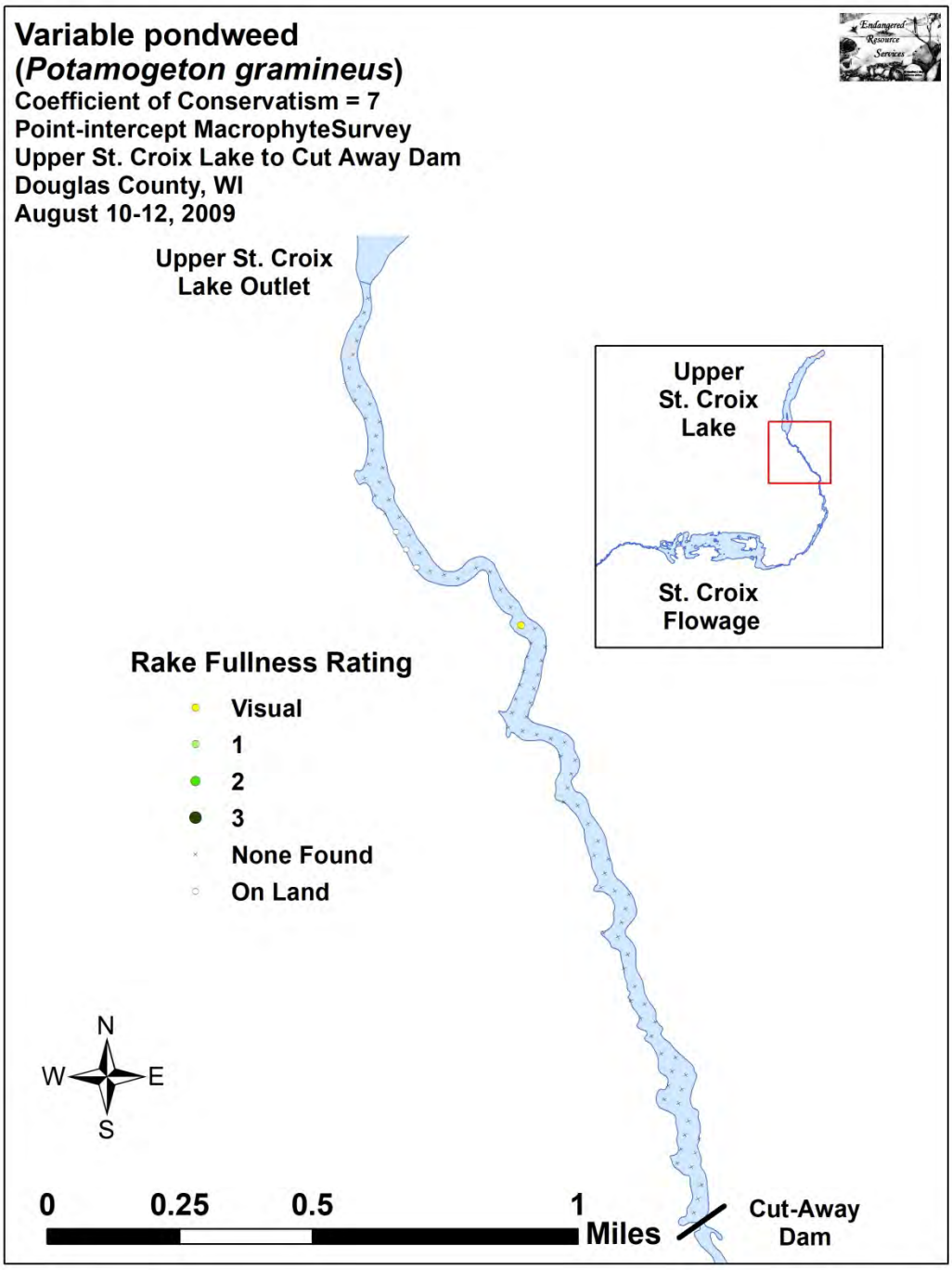

Slender naiad
(Najas flexilis)
Coefficient of Conservatism = 6
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
1
2
3
None Found
On Land
N
W
E
S
0
0.25
0.5
1
Miles
Cut-Away Dam

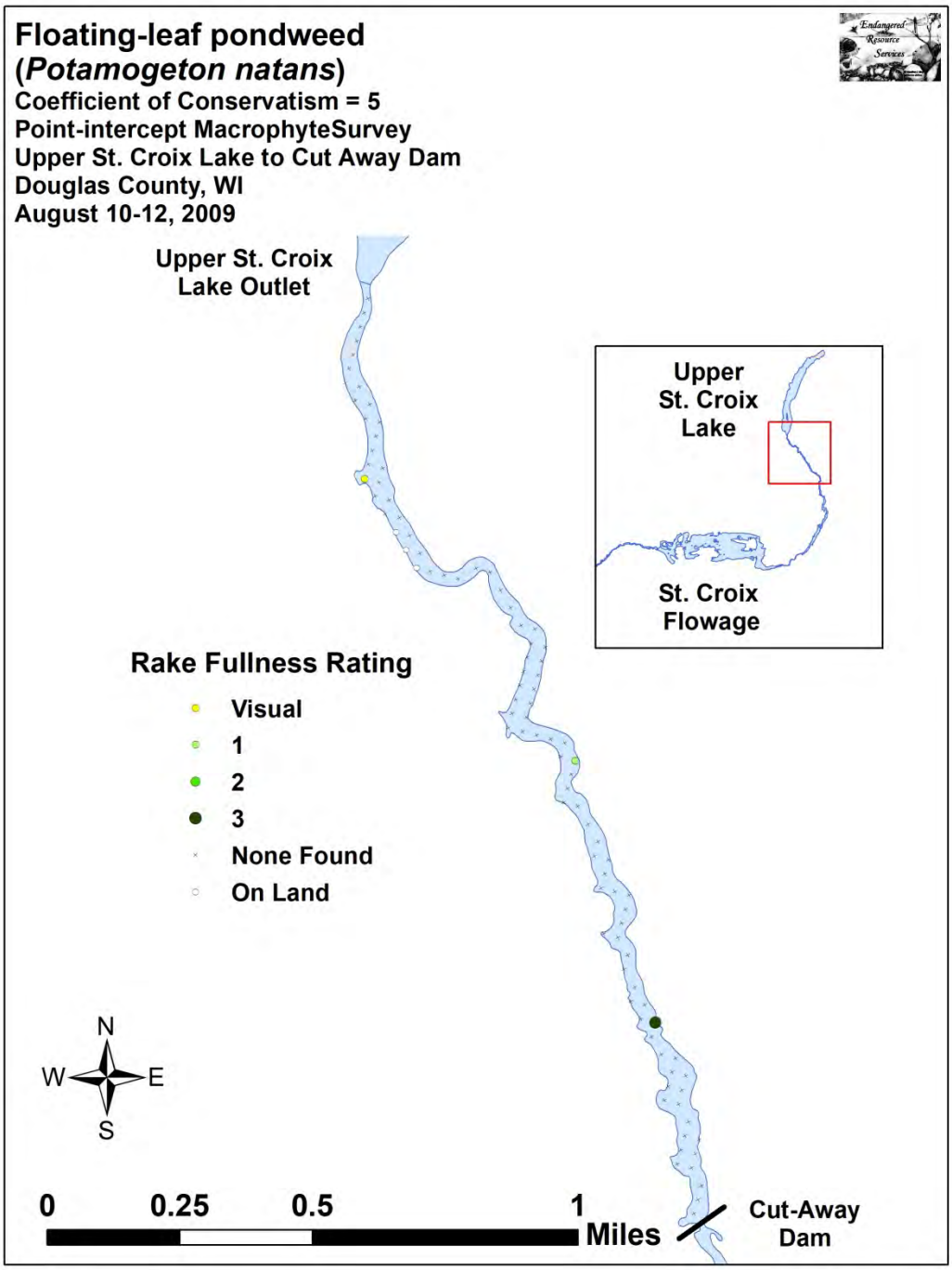

Spatterdock
(Nuphar variegata)
Coefficient of Conservatism = 6
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
1
2
3
None Found
On Land
N
W
E
S
0
0.25
0.5
1
Miles
Cut-Away Dam

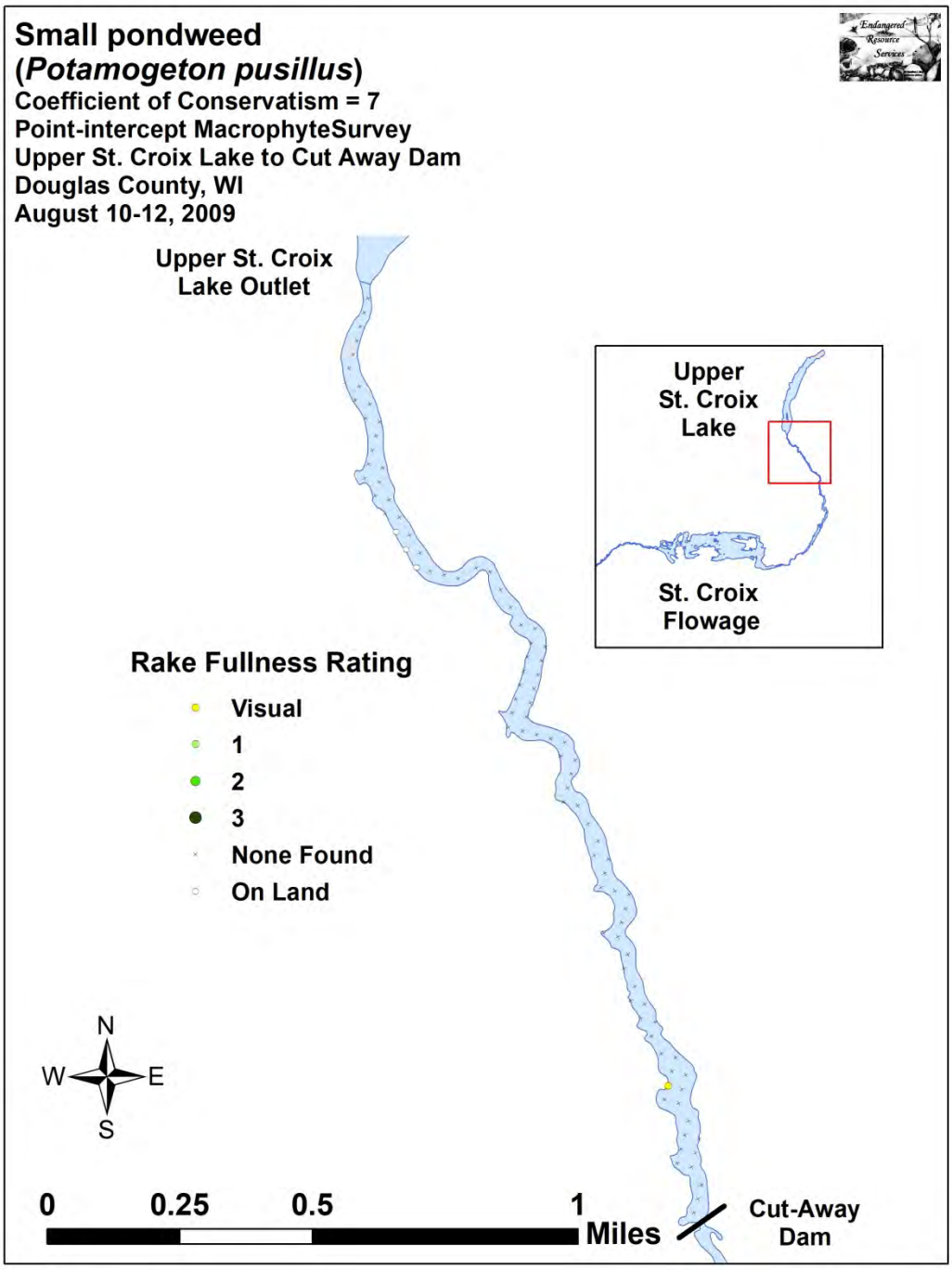

White water lily
(Nymphaea odorata)
Coefficient of Conservatism = 6
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
1
2
3
None Found
On Land
N
W
E
S
0
0.25
0.5
1
Miles
Cut-Away Dam

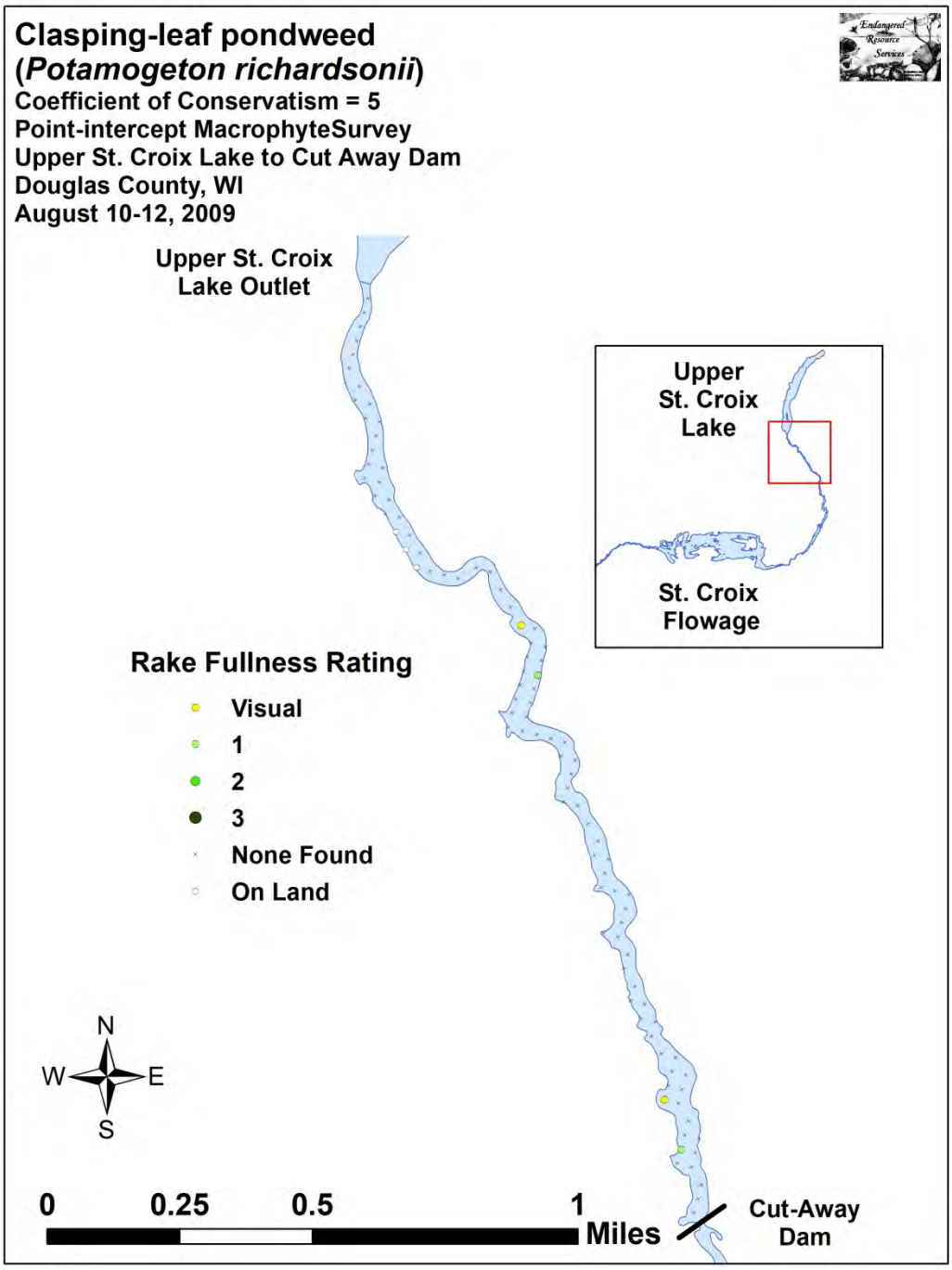

Large-leaf pondweed
(Potamogeton amplifolius)
Coefficient of Conservatism = 7
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
1
2
3
None Found
On Land
N
W
E
S
0
0.25
0.5
1
Miles
Cut-Away Dam

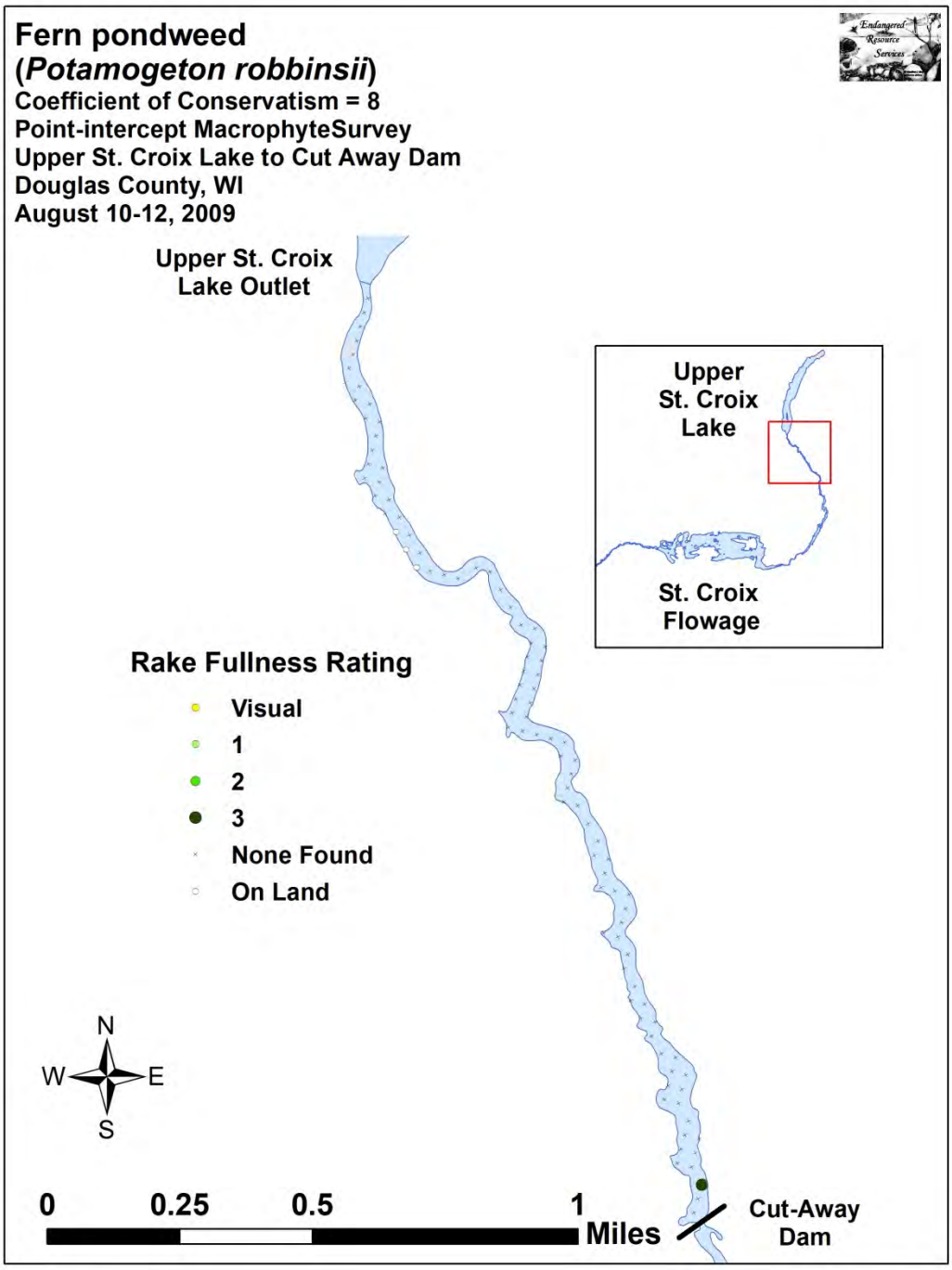

Ribbon-leaf pondweed
(Potamogeton epihydrus)
Coefficient of Conservatism = 8
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
1
2
3
None Found
On Land
N
W
E
S
0
0.25
0.5
1
Miles
Cut-Away Dam

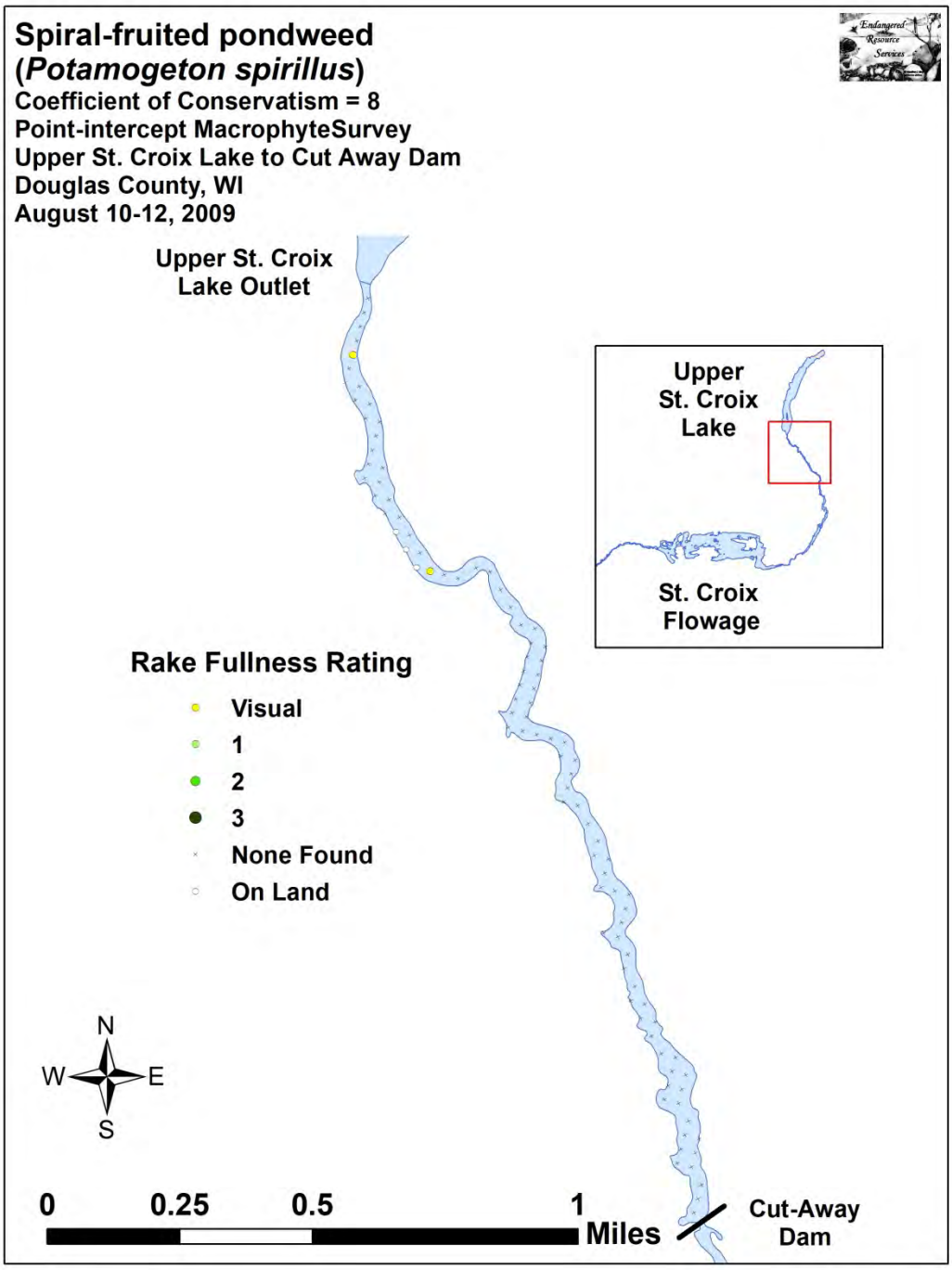

Variable pondweed
(Potamogeton gramineus)
Coefficient of Conservatism = 7
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
1
2
3
None Found
On Land
N
W
E
S
0
0.25
0.5
1
Miles
Cut-Away Dam


Floating-leaf pondweed
(Potamogeton natans)
Coefficient of Conservatism = 5
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
1
2
3
None Found
On Land
N
W
E
S
0
0.25
0.5
1
Miles
Cut-Away Dam


Small pondweed
(Potamogeton pusillus)
Coefficient of Conservatism = 7
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
1
2
3
None Found
On Land
N
W
E
S
0
0.25
0.5
1
Miles
Cut-Away Dam


Clasping-leaf pondweed
(Potamogeton richardsonii)
Coefficient of Conservatism = 5
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
1
2
3
None Found
On Land
N
W
E
S
0
0.25
0.5
1
Miles
Cut-Away Dam


Fern pondweed
(Potamogeton robbinsii)
Coefficient of Conservatism = 8
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
1
2
3
None Found
On Land
N
W
E
S
0
0.25
0.5
1
Miles
Cut-Away Dam


Spiral-fruited pondweed
(Potamogeton spirillus)
Coefficient of Conservatism = 8
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
1
2
3
None Found
On Land
N
W
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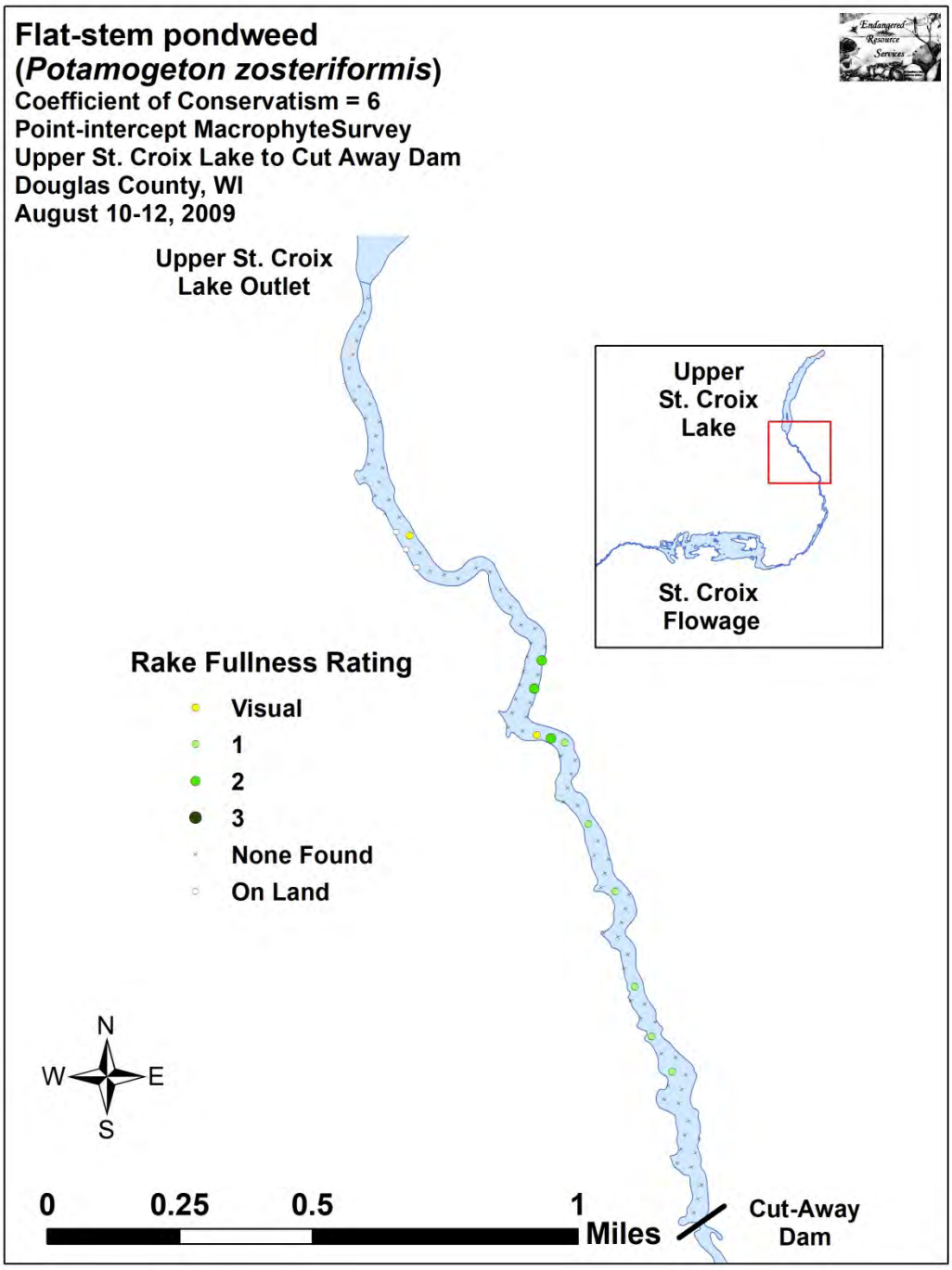
S
0
0.25
0.5
1
Miles
Cut-Away Dam


Flat-stem pondweed
(Potamogeton zosteriformis)
Coefficient of Conservatism = 6
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
1
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3
None Found
On Land
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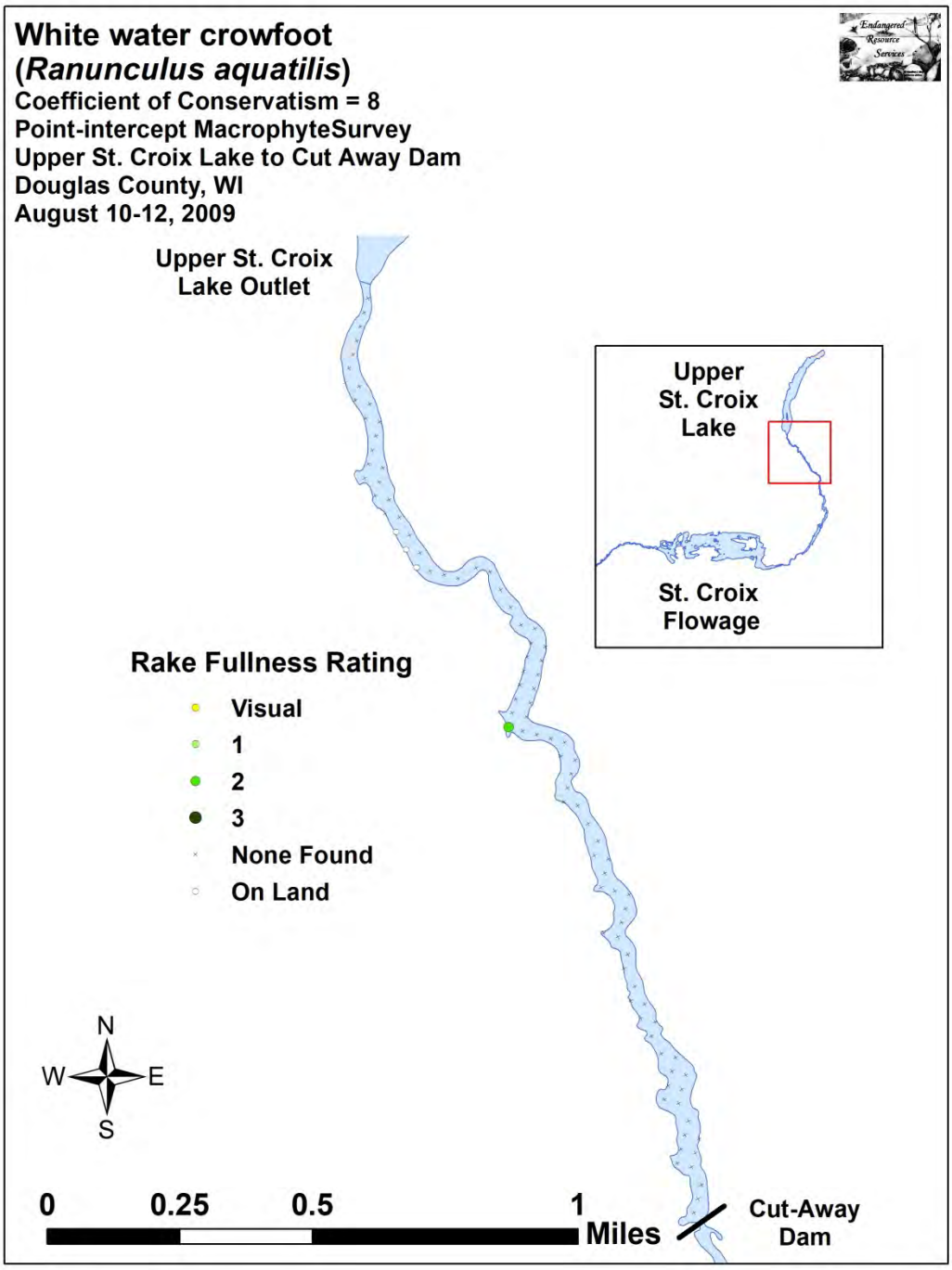
0.25
0.5
1
Miles
Cut-Away Dam


White water crowfoot
(Ranunculus aquatilis)
Coefficient of Conservatism = 8
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
1
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3
None Found
On Land
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0.25
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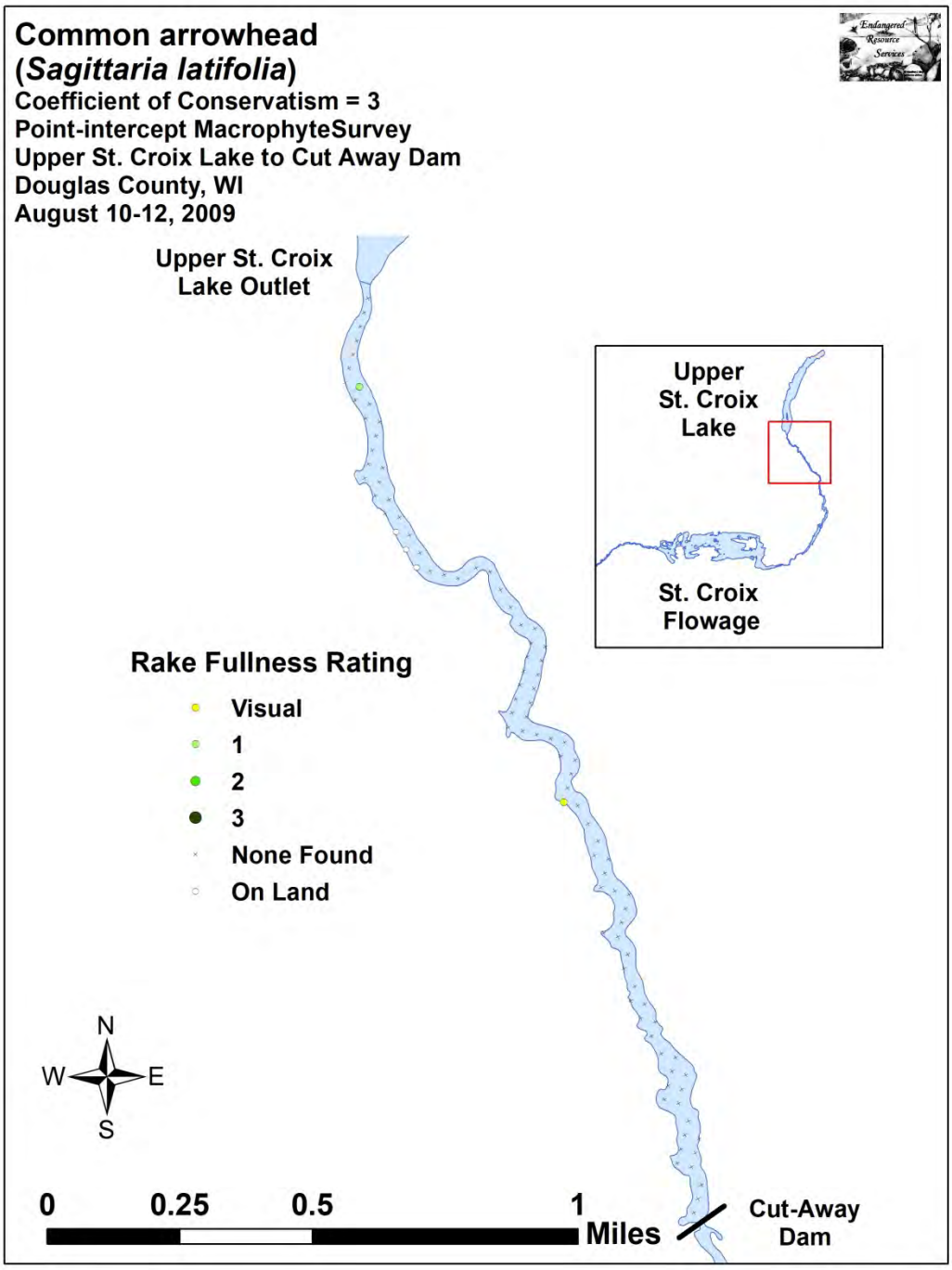
1
Miles
Cut-Away Dam


Common arrowhead
(Sagittaria latifolia)
Coefficient of Conservatism = 3
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
1
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None Found
On Land
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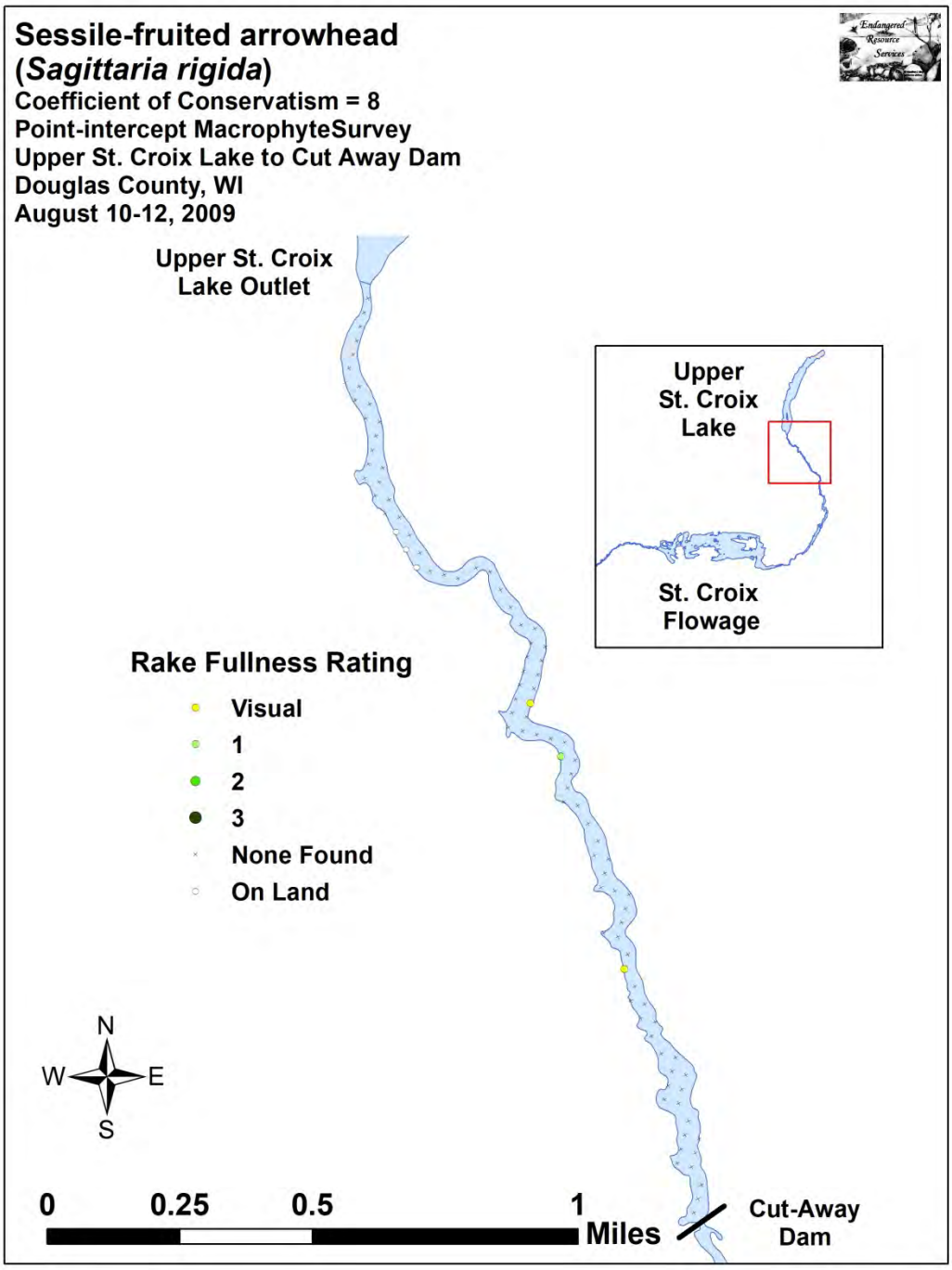
0.25
0.5
1
Miles
Cut-Away Dam


Sessile-fruited arrowhead
(Sagittaria rigida)
Coefficient of Conservatism = 8
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
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None Found
On Land
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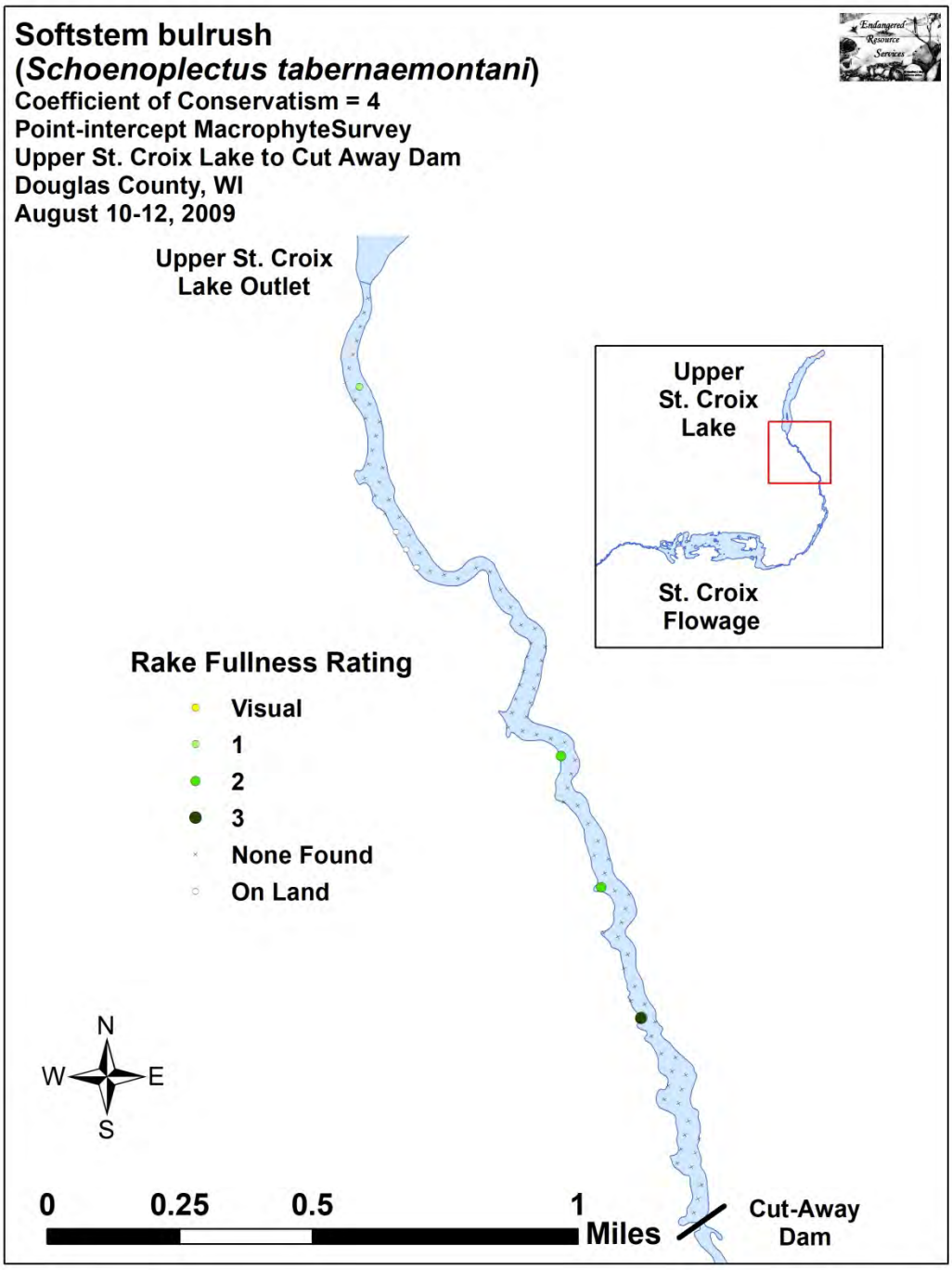
1
Miles
Cut-Away Dam


Softstem bulrush
(Schoenoplectus tabernaemontani)
Coefficient of Conservatism = 4
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
1
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None Found
On Land
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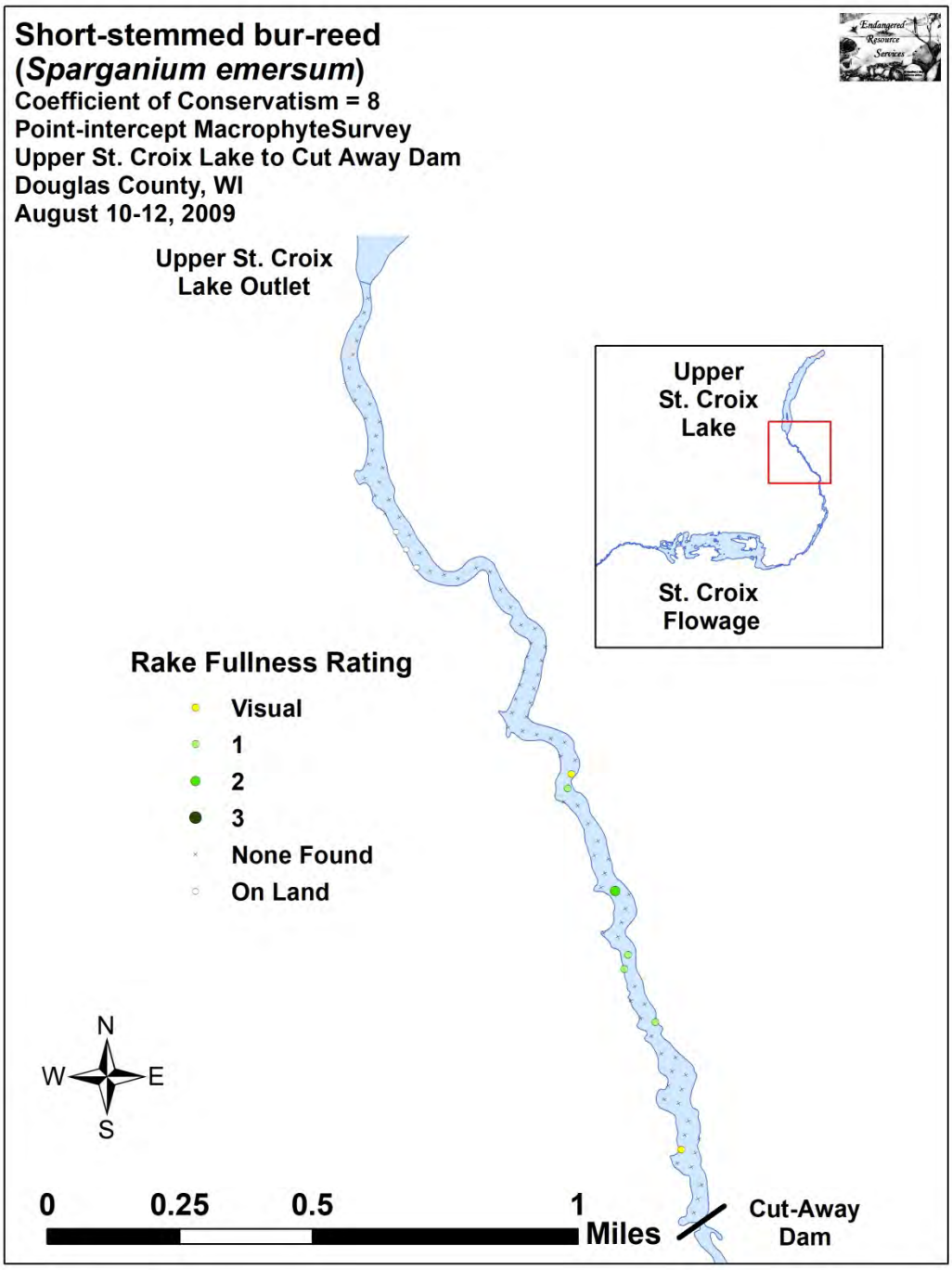
1
Miles
Cut-Away Dam


Short-stemmed bur-reed
(Sparganium emersum)
Coefficient of Conservatism = 8
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
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None Found
On Land
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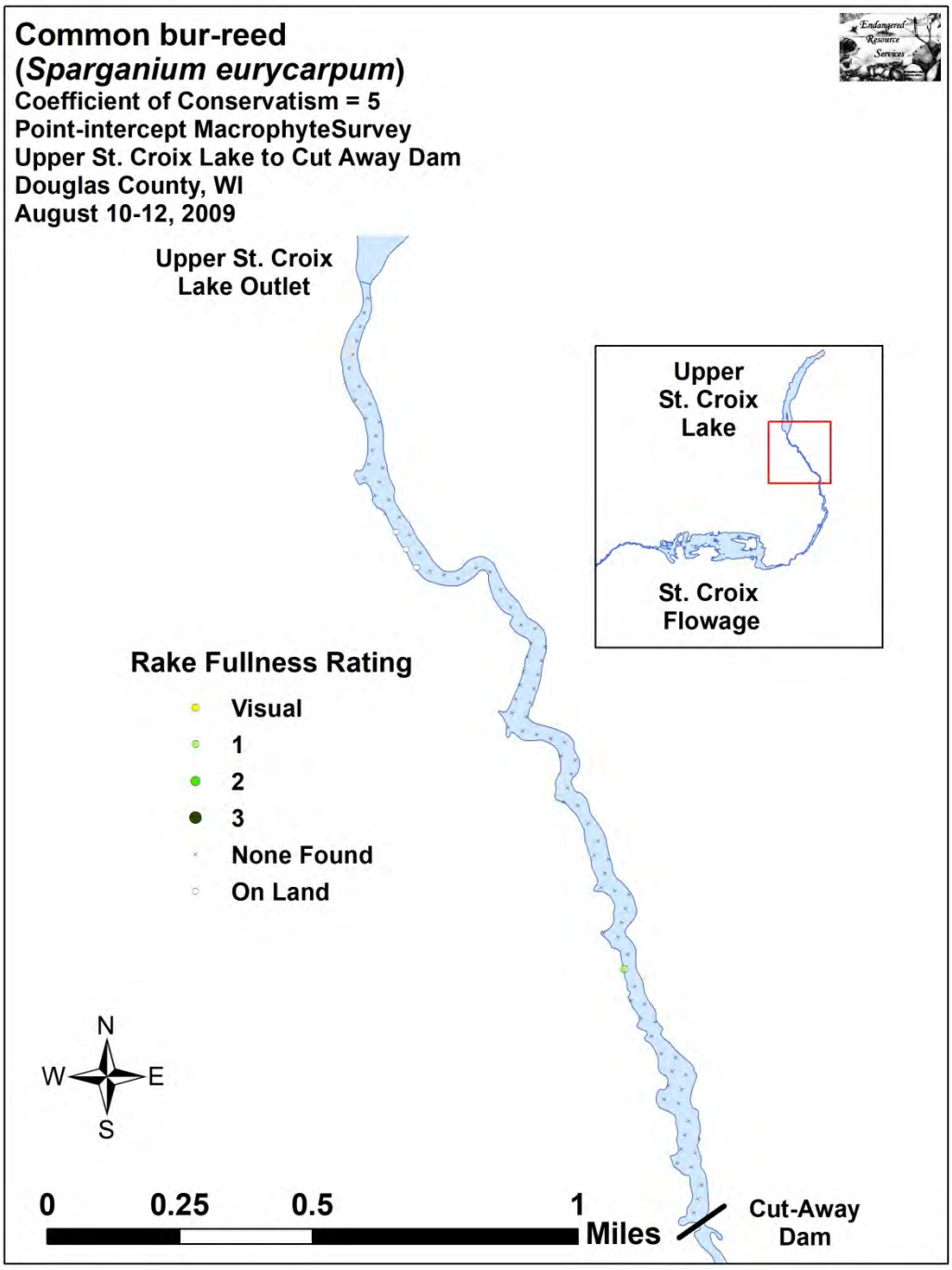
1
Miles
Cut-Away Dam


Common bur-reed
(Sparganium eurycarpum)
Coefficient of Conservatism = 5
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
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None Found
On Land
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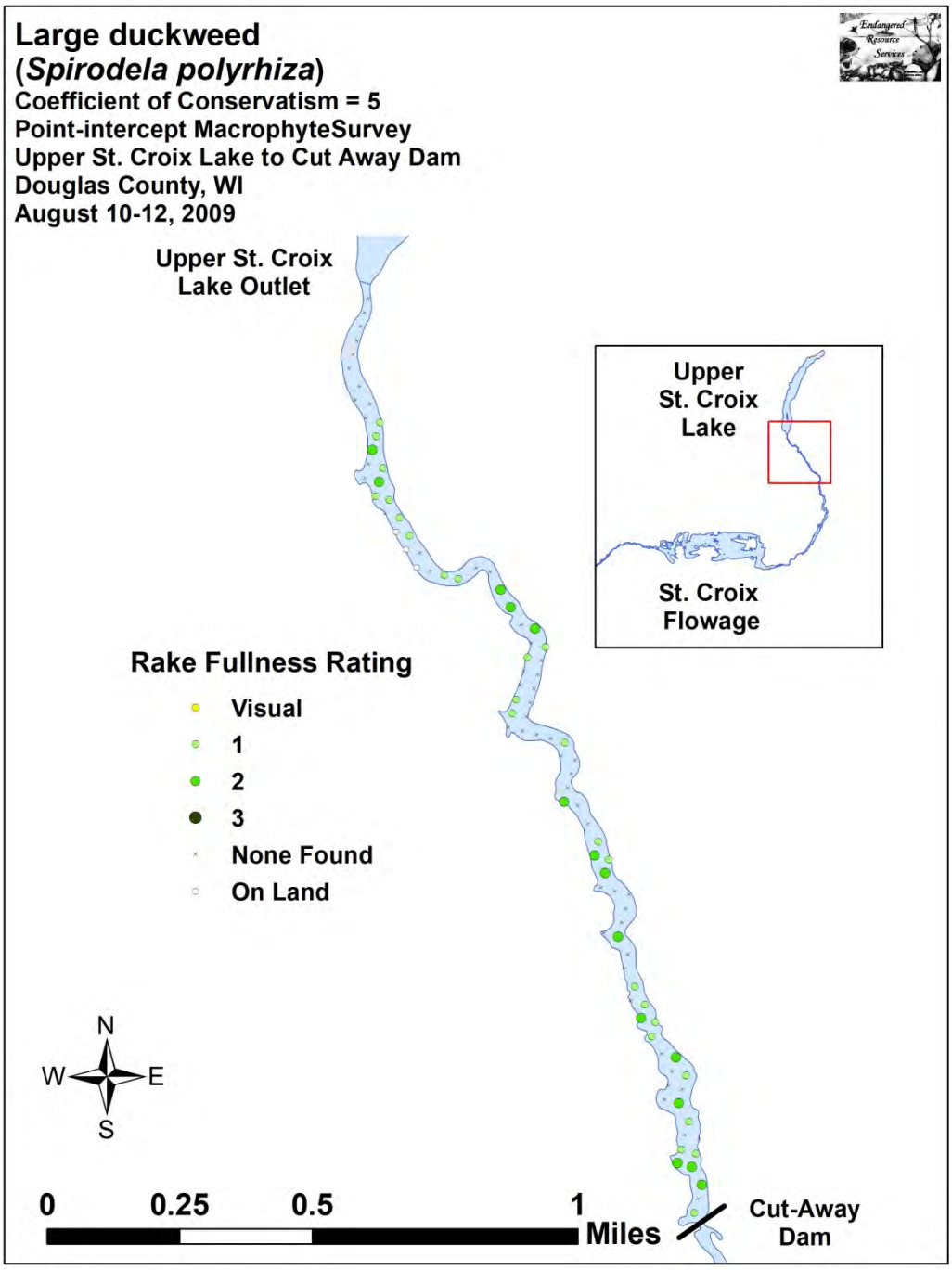
Miles
Cut-Away Dam


Large duckweed
(Spirodela polyrhiza)
Coefficient of Conservatism = 5
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
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None Found
On Land
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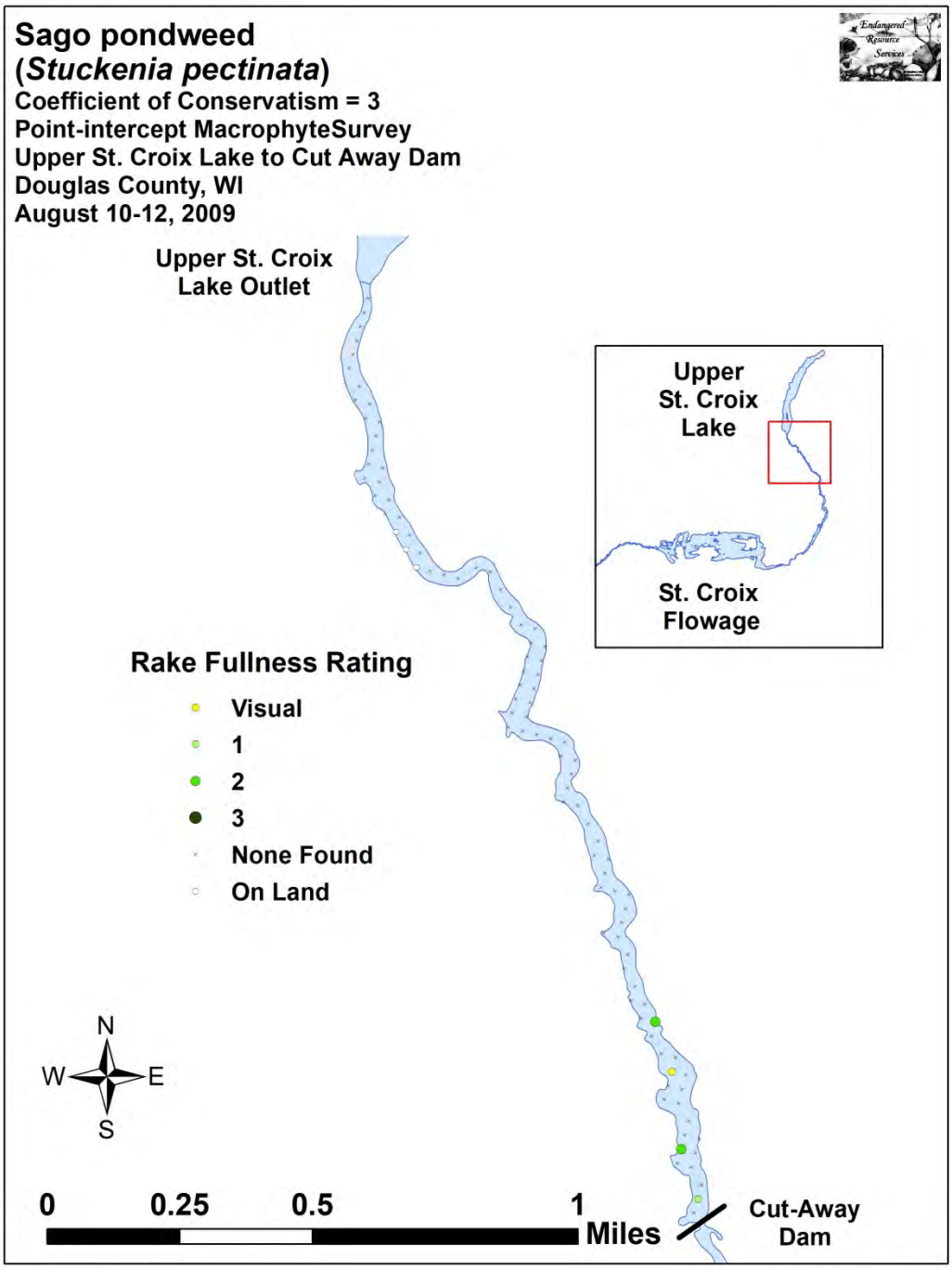
Miles
Cut-Away Dam


Sago pondweed
(Stuckenia pectinata)
Coefficient of Conservatism = 3
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
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None Found
On Land
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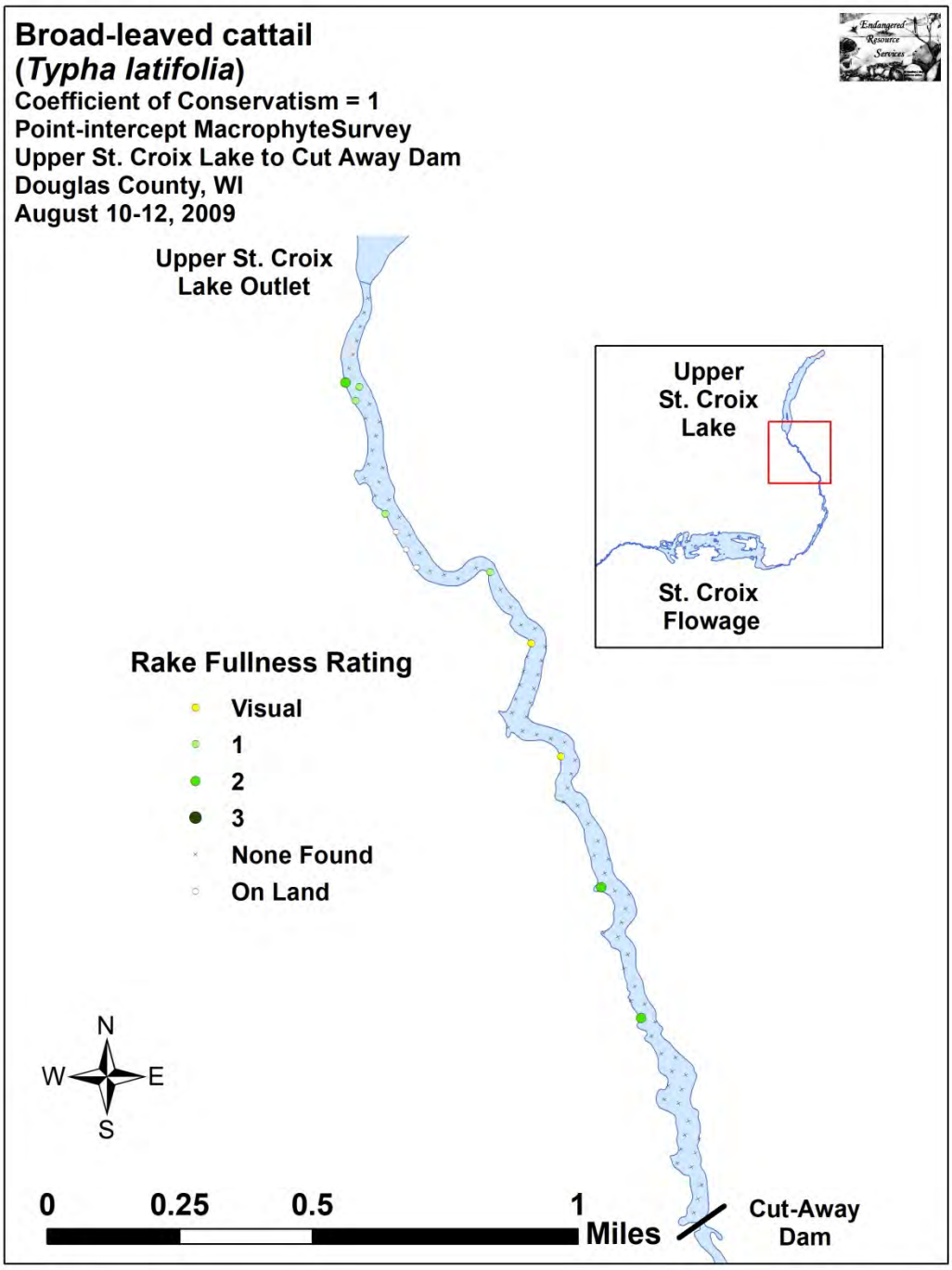
Miles
Cut-Away Dam


Broad-leaved cattail
(Typha latifolia)
Coefficient of Conservatism = 1
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
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None Found
On Land
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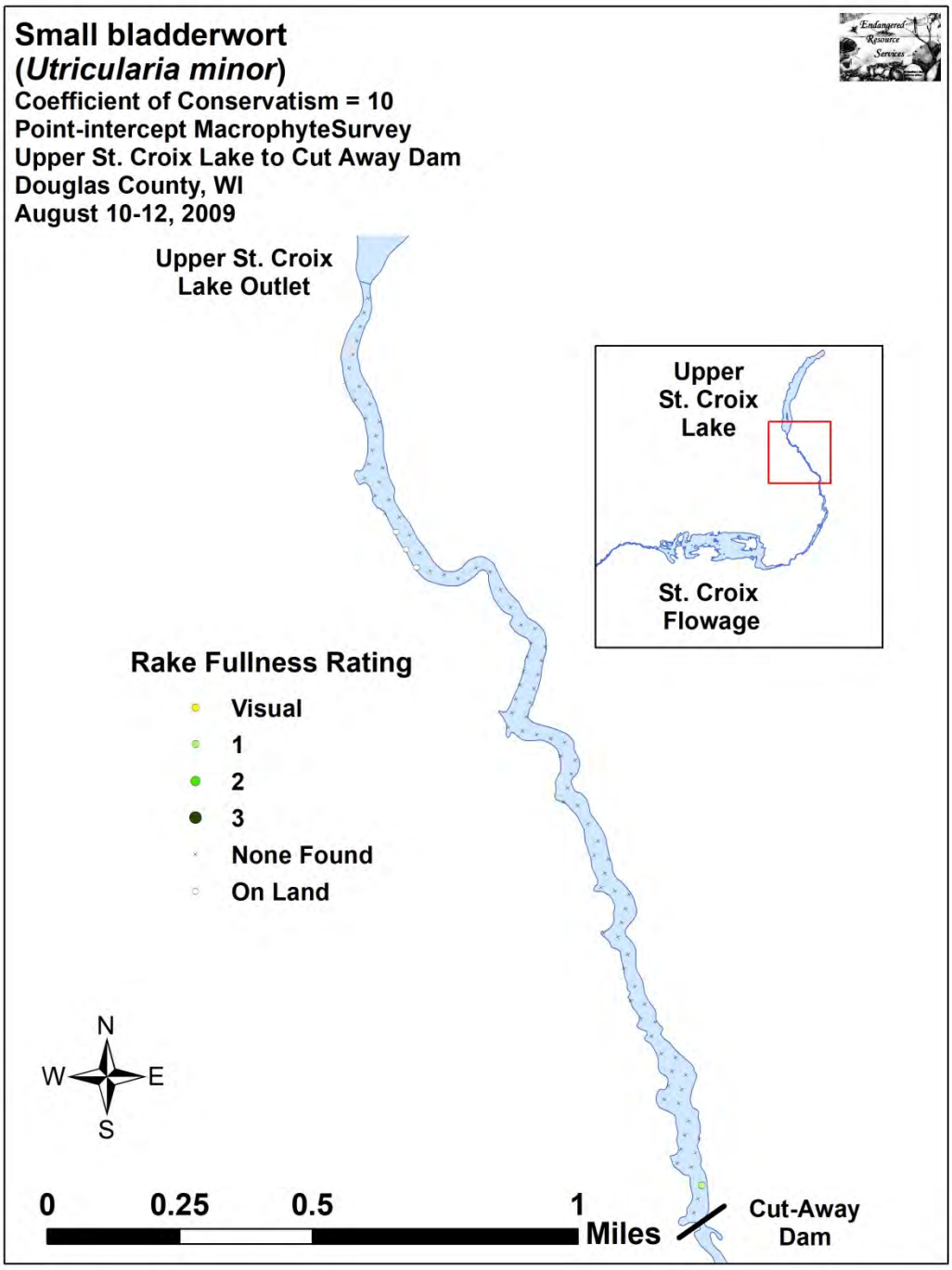
Miles
Cut-Away Dam


Small bladderwort
(Utricularia minor)
Coefficient of Conservatism = 10
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
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None Found
On Land
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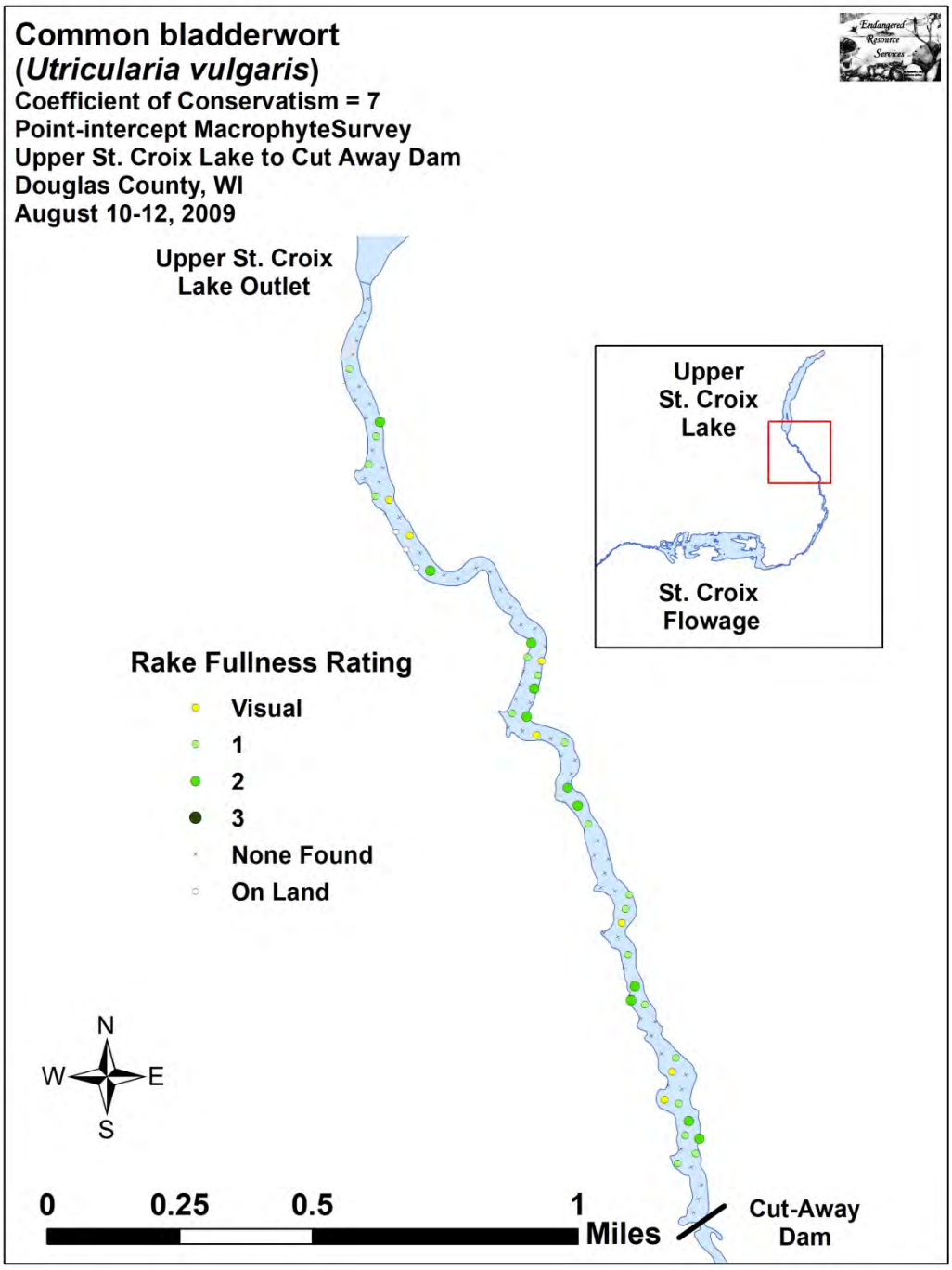
1
Miles
Cut-Away Dam


Common bladderwort
(Utricularia vulgaris)
Coefficient of Conservatism = 7
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
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None Found
On Land
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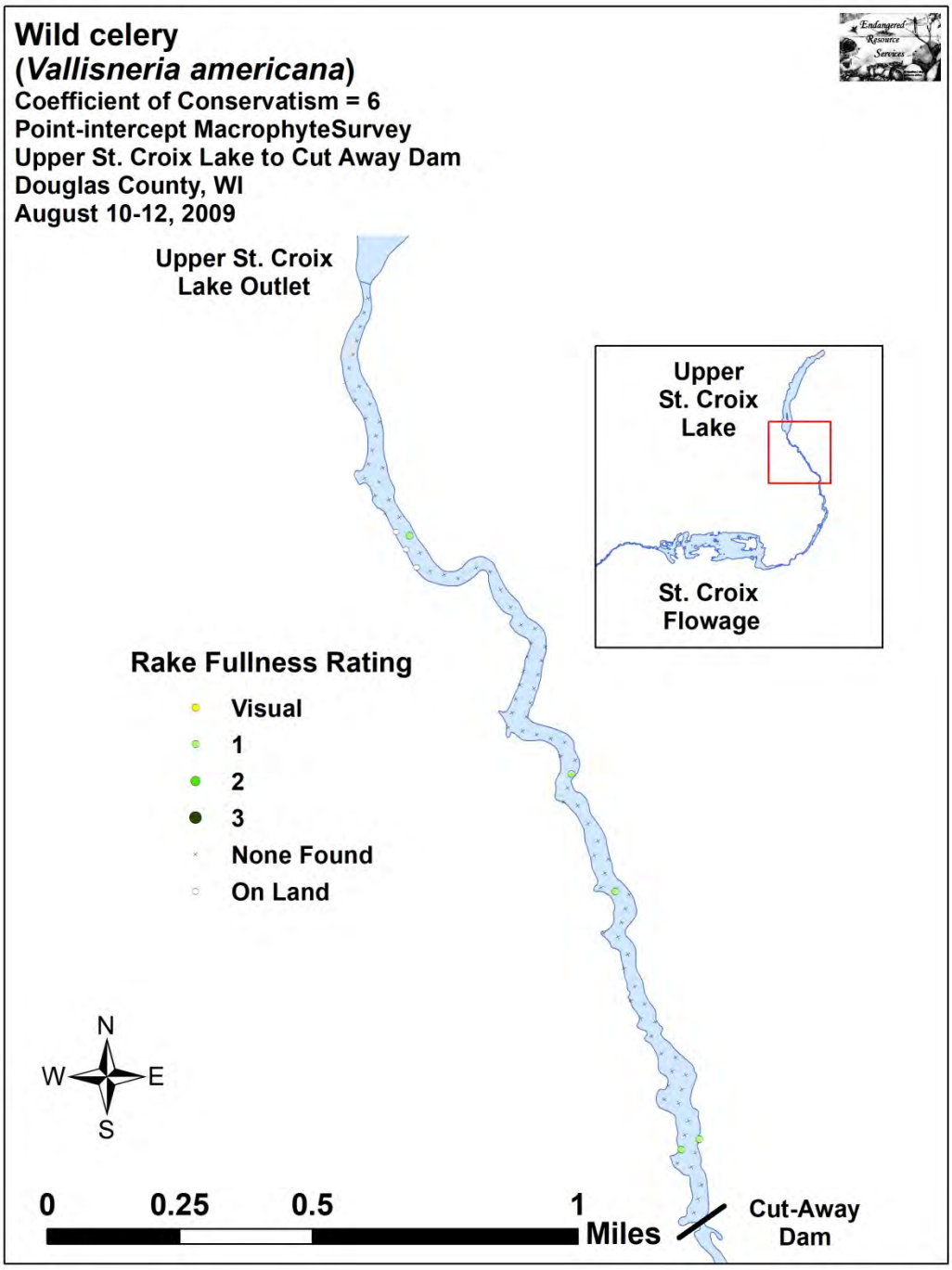
0.5
1
Miles
Cut-Away Dam


Wild celery
(Vallisneria americana)
Coefficient of Conservatism = 6
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
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Visual
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None Found
On Land
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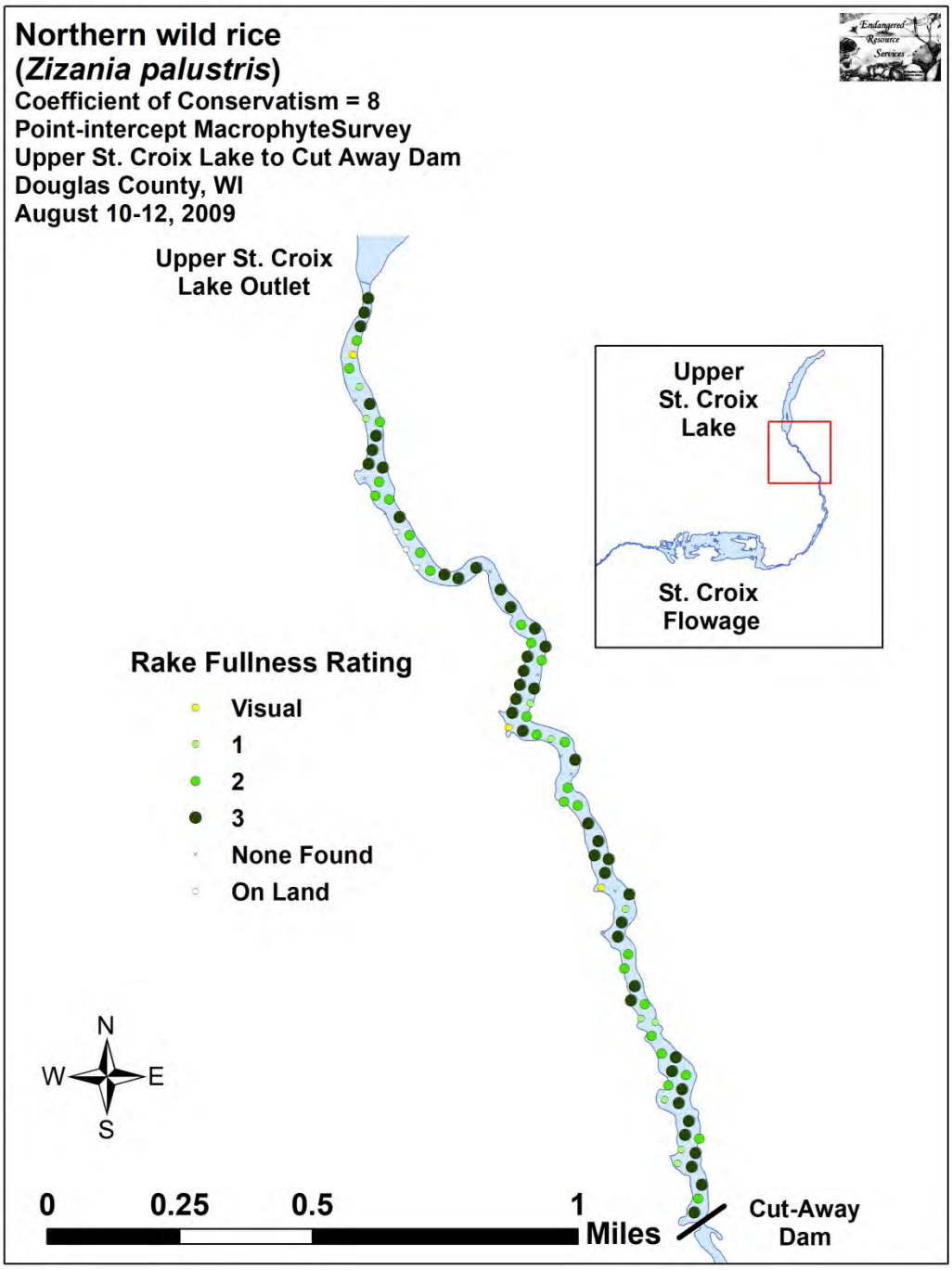
0.25
0.5
1
Miles
Cut-Away Dam


Northern wild rice
(Zizania palustris)
Coefficient of Conservatism = 8
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 10-12, 2009
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
1
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None Found
On Land
N
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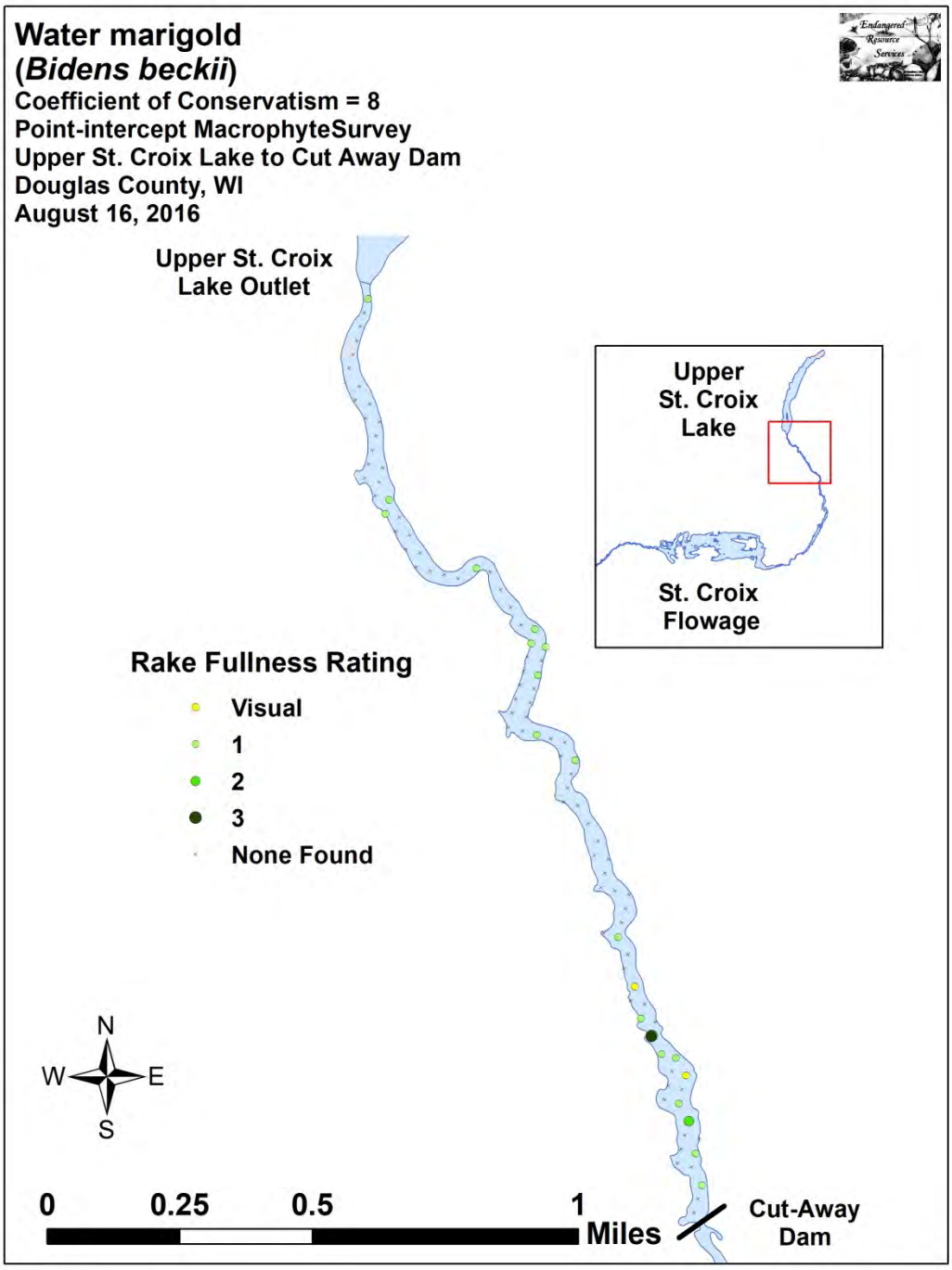
0.25
0.5
1
Miles
Cut-Away Dam

Appendix VII: August 2016 Species Density and Distribution Maps


Water marigold
(Bidens beckii)
Coefficient of Conservatism = 8
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
1
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None Found
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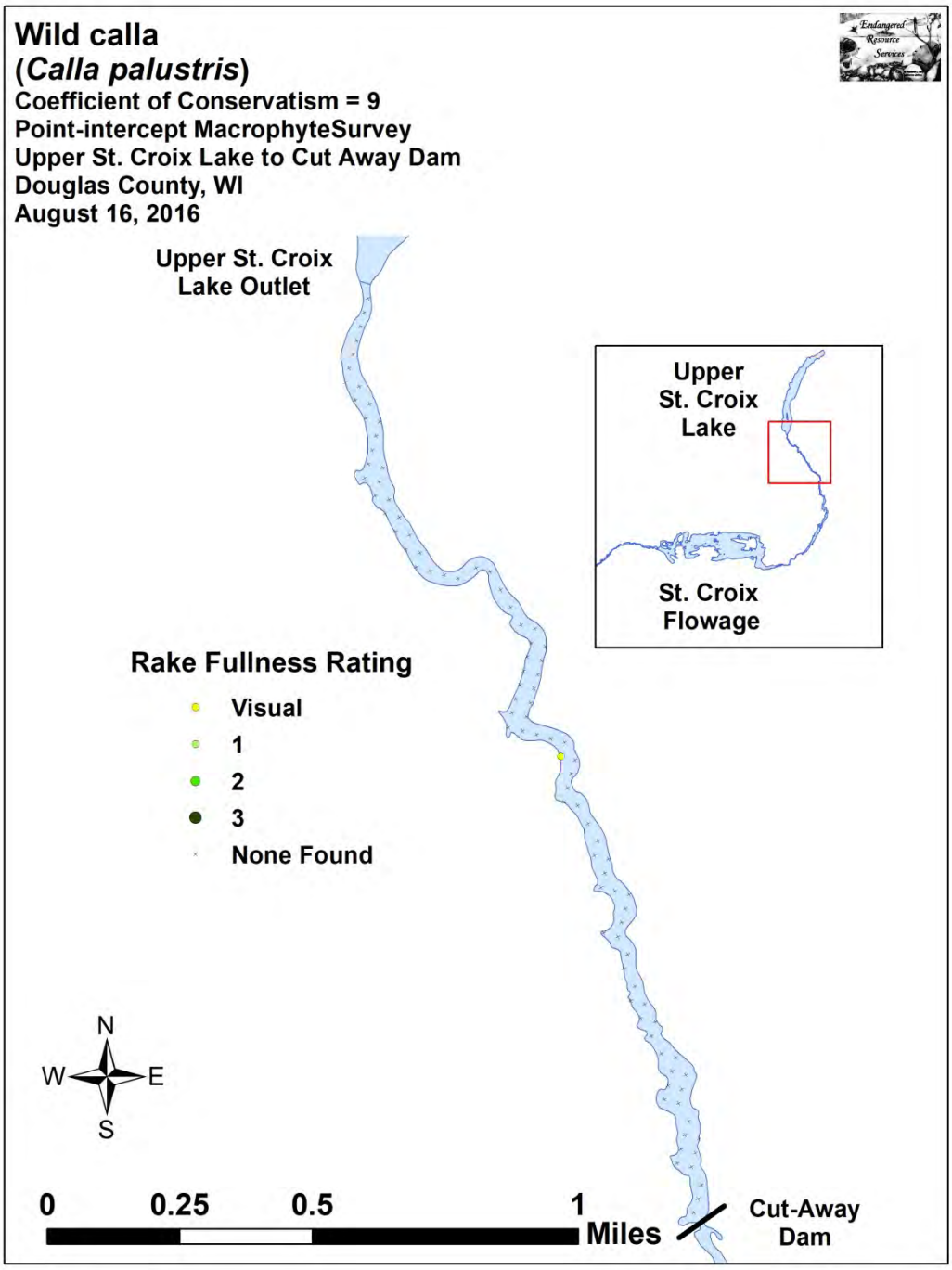
1
Miles
Cut-Away Dam


Wild calla
(Calla palustris)
Coefficient of Conservatism = 9
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
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None Found
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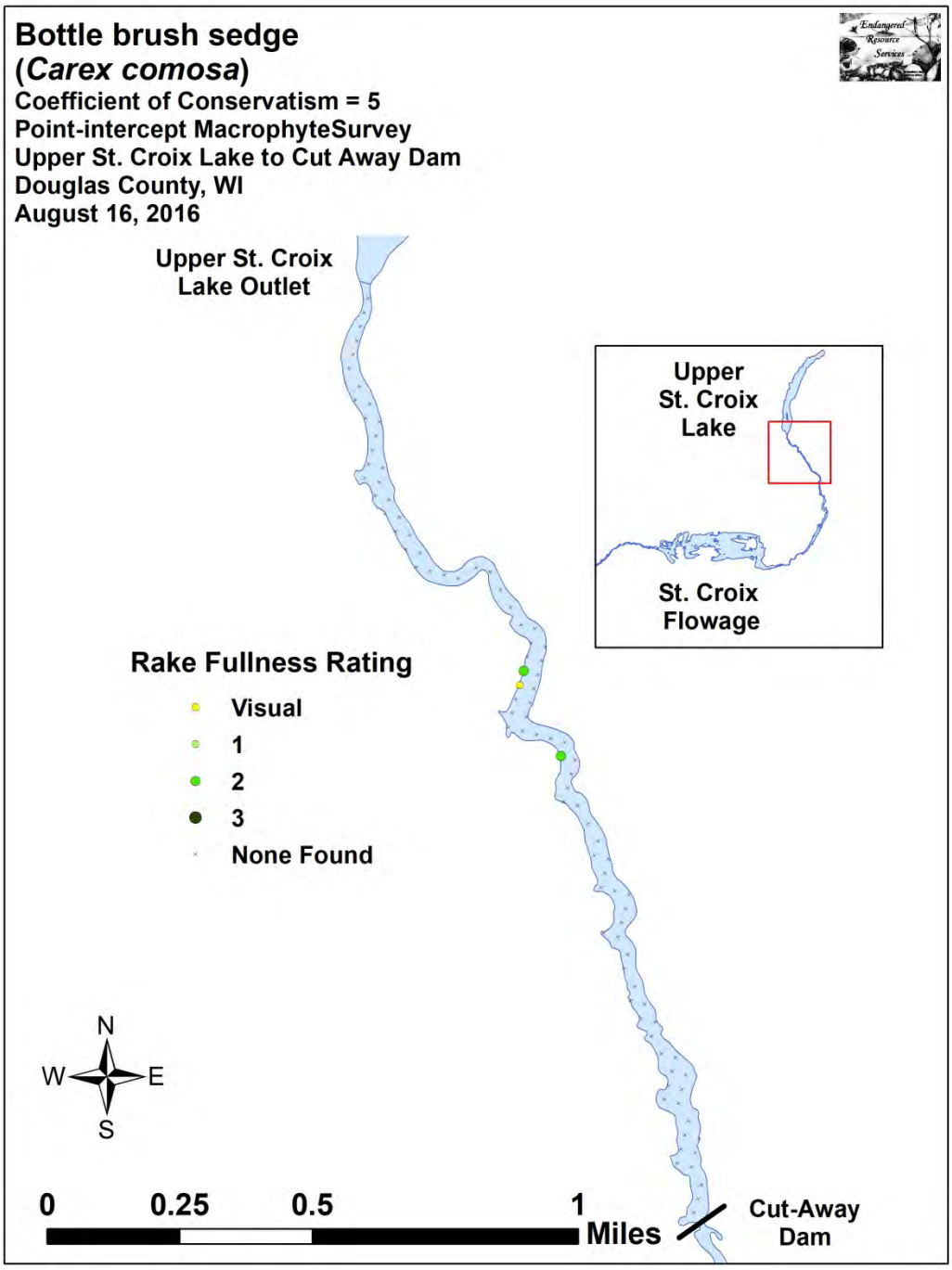
1
Miles
Cut-Away Dam


Bottle brush sedge
(Carex comosa)
Coefficient of Conservatism = 5
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
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None Found
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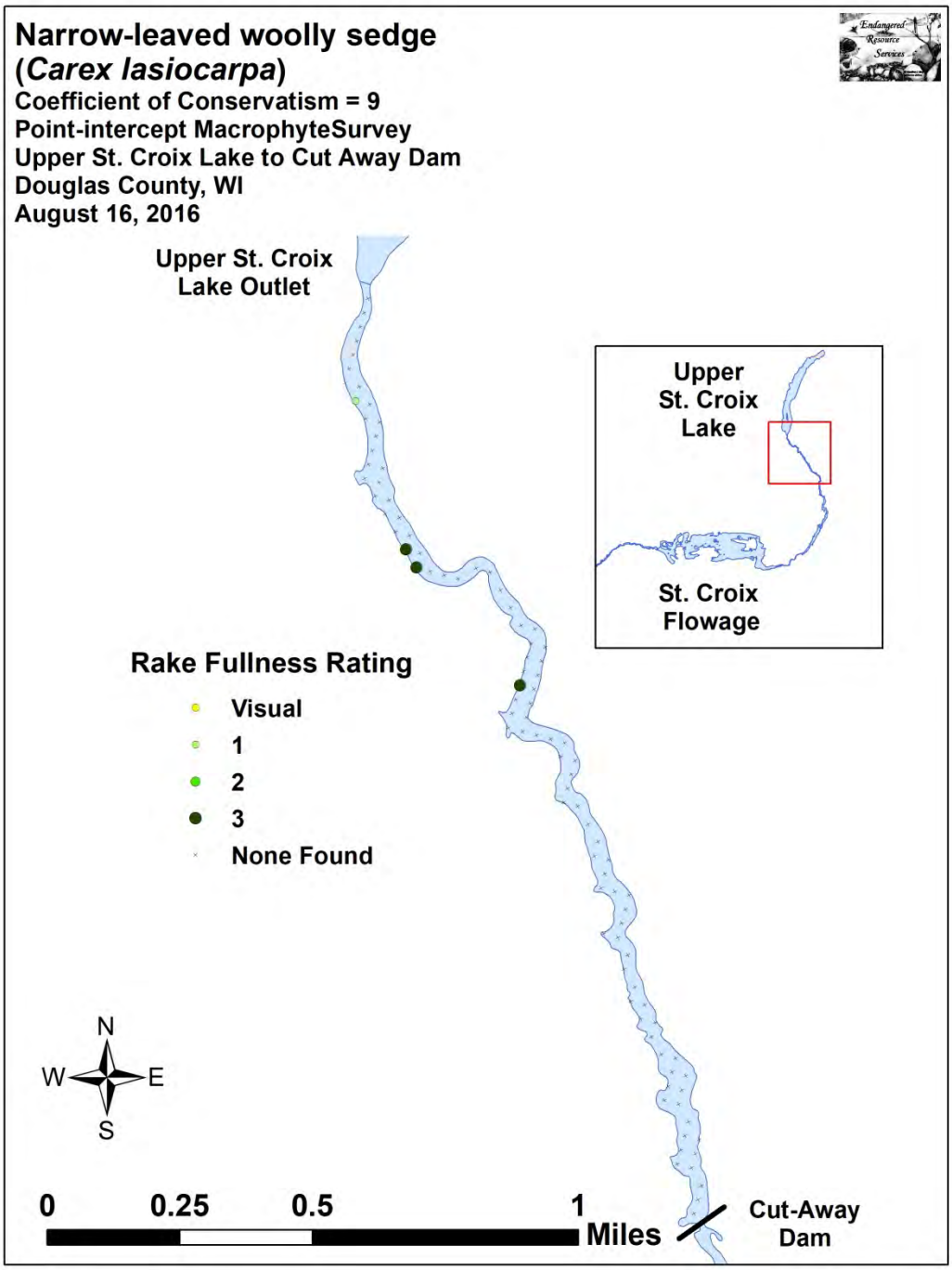
0.5
1
Miles
Cut-Away Dam


Narrow-leaved woolly sedge
(Carex lasiocarpa)
Coefficient of Conservatism = 9
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
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None Found
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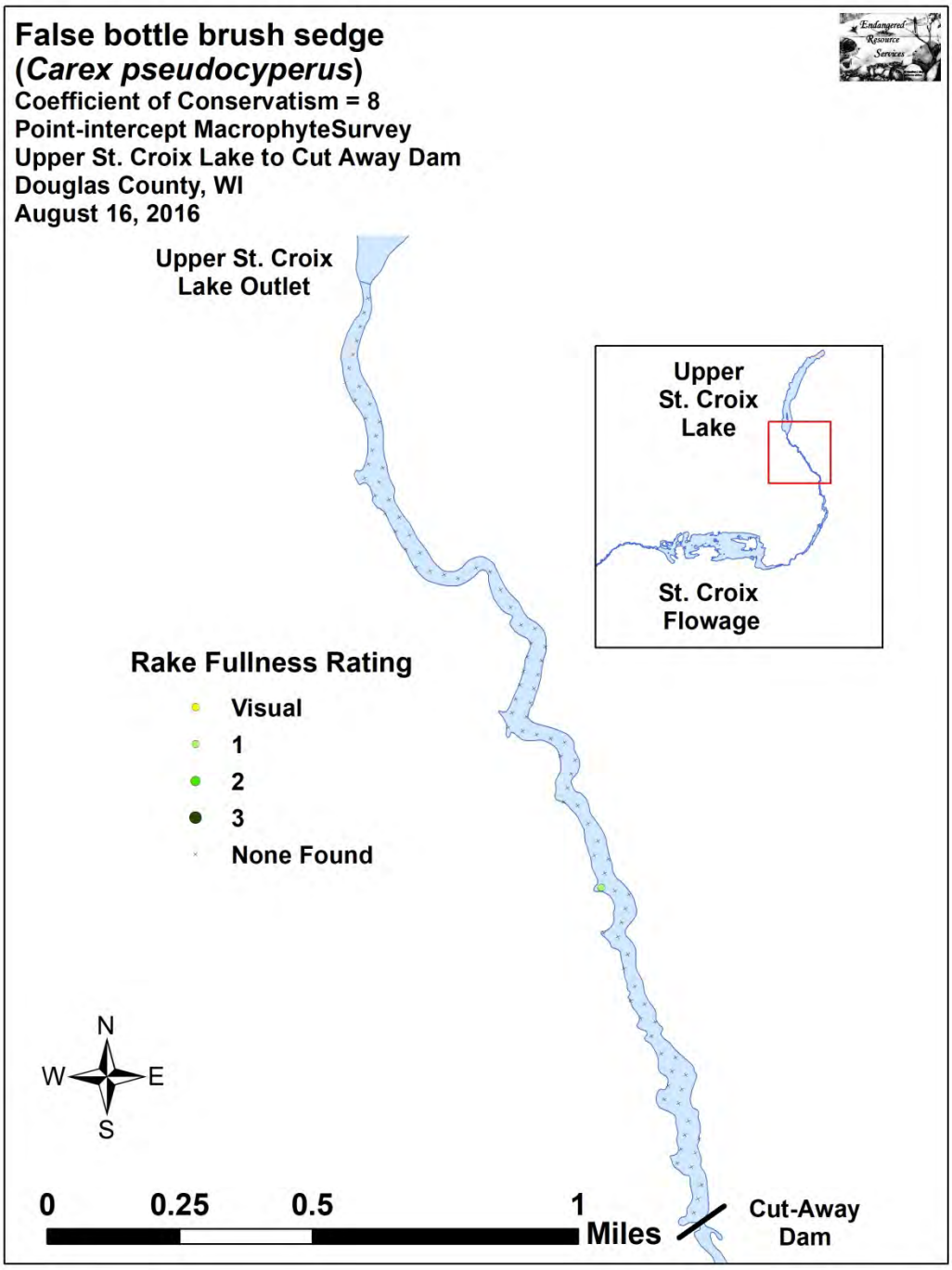
1
Miles
Cut-Away Dam


False bottle brush sedge
(Carex pseudocyperus)
Coefficient of Conservatism = 8
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
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None Found
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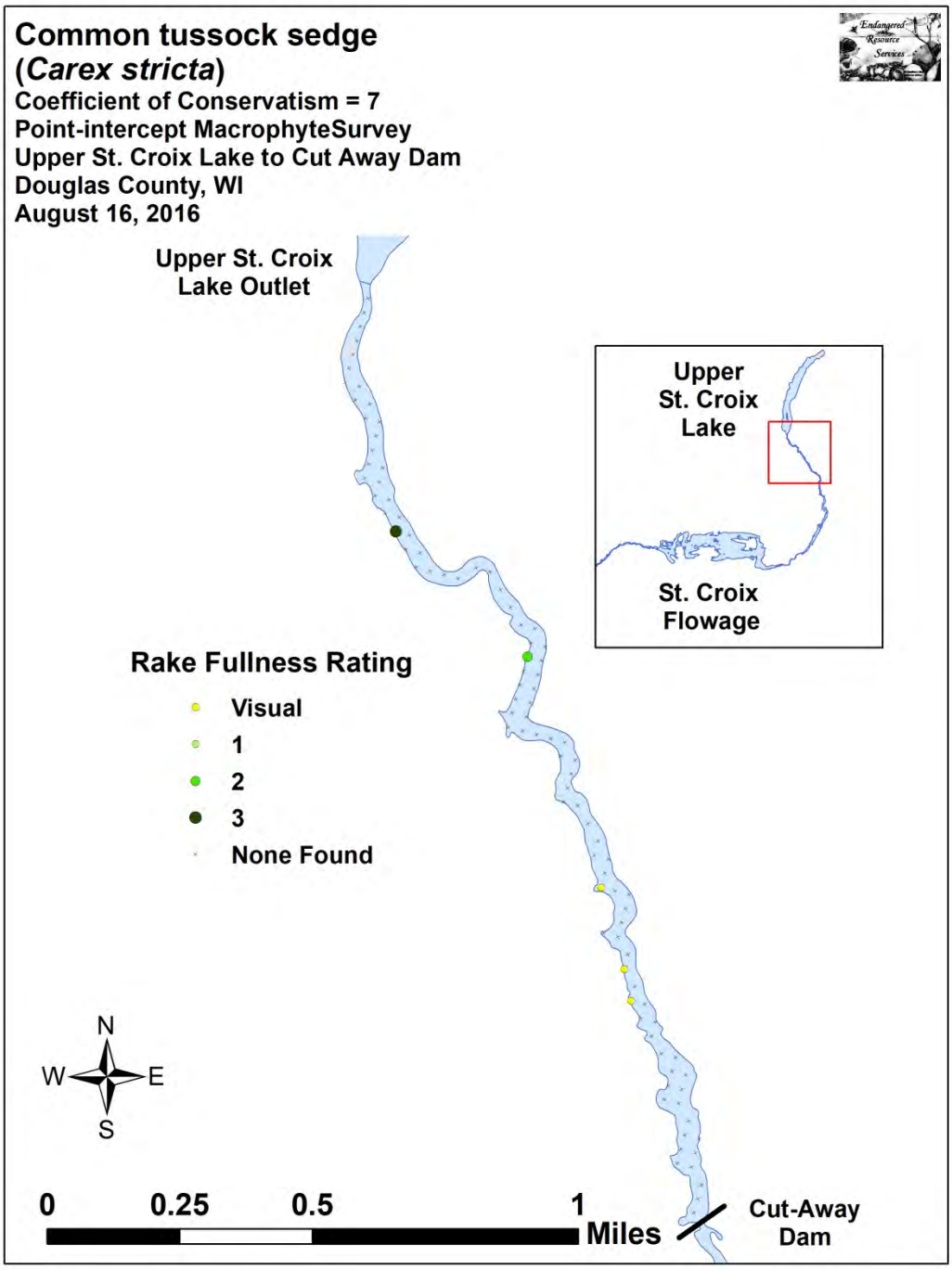
1
Miles
Cut-Away Dam


Common tussock sedge
(Carex stricta)
Coefficient of Conservatism = 7
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
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None Found
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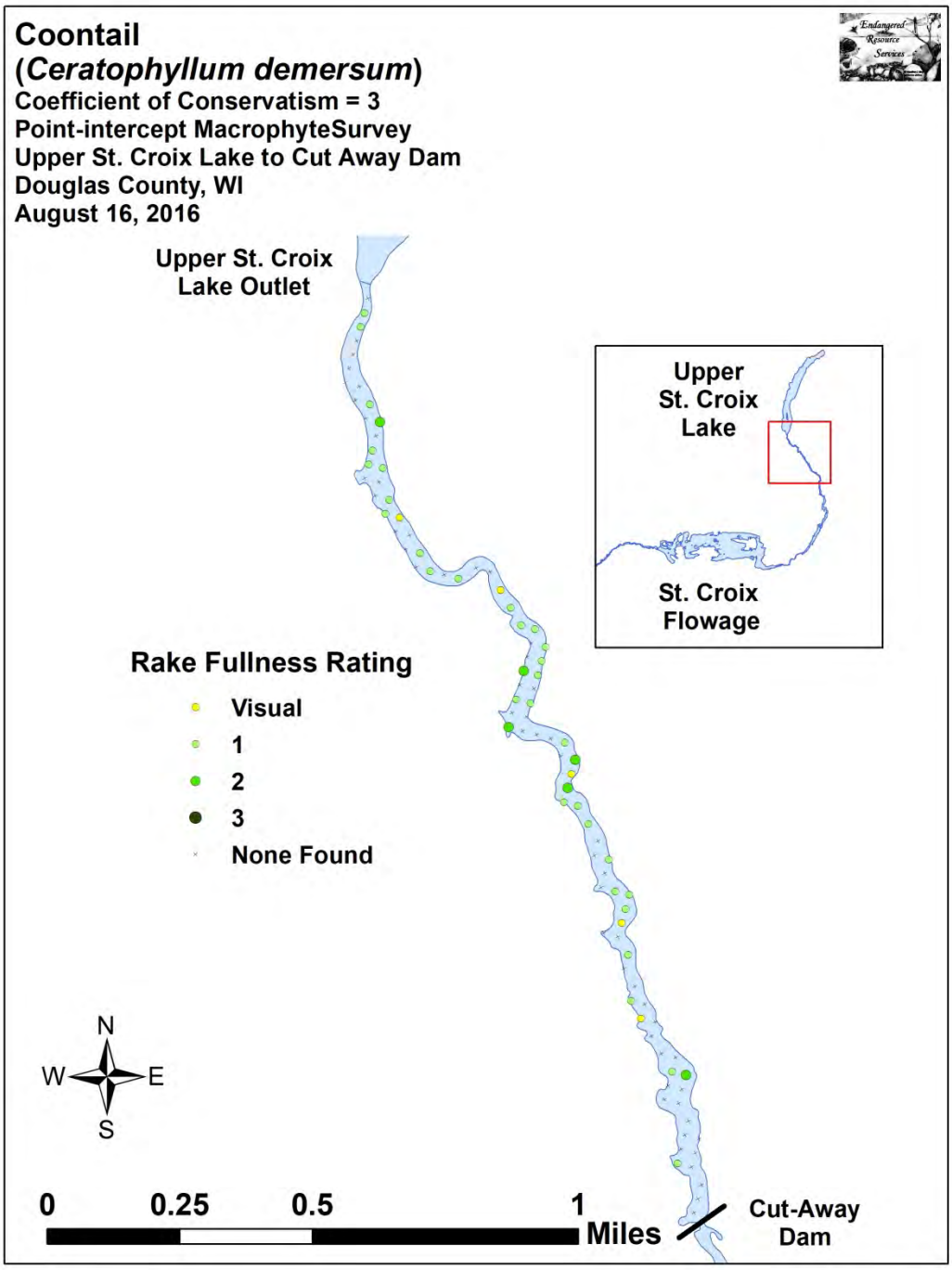
Miles
Cut-Away Dam


Coontail
(Ceratophyllum demersum)
Coefficient of Conservatism = 3
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
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None Found
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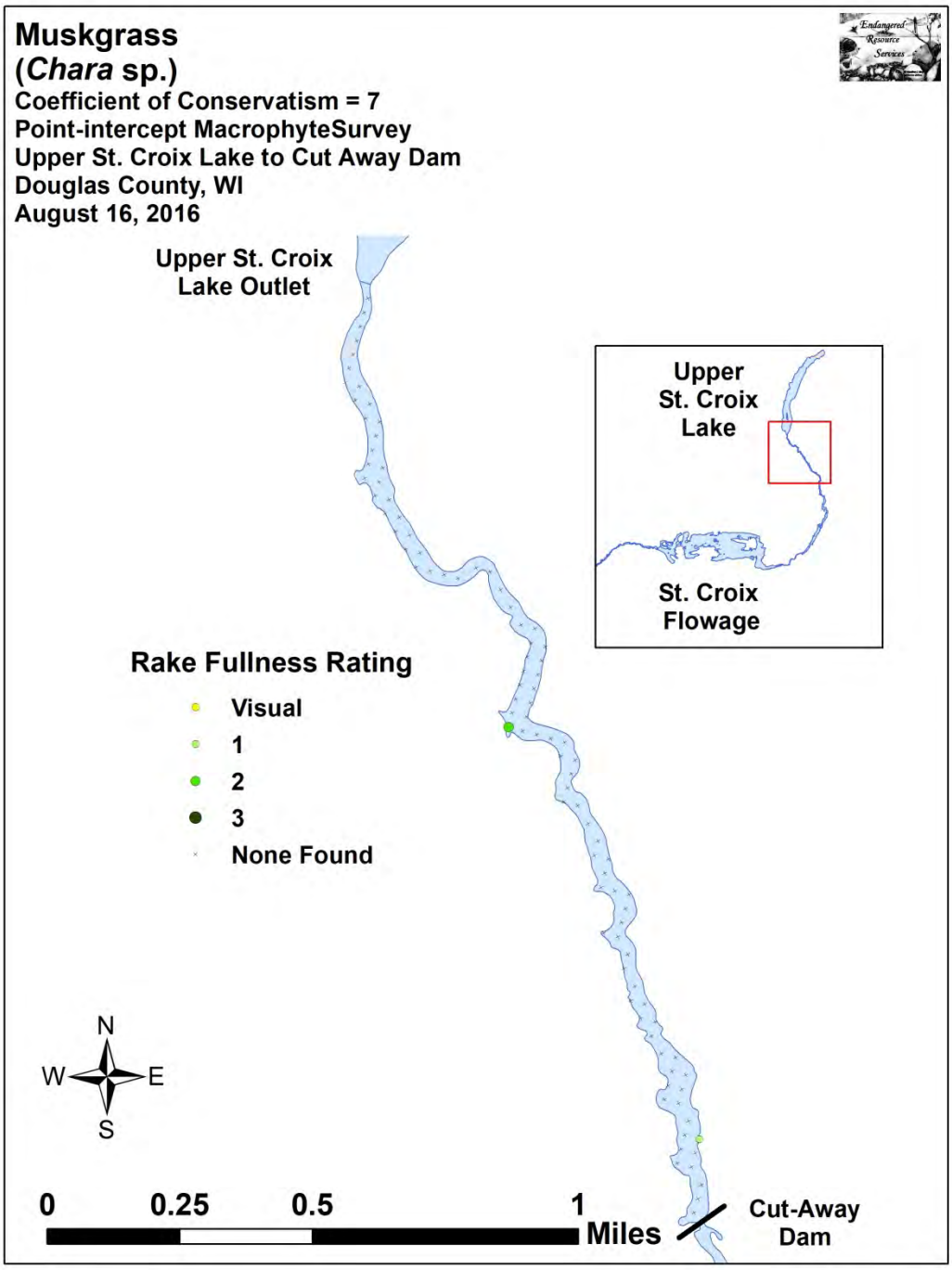
Miles
Cut-Away Dam


Muskgrass
(Chara sp.)
Coefficient of Conservatism = 7
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
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None Found
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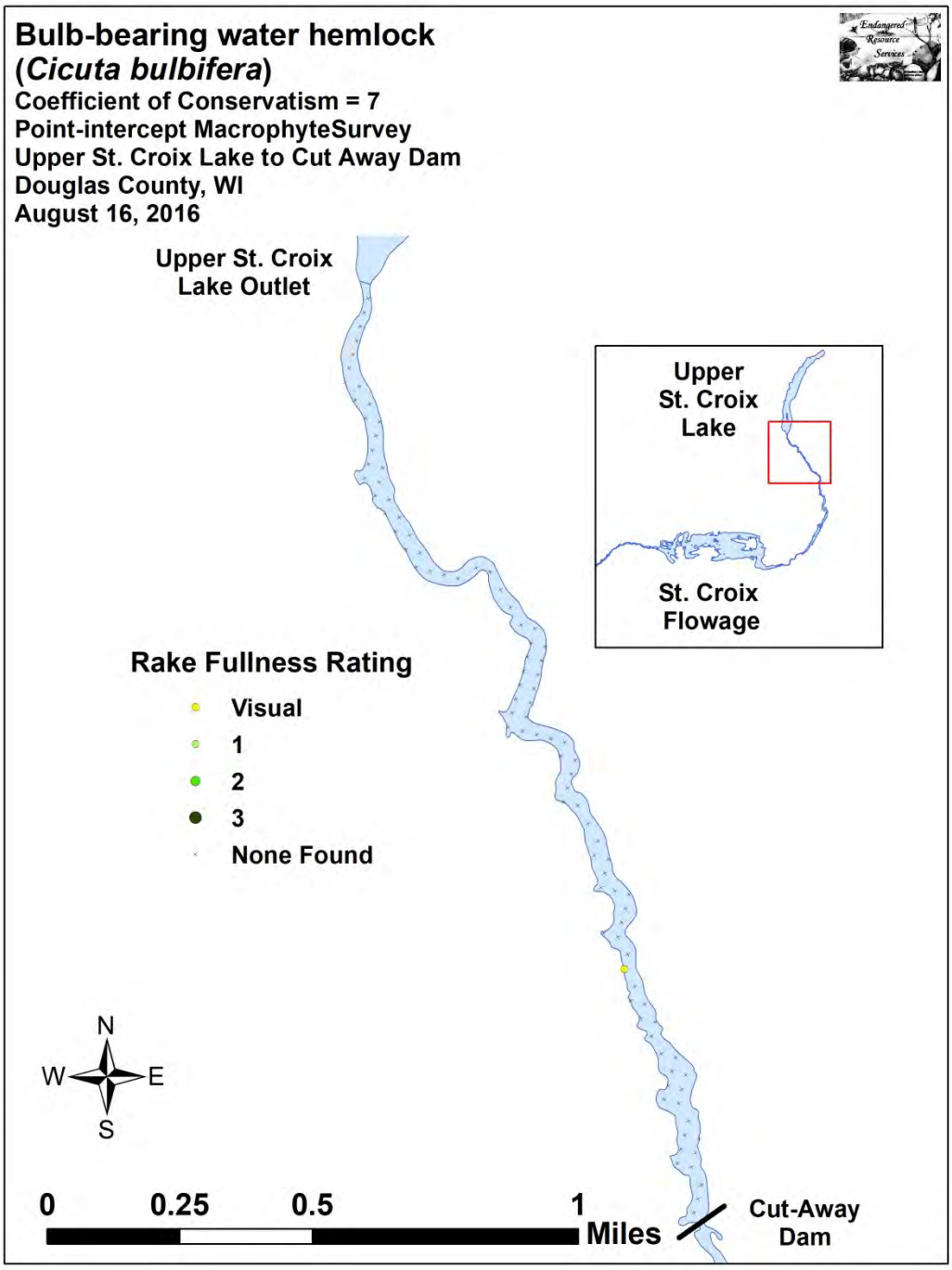
Miles
Cut-Away Dam


Bulb-bearing water hemlock
(Cicuta bulbifera)
Coefficient of Conservatism = 7
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
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None Found
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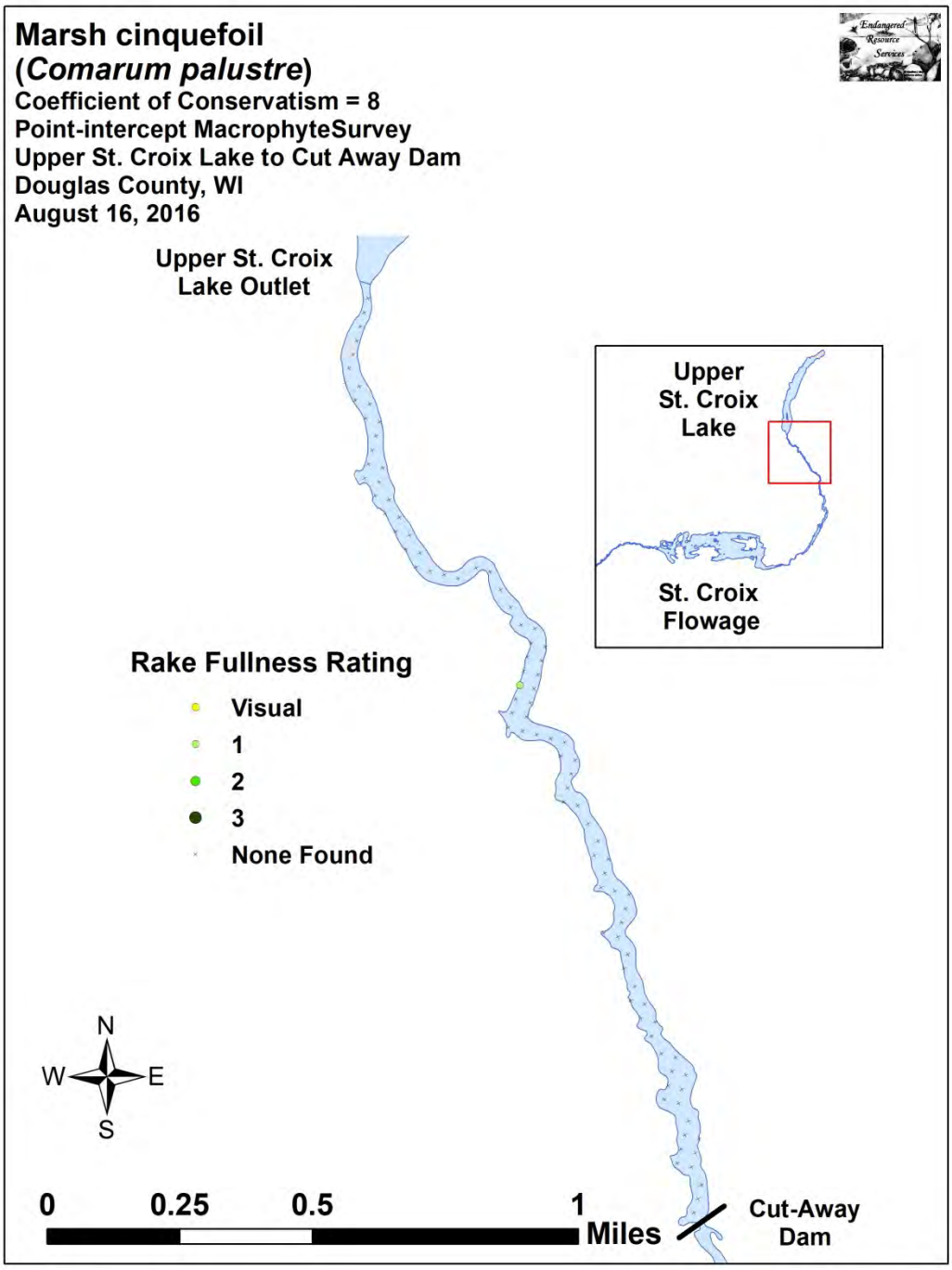
Miles
Cut-Away Dam


Marsh cinquefoil
(Comarum palustre)
Coefficient of Conservatism = 8
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
Upper St. Croix Lake Outlet
Upper St. Croix Lake
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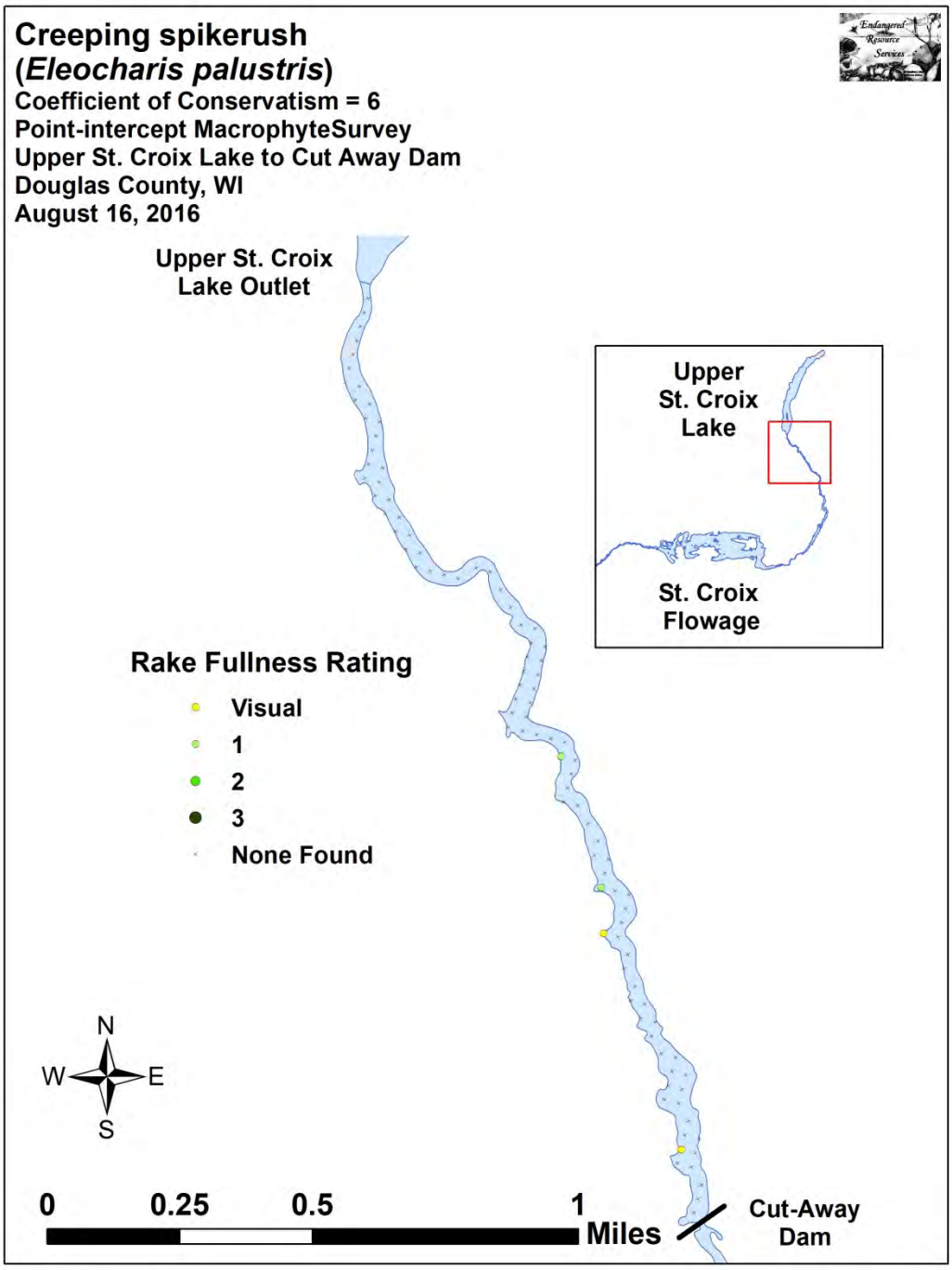
Miles
Cut-Away Dam


Creeping spikerush
(Eleocharis palustris)
Coefficient of Conservatism = 6
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
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Upper St. Croix Lake
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None Found
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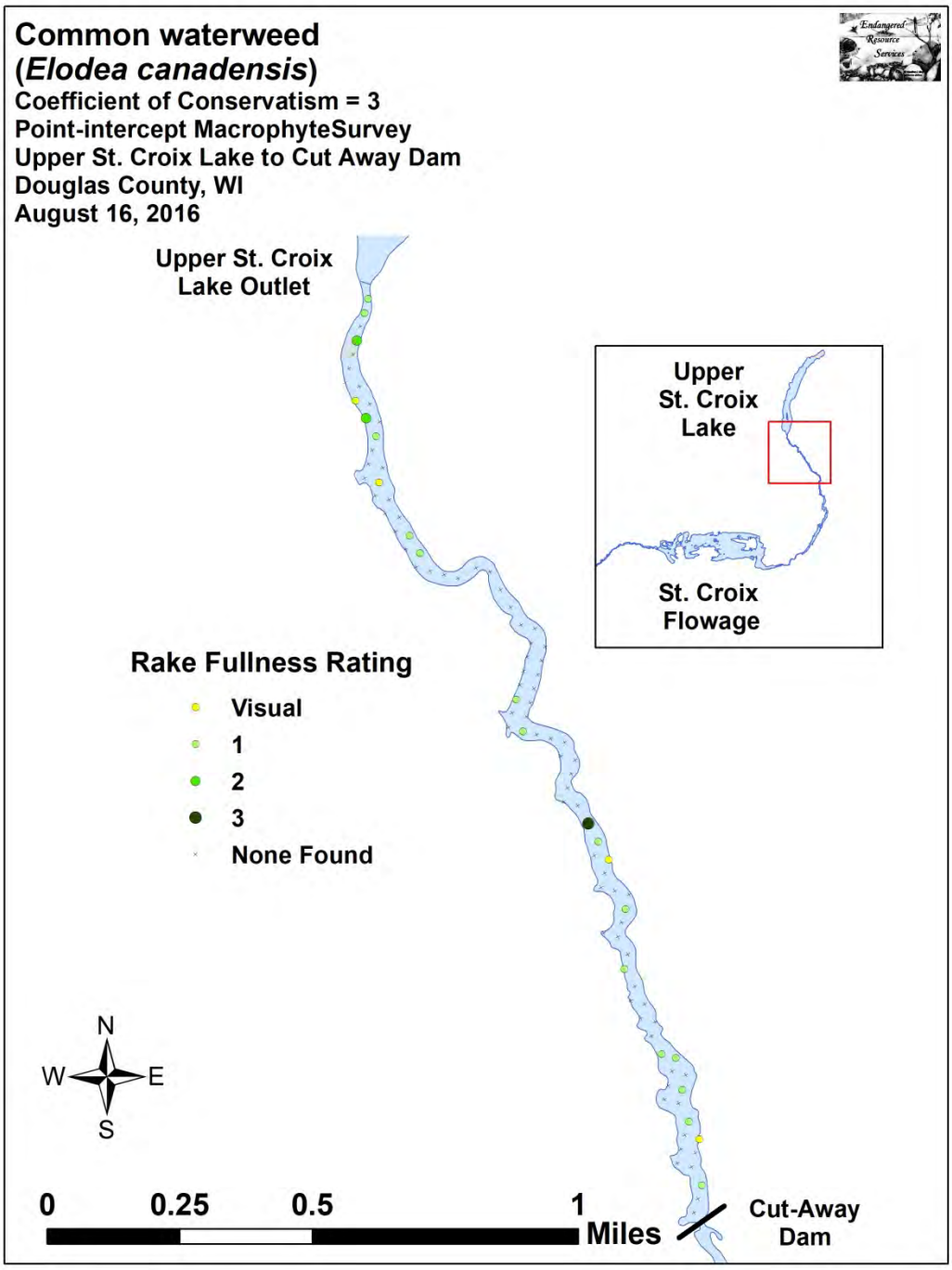
Miles
Cut-Away Dam


Common waterweed
(Elodea canadensis)
Coefficient of Conservatism = 3
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
Upper St. Croix Lake Outlet
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St. Croix Flowage
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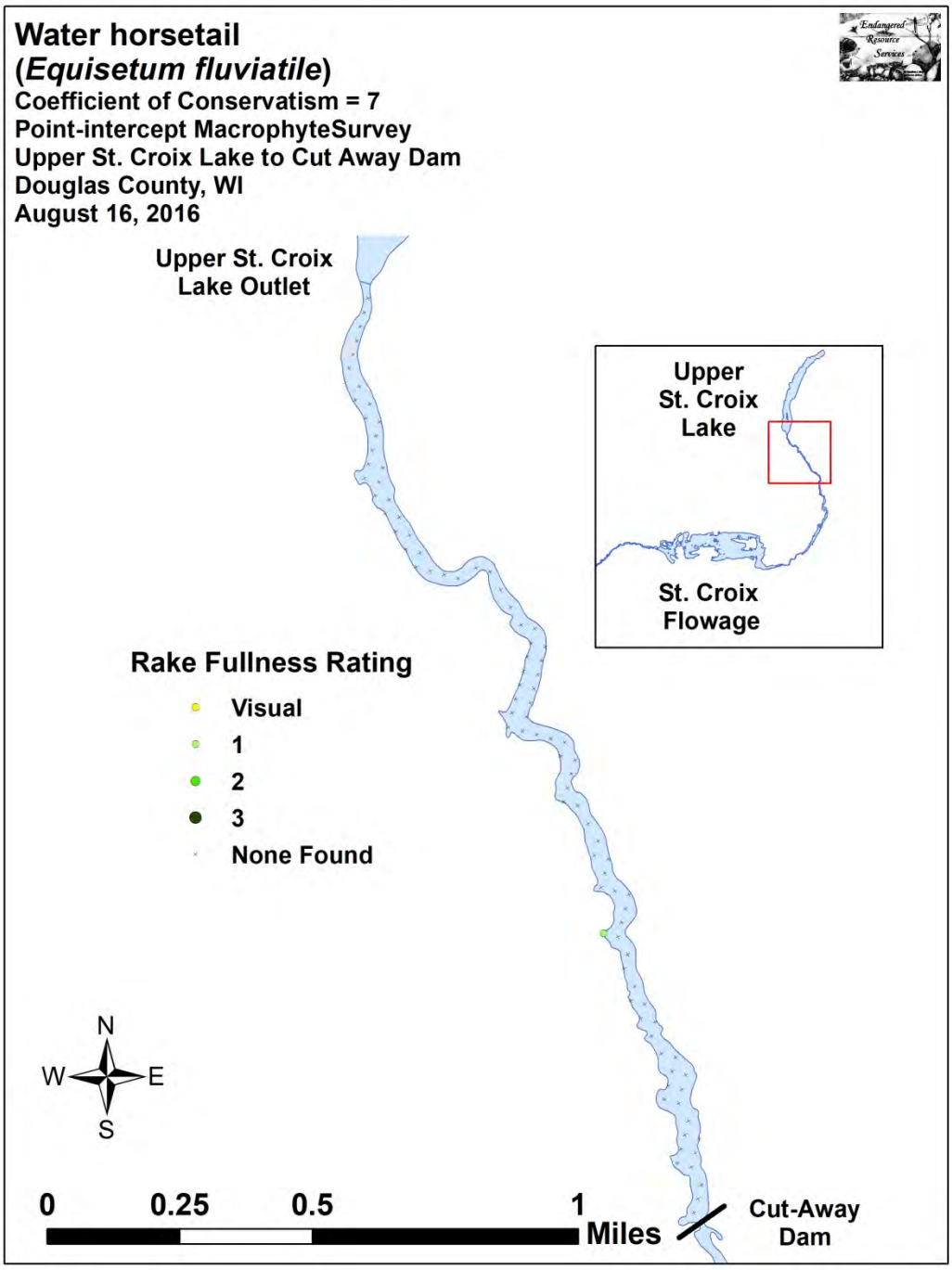
Miles
Cut-Away Dam


Water horsetail
(Equisetum fluviatile)
Coefficient of Conservatism = 7
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
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St. Croix Flowage
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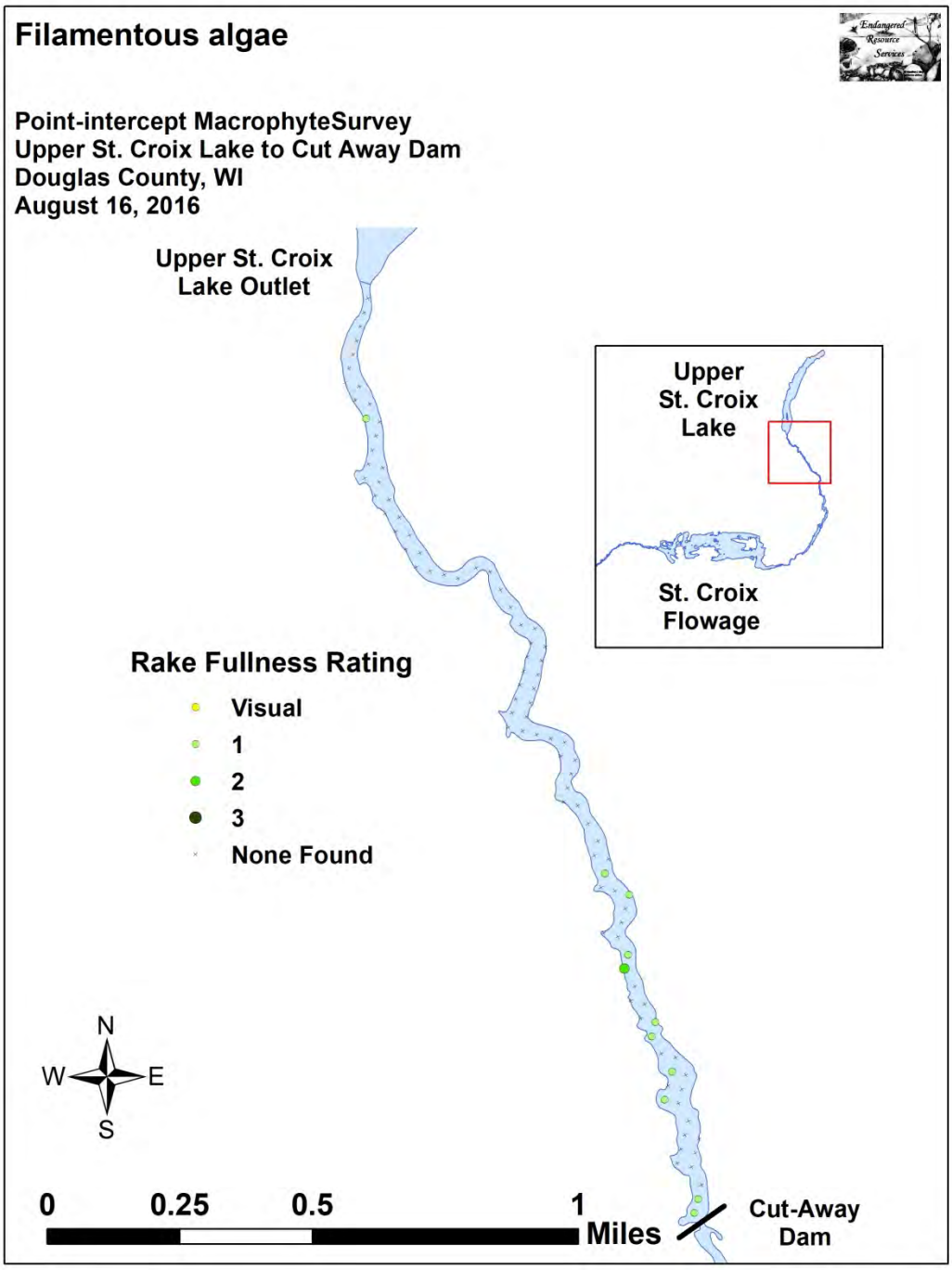
Miles
Cut-Away Dam


Filamentous algae
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
1
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None Found
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0.25
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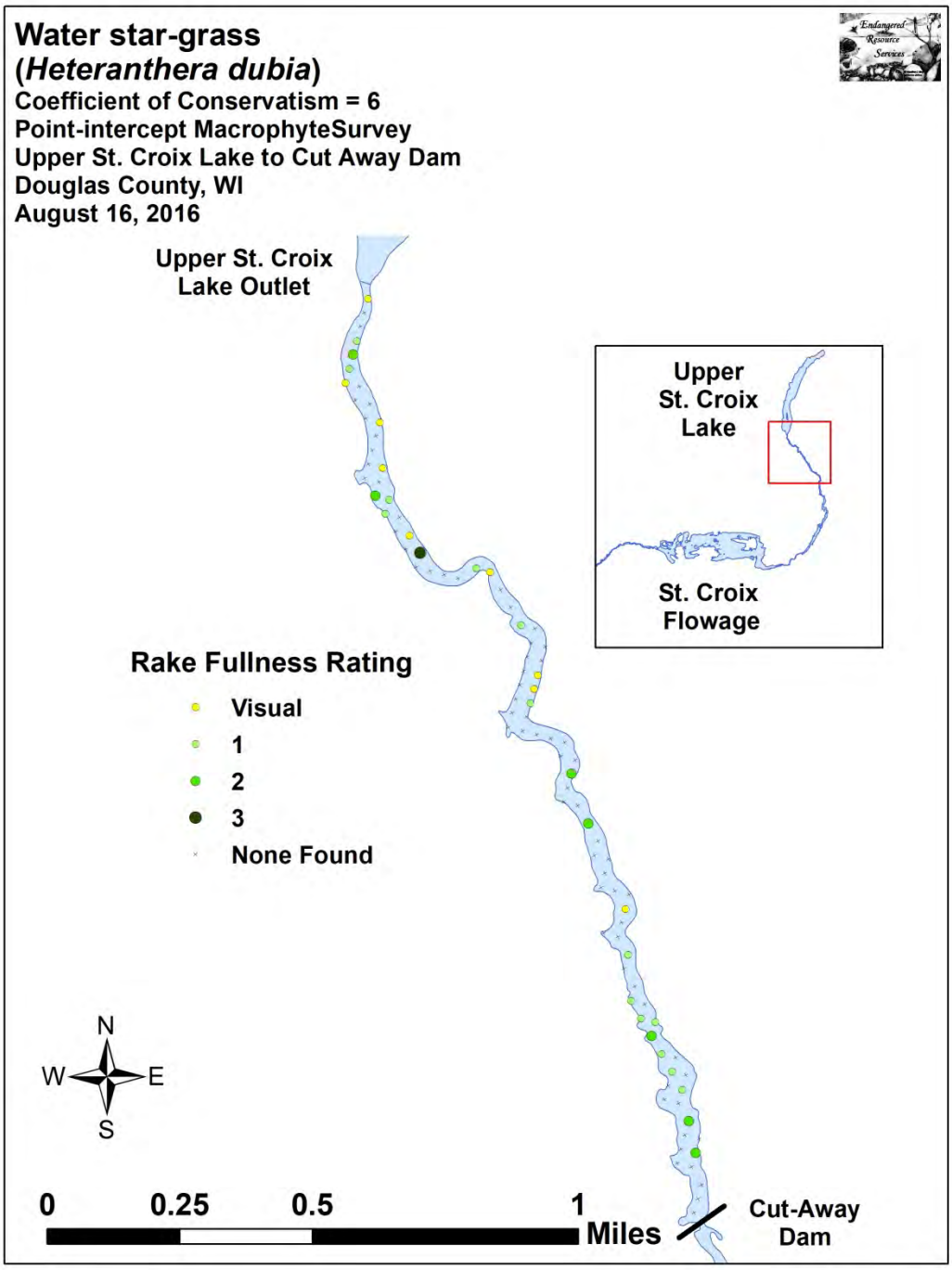
Miles
Cut-Away Dam


Water star-grass
(Heteranthera dubia)
Coefficient of Conservatism = 6
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
1
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None Found
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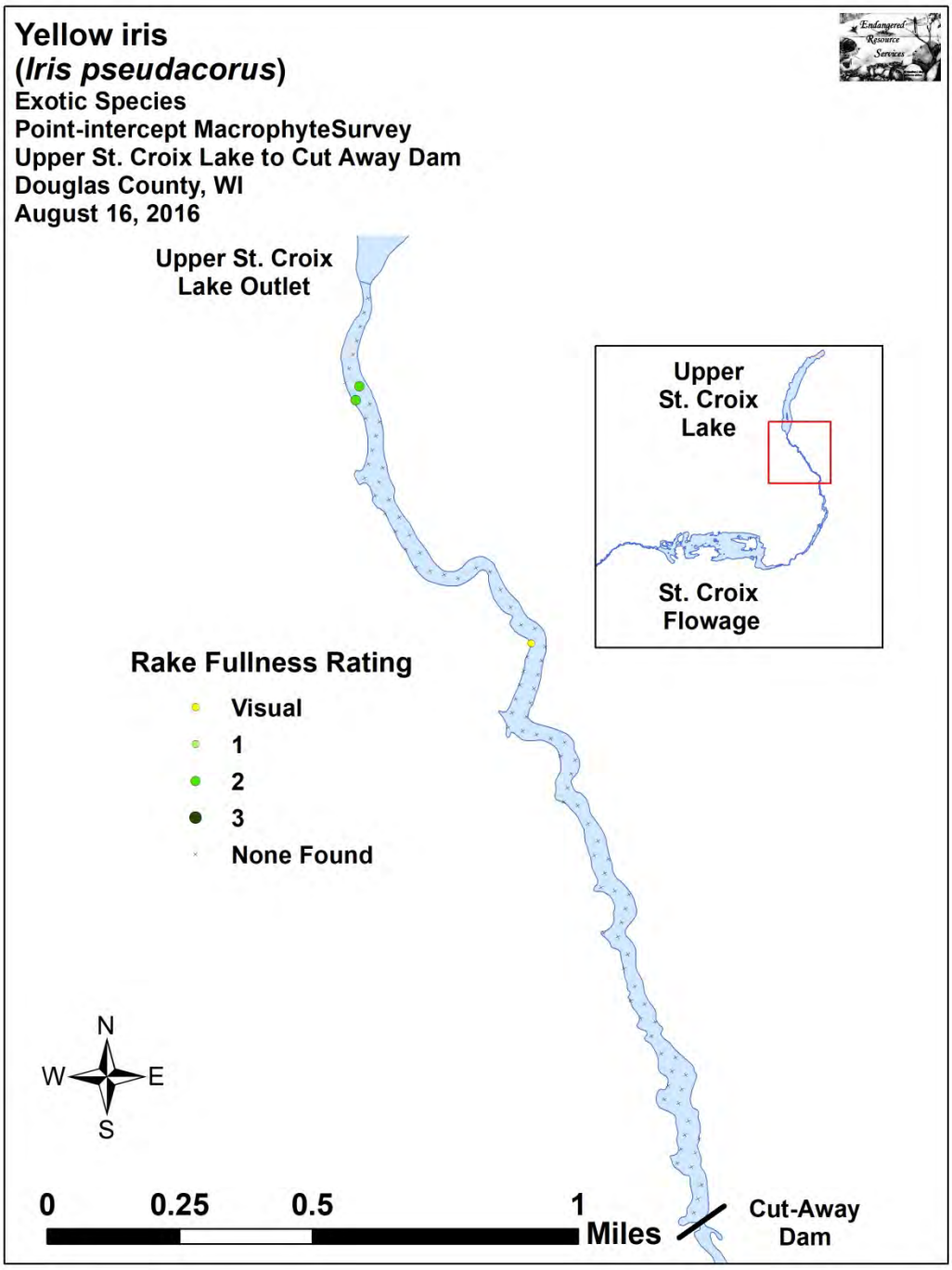
Miles
Cut-Away Dam


Yellow iris
(Iris pseudacorus)
Exotic Species
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
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None Found
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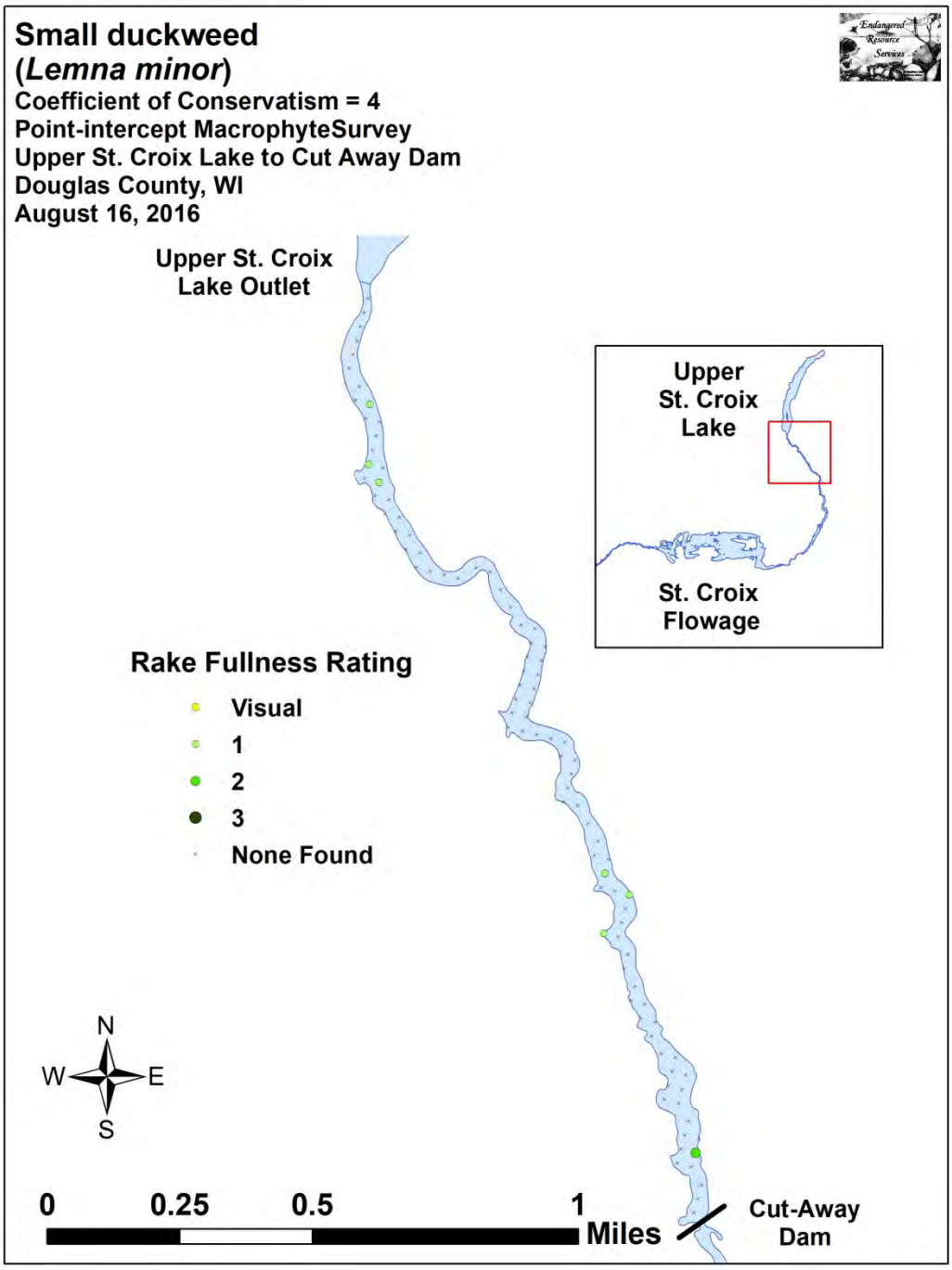
Miles
Cut-Away Dam


Small duckweed
(Lemna minor)
Coefficient of Conservatism = 4
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
Upper St. Croix Lake Outlet
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Visual
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None Found
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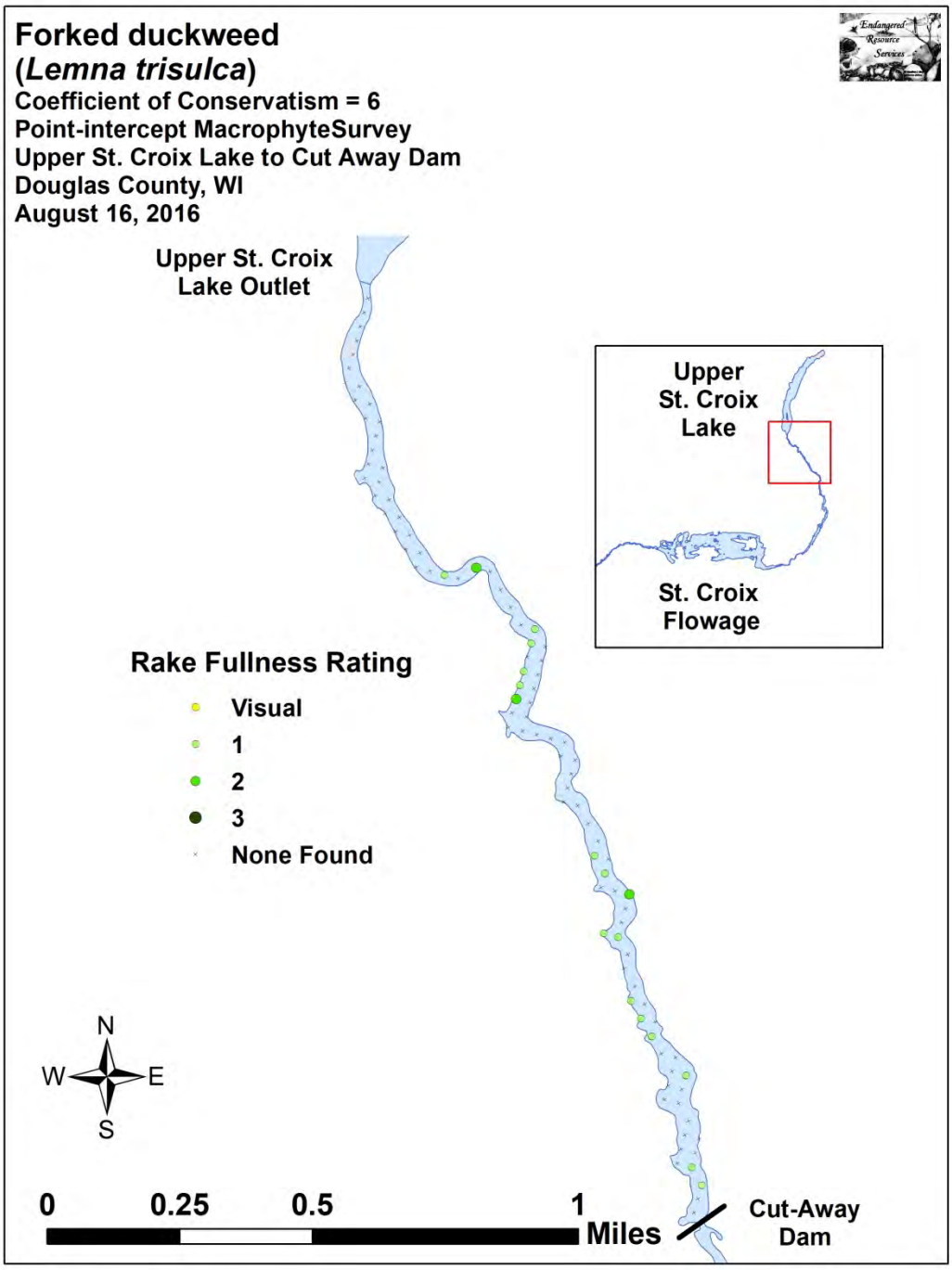
Miles
Cut-Away Dam


Forked duckweed
(Lemna trisulca)
Coefficient of Conservatism = 6
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
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St. Croix Flowage
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Visual
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None Found
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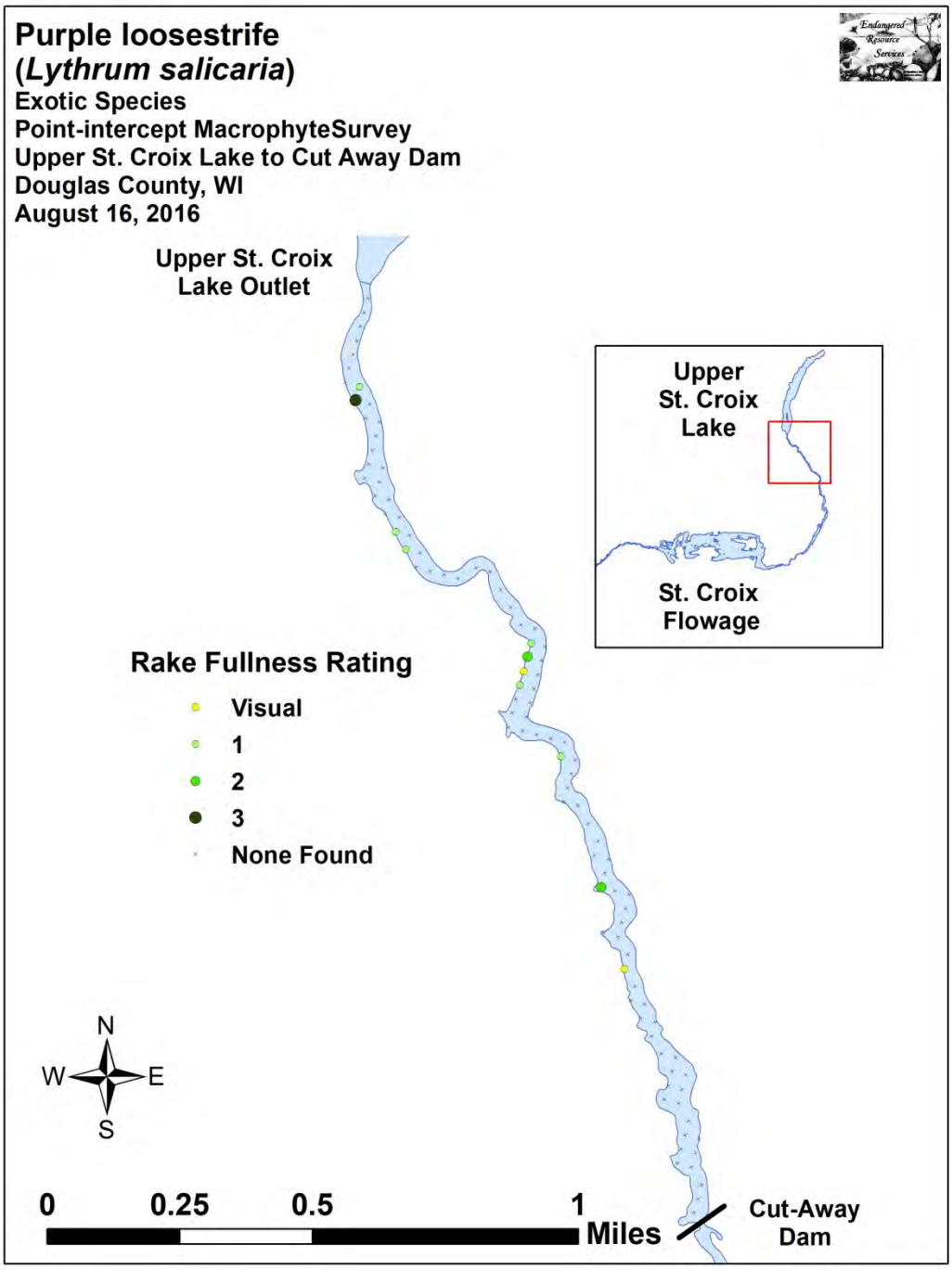
Miles
Cut-Away Dam


Purple loosestrife
(Lythrum salicaria)
Exotic Species
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
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Visual
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None Found
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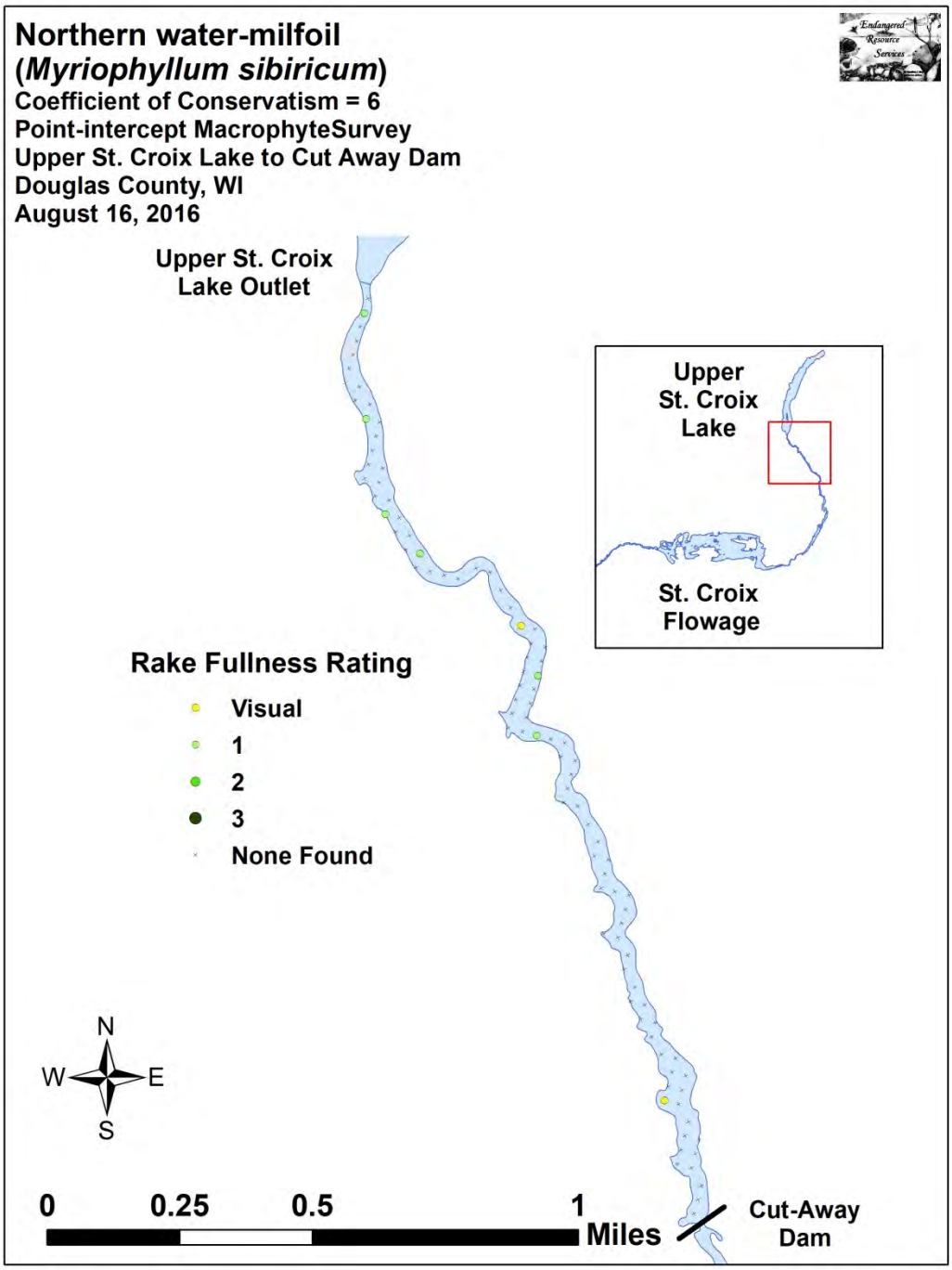
Miles
Cut-Away Dam


Northern water-milfoil
(Myriophyllum sibiricum)
Coefficient of Conservatism = 6
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
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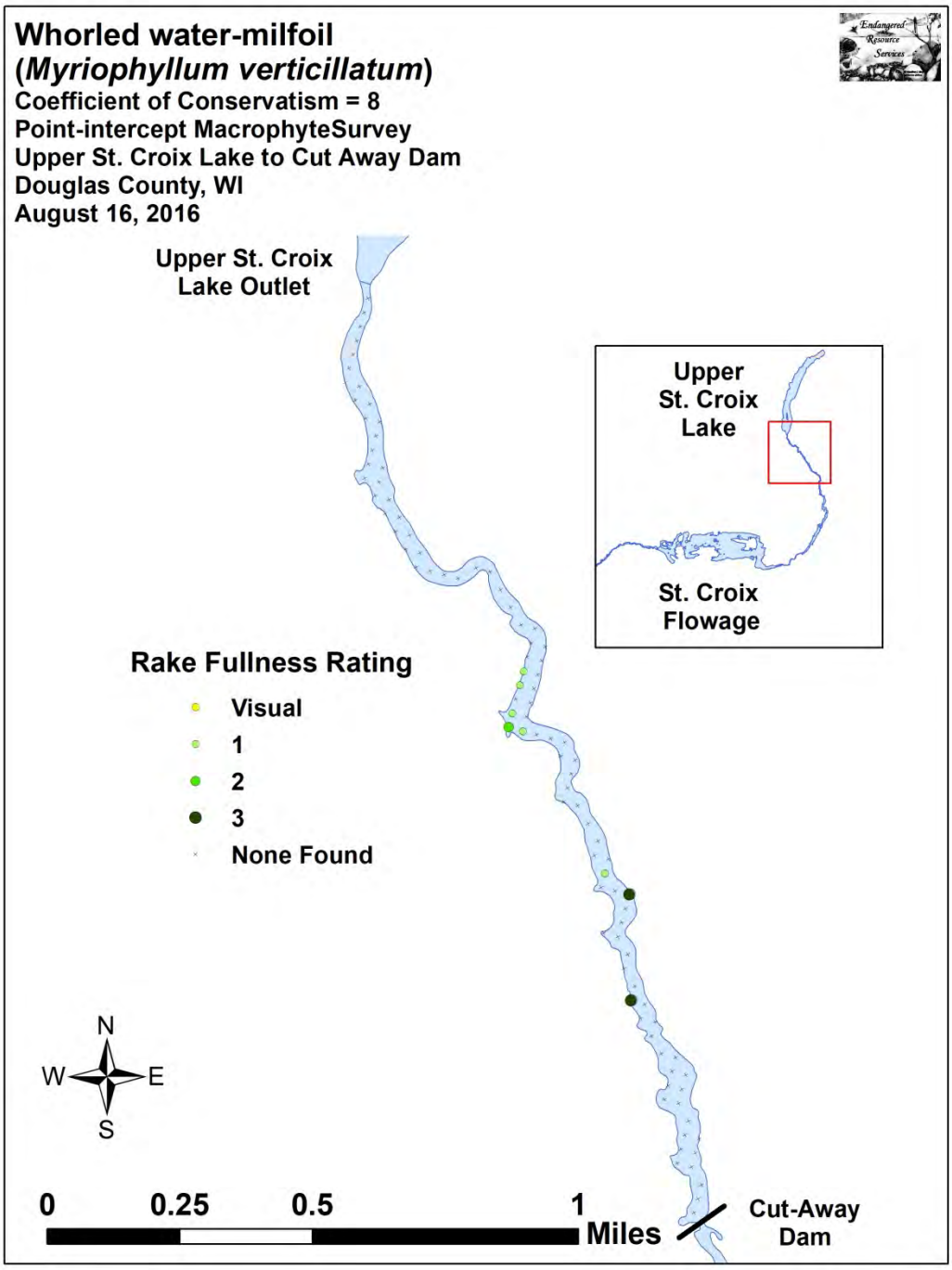
Miles
Cut-Away Dam


Whorled water-milfoil
(Myriophyllum verticillatum)
Coefficient of Conservatism = 8
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
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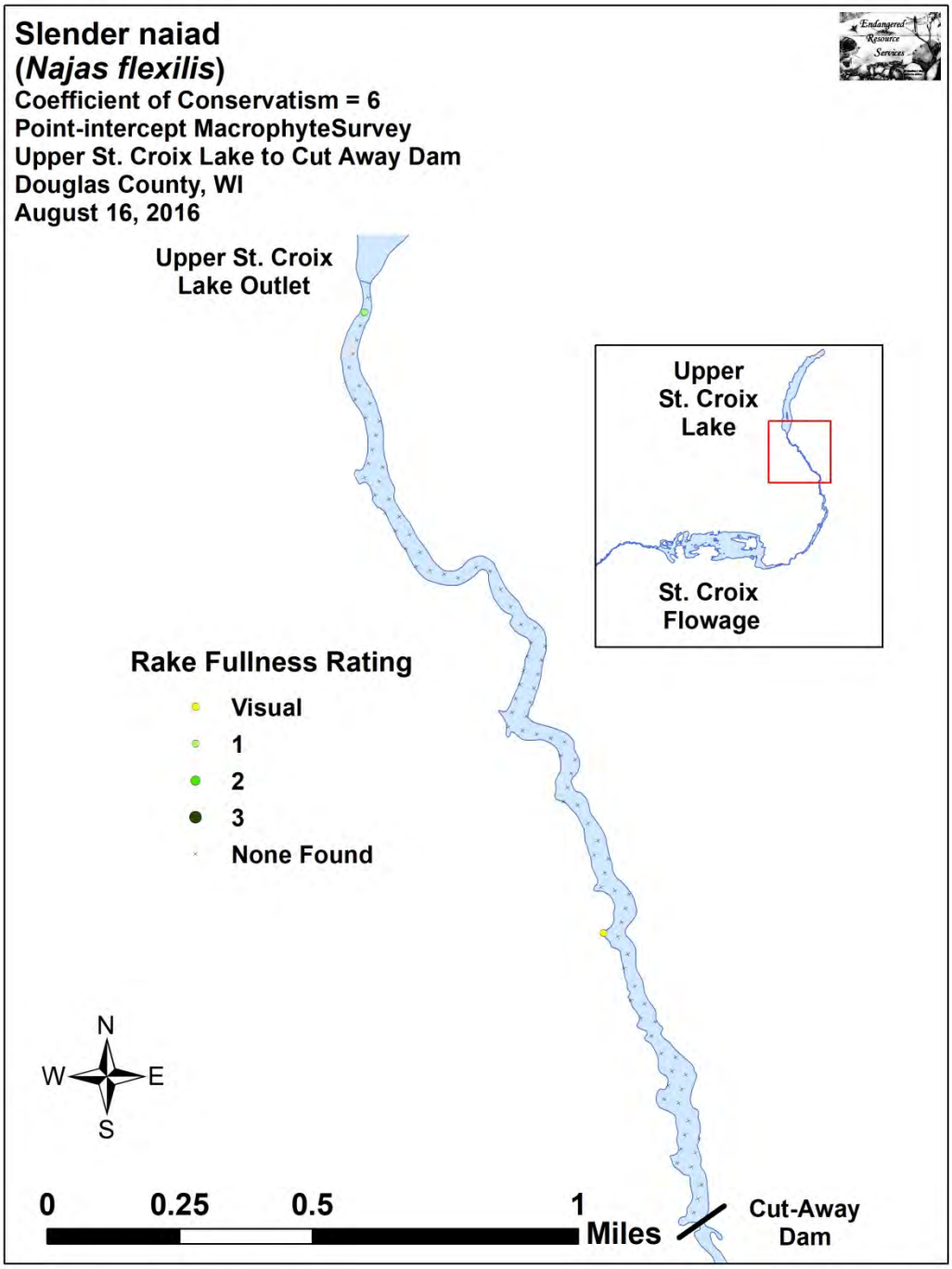
Miles
Cut-Away Dam


Slender naiad
(Najas flexilis)
Coefficient of Conservatism = 6
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
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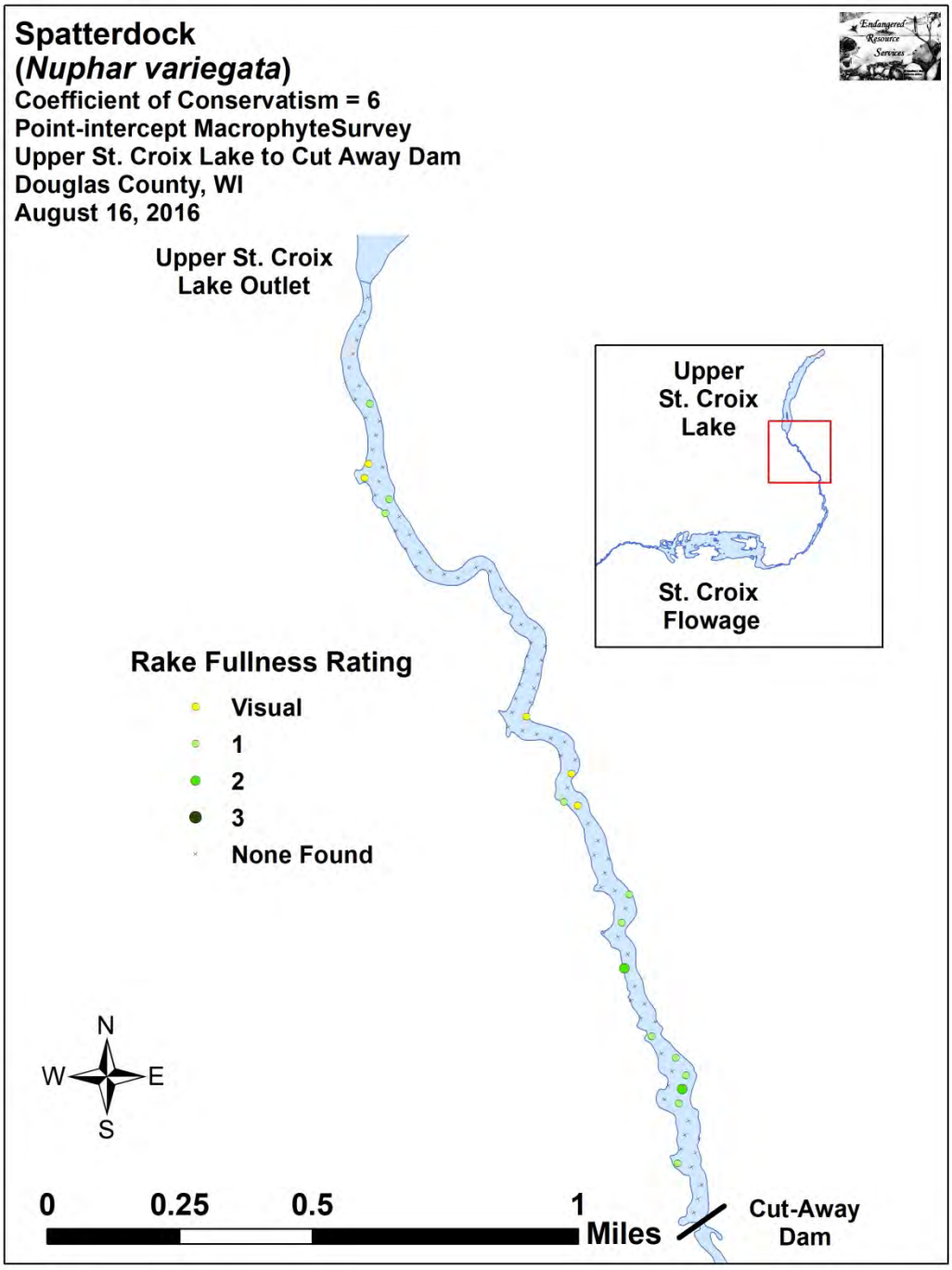
Spatterdock
(Nuphar variegata)
Coefficient of Conservatism = 6
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
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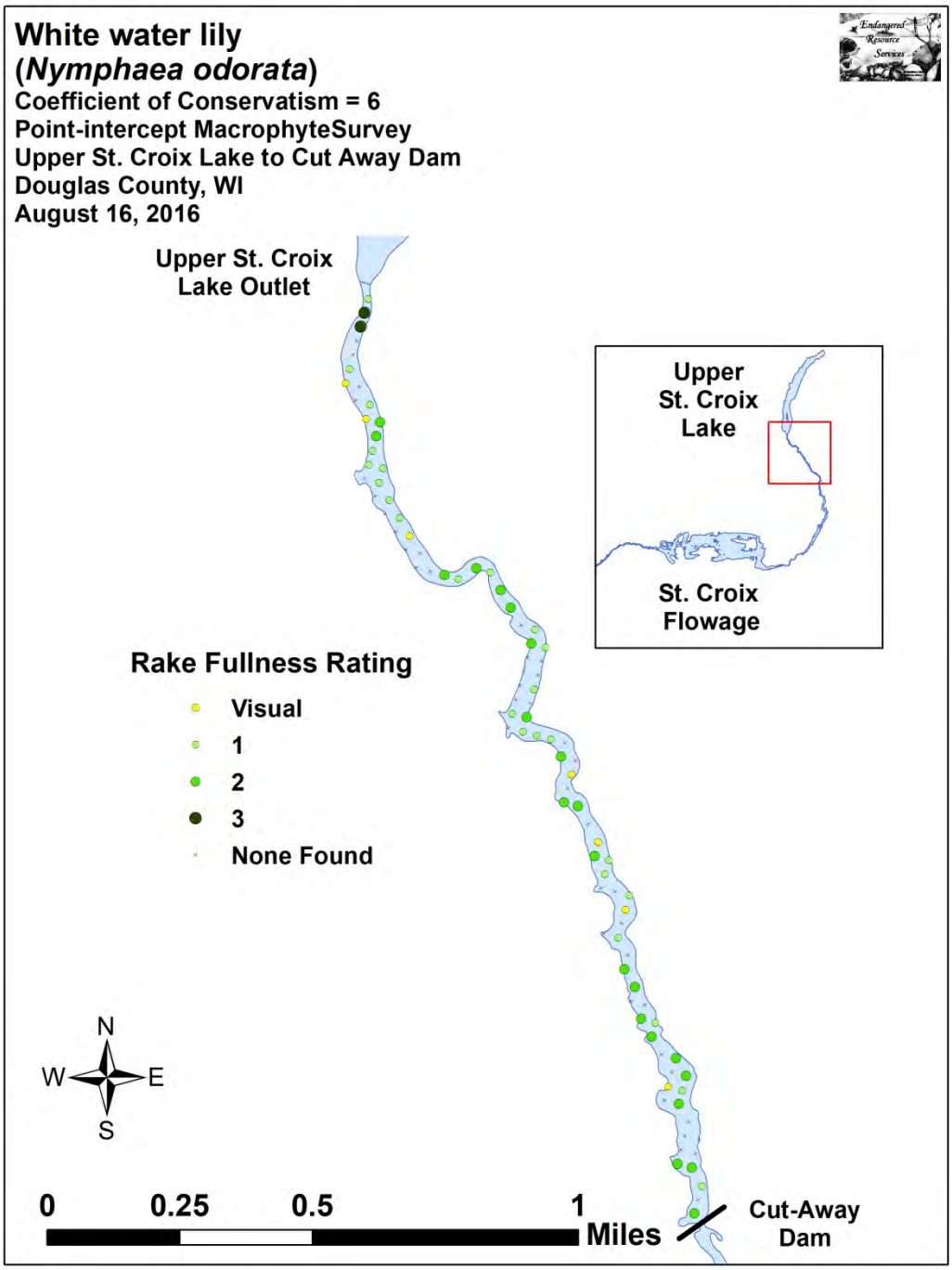
Miles
Cut-Away Dam


White water lily
(Nymphaea odorata)
Coefficient of Conservatism = 6
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
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Upper St. Croix Lake
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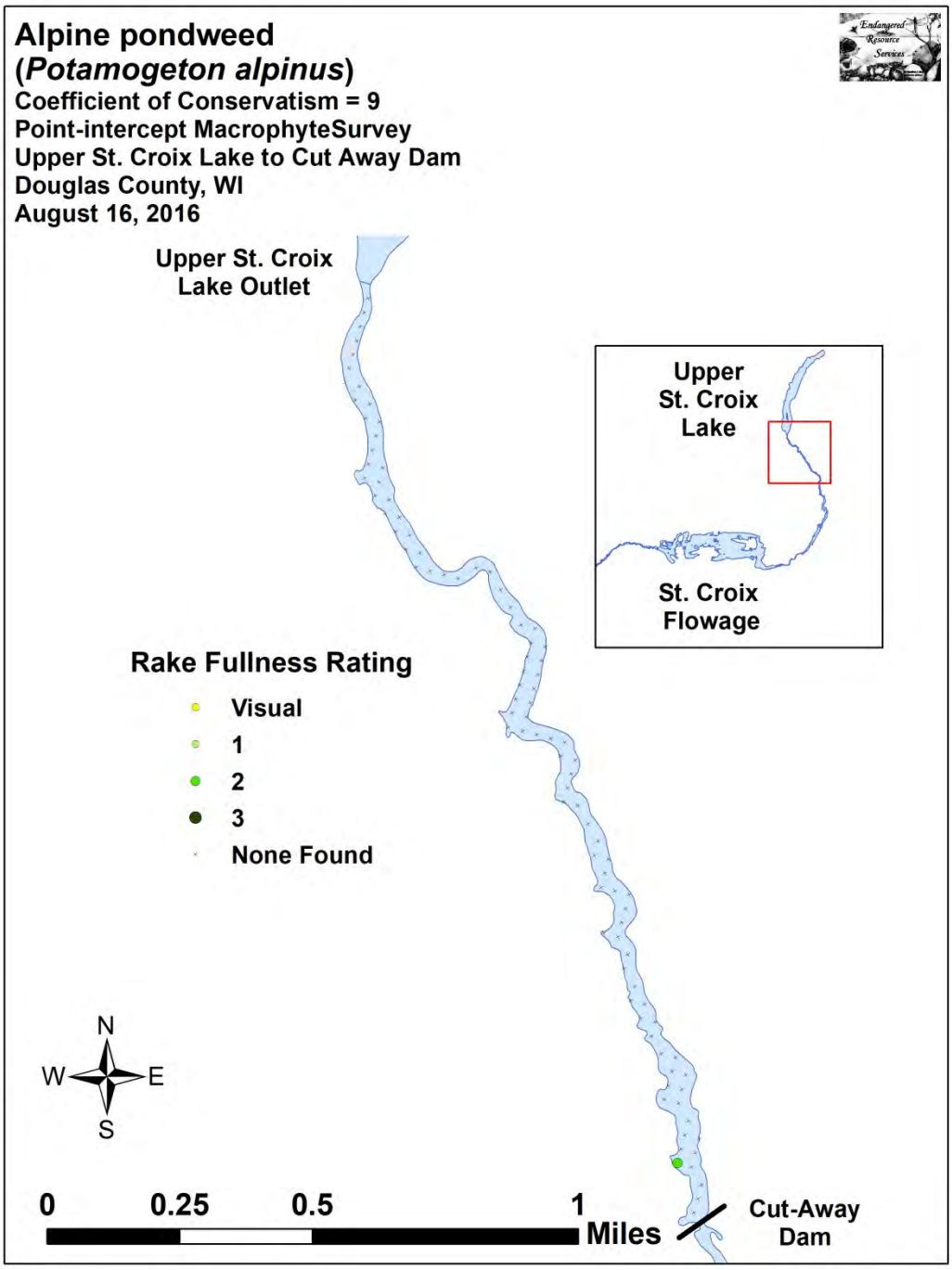
Miles
Cut-Away Dam


Alpine pondweed
(Potamogeton alpinus)
Coefficient of Conservatism = 9
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
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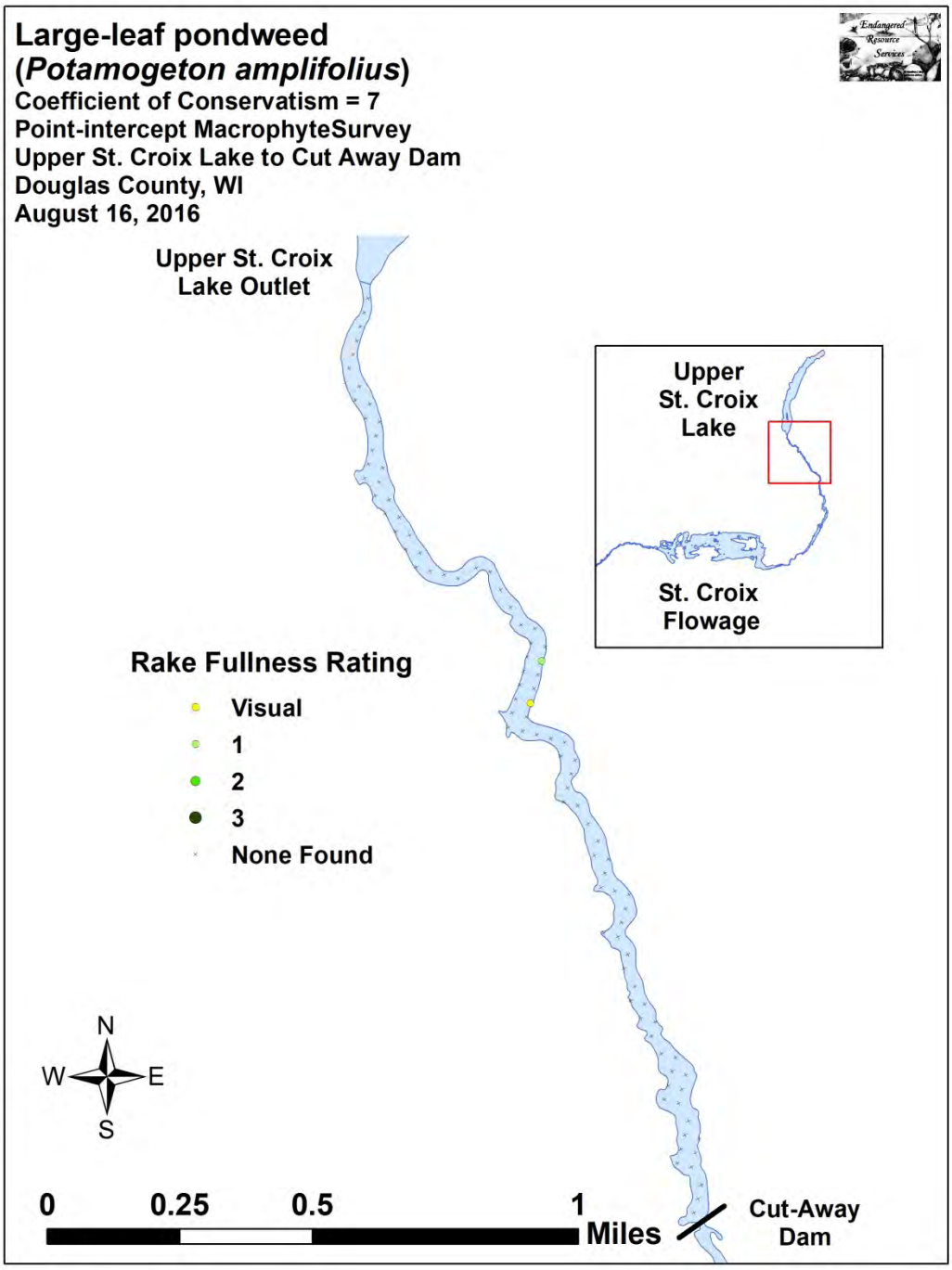
Miles
Cut-Away Dam


Large-leaf pondweed
(Potamogeton amplifolius)
Coefficient of Conservatism = 7
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
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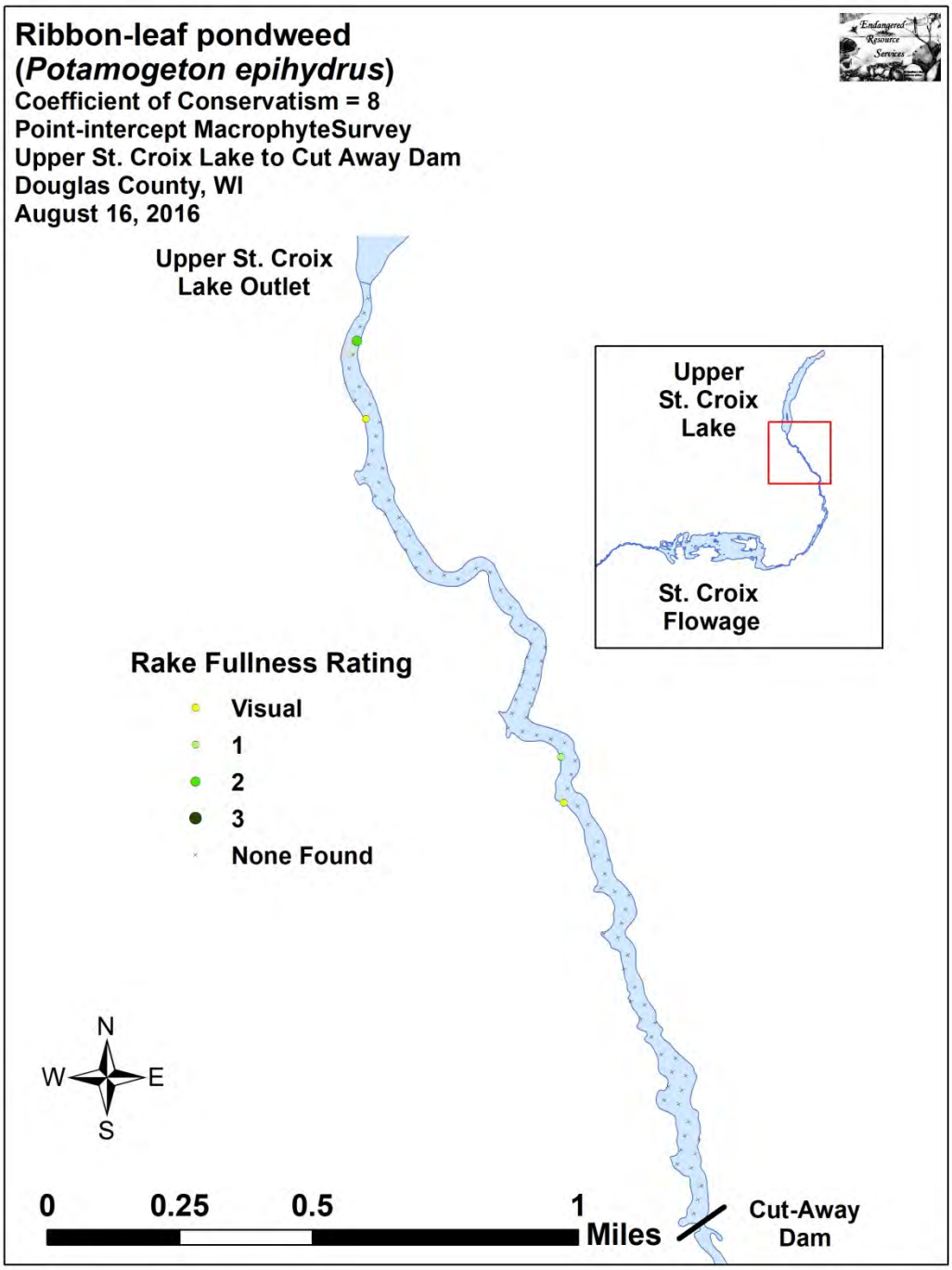
Miles
Cut-Away Dam


Ribbon-leaf pondweed
(Potamogeton epihydrus)
Coefficient of Conservatism = 8
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
Upper St. Croix Lake Outlet
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None Found
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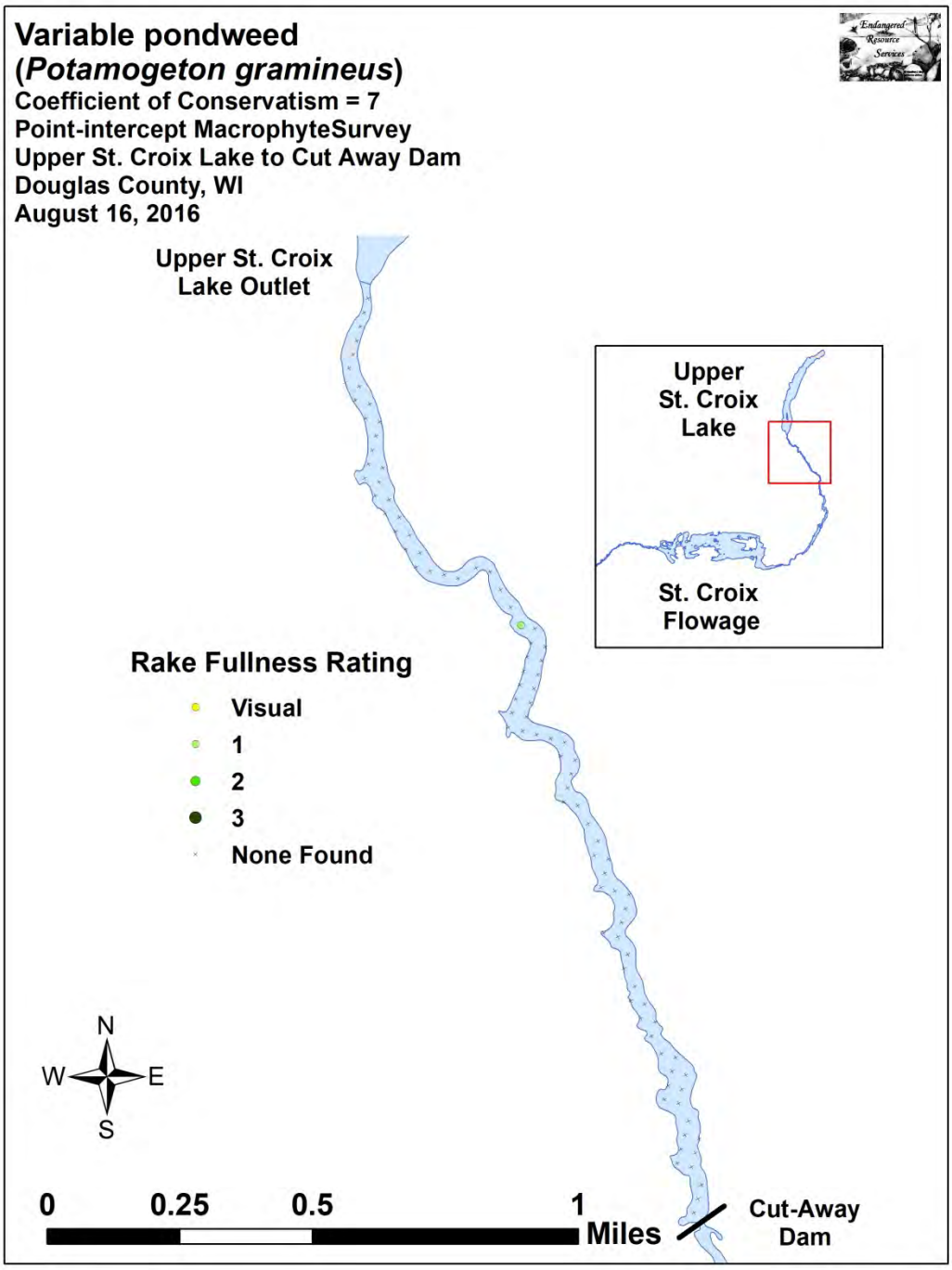
Miles
Cut-Away Dam


Variable pondweed
(Potamogeton gramineus)
Coefficient of Conservatism = 7
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
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None Found
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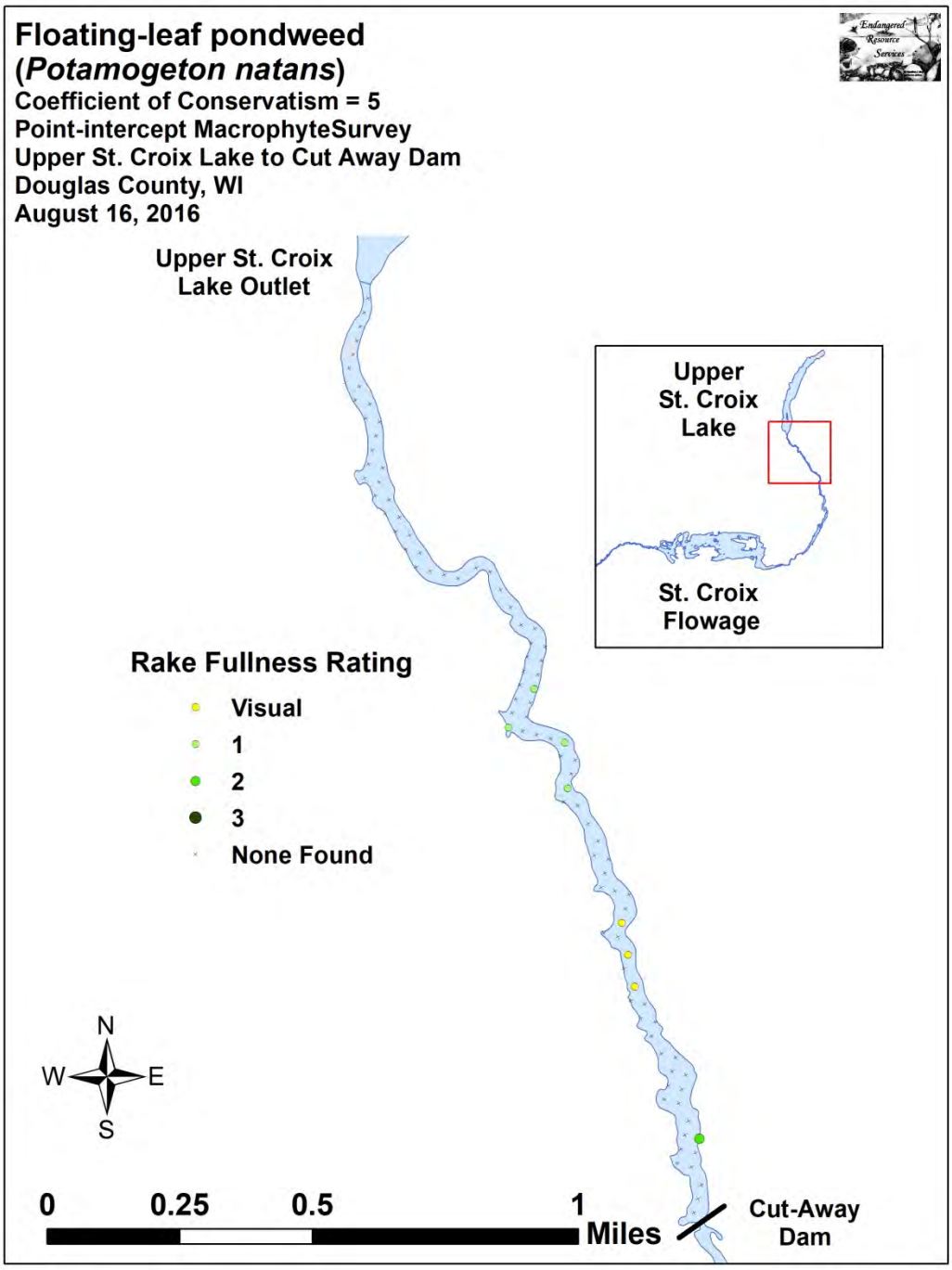
Miles
Cut-Away Dam


Floating-leaf pondweed
(Potamogeton natans)
Coefficient of Conservatism = 5
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
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Visual
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None Found
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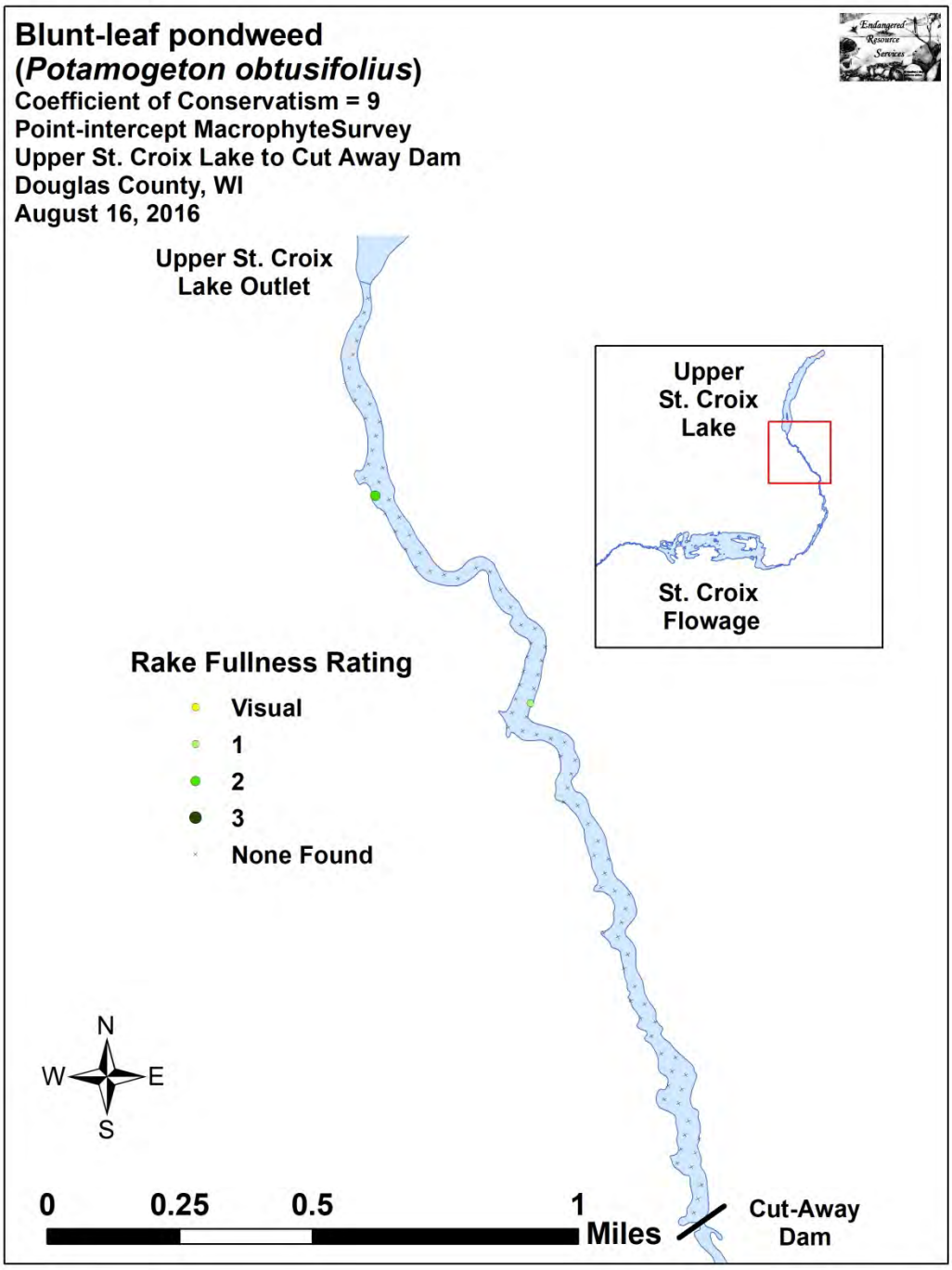
Miles
Cut-Away Dam


Blunt-leaf pondweed
(Potamogeton obtusifolius)
Coefficient of Conservatism = 9
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
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None Found
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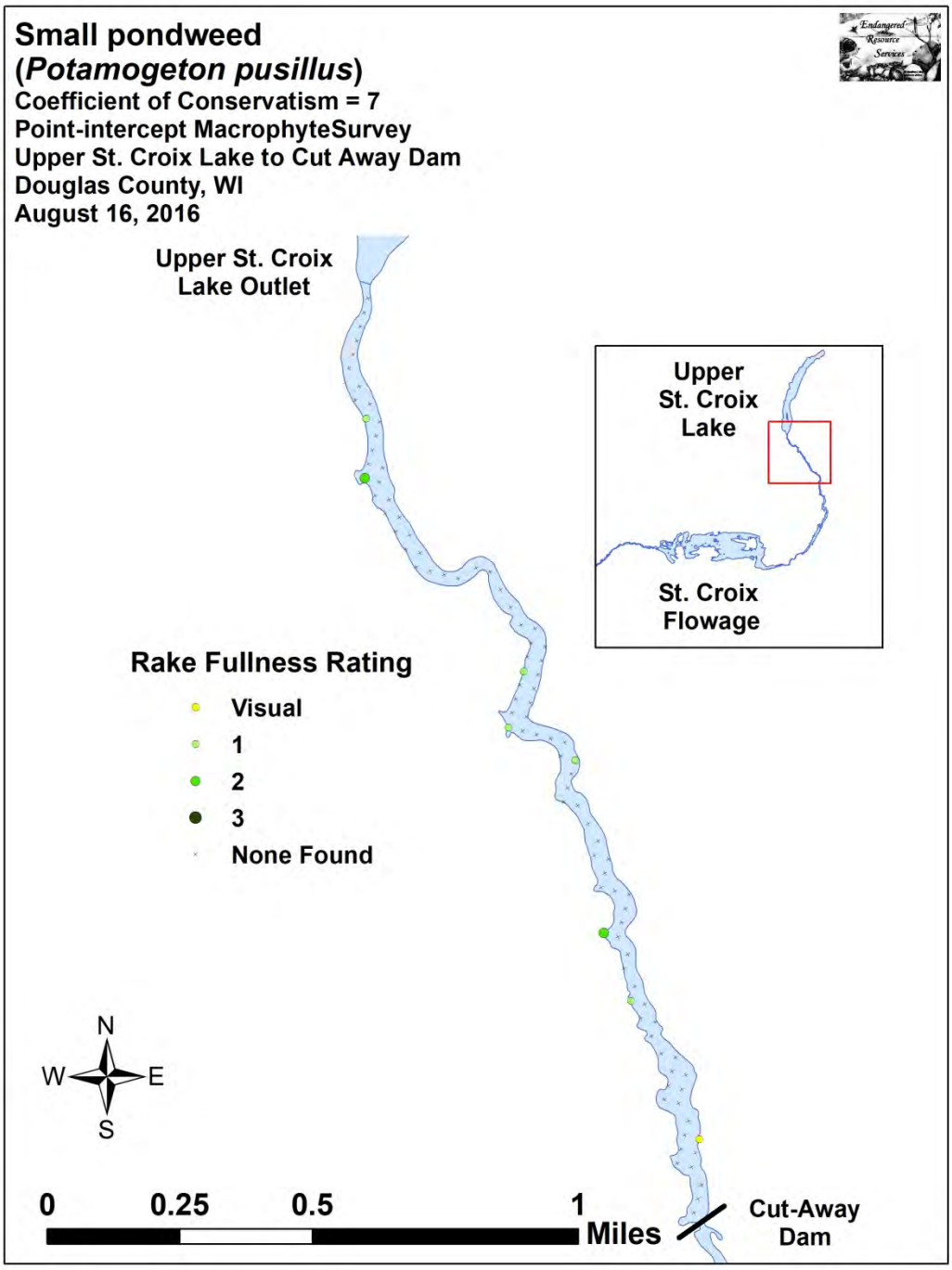
Miles
Cut-Away Dam


Small pondweed
(Potamogeton pusillus)
Coefficient of Conservatism = 7
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
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None Found
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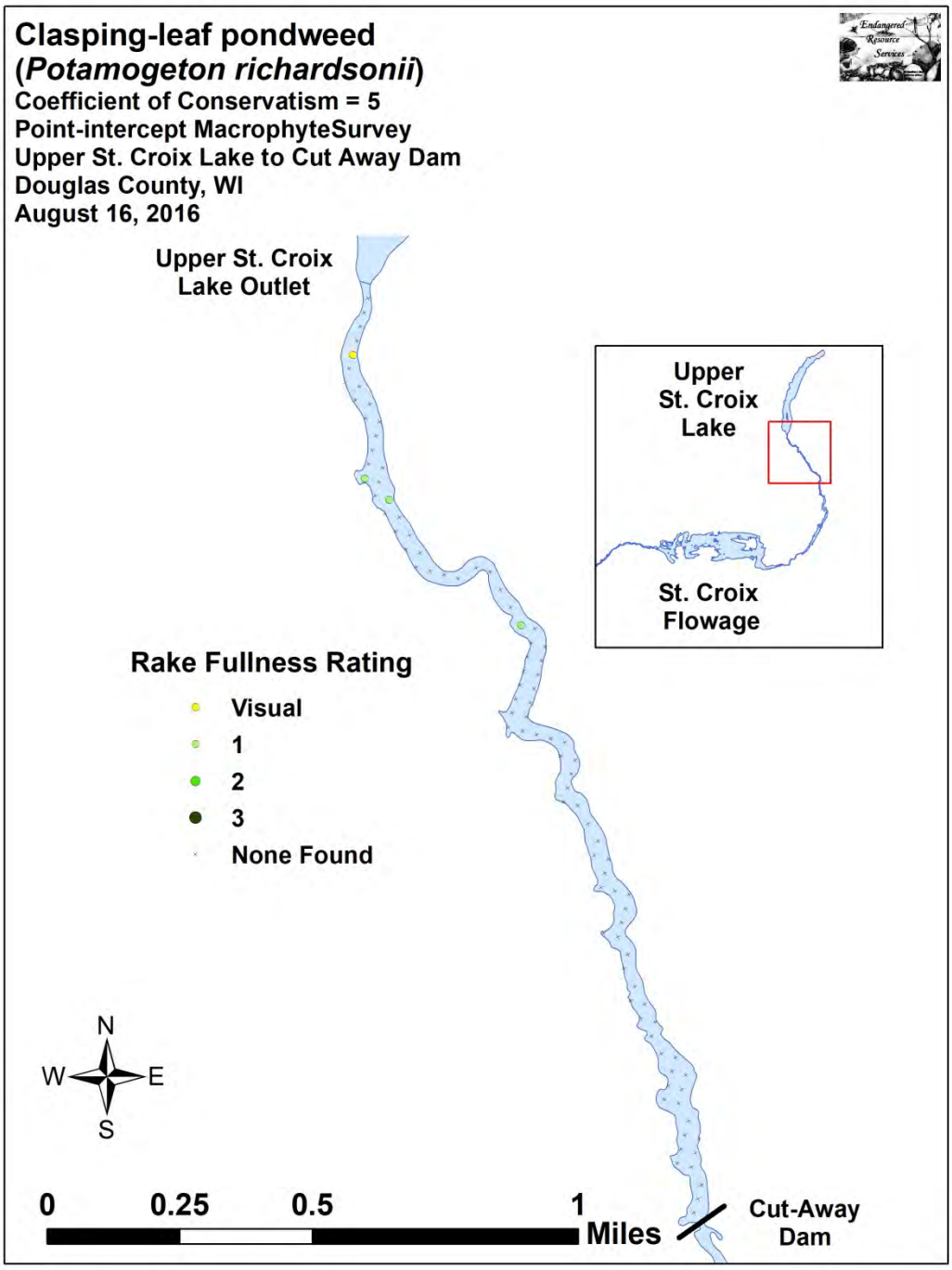
Miles
Cut-Away Dam


Clasping-leaf pondweed
(Potamogeton richardsonii)
Coefficient of Conservatism = 5
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
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None Found
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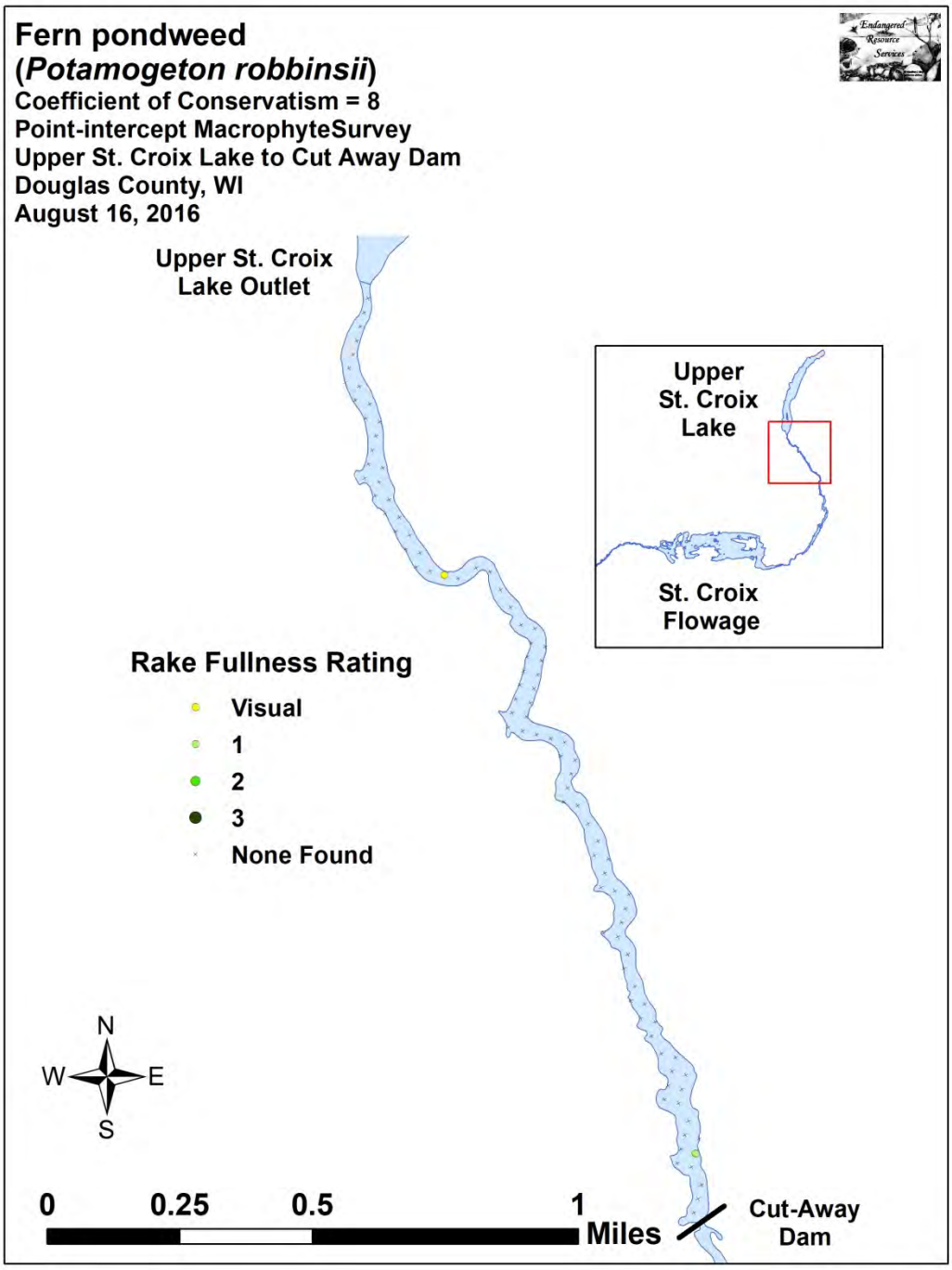
Miles
Cut-Away Dam


Fern pondweed
(Potamogeton robbinsii)
Coefficient of Conservatism = 8
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
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Visual
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None Found
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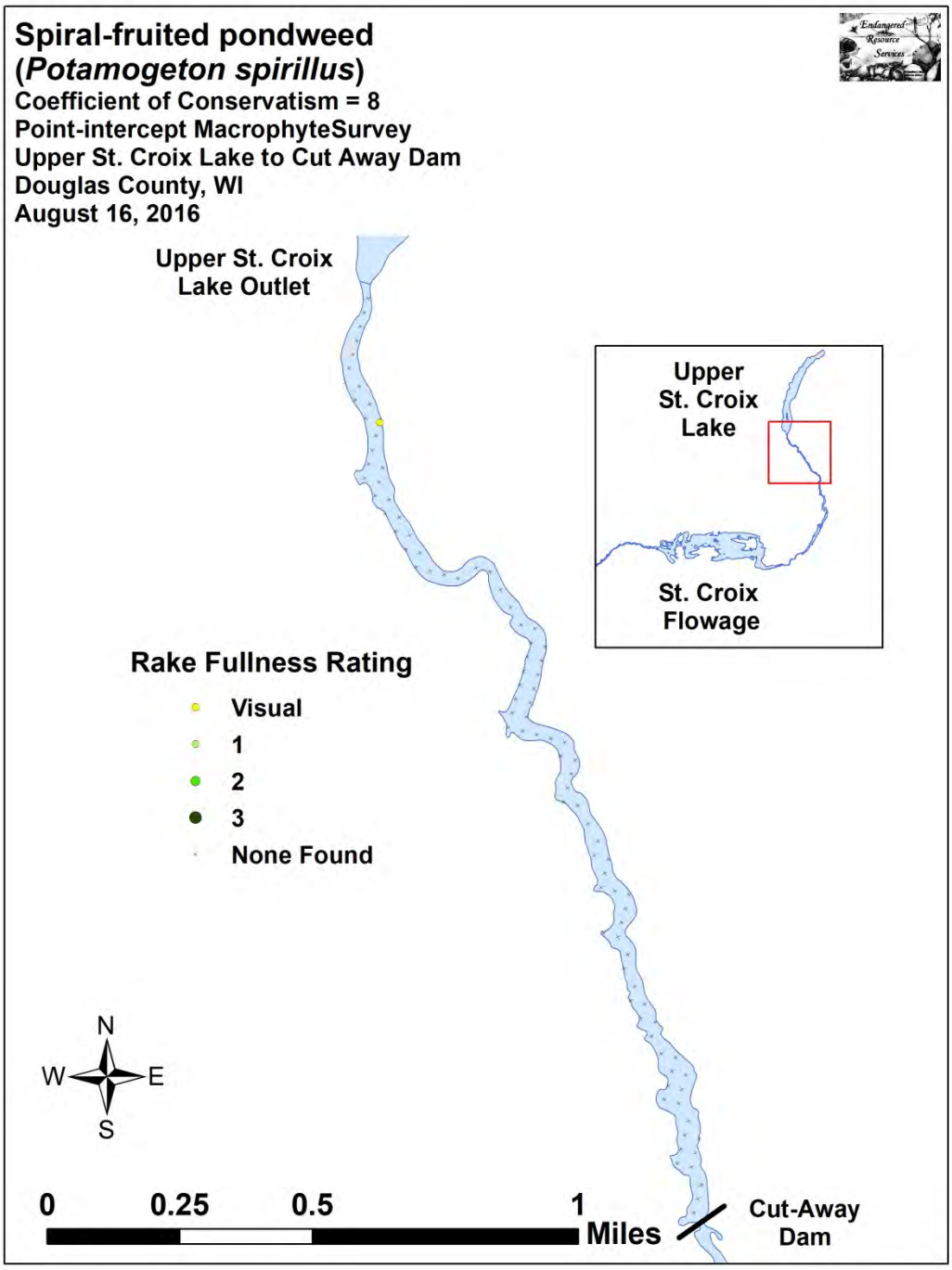
Miles
Cut-Away Dam


Spiral-fruited pondweed
(Potamogeton spirillus)
Coefficient of Conservatism = 8
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
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None Found
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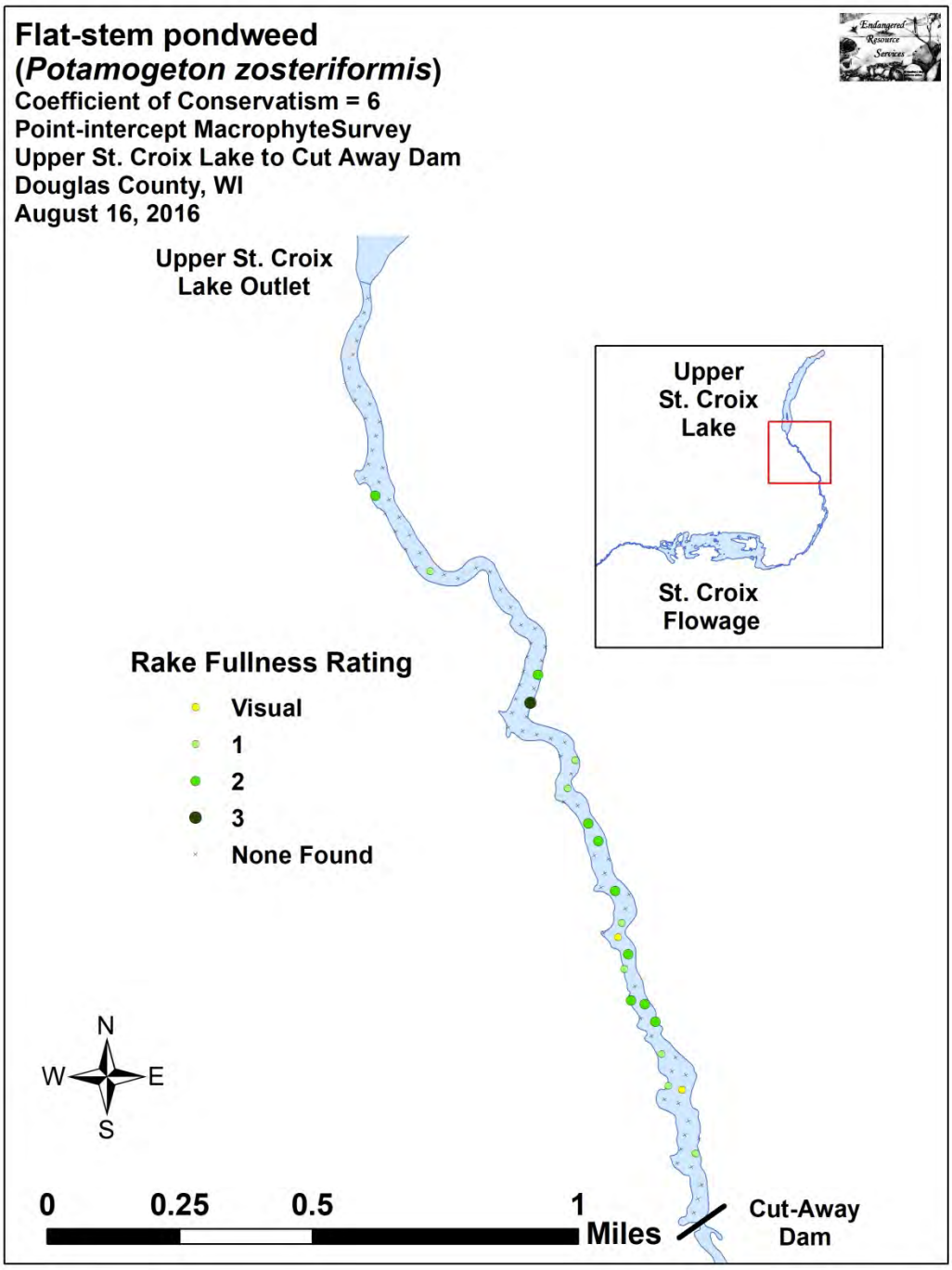
Miles
Cut-Away Dam


Flat-stem pondweed
(Potamogeton zosteriformis)
Coefficient of Conservatism = 6
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
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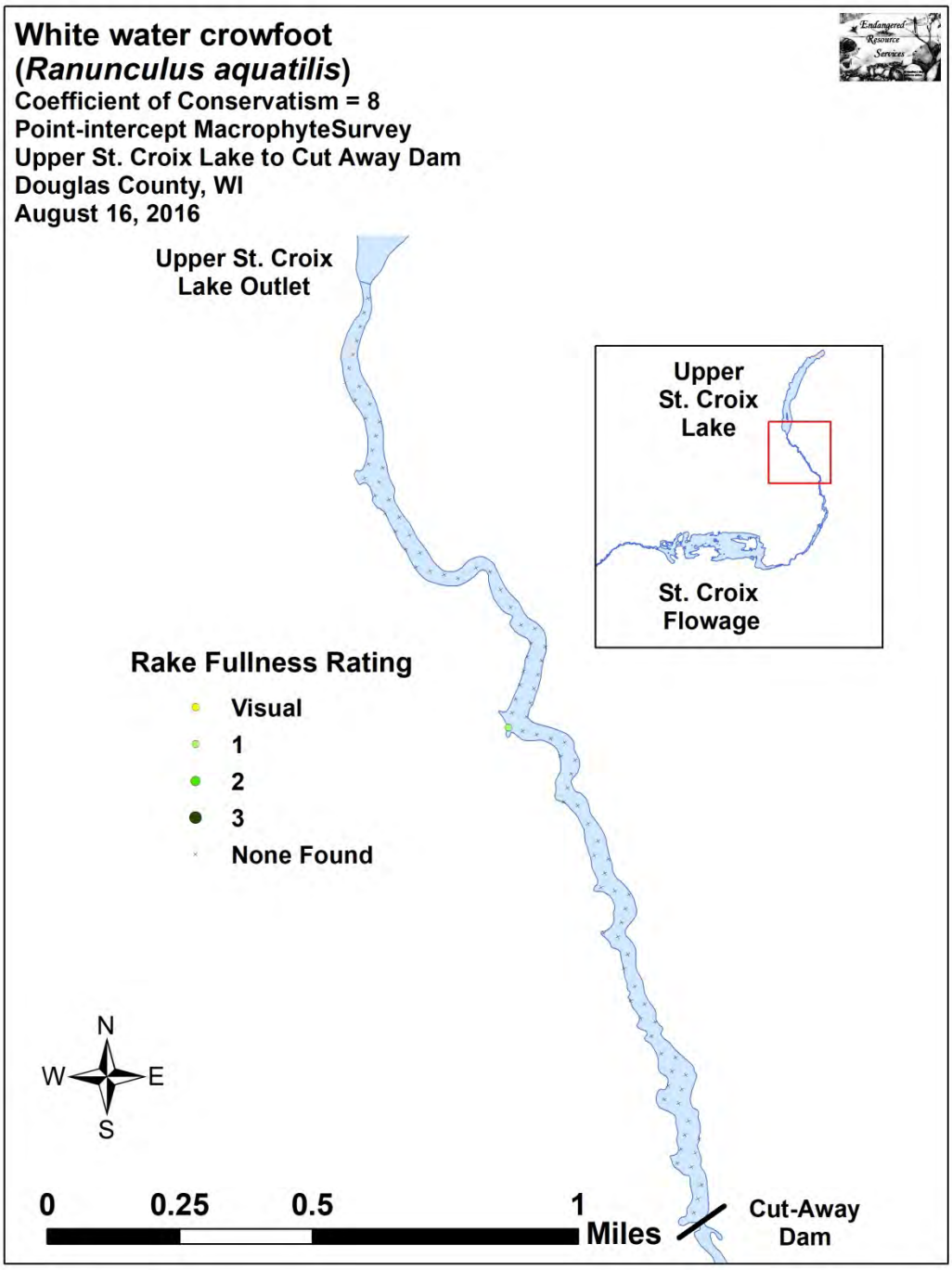
Miles
Cut-Away Dam


White water crowfoot
(Ranunculus aquatilis)
Coefficient of Conservatism = 8
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
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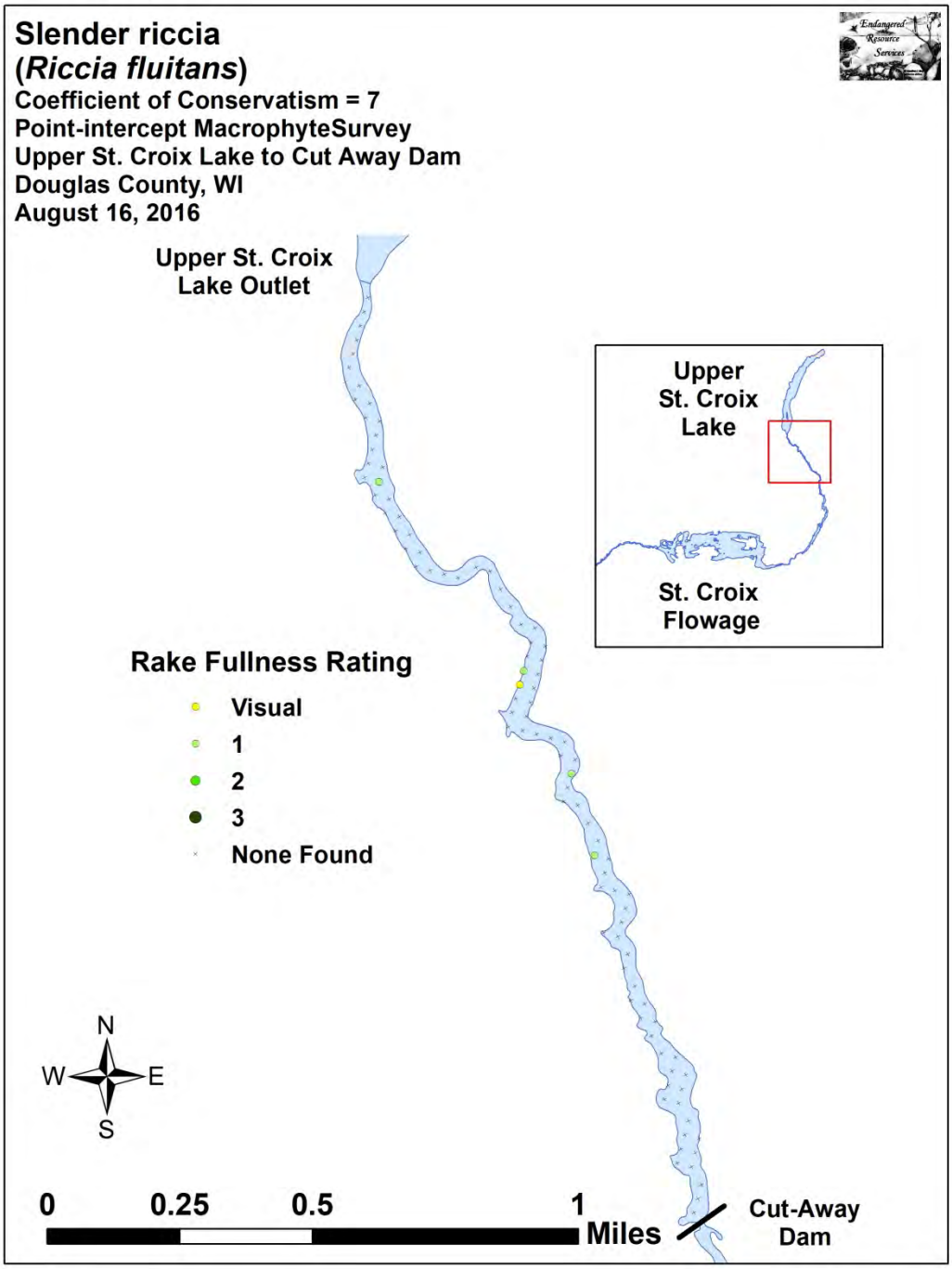
Miles
Cut-Away Dam


Slender riccia
(Riccia fluitans)
Coefficient of Conservatism = 7
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
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Miles
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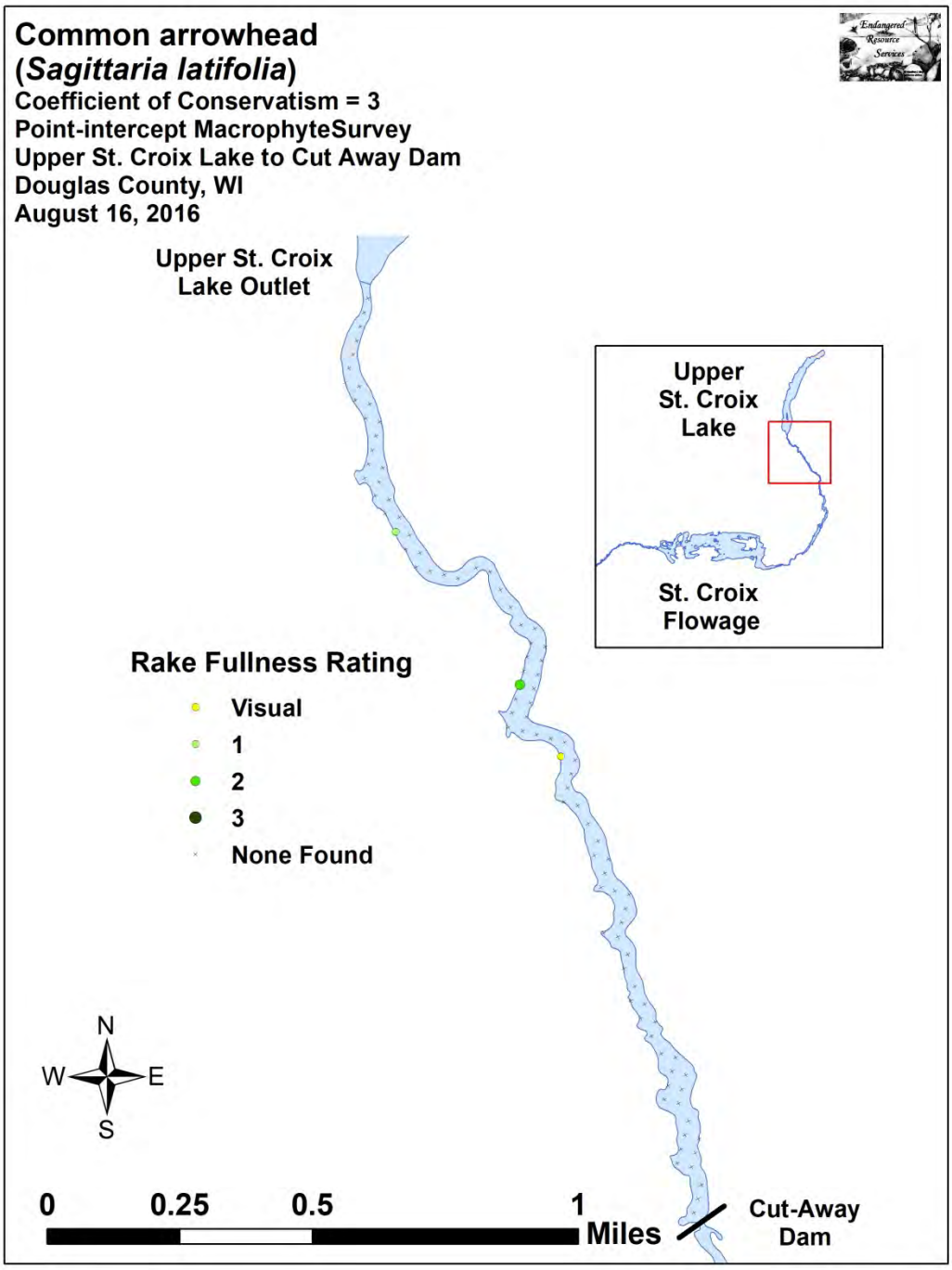
Common arrowhead
(Sagittaria latifolia)
Coefficient of Conservatism = 3
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
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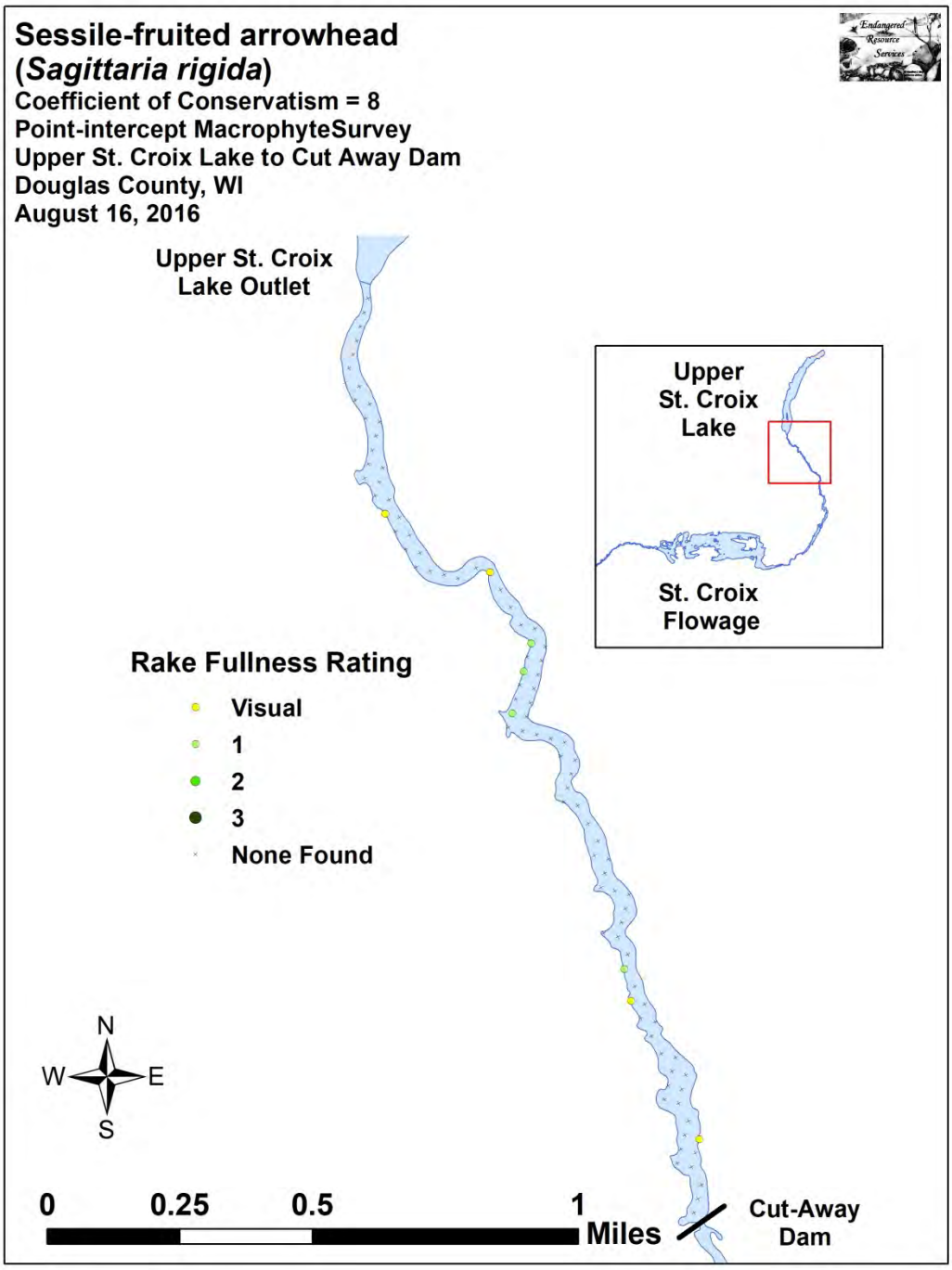
Sessile-fruited arrowhead
(Sagittaria rigida)
Coefficient of Conservatism = 8
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
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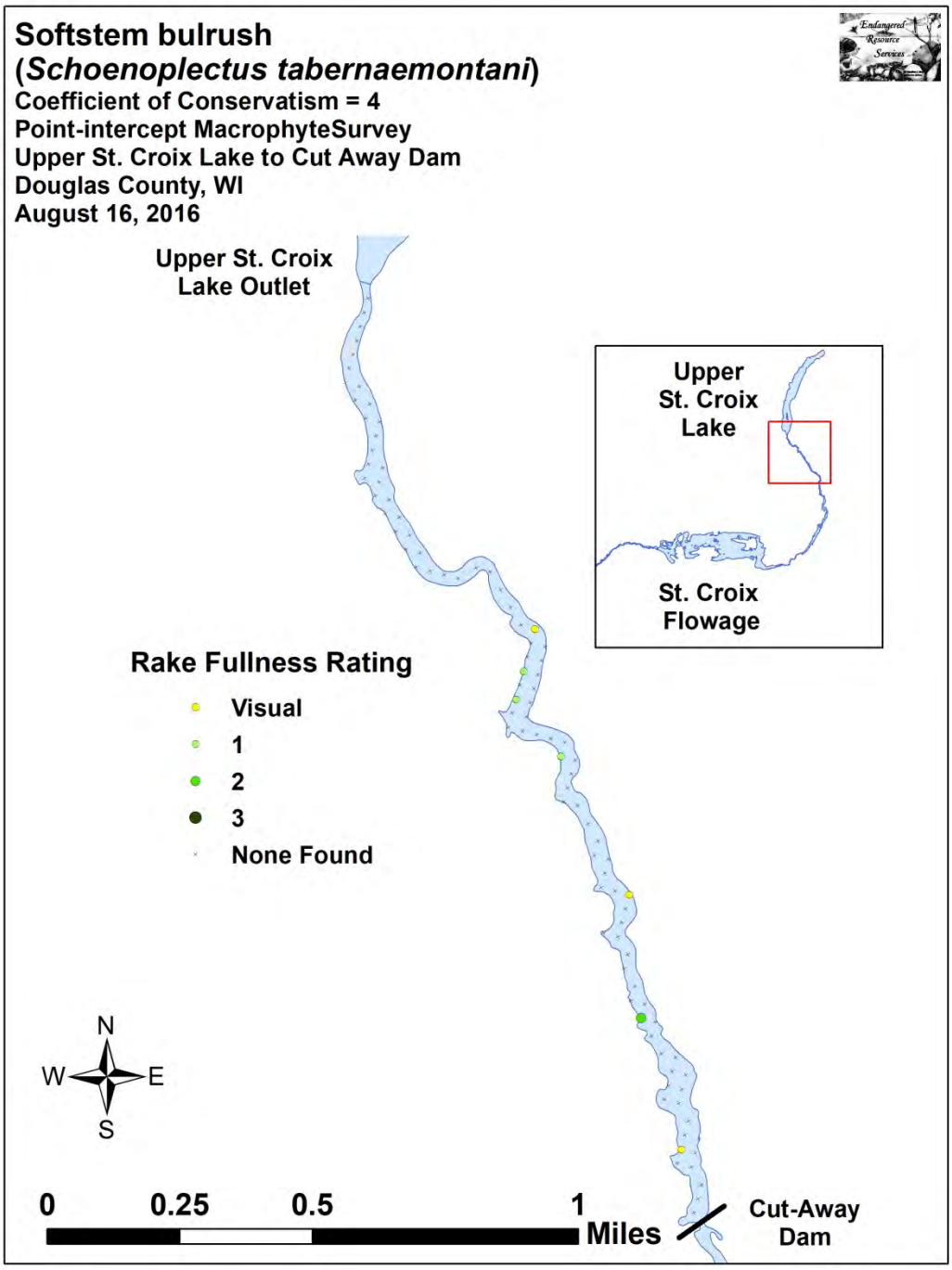
Softstem bulrush
(Schoenoplectus tabernaemontani)
Coefficient of Conservatism = 4
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
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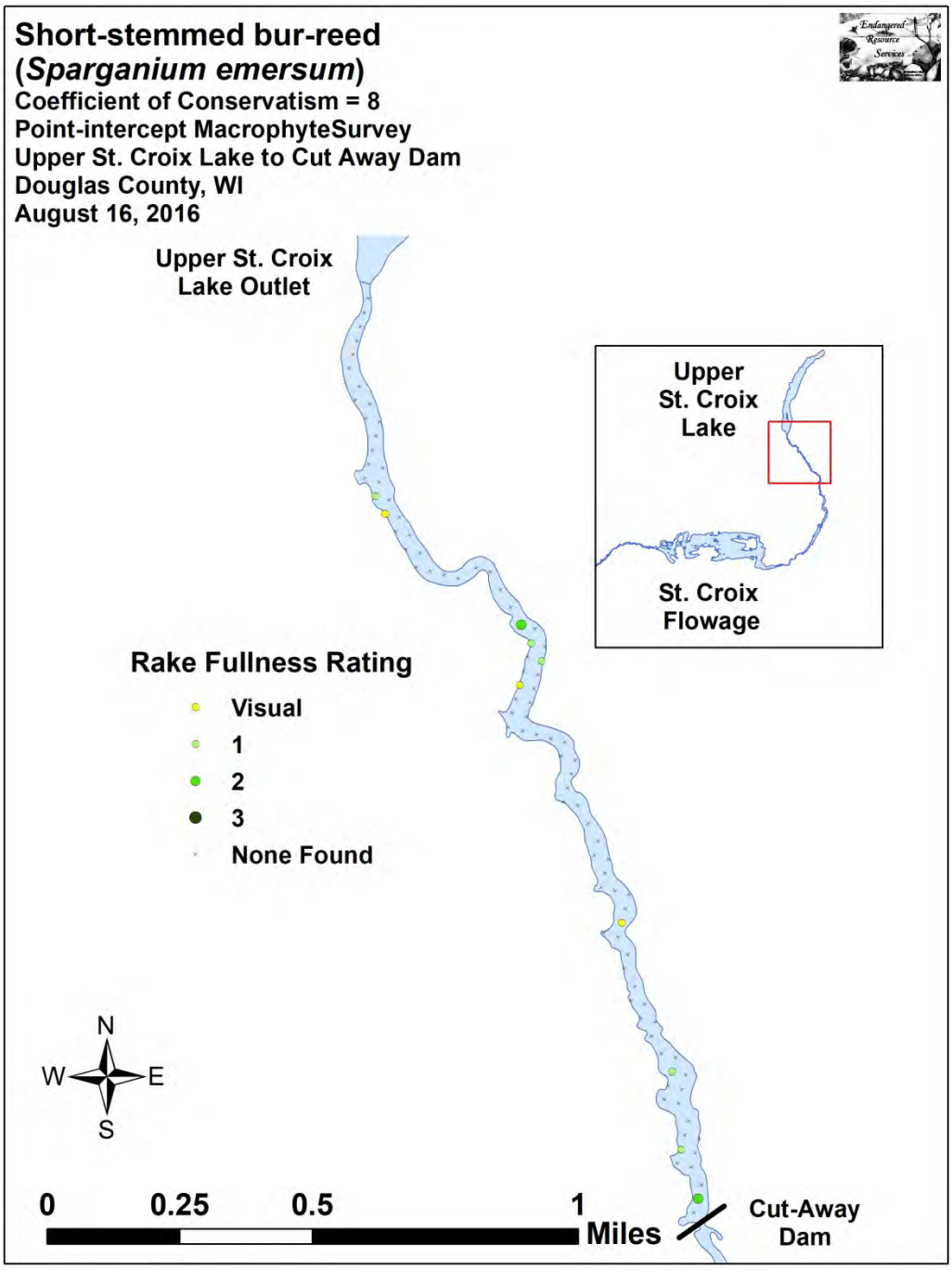
Short-stemmed bur-reed
(Sparganium emersum)
Coefficient of Conservatism = 8
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
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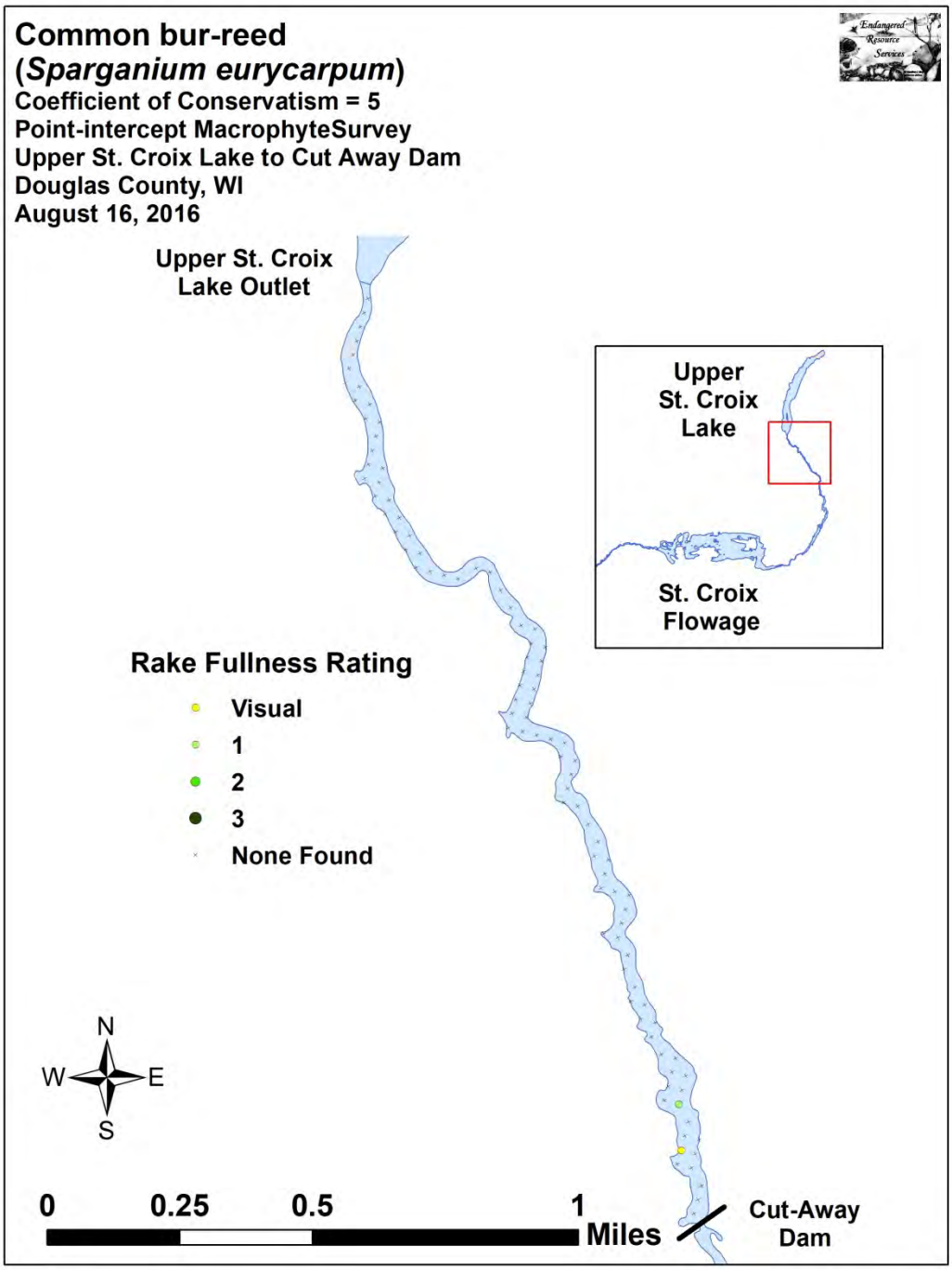
Common bur-reed
(Sparganium eurycarpum)
Coefficient of Conservatism = 5
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
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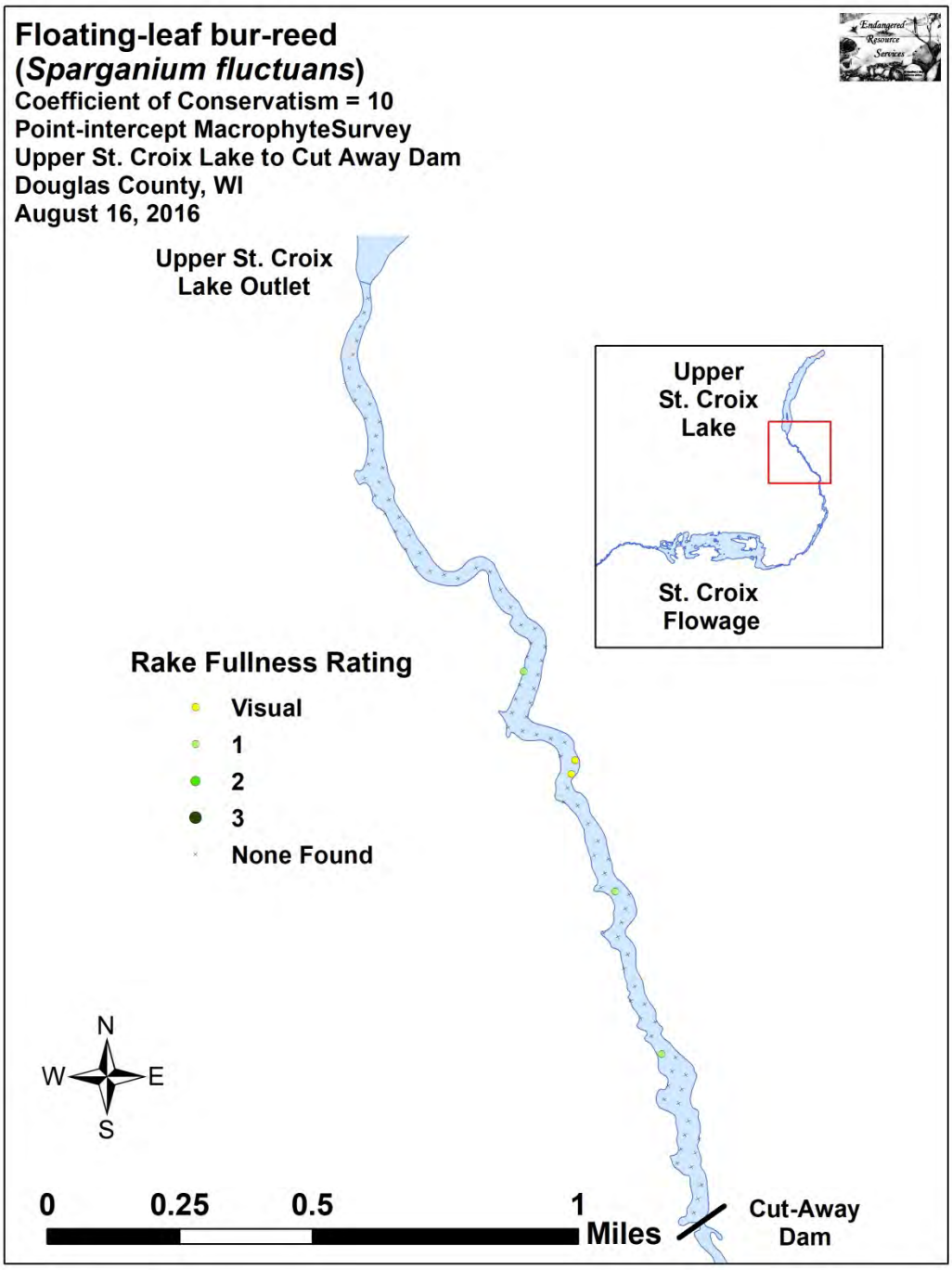
Miles
Cut-Away Dam


Floating-leaf bur-reed
(Sparganium fluctuans)
Coefficient of Conservatism = 10
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
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3
None Found
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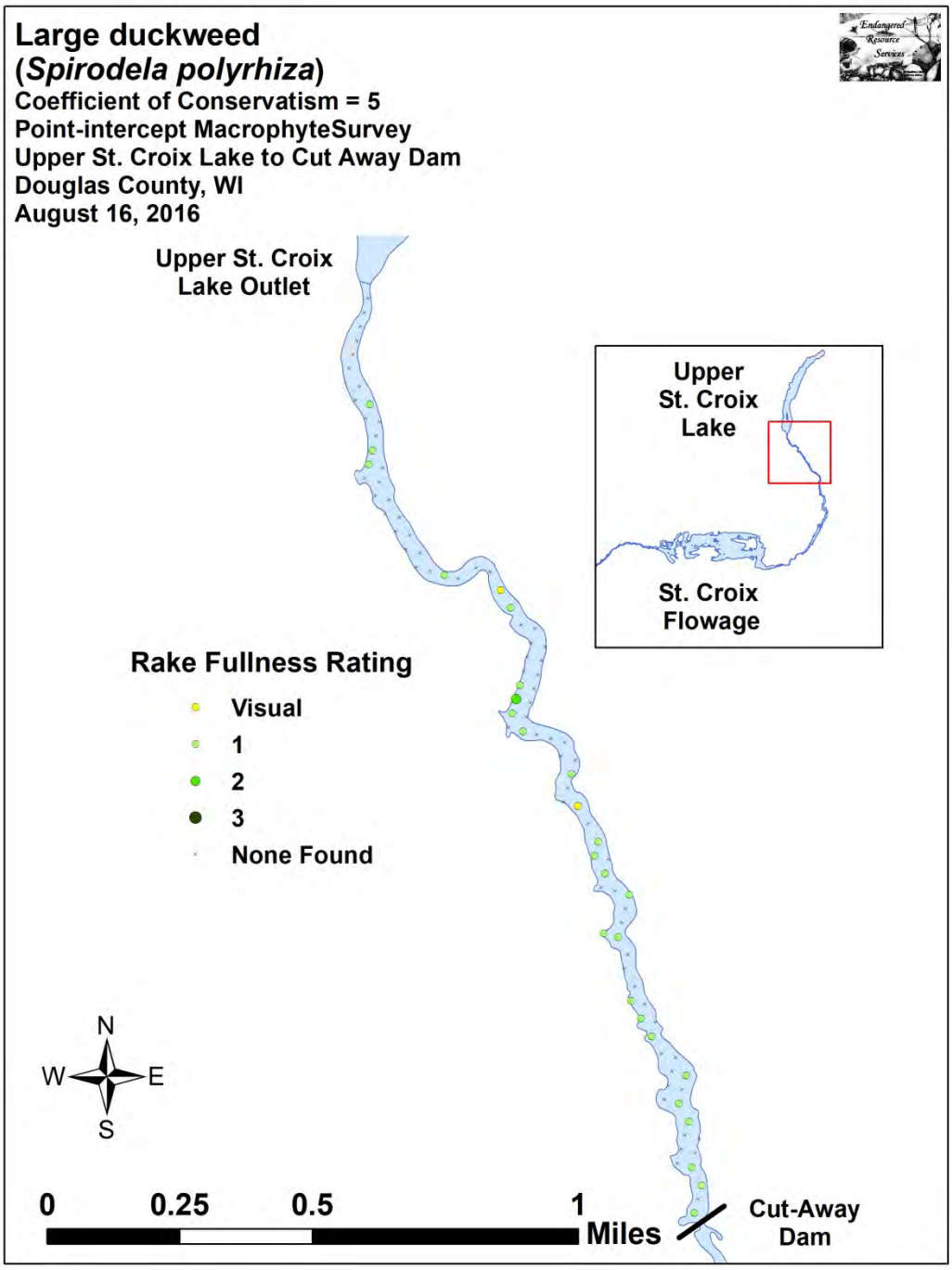
Miles
Cut-Away Dam


Large duckweed
(Spirodela polyrhiza)
Coefficient of Conservatism = 5
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
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None Found
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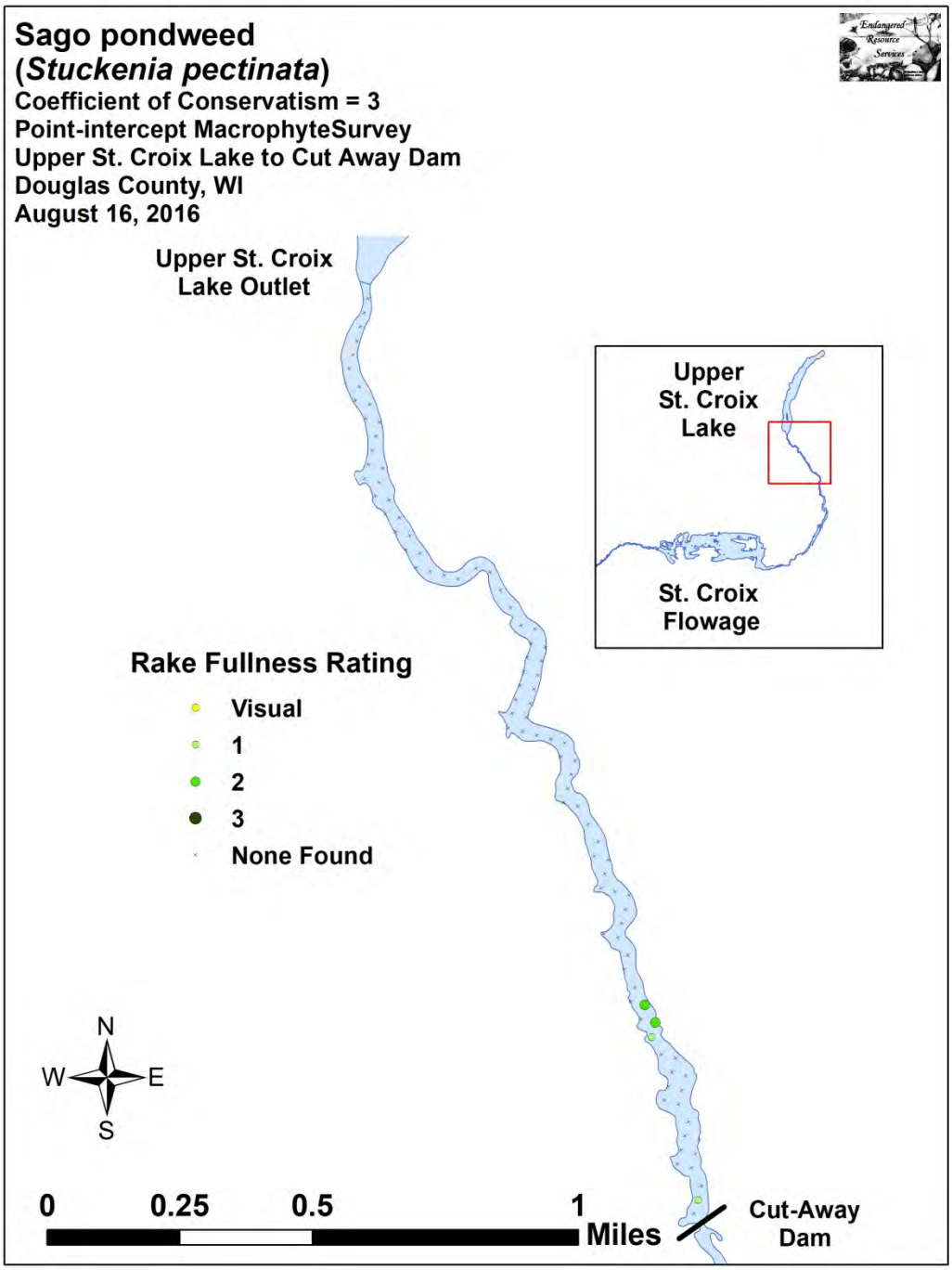
Miles
Cut-Away Dam


Sago pondweed
(Stuckenia pectinata)
Coefficient of Conservatism = 3
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
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None Found
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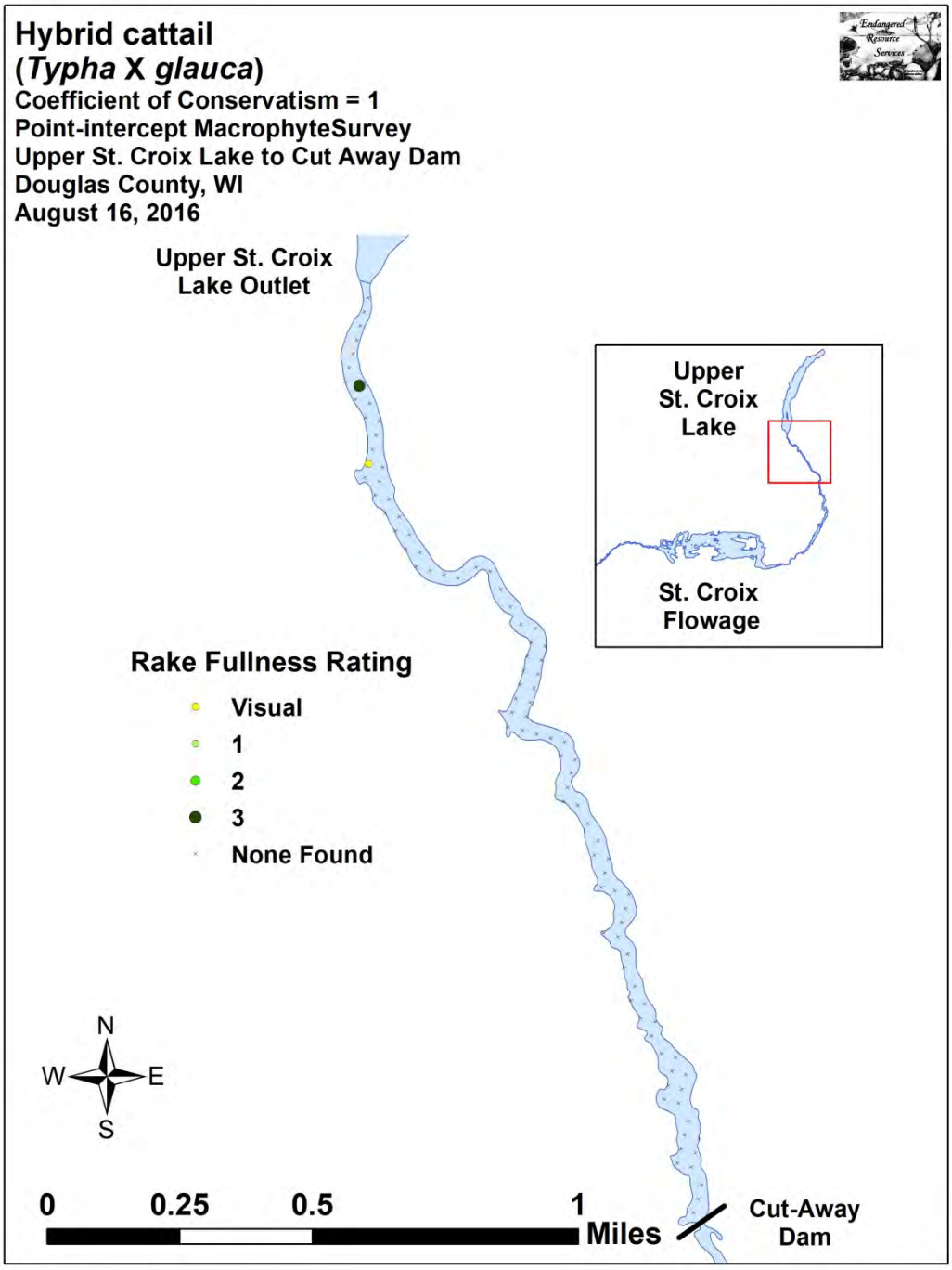
Miles
Cut-Away Dam


Hybrid cattail
(Typha X glauca)
Coefficient of Conservatism = 1
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
Upper St. Croix Lake Outlet
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St. Croix Flowage
Rake Fullness Rating
Visual
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None Found
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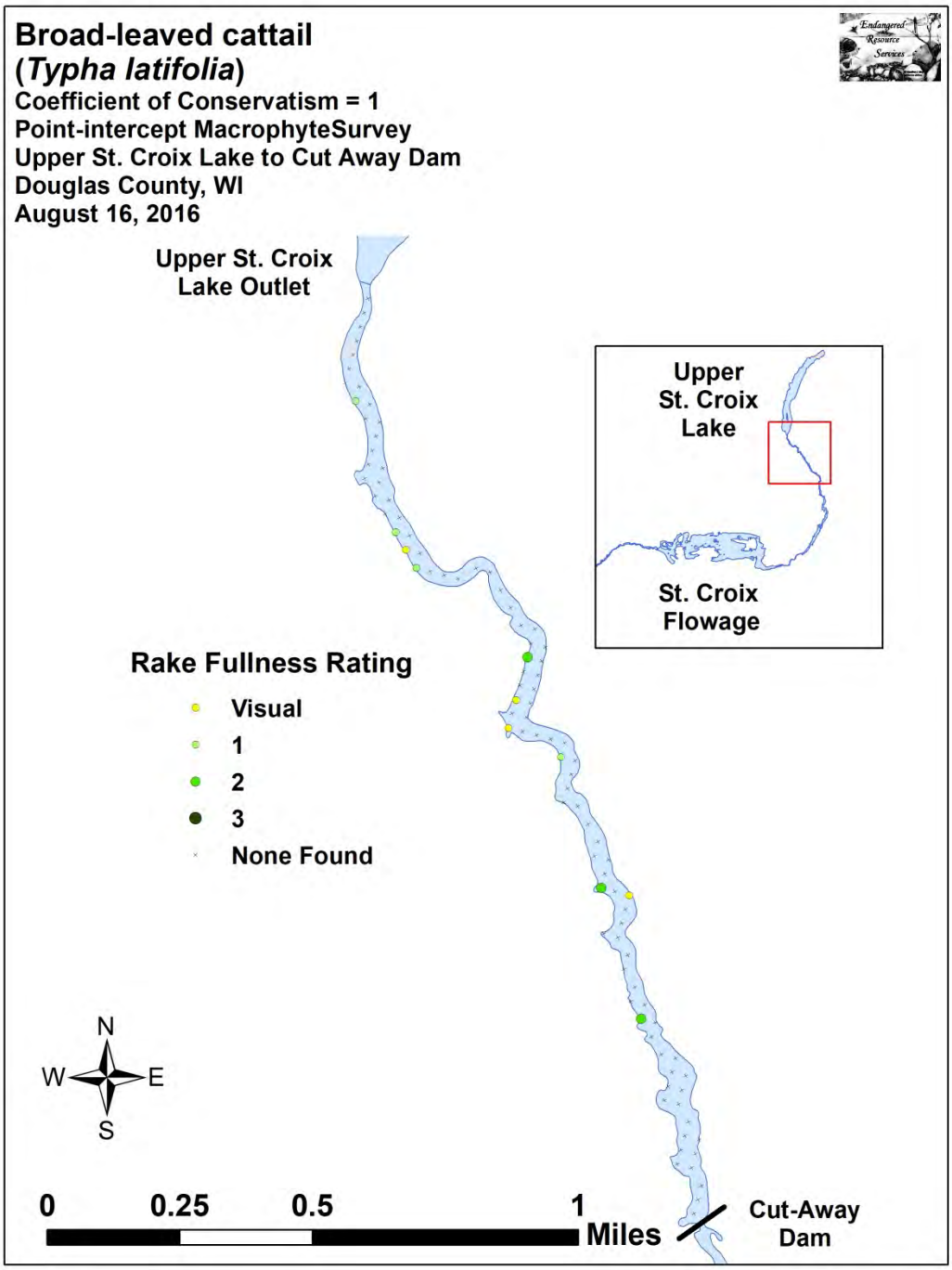
Miles
Cut-Away Dam


Broad-leaved cattail
(Typha latifolia)
Coefficient of Conservatism = 1
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
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None Found
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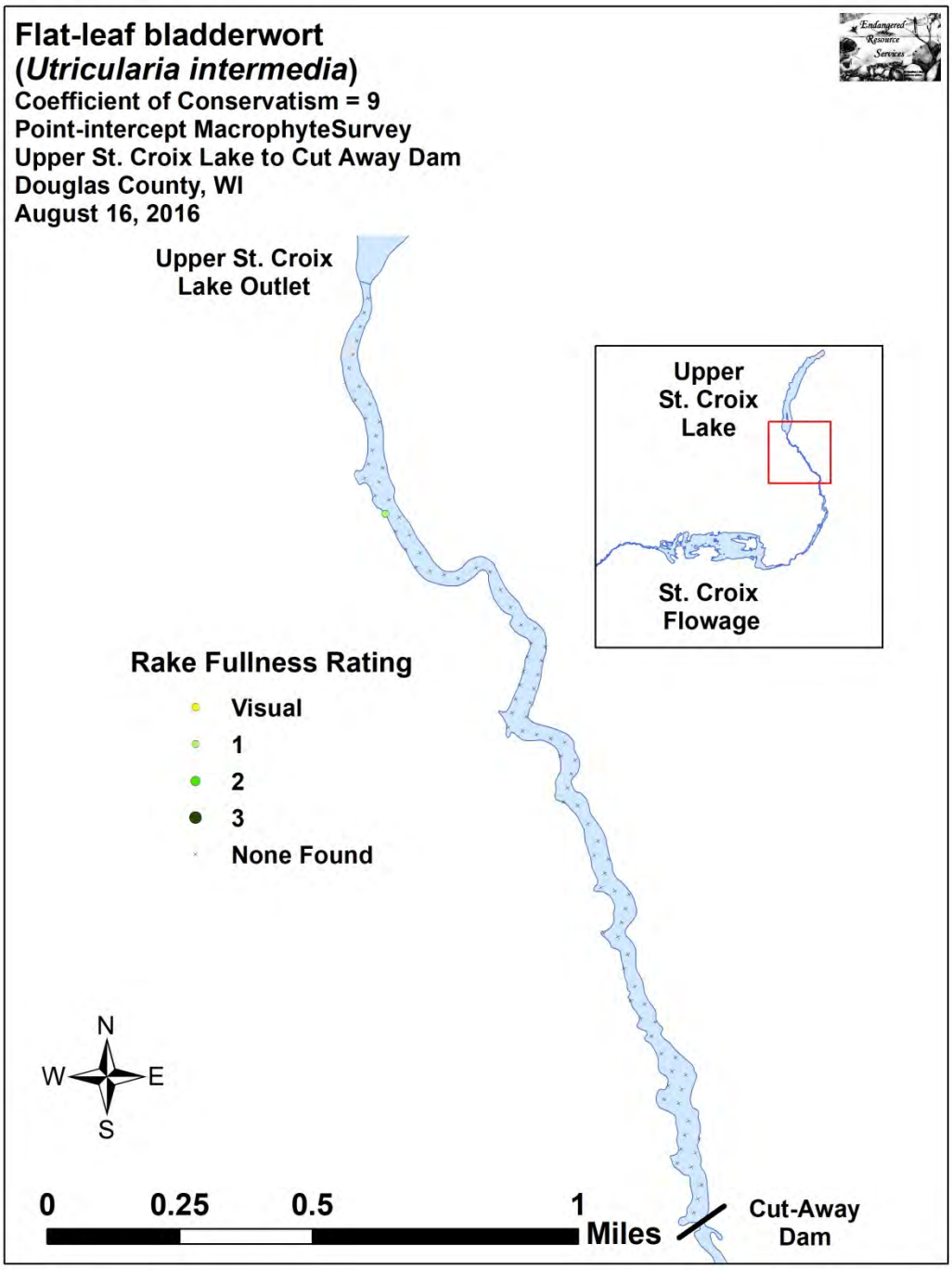
Miles
Cut-Away Dam


Flat-leaf bladderwort
(Utricularia intermedia)
Coefficient of Conservatism = 9
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
Upper St. Croix Lake Outlet
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St. Croix Flowage
Rake Fullness Rating
Visual
1
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None Found
N
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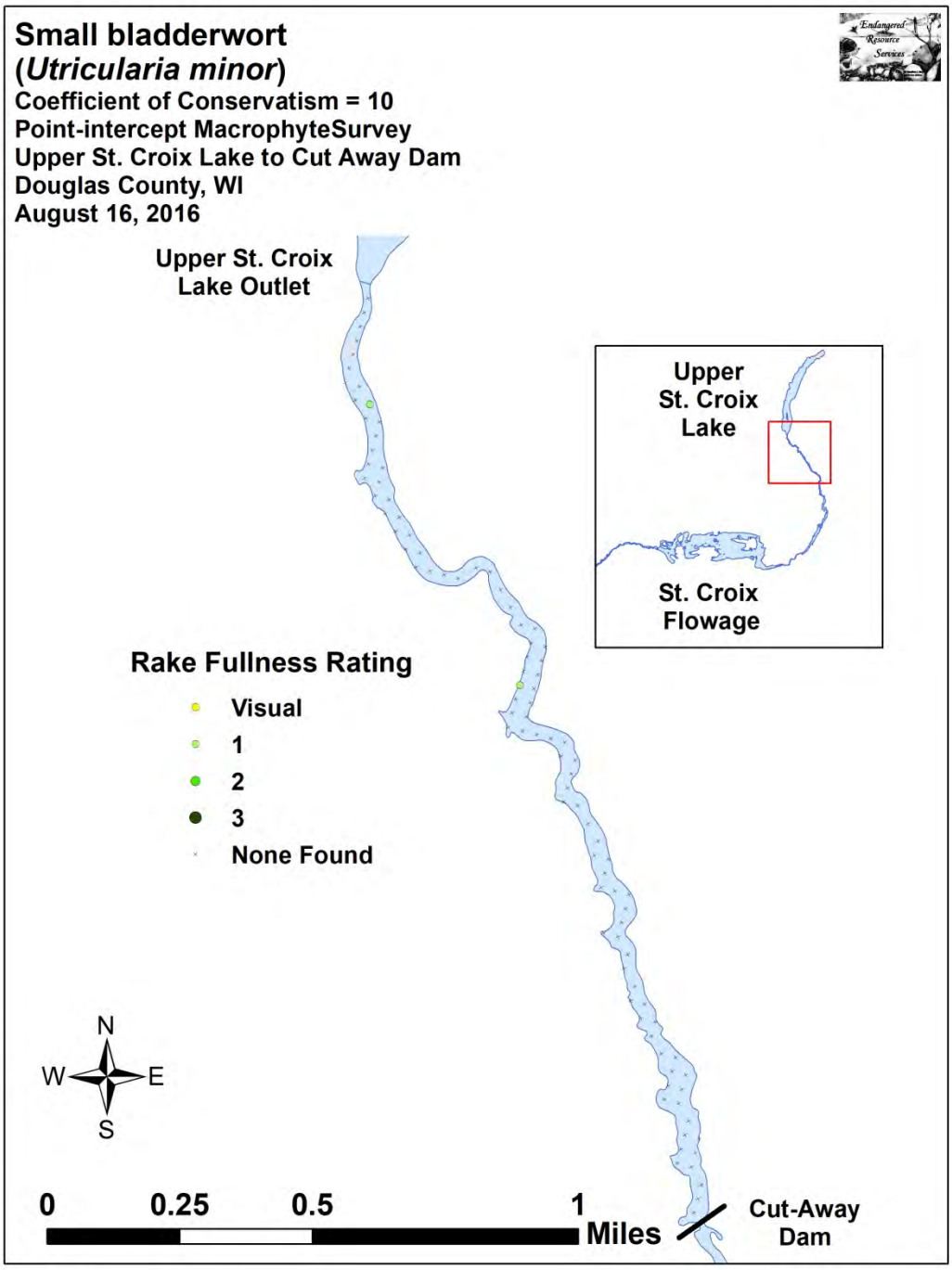
1
Miles
Cut-Away Dam


Small bladderwort
(Utricularia minor)
Coefficient of Conservatism = 10
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
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None Found
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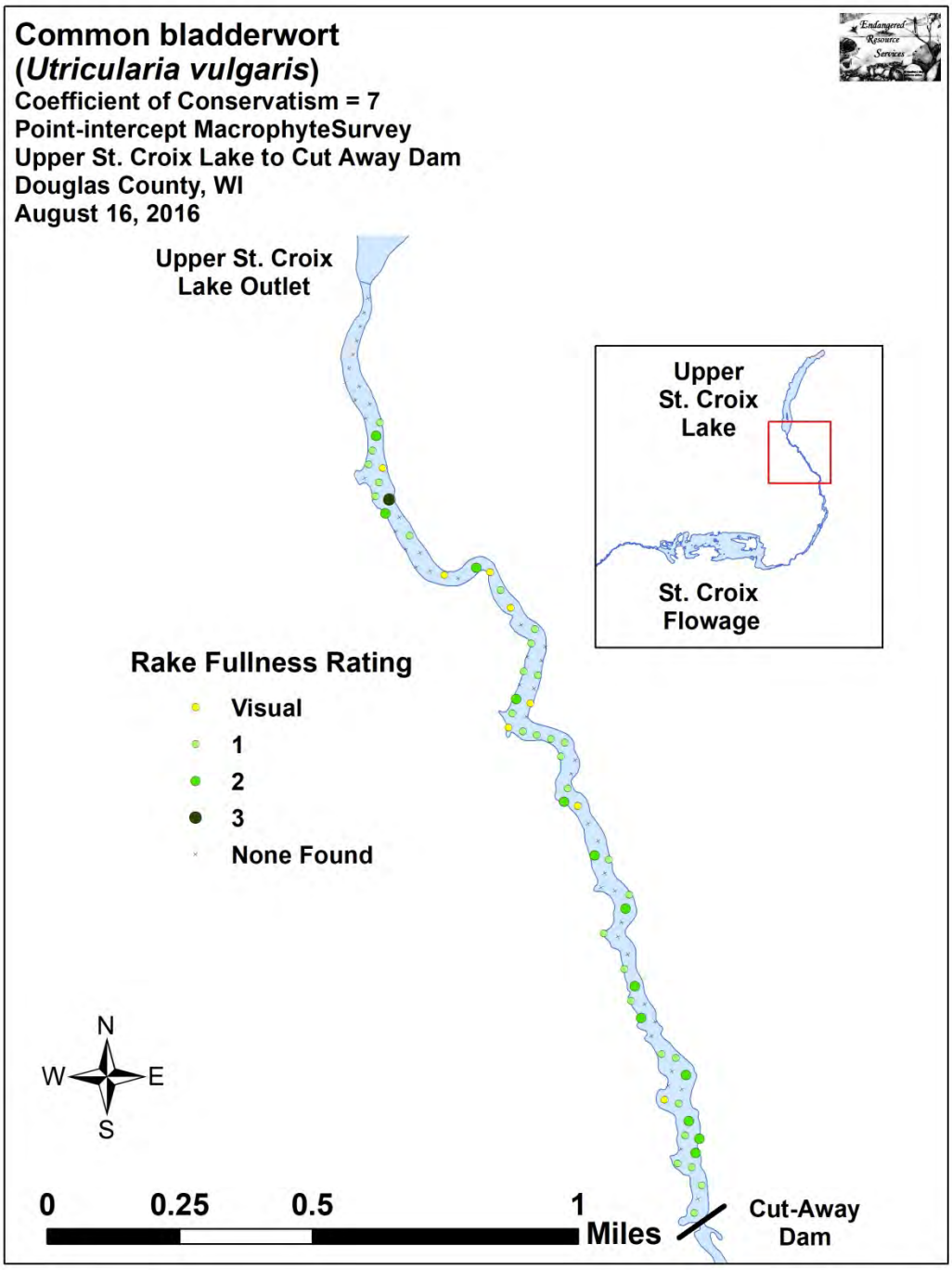
Miles
Cut-Away Dam


Common bladderwort
(Utricularia vulgaris)
Coefficient of Conservatism = 7
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
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None Found
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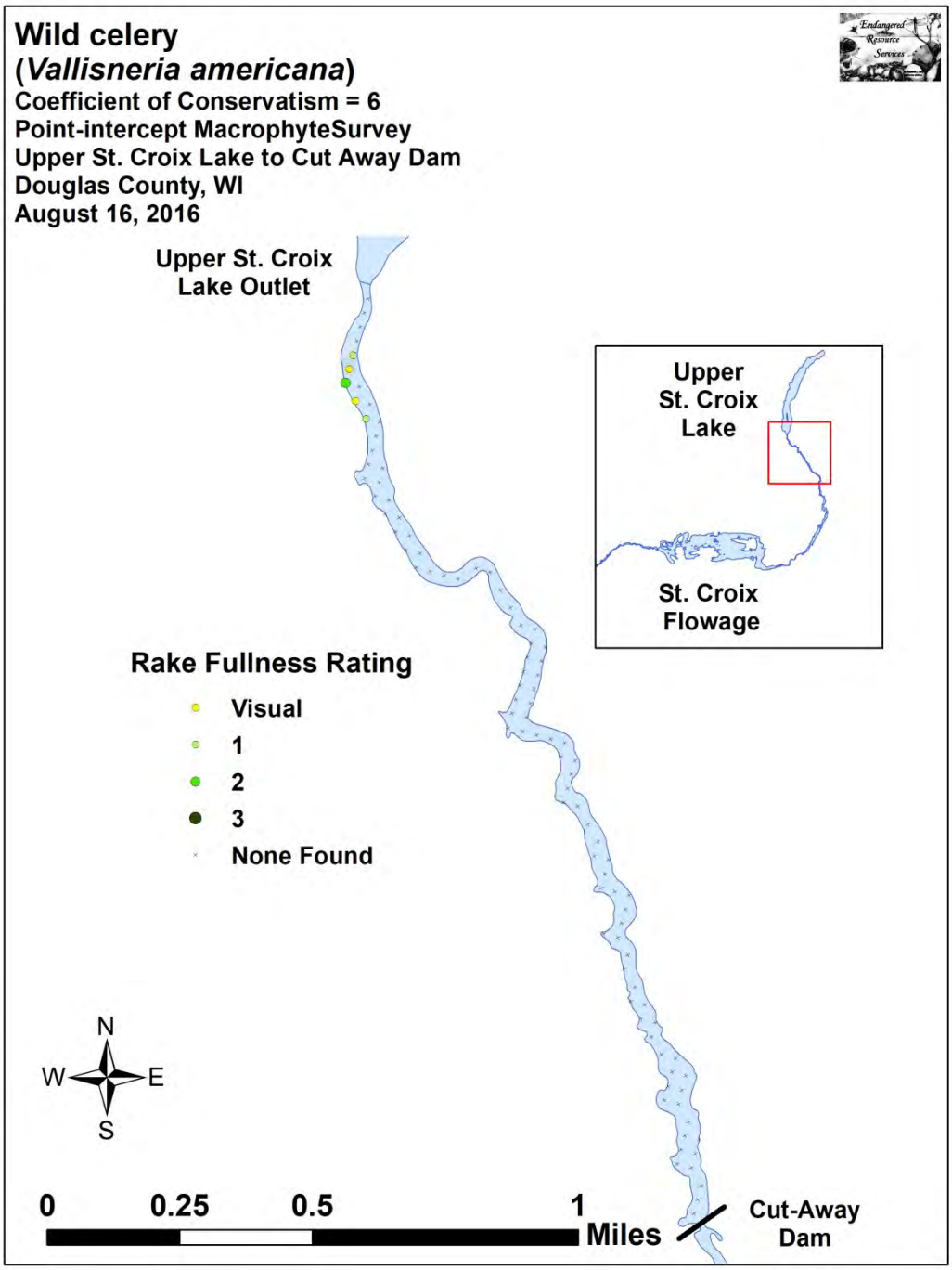
1
Miles
Cut-Away Dam


Wild celery
(Vallisneria americana)
Coefficient of Conservatism = 6
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
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None Found
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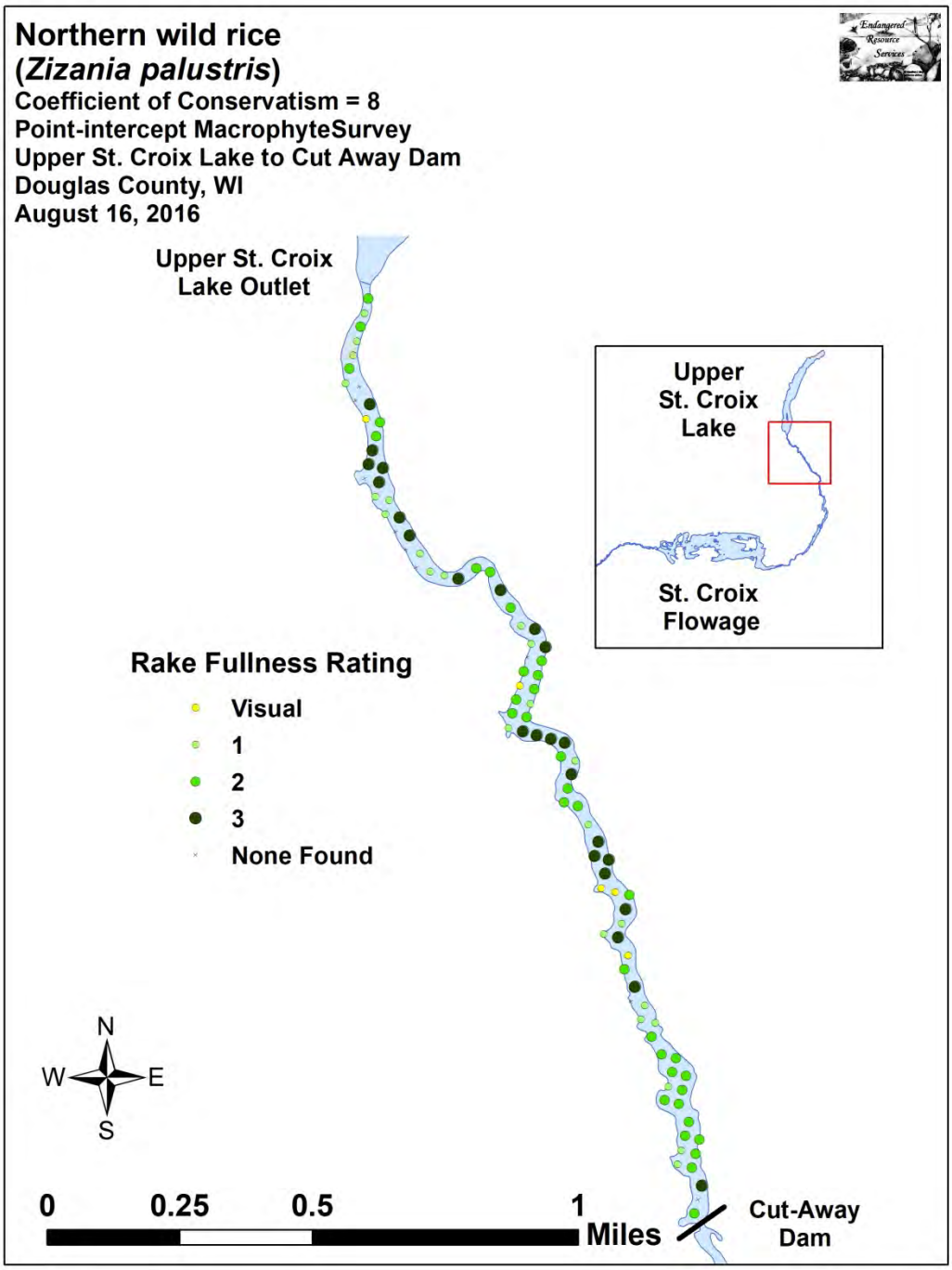
0.25
0.5
1
Miles
Cut-Away Dam


Northern wild rice
(Zizania palustris)
Coefficient of Conservatism = 8
Point-intercept MacrophyteSurvey
Upper St. Croix Lake to Cut Away Dam
Douglas County, WI
August 16, 2016
Upper St. Croix Lake Outlet
Upper St. Croix Lake
St. Croix Flowage
Rake Fullness Rating
Visual
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None Found
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0
0.25
0.5
1
Miles
Cut-Away Dam

Appendix VIII: Glossary of Biological Terms
(Adapted from UWEX 2010)

Aquatic:

organisms that live in or frequent water.

Cultural Eutrophication:

accelerated eutrophication that occurs as a result of human activities in the watershed that increase nutrient loads in runoff water that drains into lakes.

Dissolved Oxygen (DO):

the amount of free oxygen absorbed by the water and available to aquatic organisms for respiration; amount of oxygen dissolved in a certain amount of water at a particular temperature and pressure, often expressed as a concentration in parts of oxygen per million parts of water.

Diversity:

number and evenness of species in a particular community or habitat.

Drainage lakes:

Lakes fed primarily by streams and with outlets into streams or rivers. They are more subject to surface runoff problems but generally have shorter residence times than seepage lakes. Watershed protection is usually needed to manage lake water quality.

Ecosystem:

a system formed by the interaction of a community of organisms with each other and with the chemical and physical factors making up their environment.

Eutrophication:

the process by which lakes and streams are enriched by nutrients, and the resulting increase in plant and algae growth. This process includes physical, chemical, and biological changes that take place after a lake receives inputs for plant nutrients--mostly nitrates and phosphates--from natural erosion and runoff from the surrounding land basin. The extent to which this process has occurred is reflected in a lake's trophic classification: oligotrophic (nutrient poor), mesotrophic (moderately productive), and eutrophic (very productive and fertile).

Exotic:

a non-native species of plant or animal that has been introduced.

Habitat:

the place where an organism lives that provides an organism's needs for water, food, and shelter. It includes all living and non-living components with which the organism interacts.

Limnology:

the study of inland lakes and waters.

Littoral:

the near shore shallow water zone of a lake, where aquatic plants grow.

Macrophytes:

Refers to higher (multi-celled) plants growing in or near water. Macrophytes are beneficial to lakes because they produce oxygen and provide substrate for fish habitat and aquatic insects. Overabundance of such plants, especially problem species, is related to shallow water depth and high nutrient levels.

Nutrients:

elements or substances such as nitrogen and phosphorus that are necessary for plant growth. Large amounts of these substances can become a nuisance by promoting excessive aquatic plant growth.

Organic Matter:

elements or material containing carbon, a basic component of all living matter.

Photosynthesis:

the process by which green plants convert carbon dioxide (CO2) dissolved in water to sugar and oxygen using sunlight for energy. Photosynthesis is essential in producing a lake's food base, and is an important source of oxygen for many lakes.

Phytoplankton:

microscopic plants found in the water. Algae or one-celled (phytoplankton) or multicellular plants either suspended in water (Plankton) or attached to rocks and other substrates (periphyton). Their abundance, as measured by the amount of chlorophyll a (green pigment) in an open water sample, is commonly used to classify the trophic status of a lake. Numerous species occur. Algae are an essential part of the lake ecosystem and provides the food base for most lake organisms, including fish. Phytoplankton populations vary widely from day to day, as life cycles are short.

Plankton:

small plant organisms (phytoplankton and nanoplankton) and animal organisms (zooplankton) that float or swim weakly though the water.

ppm:

parts per million; units per equivalent million units; equal to milligrams per liter (mg/l)

Richness:

number of species in a particular community or habitat.

Rooted Aquatic Plants:

(macrophytes) Refers to higher (multi-celled) plants growing in or near water. Macrophytes are beneficial to lakes because they produce oxygen and provide substrate for fish habitat and aquatic insects. Overabundance of such plants, especially problem species, is related to shallow water depth and high nutrient levels.

Runoff:

water that flows over the surface of the land because the ground surface is impermeable or unable to absorb the water.

Secchi Disc:

An 8-inch diameter plate with alternating quadrants painted black and white that is used to measure water clarity (light penetration). The disc is lowered into water until it disappears from view. It is then raised until just visible. An average of the two depths, taken from the shaded side of the boat, is recorded as the Secchi disc reading. For best results, the readings should be taken on sunny, calm days.

Seepage lakes:

Lakes without a significant inlet or outlet, fed by rainfall and groundwater. Seepage lakes lose water through evaporation and groundwater moving on a down gradient. Lakes with little groundwater inflow tend to be naturally acidic and most susceptible to the effects of acid rain. Seepage lakes often have long, residence times. and lake levels fluctuate with local groundwater levels. Water quality is affected by groundwater quality and the use of land on the shoreline.

Turbidity:

degree to which light is blocked because water is muddy or cloudy.

Watershed:

the land area draining into a specific stream, river, lake or other body of water. These areas are divided by ridges of high land.

Zooplankton:

Microscopic or barely visible animals that eat algae. These suspended plankton are an important component of the lake food chain and ecosystem. For many fish, they are the primary source of food.

Appendix IX: 2016 Raw Data Spreadsheets