

Final Report for AIS Grant ACEI-209-18

Wetland Invasives Control at Pheasant Branch Conservancy



Drone image by Gary Sater

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Acknowledgements

Patricia Trochlell served as the lead botanist for the vegetation surveys, following up on identification of unknown samples collected in the field. Rob Schubert provided information on the management work reported here, joined Patricia and Tom in several of the surveys, and provided comments on this report. Gary Sater flew his recreational drone over managed areas and took the drone imagery used in this report. Tom Bernthal took the photos used here, entered survey data and compiled this report.

Introduction

This Final Report is written to satisfy monitoring requirements for Wisconsin Department of Natural Resources Aquatic Invasive Species Control Grant ACEI-209-18, “Wetland Invasives Control at Pheasant Branch Conservancy” to the Friends of Pheasant Branch Conservancy, Inc. This grant covered wetland invasives control activities for the period from April 15, 2018 through December 31, 2021, continuing work funded under two previous AIS Grants, ACEI 114-12, and ACEI 157-15, which funded work from 2012-2018. All AIS grant-funded wetland invasive control work at the Dane County Unit of Pheasant Branch Conservancy has been based on the recommendations made in the “Aquatic Invasive Species Assessment and Management Plan for Recovery of Remnant Sedge Meadow at Pheasant Branch Marsh, Dane County Unit,” hereafter referred to as the “Sedge Meadow Recovery Plan.” This plan was prepared by Craig A. Annen and David G. Cordray of Integrated Restorations, LLC, funded through Wisconsin Department of Natural Resources Planning Grant AEPP-272-11 to the Friends of Pheasant Branch Conservancy, Inc.

A summary of Grant-funded wetland invasive control conducted continuously from July 1, 2012 through June 30, 2018, and the results of monitoring surveys of the effectiveness of this work, are found in the *Final Report for AIS Grant ACEI 157-15 Wetland Invasives Control at Pheasant Branch*, submitted July 17, 2019. This report covers the most recent work but will refer back to previous work and monitoring results for background and continuity. The Monitoring goal continues to be tracking trends in plant community condition, or floristic quality, in the vegetation associations (which will be referred to as “plant communities”) mapped in the “Sedge Meadow Recovery Plan,” towards the ultimate goal of re-establishing a fair-to-high quality Southern Sedge Community. Initial Timed-Meander vegetation surveys were conducted to calculate Floristic Quality Assessment Metrics, “Weighted Mean C” and “Weighted Floristic Quality Index (FQI)” within these mapped areas to establish baseline conditions prior to invasives control work where possible. As work progressed over the years, follow-up surveys using the same method were conducted within the subsequent growing season within these plant communities. The change in FQA values along with change in percent cover of targeted wetland invasives is used to assess the effectiveness of grant-funded activities.

Methods

Floristic Quality Assessment Metrics for Wetland Plant Community Condition

The Wisconsin Floristic Quality Assessment method was chosen for its time-efficiency, flexibility, replicability and institutional support from the Wisconsin Department of Natural Resources and University of Wisconsin Herbarium. Wisconsin Floristic Quality Assessment using the WDNR Timed-Meander Standard Operating Procedure and the Wisconsin Floristic Quality Assessment Calculator are available on the WDNR website:

<https://dnr.wi.gov/topic/Wetlands/methods.html>. Timed-Meander surveys are extremely time-efficient and thorough, yielding a complete plant inventory with percent cover estimates for every species found in a given Assessment Area. Data entry into the WFQA Calculator allows calculation of the 2 key metrics and the percent cover of invasives that are reported below.

Weighted Mean C and Weighted FQI

The FQA system is based on an expert-assigned “coefficient of conservatism” for every vascular plant species found in a regional flora – a number between 0 and 10 that reflects each species tolerance of disturbance and the likelihood of that species being found in undisturbed plant communities in the region. A “0” is assigned to species that thrive with disturbance and “10” to highly intolerant species only likely to be found in undisturbed sites. Non-natives are automatically assigned a “0.” These values were established for the state of Wisconsin as a single region in 2003 by a group of 8 botanists with the highest degree of expertise in the flora of Wisconsin. “Weighted Mean C” is calculated as the average of the C values for all plant species found in the survey, weighted by the percent cover of each species and

varies between 0 and 10. It is a measure of the degree to which species intolerant of disturbance and pollution dominate the assessed plant community. “Weighted Floristic Quality Index (FQI)” is calculated as the product of the Weighted Mean C multiplied by the square root of the total number of species found in the survey. Its lower limit is 0, but has no pre-set upper limit, depending on the total number of species found and the Weighted Mean C.

Plant Community Condition Categories

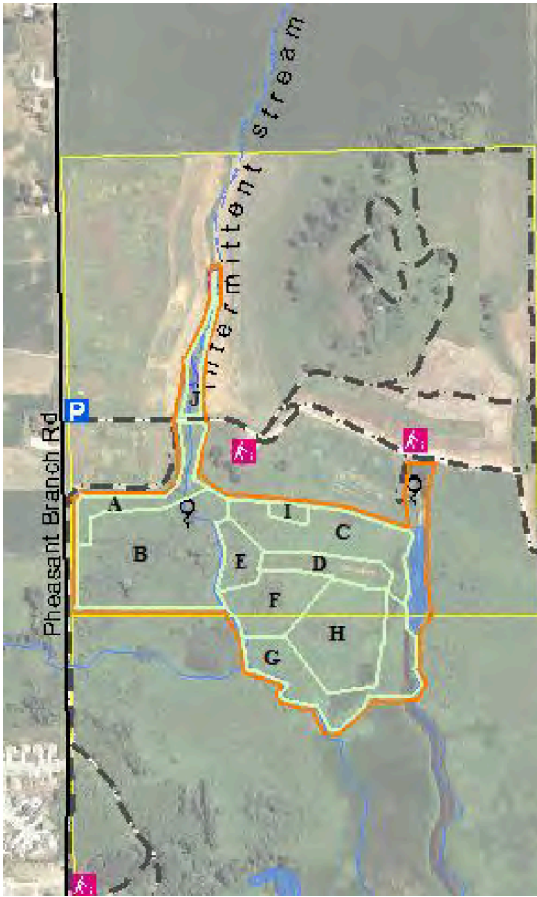
The Wisconsin Department of Natural Resources conducted over 1,000 WFQA timed-meander surveys across the four major ecoregions of the state. Surveys have targeted both “least disturbed” and “most disturbed” wetlands for the commonly occurring wetland plant communities in each ecoregion. The results have been used to calculate “Preliminary WFQA Benchmarks,” a set of statistically and scientifically defensible, numerical benchmarks to define 5 categories of wetland plant community condition or health for each surveyed wetland plant community in each ecoregion (Marti and Bernthal 2019). Condition categories were delineated based on ecoregional survey data to give more contextual meaning to numerical FQA results. The categories are “Very Poor, Poor, Fair, Good and Excellent.” The study found Weighted Mean C to be a more robust reliable measure of plant community condition, so Benchmarks were set based on that metric. For example, for Southern Sedge Meadow in the SE Glacial Plains – the target community for most of our work – the Benchmark dividing “Very Poor” from “Poor” Condition is a Weighted Mean C of 1.9, while the dividing line between “Poor” and “Fair” is 3.8, and the dividing line between “Fair” and “Good” is 4.5. A value of 6.4 was set to divide “Good” from “Excellent.”

We also report Weighted FQI values. This metric has not been found to be statistically robust enough to be appropriate for defining condition categories but is useful for tracking increases in species richness. For example, an increase in Weighted FQI while Weighted Mean C stays relatively constant would indicate that the species being added are conservative. A decrease in Weighted Mean C while Weighted FQI remains relatively stable would indicate that the species being added are weedy. Where sites are very low in species richness, the Weighted Mean C alone is not a good indicator of floristic quality. Our recommendation is to use both metrics to understand change in vegetation composition at a site.

Survey Personnel and Design

All of the vegetation surveys were conducted by Patricia Trochlell and Tom Bernthal, with Rob Schubert joining them from time to time. Limiting the number of surveyors ensures observer consistency and comparability from survey to survey over the 3-year time period. The Timed-Meander survey, a “plotless” method chosen for its greater efficiency and completeness compared to other plot-based methods, has been used for all surveys. This is the same method used by WDNR for the statewide WFQA Benchmarks Survey project, which developed the plant community condition categories to which we refer.

Survey areas were chosen based on the “vegetation associations” defined in the Recovery Plan, since specific management actions were planned for each area.

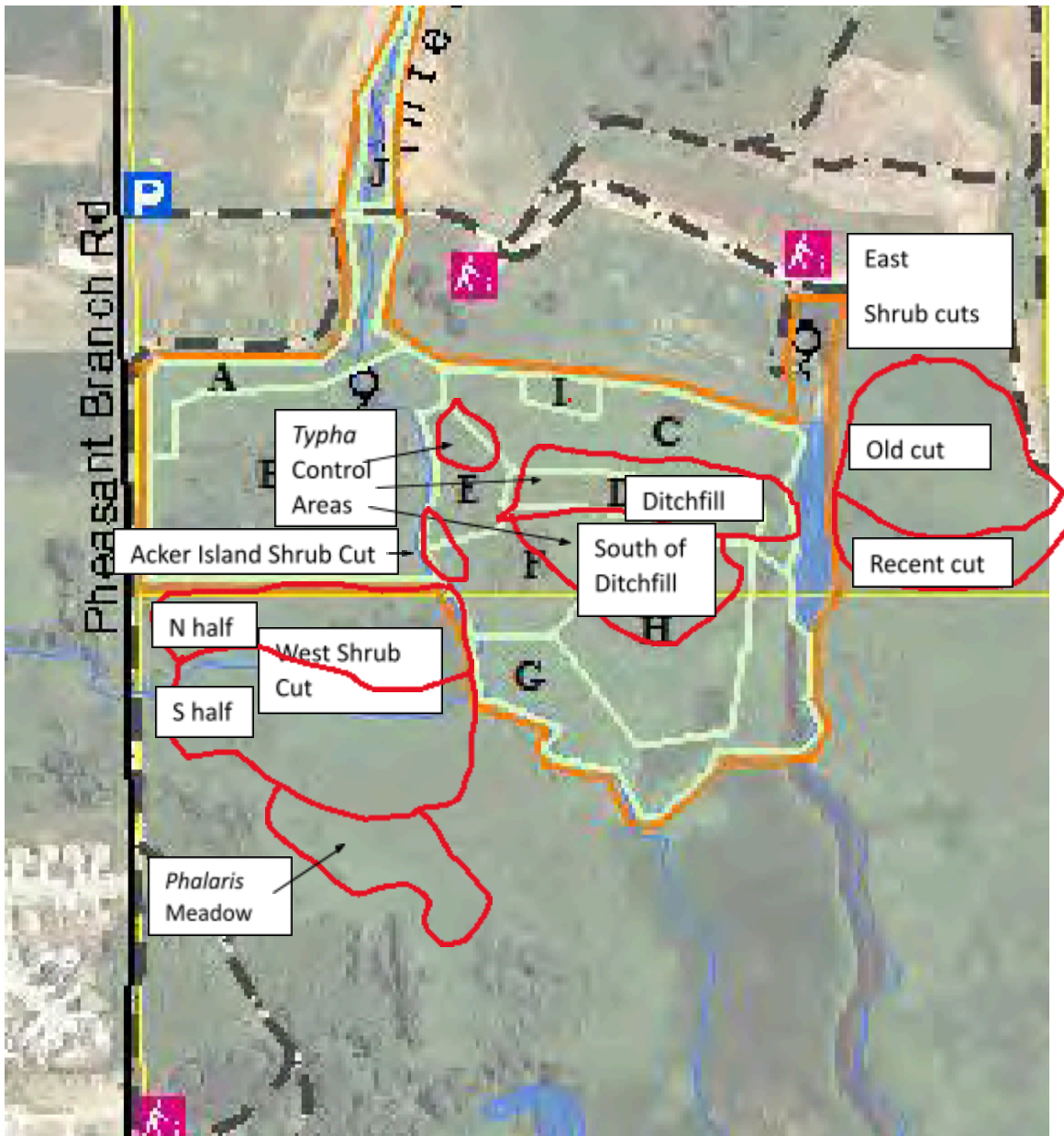


Map 1. Vegetation Associations delineated in the Sedge Meadow Recovery Plan.

The major targets for the first two grants were the Fredericks' Springs, and areas A, B, C, D, E and I, coinciding with the general strategy of working from north to south. Over the course of the project some areas have been combined and some have been further subdivided to reflect changes in location of management activities, diverging vegetation composition, or to create efficiency for conducting comparable surveys. Initially Area A was added to Area B, and Area I was combined with Area C. Beginning with the 2017 survey, Area C was subdivided into Area C – East and Area C – West. A large willow clone in Area C that was cut and treated in December of 2014 was surveyed separately from 2015 to 2018.

Baseline surveys were to be done for all areas early in the 2012 growing season before grant funded control work was conducted, but because of Tom Bernthal's illness throughout that year, the only area surveyed was the small Frederick's Springs area and true baseline conditions were not documented by surveys for most areas. However we have managed to ensure that "before treatment" and "after treatment" surveys have been conducted for the areas reported on in the previous monitoring report and continued in this one.

Surveys have been undertaken based on the location, timing and type of work occurring within the area and the amount of time since the previous survey. Where significant work was done, that area was prioritized to be surveyed within the next growing season to allow the vegetation response to take place before the next survey was conducted. As work has progressed and plant composition changed, it was necessary to change the boundaries of Assessment Areas. The following updated map shows the areas where significant invasives control work was undertaken using current AIS grant funds. These areas became the focal point of monitoring surveys during the growing seasons of 2019 through 2022.



Map 2 Major Treatment Areas for AIS Grant 209-18.

Description of Work, Monitoring Results and Recommendations

1. *Phalaris* and *Typha* Control at Fredericks' Springs

1.1 Background on Prior Work

The Fredericks' Springs and their surrounding seepage meadow is the most visited wetland area in the area in the Conservancy. During the floods of 2008, water backed up from Lake Mendota to cover Conservancy wetlands with several feet of sediment-laden water. Over the next several years, reed canary grass, *Phalaris arundinacea*, became well-established and expanded to cover approximately 75% percent of the meadow wetlands by the end of the 2010 growing season, prompting the Friends of Pheasant Branch to apply for an AIS Planning Grant in 2011.

Annual control work at Frederick's Springs involved spraying *Phalaris* with clethodim at anthesis (flowering) in June and cutting *Typha* and treating the cut stumps with imazypyr. This produced dramatic progress from a highly degraded, *Phalaris arundinacea* dominated community with low species richness toward a good quality sedge meadow. A smaller mixed stand of *Typha X glauca* and *Typha angustifolia* was also present in the area. Because genetic studies have shown the ability to distinguish *T. X glauca* from *T. angustifolia* in the field is not reliable, and both species are targets for the project, we combine their surveyed cover as *Typha X glauca* throughout the report. This stand of invasive *Typha* had been nearly eliminated by the beginning of this grant period in 2018.

1.2 AIS Grant 209-18: Description of Work and Monitoring Results

Throughout this report we will provide data from past years along with current monitoring results (in **Bold**) to show how floristic quality and target species have changed over the last decade, as well as during this grant period. This provides more context to understand the results.

Table 1. Fredericks' Springs WFQA Results

Year	Target Wetland Invasive Species Absolute % cover	wMean C	wFQI	Plant Community Condition (S. Sedge Meadow)	# of Species Native vs Non-native	Relative % Cover Native vs Non-Native
2012	<i>Phalaris arundinacea</i> 60% <i>Typha X glauca</i> 20%	0.9	4.2	Very Poor	7 vs 23	22% vs 78%
2014	<i>Phalaris arundinacea</i> 19% <i>Typha X glauca</i> 10%	3.1	21.0	Poor	47 vs 8	70% vs 30%
2015	<i>Phalaris arundinacea</i> 15% <i>Typha X glauca</i> 15%	3.0	19.5	Poor	43 vs 7	60% vs 40%
2016	<i>Phalaris arundinacea</i> 5% <i>Typha X glauca</i> 1%	3.7	29.3	Poor	55 vs 7	85% vs 15%
2017	<i>Phalaris arundinacea</i> 5% <i>Typha X glauca</i> 1%	4.1	30.3	Fair	45 vs 10	90% vs 10%
2018	<i>Phalaris arundinacea</i> 5% <i>Typha X glauca</i> 1%	4.2	32.2	Fair	51 vs 8	84% vs 16%
2019	<i>Phalaris arundinacea</i> 7% <i>Typha X glauca</i> 1%	4.2	31.3	Fair	48 vs 8	82% vs 18%
2022	<i>Phalaris arundinacea</i> 7% <i>Typha X glauca</i> not found	4.1	29.9	Fair	46 vs 7	84% vs 16%

The grant period the monitoring results for 2018-2022 show that floristic quality, native species richness and cover and target species cover has remained essentially constant, with a slight but not significant increase in the absolute cover of *Phalaris* from 5% to 7% and *Typha* now apparently absent from the site. This contrasts with the dramatic improvement that took place from 2012 to 2016. It appears that the site has stabilized. However we recommend continuing spring treatment of *Phalaris arundinacea*, in order to prevent its spread. With the level of trampling that takes place near the observation deck expected to continue, at least in the near term, dense native vegetation, particularly *Carex stricta* is unlikely to establish at densities sufficient to outcompete established clusters of *Phalaris*. A monitoring survey should be conducted at least once during the next grant period (2021-2024) but annual monitoring is not likely to be needed unless site conditions change.

2. *Typha* Control in Areas D, E, F and H

2.1 Background on Prior Work

As noted previously the 3 species of *Typha* commonly found throughout southern and central Wisconsin (native *Typha latifolia*, non-native *Typha angustifolia*, and the highly aggressive, non-native hybrid *Typha x glauca*) have become increasingly difficult to reliably separate from each other when conducting vegetation surveys in our area. For purposes of management it is best to focus on how invasive a population is behaving. For ease of reading, this report will simply use the word *Typha*.



Map 3. Annotated 2014 Aerial Photo (Compiled by RS Baller 2017-1-18). Dark areas on this photo are dense shrub thickets in the west and east ends of the WDNR parcel. The area south of the Filled Ditch had extensive shrub cover, but was not as dense. Whitish areas are *Phalaris arundinacea* (reed canary grass) dominated areas.

To understand the *Typha* invasion as well as shrub dynamics in the project area some site history is needed. A major hydrologic disturbance took place in the 1960s when a drainage ditch was dug from west to east to connect the smaller western springs to the stream flowing out of the Fredericks' Springs (shown as "Filled Ditch" on photo). The dredge spoils were piled on the south side of the ditch, which became heavily colonized by shrubs and provided a source area for native and non-native shrubs to spread into areas B, C, D, E and F and form dense thickets in some areas. A major hydrologic wetland restoration was undertaken in 2003 and 2004. The drainage ditch was filled, not just plugged, and two sediment detention basins were dug along an intermittent stream in the restored prairie upstream of the wetlands (not shown in photo). Because of the deep frost that formed during the extremely cold period when excavation took place in the winter of 2003 it was not possible to create a complete seal around both edges of the ditchfill. Several areas of ponding formed along the edges of the ditch-fill areas allowing *Typha X glauca* (hybrid cattail) and small populations of *Phragmites australis* (giant reed grass) to invade. Shrubs also re-invaded portions of the ditch-fill.

From 2004 through 2012, prior to the beginning of AIS Grant funding the primary management goal for the ditchfill (Area D) and the meadows to the north (Areas C, E and I) was to reduce cover of invasive shrubs, and overall shrub cover. Grant funding from the US Fish & Wildlife Service for contractors to cut and treat shrubs with Garlon, supplemented by volunteer efforts resulted in a major reduction in shrub cover and re-emergence of sedge meadow vegetation. However re-sprouting and bird-dispersed seed led to re-invasion by shrubs. During this time Dane County and City of Middleton land managers were unwilling to conduct prescribed burns in this area due to lack of resources and risk management

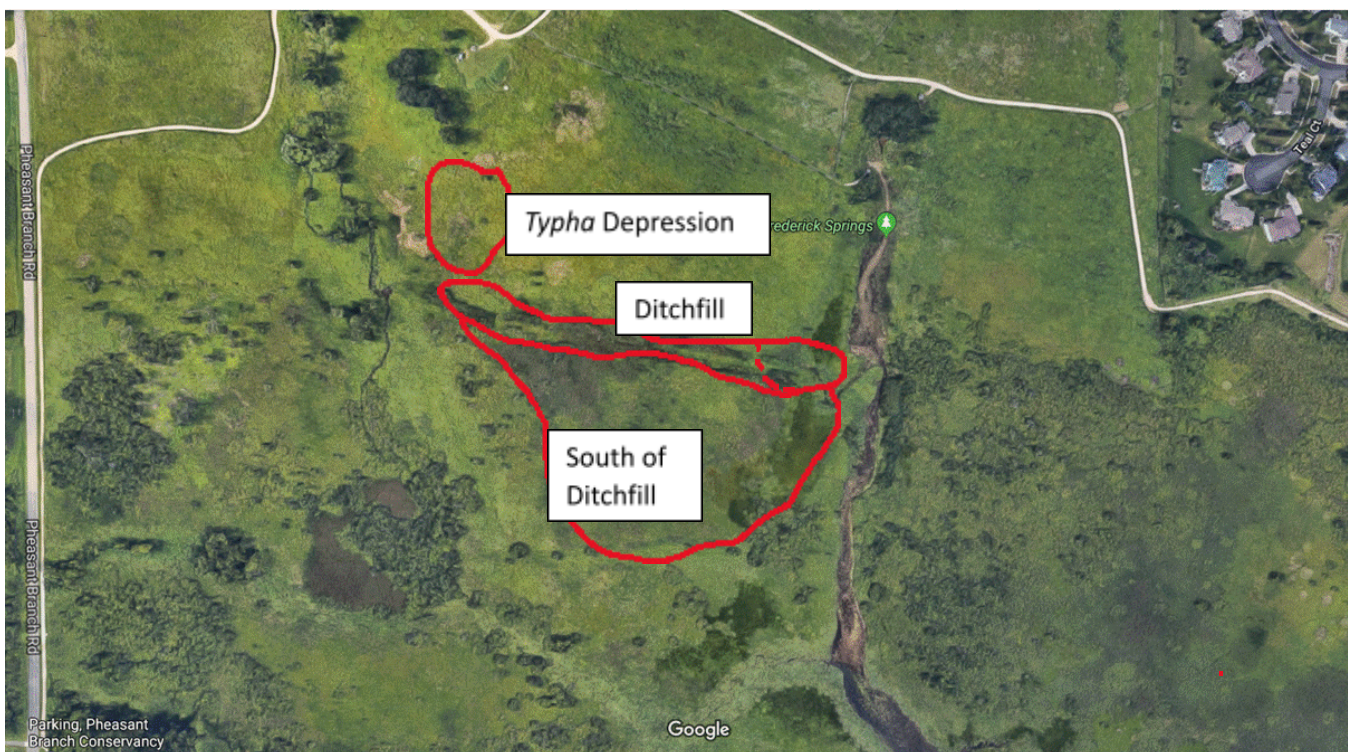
considerations. AIS funding from 2012-2017 was targeted toward reducing the cover of wetland invasive shrubs *Lonicera X bella* (honeysuckle), *Rhamnus cathartica* (common buckthorn) and *Salix interior* (sandbar willow), as well as overall shrub cover, including *Cornus sericea* (red-osier dogwood) and *Cornus racemosa* (gray dogwood), due to their tendency to invade and dominate sedge meadow communities. A second goal was to treat small areas of herbaceous invaders, *Phalaris*, *Phragmites* and *Typha* and treat any new invasions of these species.

In 2016 our shrub control efforts were greatly enhanced by the introduction of prescribed burning by qualified contractors. From 2012-2017 we eventually succeeded in meeting our shrub cover reduction goals, but *Typha* cover remained at 15% throughout this period and began to explode in 2017 (unfortunately not documented by a formal survey) and by 2018 the cover of *Typha* was at 70%. This caused us to focus on *Typha* control in these areas as a primary goal of this grant, while still maintaining shrub control through continuation of prescribed burning.

2.2 AIS Grant 209-18: Description of Work and Monitoring Results

The explosion of *Typha* was likely the result of a combination of wetter conditions in ponded areas along the ditchfill and increase in sunlight availability as shrub cover was removed. The spread from these source areas was also likely aided by several wetter than normal years in our area, favoring emergent vegetation over sedge meadow vegetation.

In the fall of 2019 there was a major effort to cut and treat *Typha*. Over the course of 3 years we spent \$60,000 on contractor treatment of cattail, supplemented by summer intern workers under the direction of our land manager. The work was very labor intensive because *Typha* cover was very dense, especially in the ponded source areas. We considered using a boom/wick applicator deployed from an ATV but rejected that technique as likely to cause considerable rutting and result in considerable collateral damage to non-target species. Instead contractors worked in groups of 2 or 3 with 2 people cutting cattails at ground level and piling cut stems and 1 person applying herbicide to the cut stumps. Initially all stumps were treated but this is potentially wasteful of herbicide in stands where individual stems are very close together and connected rhizomotously. Therefore in 2020, along the ditchfill and in dense stands to the south we started treating every 5th stump in densely clustered stands. Where *Typha* was less dense every stump was treated.



Map 4. Major *Typha* Control Areas for AIS Grant 209-18. Date of photography for Google image not known.

2.2.1 *Typha* Treatment in Depression within Community E

This area is north of the ditchfill, so it was not affected by the “leaky ditchfill” phenomenon but is a closed depressional area within Plant Community E delineated in the original Recovery Plan. This area had only scattered *Typha* previous to 2016. In early July of 2017, a “before treatment” survey was done that showed 37% cover of *Typha*, but clusters were not nearly as dense as those along the ditchfill. The first treatment was conducted in July and August of 2017, consisting of cutting, followed by spraying cut stumps with imazapyr. This treatment was so successful that only spot treatment was carried out in subsequent years.

Table 2. *Typha X glauca* Invaded Depression within Plant Community E – WFQA Results

Year	Target Wetland Invasive Species Absolute % cover	wMean C	wFQI	Plant Community Condition (S.Sedge Meadow)	# of Species Native vs Non-native Or Native Target	Relative % Cover Native vs Non-Native or Native Target
2017	<i>Typha X glauca</i>37% <i>Phalaris arundinacea</i>1%	3.2	19.7	Poor	38 vs 6	Not calculated
2018	<i>Typha X glauca</i>1% <i>Phalaris arundinacea</i> 1%	4.0	27.4	Fair	41 vs 6	95% vs 5%
2021	<i>Typha X glauca</i>2% <i>Phalaris arundinacea</i> 2% <i>Lythrum salicaria</i> 1%	5.4	33.2	Good	34 vs 5	95% vs 5%
2022	<i>Typha X glauca</i>6% <i>Phalaris arundinacea</i> 2% <i>Lythrum salicaria</i> 1% <i>Phragmites australis</i> 1% <i>Rhamnus cathartica</i> 1%	4.7	33.5	Good	51 vs 8	87% vs 13%

The first “after treatment” survey, conducted July 28 2018, showed *Typha* cover was drastically reduced by the first treatment in 2017 from 37% to 1%. This survey also noted that there was 20% cover of standing dead *Typha*. The area was resurveyed in 2021 and 2022. The survey in 2021 was conducted in late September, which may explain why fewer species were observed than in the 2022 survey (39 total species in 2021 vs 59 total species in 2022). The 2021 survey also noted, “Cut/treated areas revegetating well with *Carex stricta* (tussock sedge), *Epilobium sp* (willow herb), *Carex hystericina* (porcupine sedge), *Symphiotrichum firmum* (glossy-leaved aster), *Eupatorium perfoliatum* (boneset) and *Rumex brittanica* (great water dock). Some cut/treated areas are very wet and not revegetating except with short mudflat vegetation: *Eleocharis sp* (spikerushes), *Juncus sp.* (rushes)” Taken together the 2021 and 2022 surveys show that *Typha* cover has rebounded slightly to 6%, and *Phalaris* continues to persist, but neither are at levels that cause concern. These and the other 3 invasives can likely be controlled by spot-treatment in the future.

2.2.2 *Typha* Treatment – Ditchfill

The Ditchfill is the part of the project area where *Typha* occurs at the highest density. Cutting and treating the cut stumps as described above was carried out by teams of two contractors in July and August when plant growth was most robust. This was done to complete the significant amount of work in the time window that was available.

Table 3. *Typha* Control in Area D (Ditchfill) WFQA Results

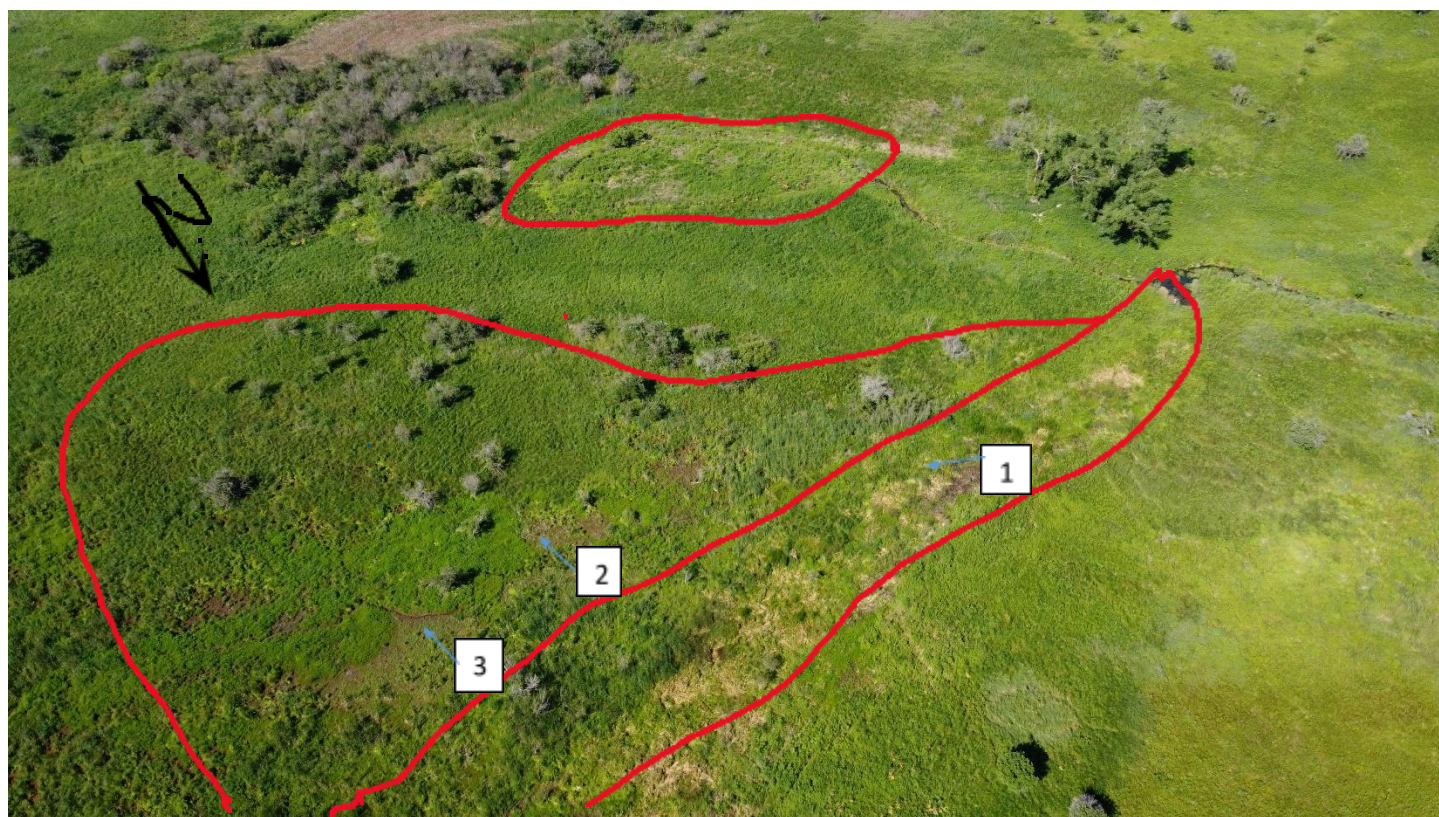
Year	Target Wetland Invasive Species Absolute % cover	wMean C	wFQI	Plant Community Condition (S.Sedge Meadow)	# of Species Native vs Non-native Or Native Target	Relative % Cover Native vs Non-Native or Native Target
2013	<i>Salix interior</i> 15% <i>Typha X glauca</i> 15%	3.1	24.2	Poor	60 vs 8	76% vs 24%
2015	<i>Salix interior</i> 22% <i>Typha X glauca</i> 15%	3.9	28.7	Fair	53 vs 7	70% vs 30%
2018	<i>Salix interior</i> 3% <i>Typha X glauca</i> 70%	2.9	24.0	Poor	57 vs 11	55% vs 45%
2021	<i>Salix interior</i> 1% <i>Typha X glauca</i> 10%	3.8	20.7	Fair	35 vs 5	83% vs 17%
2022	<i>Salix interior</i> not found <i>Typha X glauca</i> 20%	4.1	32.2	Fair	55 vs 8	79% vs 21%

The Ditchfill area remained consistently delineated from 2013 to 2018, giving us the best overview of *Typha* control in the project area of the 3 survey areas. In 2019 and 2020 we decided not to survey the area because it was either in the process of being treated or had recently been treated at the time we conducted surveys. We also felt it would be more instructive to wait until several years of treatment had taken place to avoid capturing the temporary results of treatment, which could confuse the interpretation of the results. We did shrink the area surveyed somewhat to cut out about 150 feet of the eastern end of the ditchfill, which never had more than scattered *Typha* cover at any time during the project and therefore was not intensively treating during 2019-2022. This concentrates our results on the actual treated areas and presents a more conservative view of native plant recovery. The dashed line in Map 4 shows the easternmost area that was not included in the Ditchfill surveys of 2021 and 2022. The table shows these as “Treated Areas.”

The results show a drastic reduction in *Typha* cover as a result of our intensive treatment from 2019-2021, from 70% cover to 10% cover in 2021 and 20% cover in 2022. *Typha* cover now appears to be similar to the levels we found prior to the explosive growth in 2017 and 2018. The strategy of treating every 5th cut stump in the densest appears to be successful. Given the ponded areas that exist along the ditchfill, the level of rhizome density and seed-bank richness in existing stands and the availability of seed from nearby stands of *Typha* it is not realistic to target eradication of *Typha* in this area as a management goal, but it should be possible to maintain cover close to current levels, though fluctuations in cover should be expected in response to fluctuating water levels. Future planning should provide for continual spot-treatment and budget for periodic intensive treatment.

2.2.3 *Typha* Treatment Area - South of Ditchfill

This area was not surveyed in 2017 or 2018, the years in which the *Typha X glauca* explosive growth occurred, though this area also was heavily invaded by *Typha*. The increase observed in the ditchfill was thought sufficient to document the problem. As work was carried out under this grant we realized that though this area didn't have "before treatment" data we should survey it as well to ascertain whether this area was responding any differently to treatment and also to document the areal extent of the *Typha* invasion. The 2022 survey documented species composition and cover similar to that of the Ditchfill area. The spatial patterns of the vegetation response are evident in the following drone image and photos.



Drone image 1. Taken July 18, 2022. Locations of photos 1-3 are shown. The "Ditchfill," "South of Ditchfill", and the "Acker Island" shrub-cut (top of photo) are outlined in red. Note homespun North arrow for orientation of image.

The drone image reveals some important aspects of the vegetative response to treatment. Multiple areas of bare soil with little or no standing *Typha* litter are evident just south of the ditchfill, including those portrayed further in photos 2 and 3. These are areas where *Typha* cover was dense, but not as dense as that shown in photo 1. The tan areas along the ditchfill have more litter left. The ditchfill was the source area for *Typha* invasion and had the densest cover of both standing dead stems and fallen litter. The wetland burns that took place during the grant period apparently were apparently more complete in terms of consuming dead litter south of the ditchfill than along the ditchfill itself. In both these areas mudflat conditions developed that were conducive to dense colonization by annual *Bidens* species, a common occurrence in mudflats where bare soil and shallow ponded water predominate. Other mudflat colonizers, like *Rumex brittanica*, *Scirpus atrovirens*, *Persicaria* species and *Leersia oryzoides* were also present. These areas were observed to be favored by Sandhill Cranes gathering for migration in the fall of 2021 and 2022. The *Typha* resprouts shown in photos 2 and 3 from 2022 will need to be watched and likely spot-treated to ensure they do not spread or intensify.

Further south of the Ditchfill the density of *Typha* stands decreases and eventually becomes scattered clusters embedded in a matrix of robust native sedge meadow vegetation such as *Carex stricta* (tussock sedge), other *Carices* and *Calamagrostis canadensis* (Canada Bluejoint grass). This vegetation appears darker green in the drone image, with a

coarser texture common in tussock dominated areas, with the lighter green areas dominated by the mudflat colonizers. These areas can be characterized as areas where the native sedge meadow vegetation remained robust in the face of *Typha* invasion. The fact that much of areas F, H and G (Maps 1 and 2) remains intact is very encouraging and justifies the investment made in *Typha* treatment. Unfortunately intact sedge meadow habitat is becoming increasingly scarce in our region. Future monitoring will show whether the sedge meadow vegetation will expand back into the mudflat areas after initially being displaced by *Typha*.



Photo 1 (Tom Bernthal). *Typha* treated area along ditchfill facing southeast toward Bock parcel. Photo taken August 9, 2020, 1 month after treatment. Note significant amount of standing dead vegetation and litter, and density of cattails.



Photo 2 (Tom Bernthal). Photo taken July, 8 2022, along south edge of ditchfill. Note scattered *Typha* resprouts and bare mud areas in the foreground, and a dense patch of *Bidens cernua* outlined in red. It was not necessary to treat this area in 2022.



Photo 3 (Tom Bernthal). Photo taken July 8, 2022 just south of ditchfill facing south. Small flow path is visible in drone image and may persist. This area was last treated in 2021. A dense patch of *Bidens cernua* is outlined in red.

3. Shrub Cutting and Prescribed Burning in Area C-E-I

3.1 Background on Prior Work

These three areas were combined into one Assessment Area for monitoring purposes in the previous monitoring report covering 2012-2018. Area I was delineated because it hosts a population of *Eriophorum angustifolium*, or cottongrass, a highly conservative species rarely found in southern Wisconsin. Further scouting and vegetation surveys revealed this area to also support several important calcareous fen species of special conservation interest as well, such as *Pedicularis lanceolatus* (swamp lousewort), *Cirsium muticum* (swamp thistle), *Parnassia glauca* (grass of Parnassus), and *Solidago riddellii* (Riddell's goldenrod). A series of aerial photos showed Area C (and I) to have been an open sedge meadow in the 1930's and 1940's with sparse shrub cover. After the drainage ditch was dug in Area D, described above, shrub invasion increased in Area C, yet a fairly complete suite of sedge meadow species co-occurred in areas that remained open. It was hypothesized that following shrub removal the dramatic increase in sunlight would allow increased growth of sedge meadow vegetation from the seedbank and from colonization from adjacent vegetation after treatments. Some cut and treat shrub removal work had already been done in 2005 and 2006. However, a significant amount of re-invasion had taken place by the time the plan was written in 2011 and it called for shrub cutting and treating cut stumps.

Intensive cut and treat control work by our contractor and by Operation Fresh Start crews greatly reduced un-desirable shrubs within the first several years (2012-2014). Shrub cover was down to acceptable levels by 2015 and has remained low since then. Re-sprouting and re-invasion from seed have been less of a problem since prescribed fire was started as a control technique in 2016. Starting in 2016 native sedge meadow seed has also been harvested from this area by volunteers and sown into newly treated areas.

3.2 Note on Introduction of Prescribed Fire from 2016 to 2021

Prescribed burning was first introduced to this area in the spring of 2016, from the ditchfill (Area D) north throughout Areas C, I and E. That was a relatively complete burn in terms of area. In 2017 the boundaries of the burn area were extended southward to the Acker stream, using it as the western and southern boundary. Areas E, F, G and H, which extend into the City of Middleton portion of the Conservancy, were now within the burn unit. At this time the City of

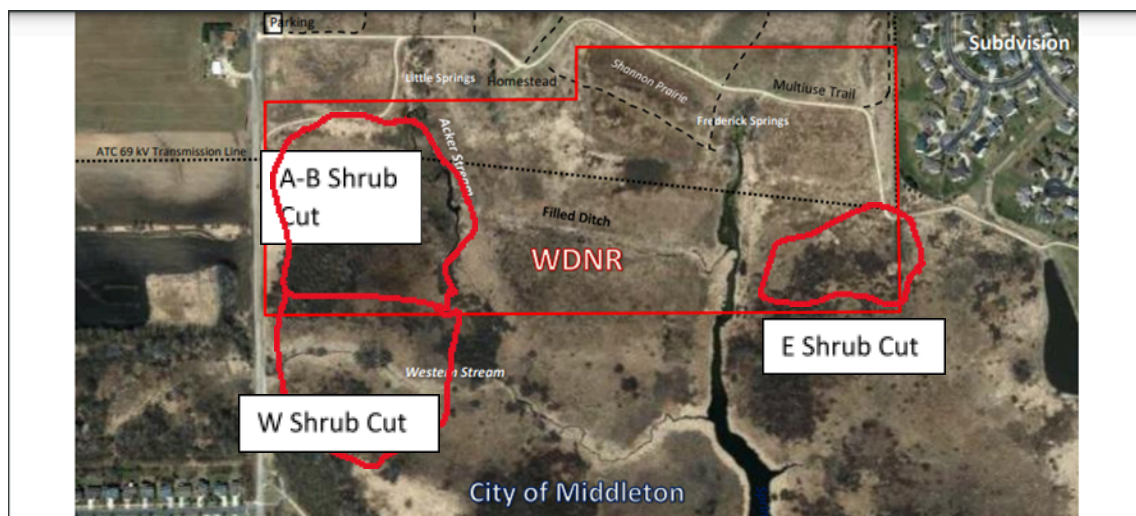
Middleton became involved, and assisted with mowing firebreaks. Spring burns conducted in 2017 and 2018 were relatively patchy but resulted in top killing shrubs that had re-sprouted.

In 2018 the burn unit was expanded west of the Acker stream to include Area B and contiguous City land, included the areas described in sections 5 (West Shrub Cut) and 6 (*Phalaris Meadow*). In 2019 these units were burned again, with a much more complete coverage, and burns were also carried out in 2020 and 2021. As a result Area C-E-I has been burned for six consecutive years and much less cut and treat work has been required to maintain low shrub cover levels. It appears the combination of these approaches has led to maintenance of almost completely shrub-free areas without the reinvasion that had taken place in the past.

With the exception of the *Typha* dominated depression in unit E reported in the previous section, no cutting and treating was done in this area. during the grant period. Therefore we did not survey these areas during this grant period. Future surveys will be able to document the long-term vegetation response to prescribed burning.

4. Shrub Cutting, Prescribed Burning and *Phalaris* Control in Area A-B

Areas A and B are similar to Area C-E-I, but are on the west side of the Acker stream. Prior to the first AIS grant in 2012 some shrub removal had taken place, but the treated area was expanded by contractors in the winter of 2014-15, and further expanded by Operation Fresh Start crews starting in the winter of 2017-18. Map 5 shows this area plus the East and West Shrub Cut areas discussed in sections 5 and 6.



Map 5. Further Annotated 2014 Aerial Photo (Compiled by RS Baller 2017-1-18). Further annotated to show Area A-B Shrub Cut, West Shrub Cut and East Shrub Cut

Results for area A-B have been very encouraging, with target shrub cover kept at low levels throughout the treated areas. Native vegetation response has resulted in a doubling of FQA metrics. In 2018 and 2019 work has focused on clearing shrubs further south into the City-managed part of the Conservancy. Area B has been included in the prescribed fire plan and has been burned in spring of 2018, 2019, 2020 and 2021 along with areas C, D, E, F and G. Because no cut and treat work was done in Areas A and B during this grant we did not survey these areas. Future surveys will be able to document the long-term vegetation response to prescribed burning.

5. East Side Shrub Cut Area

5.1 Background on Prior Work

This area was not in the original 2011 plan because it was thought we would not have sufficient resources to work in the area. However our summer intern crew was able to begin work there in 2017 and that was followed up by winter volunteer work parties and Operation Fresh Start crews beginning in the winter of 2018.

5.2 AIS Grant 209-18: Description of Work and Monitoring Results

This was followed by winter work during this grant period and the area was also included in prescribed spring burns in 2021 and 2022. There had also been a period of volunteer shrub cutting conducting prior to 2012, so we were able to identify an “old shrub cut” area. In the summer of 2019 we were able to survey that older area separately, then conduct a “before treatment” survey of the area planned to be cut. We then surveyed this same area in 2021 “after treatment. Table 4 presents this data.

Table 4. East Side Shrub Cut WFQA Results

Year	Target Wetland Invasive Species Absolute % cover	wMean C	wFQI	Plant Community Condition (S.Sedge Meadow)	# of Species Native vs Non-native Or Native Target	Relative % Cover Native vs Non-Native or Native Target
2019 “Old Cut” Area	<i>Salix interior</i> 1% <i>Rhamnus cathartica</i> 1% <i>Lonicera X bella</i> 1% <i>Phalaris arundinacea</i> 1% <i>Typha X glauca</i> 1%	4.5	39.7	Good	109 vs 13	93% vs 7%
2019 Before Cut	<i>Rhamnus cathartica</i>1% <i>Lonicera X bella</i> 2% <i>Phalaris arundinacea</i> 1% <i>Typha X glauca</i> 1%	4.4	31.4	Fair	45 vs 5	97% vs 3%
2021 Entire Area After Cut	<i>Rhamnus cathartica</i> not found <i>Lonicera X bella</i> not found <i>Phalaris arundinacea</i> 1% <i>Typha X glauca</i> 1%	5.1	38.1	Good	87 vs 11	89% vs 11%

These results are extremely encouraging. The “Old Cut” survey in 2019 showed what could be expected over the long term in areas where shrubs are removed and regular prescribed burning is carried out to keep shrub cover low. This is one of the few areas in the project where the weighted Mean C of 4.5 is high enough to surpass the benchmark for “Good” plant community condition. Species richness is extremely high, 109 native species to only 13 non-natives, reflecting years of recovery from shade suppression, historical lack of *Typha* and *Phalaris*, and adjacency to restored upland prairie. This area was likely historically in reasonably good condition to begin with, with little hydrologic disturbance (no drainage ditching or tiling) and shrub invasion due to lack of fire the main disturbance. The 2021 survey of the entire area after the planned cutting and treating of shrubs, primarily *Cornus sericea* (red-osier dogwood), shows similarly impressive results. The cover of *Carex stricta* (tussock sedge), at 60%, and *Symphiotrichum firmum* (glossy leaved aster), at 35%, indicates elements of the core structure of a quality Southern Sedge Meadow are in place. It appears likely that this area can be maintained through prescribed burning. The adjacent *Cornus sericea* shrub dominated area to the south in the City portion of Conservancy could become the target for future shrub cutting as it appears structurally similar to the East Shrub Cut area. There is not a compelling need to continue monitoring this area although surveying once in the next grant period could help provide a long-term record.

6. West Side Shrub Cut Areas

6.1 Background on Prior Work

This area lies within the City of Middleton section of the Conservancy and was not targeted in the original plan but during the previous grant period we realized that the successful response to shrub cutting and treatment in plant communities B and C could likely be duplicated in these adjacent areas with similar amounts of shrub cover. The area had about 40% total shrub cover, predominately *Salix discolor*, *Salix bebbii*, *Salix petiolaris*, and *Cornus sericea* with lesser amounts of *Rhamnus cathartica*, *Lonicera X bella*, *Salix interior* as well. Work began in the winter of 2017/18 but without the benefit of a rigorous “Before Treatment” survey to document the pre-existing shrub cover. These areas also had some stands of *Thypha* and *Phalaris* as well as occurrences of the herbaceous invaders, *Lythrum salicaria* (purple loosestrife) and *Phragmites australis*, subspecies *Australis* (common reed).

6.2 AIS Grant 209-18: Description of Work and Monitoring Results

After the initial treatment in the winter we were able to conduct full meander surveys in the summer of 2018, dividing the area into a north half and south half. In the winter of 2018/19 shrub cutting and treatment of cut stumps was completed. This was supplemented by prescribed burns that included the entire area in the spring of 2018 and again in the spring of 2019. Also beginning in 2019, annual treatment of *Typha* began (cutting and treating 1/5 of cut stumps in July)

In the summer of 2019 we conducted a full meander survey of the entire area. Results are presented below.

Table 5. West Side Shrub Cut WFQA Results

Year	Target Wetland Invasive Species Absolute % cover	wMean C	wFQI	Plant Community Condition (S.Sedge Meadow)	# of Species Native vs Non-native Or Native Target	Relative % Cover Native vs Non-Native or Native Target
2018 North Half	<i>Rhamnus cathartica</i> 1% <i>Lonicera X bella</i> 3% <i>Salix interior</i> 1% <i>Phalaris arundinacea</i> 8%	3.3	31.8	Fair	78 vs 15	74% vs 26%

Before Final Cut	<i>Typha X glauca</i> 25% <i>Lythrum salicaria</i> 1%					
2018 South Half Before Final Cut	<i>Rhamnus cathartica</i>8% <i>Lonicera X bella</i>2% <i>Acer negundo</i> 4% <i>Salix interior</i> 1% <i>Phalaris arundinacea</i> 7% <i>Typha X glauca</i> 4%	3.8	33.6	Fair	70 vs 9	85% vs 15%
2019 Entire Area After Cut	<i>Rhamnus cathartica</i> not found <i>Lonicera X bella</i> 1% <i>Salix interior</i> not found <i>Acer negundo</i> not found <i>Phalaris arundinacea</i> 4% <i>Typha X glauca</i> 1% <i>Lythrum salicaria</i> 1%	3.9	41.6	Fair	106 vs 16	89% vs 11%

Results show great success in eliminating key shrubs and small trees, *Rhamnus cathartica* (common buckthorn) and *Salix interior* (sandbar willow) and greatly reducing the shrub *Lonicera X bella* (Bell's honeysuckle), and the small tree *Acer negundo* (box elder). It is to be expected that these species will reappear at low levels of cover. The treatment of *Typha* and *Phalaris* resulted in reducing their cover to 4% and 1% respectively, an encouraging result. These levels should be able to be maintained through opportunistic spot treatment. It does not seem necessary to survey these areas on an annual basis as increases in shrub cover can easily be noted through inspection. However it will also be valuable to survey this area to establish "pre-development" condition in the area downstream of proposed residential development affecting the "Western stream" that flows through this area. It could be expected that cover increases related to an increase in nutrient and sediment delivery from stormwater flows would be seen first in *Typha*, *Phalaris*, *Lythrum salicaria* and *Phragmites australis subspecies Australis*.



Drone image 2 (Gary Sater). Taken August 6, 2021, with Pheasant Branch Road at the top of image.

The image shows the mowed and sprayed portion (grey areas) of a monocultural stand of *Typha* in the City portion of the Conservancy along the Western Stream (thin strip of green between two mowed areas). The green area on the left is a mixture of *Carex* sedges and *Phalaris* and was spot treated, but not mowed, to avoid collateral damage.

7. *Phalaris* Control in Degraded *Phalaris* Meadow

7.1 Background on Prior Work

This area, located wholly within the City of Middleton, has not been treated in the past. It was not addressed in the original Plan, but as work progressed southward, and as a good working relationship developed with the City of Middleton, it became viewed as a possible target, along with several other areas. The City of Middleton’s Conservancy Land Manager, Mark Wegner, has approved work in this and several additional areas within the City’s Conservancy lands.

7.2 AIS Grant 209-18: Description of Work and Monitoring Results

Contractors began mowing and spraying *Phalaris* regrowth with imazypr beginning in 2020. Typically the meadow area was mowed in June, vegetation would be allowed to regrow and flower, then sprayed at the time of anthesis, about a month later. Because the area was heavily dominated by *Phalaris*, spray could be efficiently applied by hand from an ATV. The near monocultural *Typha* areas were mowed in early summer, then sprayed about a month later after regrowth and anthesis (flowering).

A “Before Treatment” survey was conducted in August 2019, and an “After Treatment” was conducted in July of 2022 after the first 2 years of annual treatment.

Table 6. *Phalaris* Meadow WFQA Results

Year	Target Wetland Invasive Species Absolute % cover	wMean C	wFQI	Plant Community Condition (S.Sedge Meadow)	# of Species Native vs Non-native Or Native Target	Relative % Cover Native vs Non-Native or Native Target
2019	<i>Phalaris arundinacea</i> 80% <i>Salix interior</i> 10% <i>Rhamnus cathartica</i>1%	1.9	12.8	Poor	20 vs 5	48% vs 52%
2022	<i>Phalaris arundinacea</i> 50% <i>Salix interior</i> 1% <i>Rhamnus cathartica</i> 1%	2.2	17.6	Poor	42 vs 16	60% vs 40%

Results show treatment is being successful in reducing *Phalaris* cover but multiple years of treatment are need to get *Phalaris* cover into the 10% to 20% range. Weighted Mean C is gradually improving, but the high cover of *Phalaris* still greatly restricts competition and development of a robust native sedge meadow. Signs of improvement are appearing however. Overall species richness has doubled as more space has become available for germination and spread of competing species as *Phalaris* cover was reduced. Relative cover of native species has modestly increased but the number of non-native species has tripled from 5 to 16 while the number of native species has doubled from 20 to 42. It appears that this is an area that is “sorting itself out.” One encouraging sign is that the cover of *Carex stricta* (tussock sedge) has increased from 3% to 12 %. It is expected that this process will continue for multiple years as continued treatment further reduces the cover of *Phalaris*. We recommend the current treatment regime be continued over the next 3-year grant period. Annual monitoring will be valuable in tracking the annual pattern of response. It will also be valuable to help establish “pre-development” condition in the area downstream of proposed residential development affecting the “Western stream” that flows through the West Shrub Cut area nearby and could overflow into the meadow.

Conclusions and Recommendations

Table 7. Summary of Results and Recommendations

Area	+ Management Evaluation + Recommendation	Monitoring Recommendations
1. Fredericks' Springs	+ Effective, desired condition reached. + Continue herbicide treatment of <i>Phalaris</i> indefinitely to maintain current condition.	+ Inspect annually. + Survey every other year.
2. Major Typha Treatment Areas		
2.1 Depression in Area E	+ Effective, desired condition reached. + Spot treat as needed.	+ Inspect annually (monthly during growing season). + Before/After Survey if major work is needed.
2.2 Ditchfill	+ Partially effective, approaching desired condition. + Continue to cut and treat annually in July.	+ Inspect annually (monthly during growing season). + Survey annually at least a month after treatment.
2.3 South of Ditchfill	+ Partially effective, approaching desired condition. + Continue to cut and treat annually in July.	+ Inspect annually (monthly during growing season). + Survey annually at least a month after treatment.
3. Area C-E-I	+ Effective, desired condition reached and apparently remaining stable. + Conduct periodic prescribed burns (annually or bi-annually) to maintain sedge meadow.	+ Inspect annually for shrub recruitment and new invasives. + Survey once during grant for long term trends.
4. Area A-B	+ Effective, desired condition reached and apparently remaining stable. + Conduct periodic prescribed burns to maintain sedge meadow.	+ Inspect annually for shrub recruitment and new invasives. + Survey once during grant for long-term trends.
5. East Shrub Cut	+ Effective, desired condition reached. + Conduct periodic prescribed burns to maintain sedge meadow.	+ Inspect annually for shrub recruitment and new invasives. + Survey once during grant for long-term trends.
6. West Shrub Cut	+ Effective, desired condition reached, except for minor <i>Typha</i> and <i>Phalaris</i> stands, presence of <i>Lythrum salicaria</i> . + Spot treat as needed.	+ Inspect annually for shrub recruitment and new invasives. + Survey for baseline condition relative to "Western Stream" stormwater impacts.
7. Phalaris Meadow	+ Partially Effective, trending in right direction. + Continue annual mowing/spraying regime in June- July.	+ Inspect monthly during growing season. + Survey annually at least one month after treatment.

		+ Survey for baseline condition relative to “Western Stream” stormwater impacts
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Table 7 summarizes the findings of this report. Monitoring results show that in most treated areas we have reached the desired outcome in terms of reducing the cover of targeted invasive species. In previously shrub dominated areas native-dominated seedbanks have responded to the elimination of shade suppression from shrubs and reduced competition from *Phalaris arundinacea* with a flush of mostly herbaceous growth that has greatly increased native species cover and diversity, as measured by the Weighted Mean Coefficient of Conservatism (weighted Mean C) and Weighted Floristic Quality Index (Weighted FQI). In “older” areas, such as Areas 3, 4 and 5, where treatment began under our two previous grants, dramatic increases in FQA metrics in the early years of active management have typically levelled-off, remaining steady over the last 3 years. Over the long term since the project began in 2012 all management areas have improved in plant community condition categories, moving from “Poor” to “Fair” or “Very Poor” to “Fair” based on the Weighted Mean C metric. Our efforts in Area 4, the East Shrub Cut have been the most successful, with the attainment of “Good” condition and high native species richness. Structurally the goal of shifting from *Phalaris* and woody shrub domination to open herbaceous meadow vegetation has largely been successfully achieved, with *Carex stricta* (tussock sedge) as a notable dominant.

For recovering sedge meadow communities, the use of prescribed burning following cutting and treating appears to be successful in maintaining low levels of cover for target shrub species. These communities responded as expected, by increasing species richness of herbaceous natives, as evidenced by increases in weighted Mean C and Weighted FQI. Most of the project area now falls within a single burn unit with only the East Shrub Cut needing to be burned separately. Prescribed burning should be continued on a periodic basis for the long term. While some areas may not need to be burned annually, given the logistic difficulties involved it is best to plan for annual burns, realizing that some years it will not be possible to conduct a burn, and that fire intensity is patchy by nature.

At Fredericks’ Springs, where burning is not possible, it appears that it will be necessary to continue clethodim treatments of *Phalaris arundinacea*. If its cover can be reduced to 1% in the future it may be reasonable to skip treatment for a year and monitor the response. The *Phalaris* meadow is a longer term project, but is trending in the right direction. The current practice of mowing and treatment should be continued as long as a reduction in *Phalaris* cover and an increase in native diversity are seen.

The biggest challenge during this grant period has been controlling the explosive expansion of *Typha* in the Ditchfill Area and adjacent areas, where *Typha X glauca* cover went from 15% cover in 2015 to 70% cover in 2018, causing this area to revert from “Fair” condition in 2015 to “Poor” condition in 2018. The intensive effort we undertook appears to have been successful with *Typha* cover reduced to 10%-20% in these areas. However the treatment of monocultural patches has left some “dead zones” that are now in a mudflat stage, with patches of bare ground and shallow open water. In 2022 these were colonized by annual pioneer species, such as various *Bidens* and *Persicaria* species, as well as the perennials *Leersia oryzoides* (rice cut-grass), *Rumex brittanica* (great water dock) and *Scirpus cyperinus* (dark green bulrush), but *Typha* resprouts also occur in these areas. We will be observing these areas closely to understand the vegetation dynamics and take appropriate action. Treatment of established stands and spot treatment of scattered *Typha* will continue.