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Upper Mississippi River Restoration
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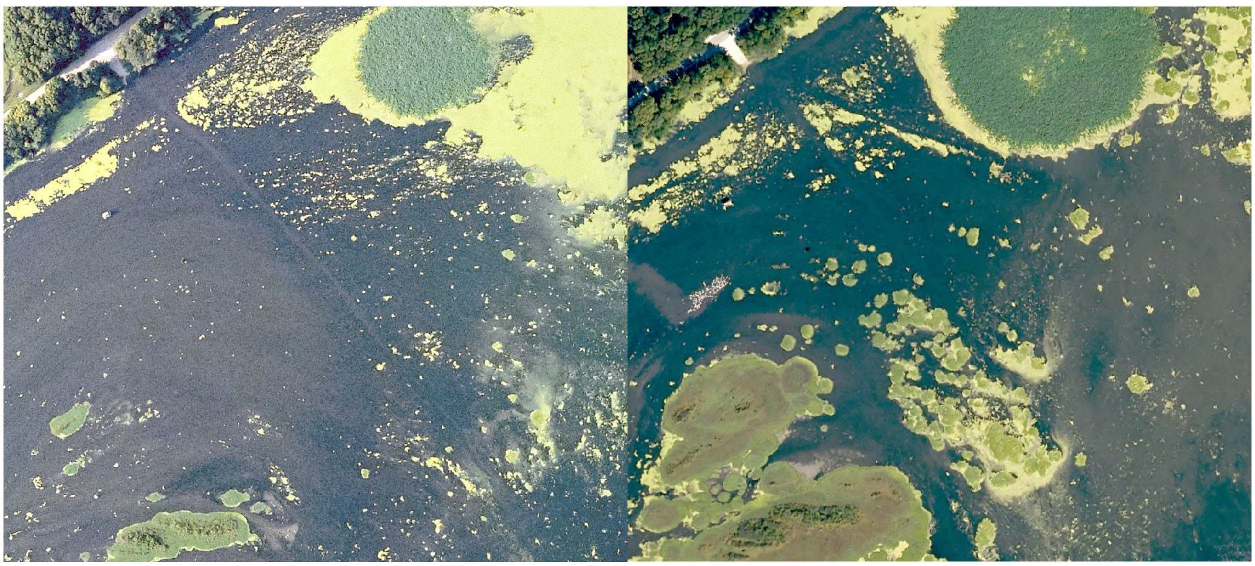
Completion Report
LTRMP-2019AER7

Changes in aquatic vegetation cover following lock closure on the Illinois Waterway from 2019 – 2021

September 2022



Changes in aquatic vegetation cover following lock closure on the Illinois Waterway from 2019 – 2021

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Abstract

Over the summer of 2020, the Illinois Waterway was closed to complete maintenance on lock chambers along the Illinois River. This closure restricted inter-pool vessel traffic along the river and potentially changed habitat characteristics for aquatic vegetation establishment and growth. To assess if patterns of vegetation establishment and growth changed during the closure, peak biomass imagery from 2019 (pre closure) and 2021 (post closure) were compared for a vegetation response. This assessment found locations where aquatic vegetation increased and locations where aquatic vegetation decreased. However, due to unforeseen limitations in vegetation and water sampling, a causal reason for observed changed in vegetation could not be established.

Introduction

Vegetation establishment and growth are important factors in river health (Langrehr and Moore 2008, Larson and others 2022). Aquatic vegetation in particular is shown to trap sediments and nutrients while also providing critical habitat for a diverse suite of aquatic organisms (Kreiling and others 2013, Larson and others 2022). Vegetation establishment and growth is also affected by the depth of the photic zone, or the area in the water column with sufficient light to support plant growth (Kreiling and others 2007, Carhart and others 2021). The amount of sediment suspension that occurs in large rivers, such as the Upper Mississippi and Illinois, is dictated by a myriad of factors including watershed geology, land use patterns, climate, river biology (Roseboom and others 1992), and commercial use (Johnson 1976, Adams and Delisio 1990). The last factor in particular was directly affected in 2020 along the IWW.

The Illinois Waterway (IWW) is located along the Illinois River and stretches from Chicago, Illinois, downstream to the confluence with the Mississippi River (fig. 1). The IWW provides a nine-foot-deep navigation channel connecting Lake Michigan with the Mississippi River and includes eight lock and dam sites. In 2020, five of these lock and dam site navigation locks were closed by the U.S. Army Corps of Engineers (USACE) Rock Island District to facilitate maintenance, effectively shutting the waterway to barge and large boat inter-pool traffic. This provided the USACE Upper Mississippi River Restoration (UMRR) program Long Term Resource Monitoring (LTRM) element (which also operates along the IWW) with an opportunity to investigate how changes in vessel traffic alter patterns in aquatic vegetation establishment and growth.

Natural resource managers were interested in whether and how vegetation would respond to this closure and differences between closure lengths at different lock and dam locations. To investigate these questions, the U.S. Geological Survey (USGS) Upper Midwest Environmental Sciences Center (UMESC) Geospatial Sciences and Technologies Branch completed a study reviewing pre- and post-closure IWW imagery. This review noted if aquatic vegetation cover, type, or extent changed between the two imagery sets with the objective of determining if lock and dam closures could be attributed to any observed aquatic vegetation changes.

Initially, the USACE planned for two different closure lengths: 15 days for the Marseilles and Starved Rock navigation locks and up to 120 days for the navigation lock from LaGrange to Brandon. However, final closure lengths were substantially different from the initial plan (tab. 1) with much of this work moved to 2023 and some canceled altogether.

Despite the changes in closure length and location, the project and questions remained viable with one major exception. Originally, this project was paired with an in situ review of how aquatic vegetation changed in the pool with visual observations and rake surveys conducted to augment the information obtained from the imagery review. Due to the travel restrictions caused by the global pandemic in 2020 these surveys never occurred and the opportunity to collect these data was lost. As such, this report only reviews the change in aquatic vegetation visible in the imagery of this project and is unable to describe site-specific vegetation conditions during the lock closure period that would have been collected during the in situ aquatic vegetation project.

Methods

This project initiated with imagery collection, moved into imagery processing and dissemination, and then compared imagery for vegetation change. This completion report graphically illustrates where major vegetation changes occurred between 2019 and 2021.

Airborne imagery collection and processing:

Imagery was collected twice for this project, first on September 17, 2019, and second on September 16–17, 2021, with an additional collection in 2020 as part of the USACE UMRR LTRM 2020 Upper Mississippi River System Land Cover/Land Use Mapping Project. Imagery for the IWW project was processed and subsequently disseminated to the public.

All imagery was collected with a ground sample distance (GSD) of approximately 0.41 m using a Phase One iXU-R 180 RGB camera co-mounted with a Phase One iXU-RS 160 Achromatic camera. This allowed the creation of 4-band imagery that could be displayed as either true-color (RGB) or color-infrared (CIR). However, a system failure on one of the flight missions in 2019 resulted in only RGB imagery for some flight lines. Imagery for Alton, LaGrange, Peoria, Starved Rock, and a portion of Marseilles were collected in 4-band imagery (river miles 1–260). The remainder of Marseilles, Dresden, and Brandon were collected in 3-band imagery (river miles 261–291).

Following collection, imagery was processed into 4-band mosaics (or 3-band, where required) for use in the geographic information system (GIS) environment with associated metadata. Imagery is available at https://doi.org/10.5066/P9K4WL1O.

Imagery Review and Aquatic Vegetation Change Mapping:

Following processing of the 2021 imagery collection, all imagery from 2019–2021 were loaded into the ArcGIS Pro (Esri 2020) software platform for visual review and comparison. The aquatic areas in the imagery from Brandon Pool downstream through the end of La Grange Pool (fig. 1) were reviewed for (1) submersed and emergent aquatic vegetation and (2) changes in density or vegetation type between 2019 and 2021. In instances where changes occurred in aquatic vegetation cover or type, a generalized polygon was created. Because of substantial changes in water level between September 2019 and September 2021, many areas of aquatic vegetation were deeply flooded for a large part of the growing season prior to imagery collection (fig. 2). River levels during each imagery collection session were relatively similar allowing for easier comparison, although water levels in 2019 were still over 2 feet higher than in 2021 (fig. 2).

This software platform allowed for the visual comparison of different georeferenced images at the same time (fig. 3), providing researchers with the ability to quickly review large areas for coarse-level aquatic vegetation change. During the review, areas of change in aquatic vegetation density or type were coarsely noted in a shapefile with a focus on areas showing evident, large-scale changes in cover or type. No minimum area of change was required, and the smallest polygon mapped was approximately 500 m^2 ($^1/_{20}$ hectare).

Results and Discussion

The scope of this project did not allow for the exact comparison of coverage or composition in areas of change. The result of this project is a visual comparison of aquatic vegetation change between the 2019 and 2021 imagery along the IWW (Strassman, 2022). Areas are presented from upstream to downstream and further subdivided into three areas based upon proximity to and hydrologic influence from the navigation channel of the IWW.

Areas of Large-scale Change: Main Navigation Channel

Reaches along the main navigation channel of the IWW with large, visible patches of submersed or emergent aquatic vegetation are relatively uncommon when compared to similar reaches along the Upper Mississippi River, but several were noted. Here, the main navigation channel of the IWW is defined as any location where the wake or seiche from boat traffic traveling along the main navigation channel can directly affect the vegetation. In addition, these areas are generally more affected by water level change in the IWW. Examined locations are presented from most upstream to most downstream in figures 4–17.

In figures 4–9, areas of observed vegetation change are primarily adjacent to the main navigation channel of the IWW and are focused submersed aquatic vegetation (SAV). These beds appear to show a general pattern towards increased cover from 2019 to 2021, but some confounding variables warrant consideration. The first is the unavailability of CIR imagery for portions of the 2019 flight in this area. The second is the increased water clarity in the 2021 imagery. The third is the higher water level in the 2019 imagery. These three issues combine to confound a simple, visual appraisal of SAV cover that might determine direction and degree of change in cover.

In figures 10–12, areas of observed vegetation change are primarily adjacent and directly exposed to the main navigation channel of the IWW and are focused on areas of emergent aquatic vegetation (EAV) cover. These beds show a definite, positive change in EAV cover with figure 10 showing particularly robust change. Figure 11, while showing some increased EAV cover, also shows expansion of SAV bed cover. Lastly, figure 12 shows both areas of increased and decreased EAV, but the general pattern is towards increased cover. Additionally, figure 12 shows a marked area of EAV decease where a landowner presumably managed out EAV cover. Although figures 10–12 were affected by the same three factors as figures 4–9, the factors had little to no impact on the ability to detect EAV. Additionally, because the areas of SAV in figure 11 were more protected and in shallower areas than in figures 4–9, the factors had little effect on detection.

In figures 13–17, areas of observed vegetation change are primarily adjacent to the main navigation channel, but also somewhat sheltered from direct wake or seiche effects from boat traffic. This sheltering introduces a confounding variable into interpretation of change in these areas. In all five figures, vegetation development occurred primarily on the more sheltered portions of the sites, although not exclusively. In figure 13, 15, and 17, vegetation development was partially related to decreased water depth and exposed sediments, but also included notable SAV expansion in areas directly facing the canal. In figure 14 and 16, expansion of EAV is very visible with expansion radiating outward from the most sheltered areas to less protected zones.

Areas of Large-scale Change: Side Channel with Direct Hydrologic Connection

Areas within the side channel that have a direct hydrologic connection to the IWW with large, visible patches of submersed or emergent aquatic vegetation are relatively common when compared to the main navigation channel of the Illinois River. Here, the side channel of the IWW is defined as any location with a hydrologic connection to the IWW and within the defined study area boundary for the 2020 Upper Mississippi River System Land Cover and Land Use mapping project (Hop and others 2021).

Although these areas are generally less affected by water level change and not directly affected by commercial navigation traffic in the IWW canal, water levels in these areas change with water levels in the IWW. Examined locations are presented from most upstream to most downstream in figures 18–56.

In figure 18–21, these large side channels are directly adjacent to the main navigation channel of the IWW but are mostly or completely isolated from wake or seiche effects. In each of these areas, different directions of change are noted, with some areas showing increases in SAV or EAV and others showing decreases. There does not appear to be a consistent direction or constant pattern of change.

In figures 22 and 23, substantial infill and modification is evident between 2019 and 2021. This activity resulted in the wholesale conversion from aquatic habitat to non-aquatic habitat. Reasons for this activity were not investigated.

In figures 24–29, 31–32, 34–47, 49–51, and 55–56 water level decreased over the two years, creating large areas of shallow water and exposing sediment to aquatic vegetation colonization. In these areas, substantial increases in SAV and EAV are evident.

In figure 30, two different areas are visible. On the left of the figure is an area with direct hydrologic influence from the IWW following the general pattern of decreased water levels leading to increased SAV and EAV. On the right of the figure is an area with indirect hydrologic influence from the IWW where water levels and landscapes were managed causing a general decrease in both SAV and EAV.

In figure 33, three different areas are visible. On the left and middle right of the figure are areas with direct hydrologic influence from the IWW following the general pattern of decreased water levels leading to increased SAV and EAV. On the top of the figure is an area with indirect hydrologic influence from the IWW where water levels and landscapes were managed causing a substantial decrease in both SAV and EAV.

In figure 48, two different areas are visible. On the lower left of the figure is an area with direct hydrologic influence from the IWW following the general pattern of decreased water levels leading to increased SAV and EAV. On the upper right of the figure is an area with indirect hydrologic influence from the IWW where water levels and landscapes were managed causing a substantial decrease in both SAV and EAV.

In figure 52, two different areas are visible. On the left of the figure is an area with direct hydrologic influence from the IWW following the general pattern of decreased water levels leading to increased SAV and EAV. On the right of the figure is an area with indirect hydrologic influence from the IWW where water levels and landscapes were managed causing a substantial decrease in EAV and an increase in SAV.

In figure 53, two different areas are visible. On the upper left of the figure is an area with direct hydrologic influence from the IWW following the general pattern of decreased water levels leading to increased EAV. On the lower right of the figure is an area with indirect hydrologic influence from the IWW where water levels and landscapes were managed causing a substantial decrease in both SAV and EAV.

The area shown in figure 54 does have a direct hydrologic connection to the IWW and has seen the expected decrease in water levels; however, vegetation has responded differently. Here, vegetation has died back with large areas of bare exposed sediment present rather than the expected increased EAV cover.

<u>Areas of Large-scale Change: Side Channel with Indirect Hydrologic Connection</u>

Areas within the side channel that have an indirect hydrologic connection to the IWW with large, visible patches of SAV or EAV are relatively common when compared to the main navigation channel of the Illinois River. However, a vast majority of them showed little or no substantial change over the two-year period. Here, the side channel of the IWW is defined as any location without a direct hydrologic connection to the IWW and within the defined study area boundary for the 2020 Upper Mississippi River System Land Cover and Land Use mapping project (Hop and others 2021). These areas are generally not directly affected by water level change in the IWW and have no effect from boating activity in the IWW canal. The water level in these areas may also be artificially maintained or modified to meet management needs. Examined locations are presented from most upstream to most downstream in figures 57–69.

In figures 57 and 67–68, these large, hydrologically isolated wetlands appear to have experienced sustained periods of high water. This resulted in a general decrease in the cover of both SAV and EAV over the two-year period.

In figures 58–59 and 61, these smaller, hydrologically isolated wetlands appear to have experienced substantial and persistent drying over the two-year period. This resulted in a general conversion from SAV to EAV in these wetlands.

In figures 60, 62–66, and 69, these large, hydrologically isolated wetlands appear to have experienced substantial and persistent drying over the two-year period, but because of their large size this resulted in a generalized increase in available habitat for both SAV and EAV. This resulted in a general increase in both SAV and EAV cover in these wetlands.

Considerations for Interpretation

Water level changes over the course of the project likely influenced the observed changes in aquatic vegetation (Spink and Rogers 1996). The water levels on the IWW were comparably low during the 2019 and 2021 imagery collections (figure 69, USGS 2022). This facilitated comparison of imagery where the water level had only minor to moderate effects on the appearance of the aquatic vegetation. However, water depth during the 2019 imagery collection was still over 2 feet higher than it was in 2021, with the USGS stream gauge at Valley City, Illinois reading 4.99 feet at 12:00 on September 17, 2019, compared to 2.39 feet at 12:00 on September 17, 2021 (USGS 2022). This could partially explain the greater amount of exposed sediment present in the 2021 imagery.

Another factor of concern for SAV and EAV development and detection is the hydrologic characteristics of the Illinois River during the growing season prior to imagery collection. In 2019, the Illinois River experienced persistent high water for many months prior to the collection (fig. 2). In 2021, the river experienced some pulses of higher water, but it was not as persistent or high as it was in 2019 and it was interspersed with periods of low water (fig. 2). These differences in growing season hydrologic characteristics likely affected the establishment and growth of SAV and EAV differently in 2019 and 2021.

Conclusions

Between the imagery collection of September 17, 2019, and September 17, 2021, changes in aquatic vegetation cover did occur. These changes did include areas of substantial SAV and EAV expansion within the main navigation channel in areas directly affected by wake or seiche from boat traffic along the IWW. Additionally, within the area directly affected by boat traffic, no area of SAV or EAV decrease were noted, except in areas of direct human management. We do know that over this time period, water levels changed substantially. Although the pools were open to barge traffic in 2019 and 2021, it is possible that the water level variations of those years affected traffic, which in turn affected water turbidity and wake prevalence or severity. However, in the absence of field vegetation data and associated water quality data, it is not possible to provide a causation for the observed change in aquatic vegetation cover.

In side channel areas with a direct hydrologic connection to the river, the directionality of a system-wide change is unclear. However, one consistent pattern did arise. This was the exposure of large areas of sediment and near-shore habitat due to decreased water levels across the system in 2021. These areas were readily, although not always, colonized by vegetation, including EAV. Additionally, because these backwaters support much larger areas of shallow water than the main navigation channel, larger beds of SAV were visible in 2021 that were not visible in 2019. Again, causation is difficult to define without field data. However, lower water will bring the photic zone to new areas of the river bottom and will reveal existing SAV beds in imagery. Because of these complicating factors, the causation for change in the side channel areas cannot be assigned.

In side channel areas lacking a direct hydrologic connection to the river, change was dependent upon local management actions or conditions unconnected to actions or events on the IWW. Consequently, the change at each of these particular sites was local in both cause and effect and not indicative of any larger changes across the IWW.

The global pandemic of 2020–2021 precluded the synchronous collection of data necessary to determine the causality of the observed changes. This study provides foundational imagery on which future studies could build to further investigate how changes in navigation may alter the direction and magnitude of change in SAV and EAV in the IWW. The imagery clearly shows where change in SAV and EAV cover is occurring. These areas could be targeted for future image collections, possibly by uncrewed aerial systems (UAS), and field vegetation data collected at the same time. Together, these two data streams, along with information on river use intensity and water quality, could help show causation and answer the questions of how lock and dam closures affect the establishment and growth of aquatic vegetation.

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Figure 1. A map showing the Illinois Waterway by pool along the Illinois River, Illinois.

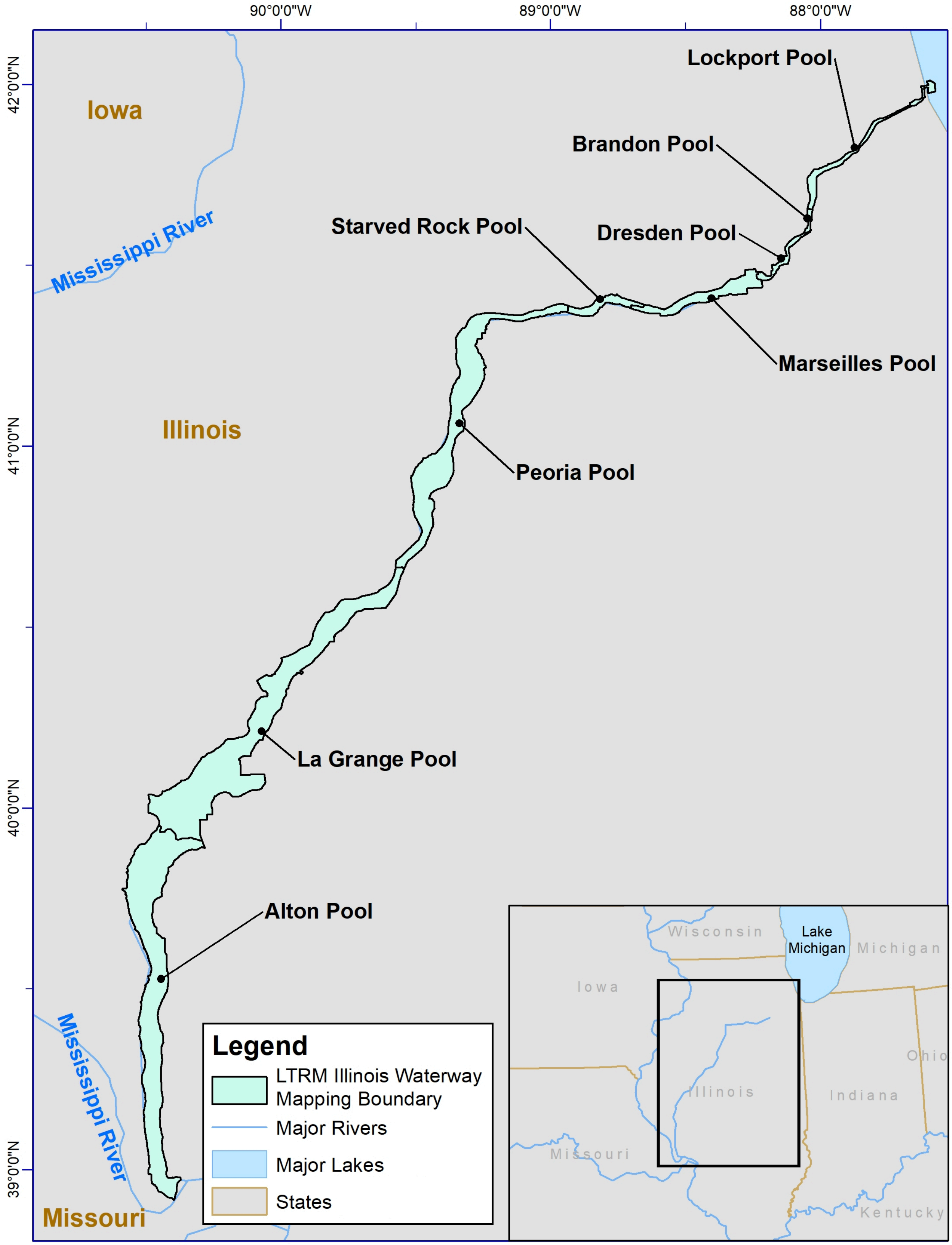

Figure 2. Water level in feet of the Illinois River at Valley City, Illinois, on Alton Pool along the Illinois Waterway from April 1, 2019, to November 1, 2021 (USGS 2022).

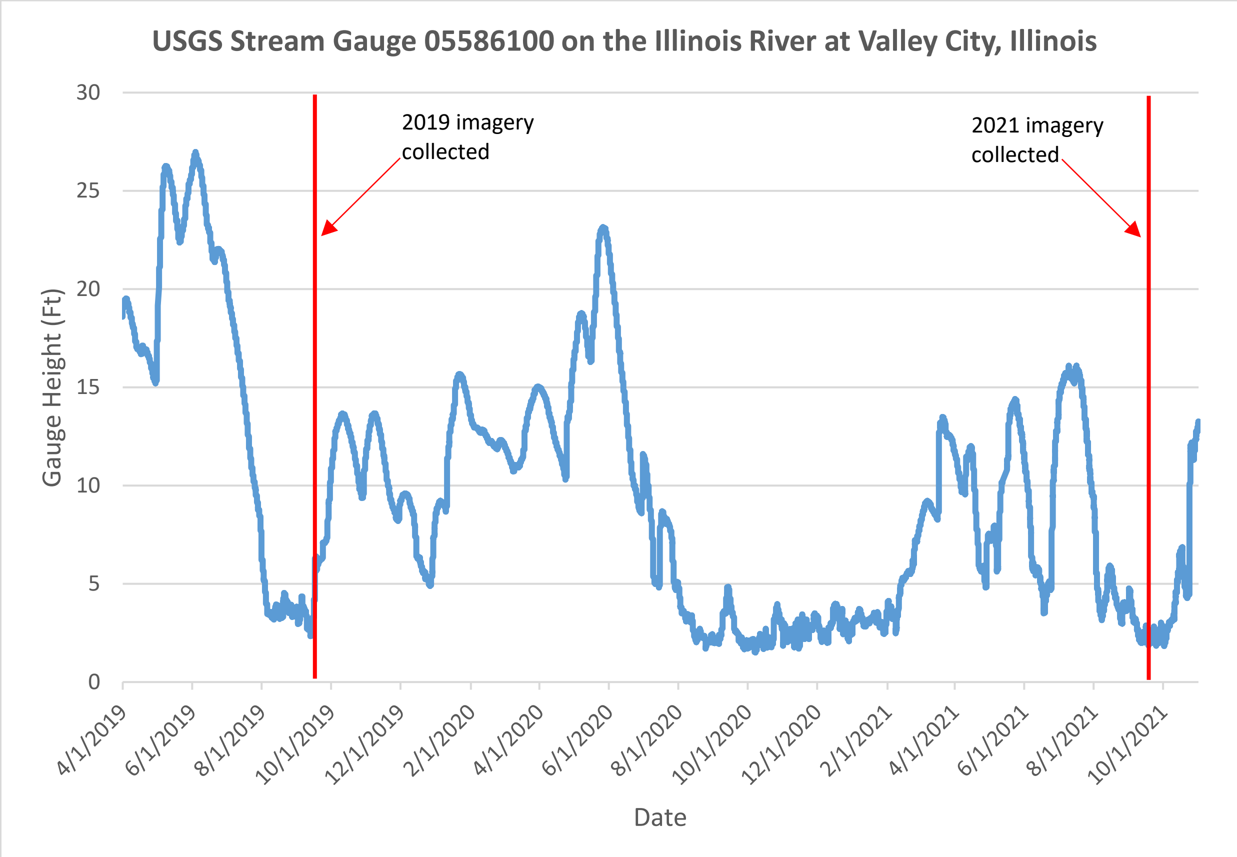

Table 1. Illinois Waterway lock and dam closure duration and dates for summer of 2020 maintenance. [Lock and Dam structures are listed from river mouth to river source]

Lock and Dam	Closure Dates		Opening Dates		Closure Days	
	Proposed	Actual	Proposed	Actual	Proposed	Actual
Alton			Not Closed			
La Grange	July 1, 2020	July 1, 2020	October 30, 2020	October 13, 2020	120	104
Peoria	July 1, 2020	July 6, 2020	October 30, 2020	September 30, 2020	120	86
Starved Rock	July 1, 2020	July 1, 2020	October 30, 2020	October 30, 2020	120	120
Marseilles	July 1, 2020	July 6, 2020	October 30, 2020	October 30, 2020	120	116
Dresden	July 1, 2020	July 6, 2020	October 30, 2020	October 28, 2020	120	114
Brandon			Not Closed			
Lockport			Not Closed			

Figure 3. An example of the program layout used to compare the 2019, 2020, and 2021 imagery of the Illinois Waterway along the Illinois River, Illinois. Area of interest outlined in yellow. Image centered on 41.321ºN, 88.937ºW.

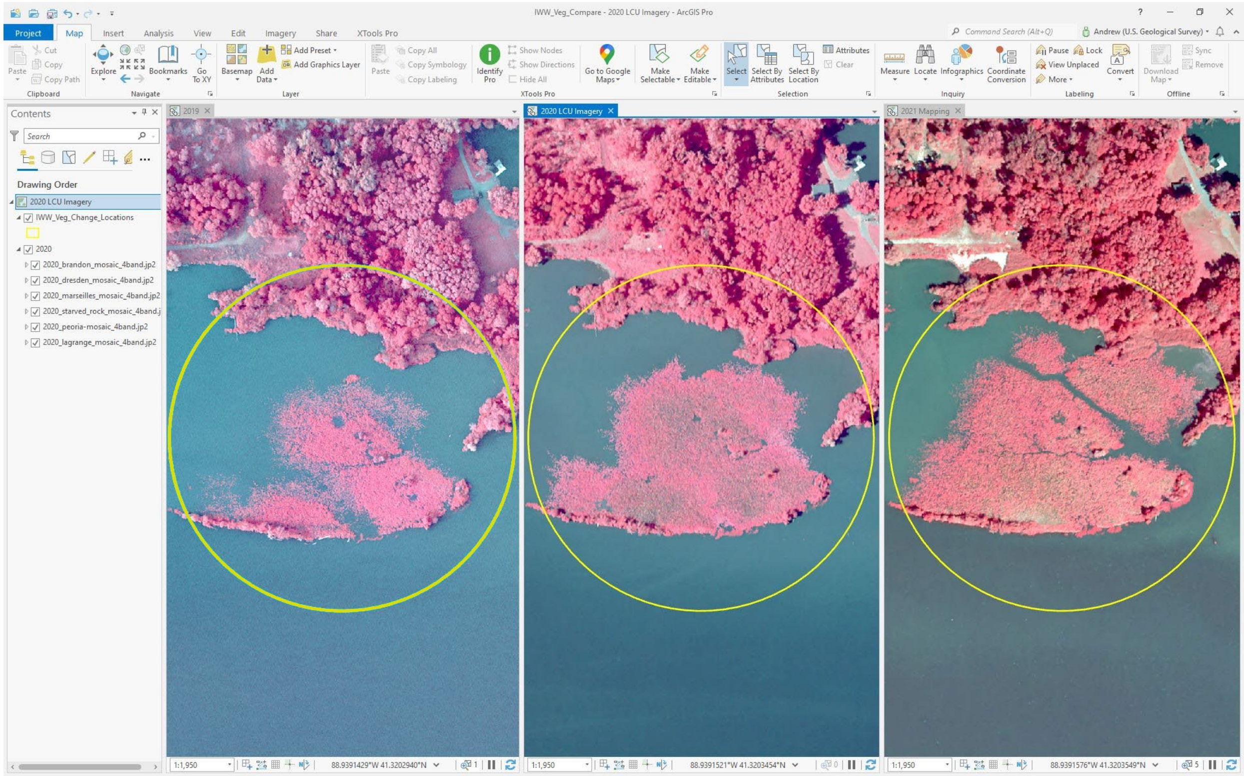

Figure 4. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at the CN Railway bridge in upper Brandon Pool along the main navigation channel of the Illinois Waterway showing increased SAV in 2021 as compared to 2019. Note that the Brandon Road Lock & Dam was not closed in 2020. Area of interest outlined in yellow. Image centered on 41.554ºN, 88.078ºW.

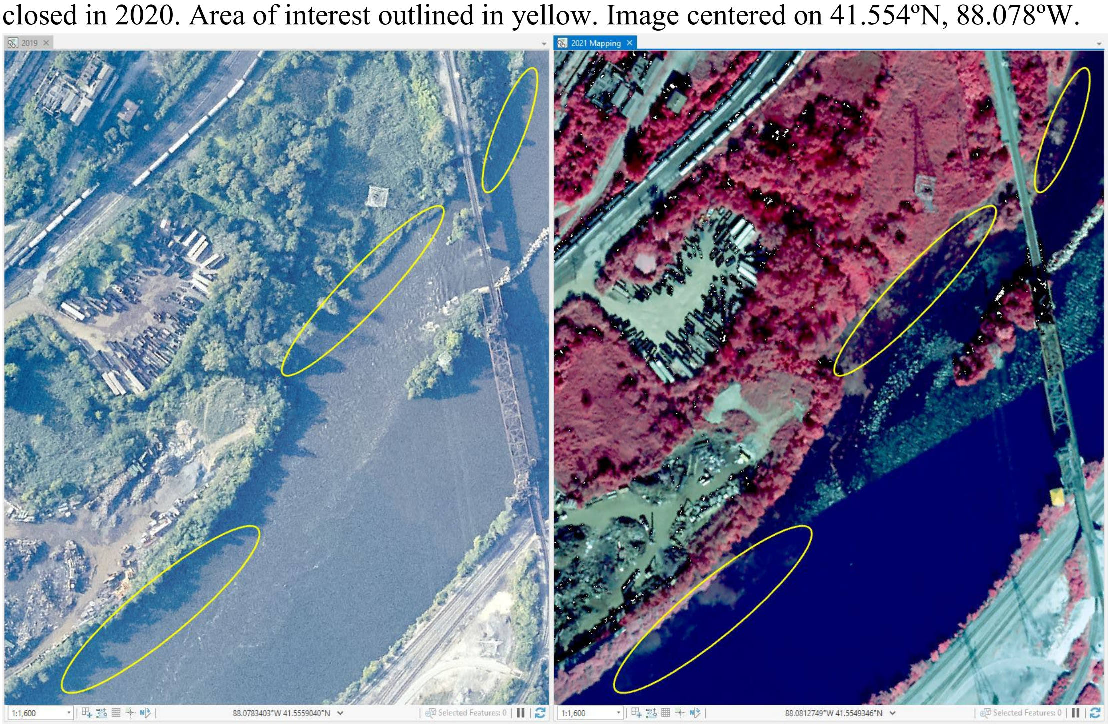

Figure 5. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at Brandon Road Lock and Dam in both Brandon and Dresden Pools along the main navigation channel of the Illinois Waterway showing increased SAV cover over the two years. Note that the Brandon Road Lock & Dam was not closed in 2020. Area of interest outlined in yellow. Image centered on 41.502ºN, 88.102ºW.

Figure 6. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at the Joliet Generating Station in Dresden Pool along the main navigation channel of the Illinois Waterway showing increased SAV over the two years. Area of interest outlined in yellow. Image centered on 41.495ºN, 88.118ºW.

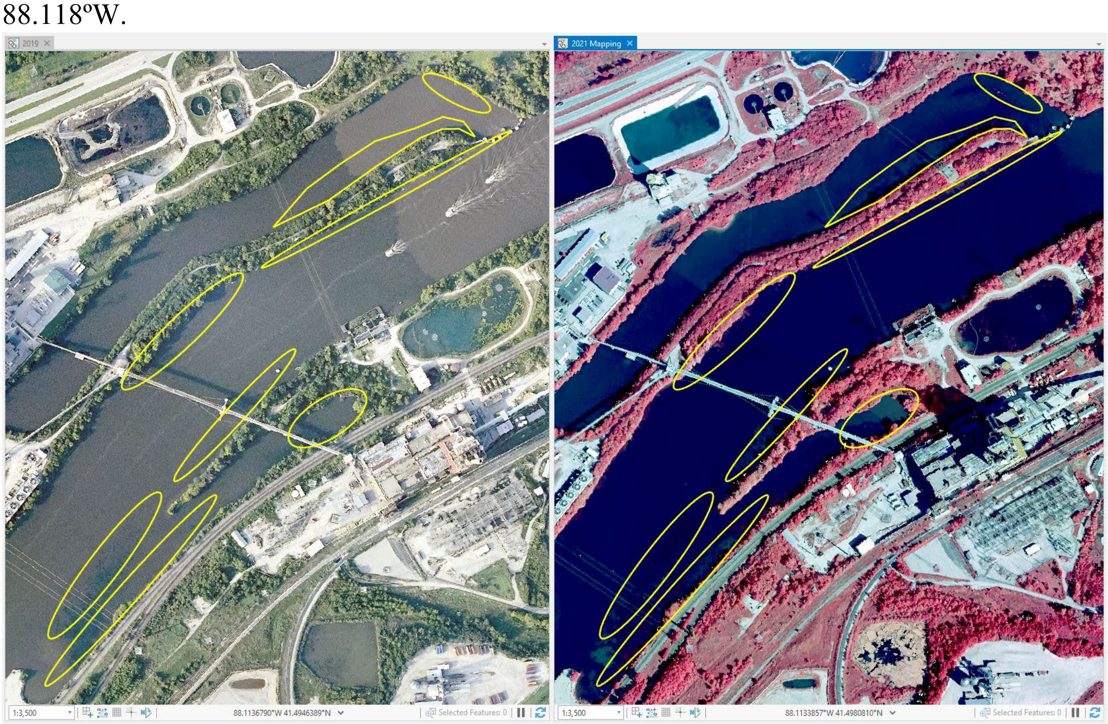

Figure 7. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) below the Lafarge Joliet Port of Will County Terminal in Dresden Pool along the main navigation channel of the Illinois Waterway showing increased SAV cover over the two years. Area of interest outlined in yellow. Image centered on 41.484ºN, 88.132ºW.

Figure 8. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at Houbolt Road extension in Dresden Pool along the main navigation channel of the Illinois Waterway showing increased submersed and emergent aquatic vegetation cover over the two years. Area of interest outlined in yellow. Image centered on 41.468ºN, 88.160ºW.

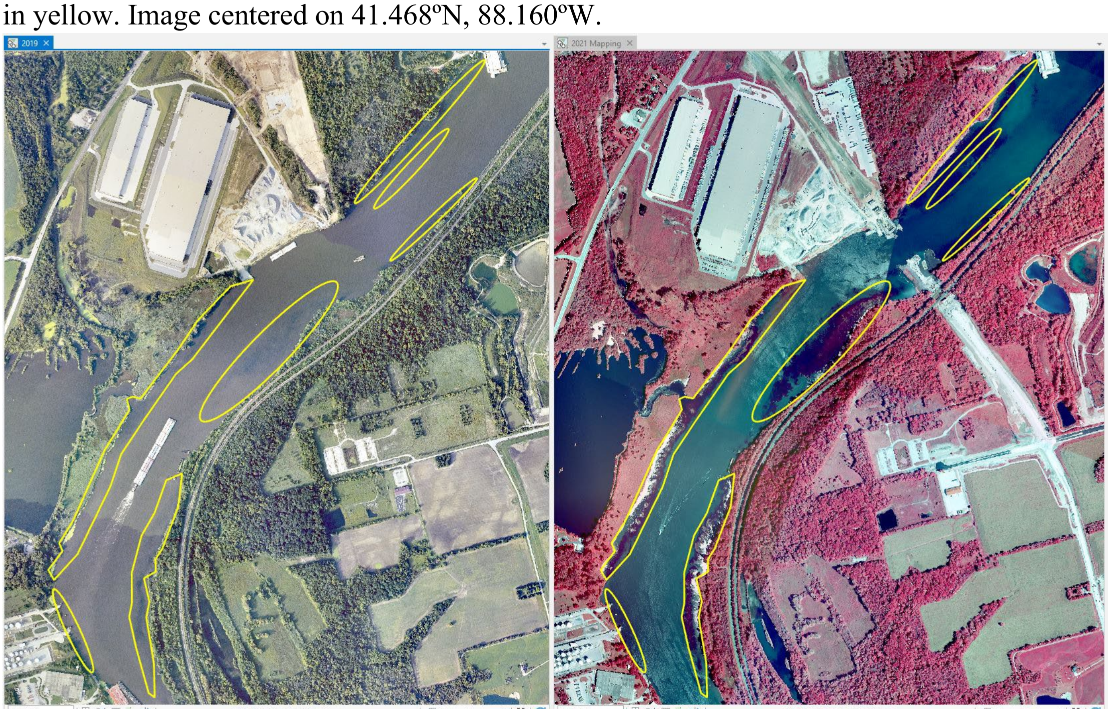

Figure 9. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) above Treat Island in Dresden Pool along the main navigation channel of the Illinois Waterway showing increased submersed and emergent aquatic vegetation cover over the two years. Area of interest outlined in yellow. Image centered on 41.450ºN, 88.165ºW.

Figure 10. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at Du Page River mouth bay, north, in Dresden Pool along the main navigation channel of the Illinois Waterway showing an increase in submersed and emergent aquatic vegetation cover over the two years. Area of interest outlined in yellow. Image centered on 41.420ºN, 88.207ºW.

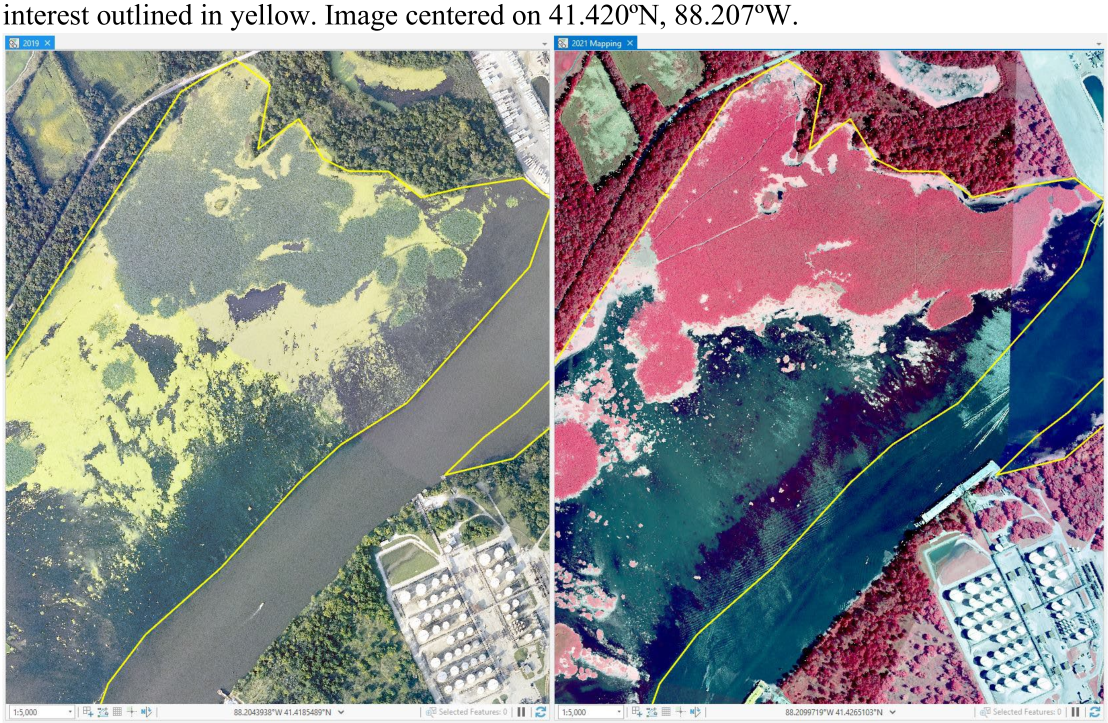

Figure 11. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at Du Page River mouth bay, south, in Dresden Pool along the main navigation channel of the Illinois Waterway showing increased submersed and emergent aquatic vegetation cover over the two years. Area of interest outlined in yellow. Image centered on 41.416ºN, 88.215ºW.

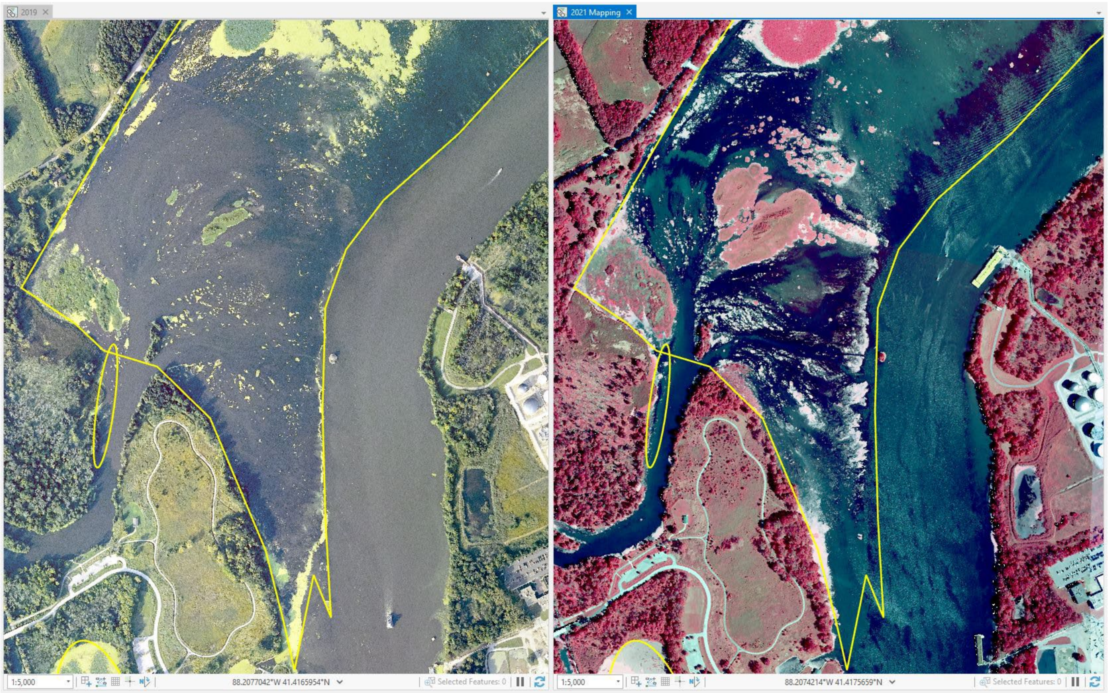

Figure 12. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at Skinner Island in Dresden Pool along the main navigation channel of the Illinois Waterway showing increased emergent aquatic vegetation cover over the two years, but also showing emergent vegetation management outlined in blue. Area of interest outlined in yellow. Image centered on 41.386ºN, 88.256ºW.

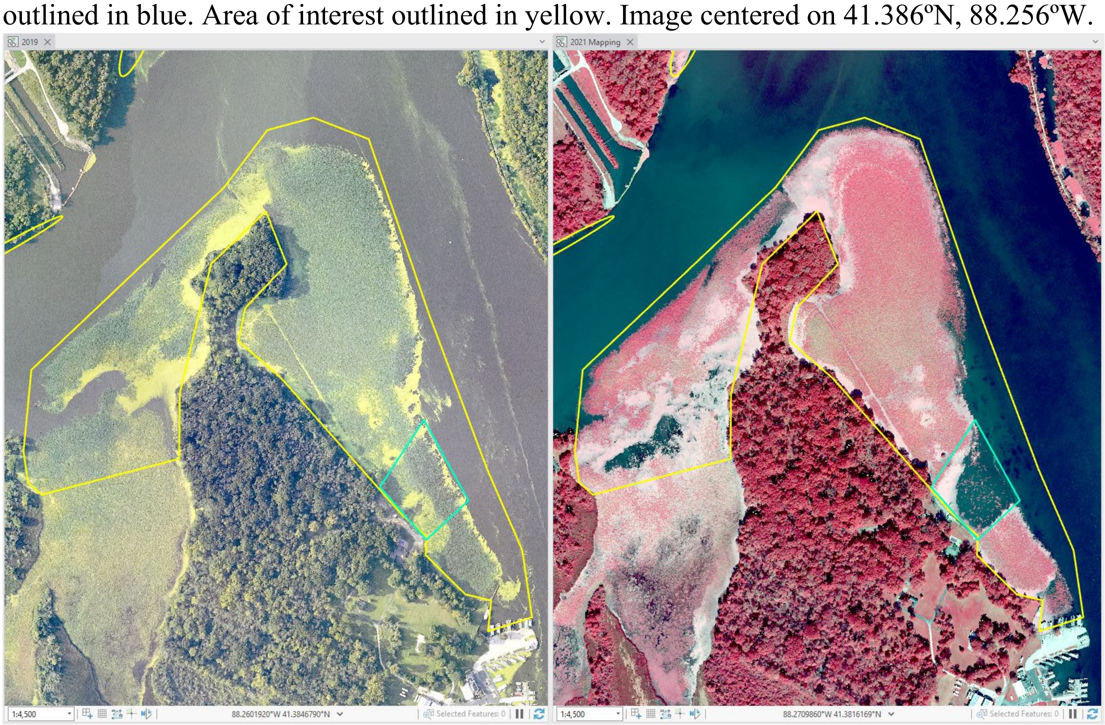

Figure 13. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at Delbridge Island in Starved Rock Pool along the main navigation channel of the Illinois Waterway showing increased submersed and emergent aquatic vegetation cover over the two years. Area of interest outlined in yellow. Image centered on 41.316ºN, 88.921ºW.

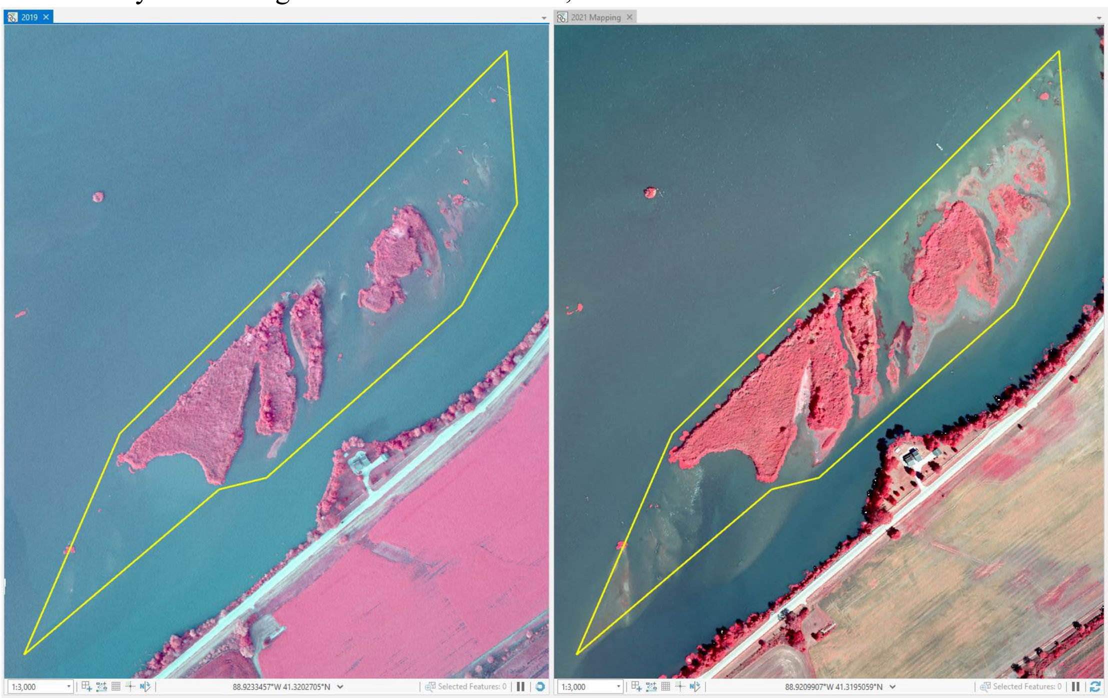

Figure 14. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at Starved Rock Yacht Club in Starved Rock Pool along the main navigation channel of the Illinois Waterway showing increased emergent vegetation cover over the two years. Area of interest outlined in yellow. Image centered on 41.321ºN, 88.929ºW.

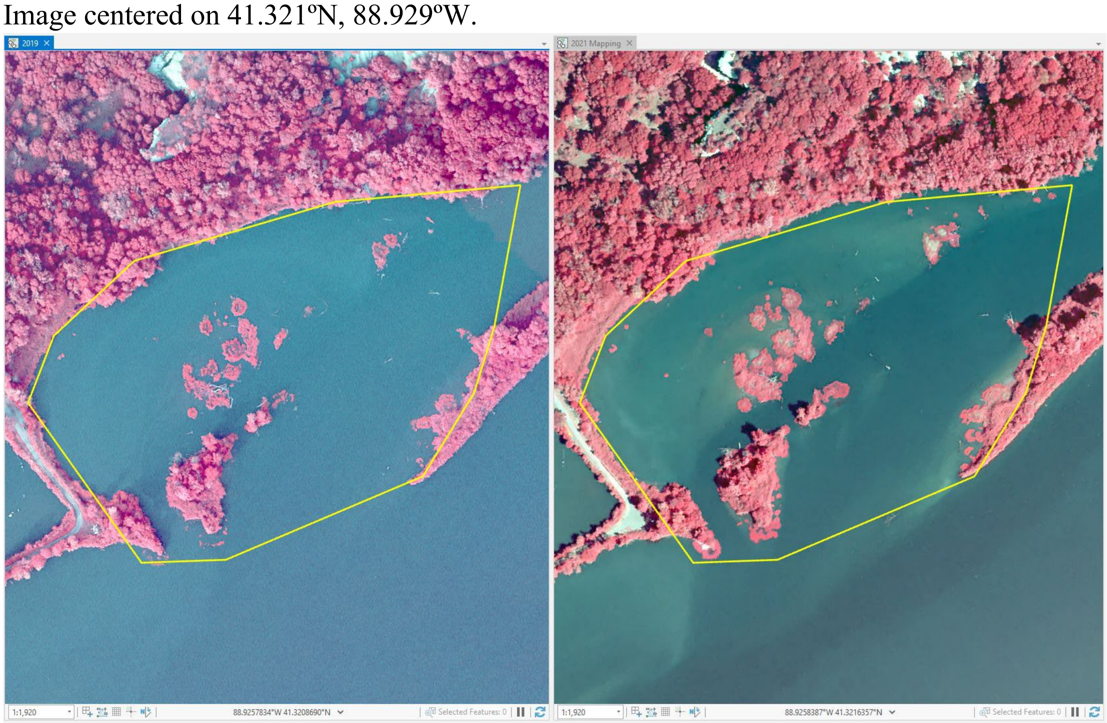

Figure 15. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at Delbridge Island in Starved Rock Pool along the main navigation channel of the Illinois Waterway showing increased submersed and emergent aquatic vegetation cover over the two years. Area of interest outlined in yellow. Image centered on 41.314ºN, 88.933ºW.

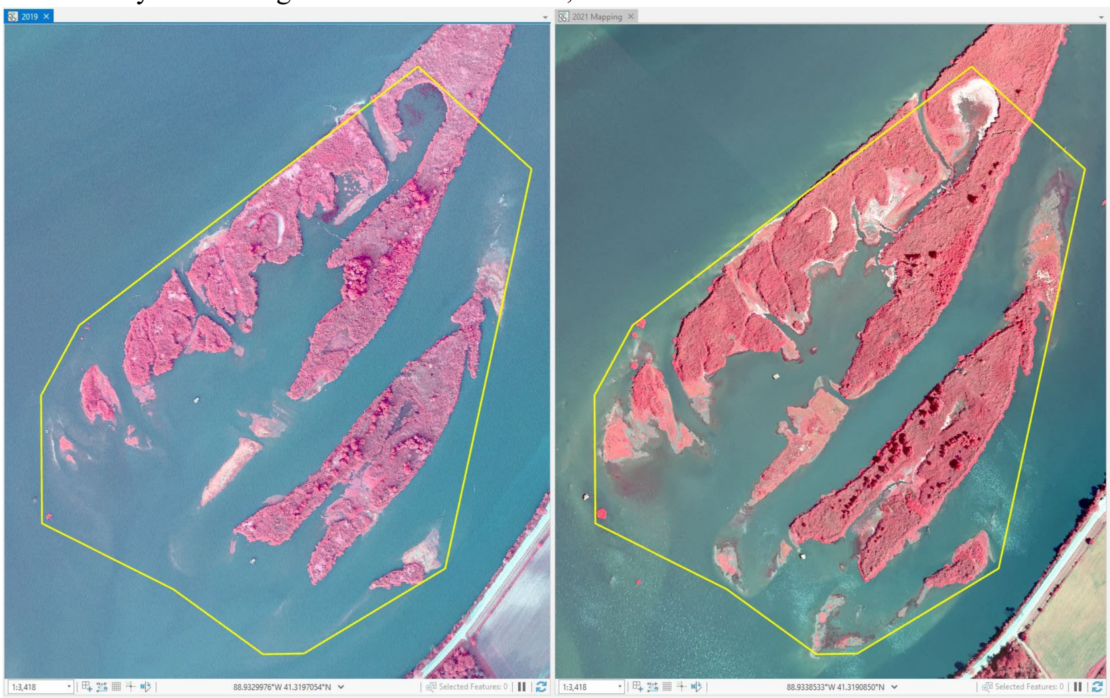

Figure 16. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at Starved Rock Campground in Starved Rock Pool along the main navigation channel of the Illinois Waterway showing an increase in emergent vegetation cover over the two years. Area of interest outlined in yellow. Image centered on 41.321ºN, 88.937ºW.

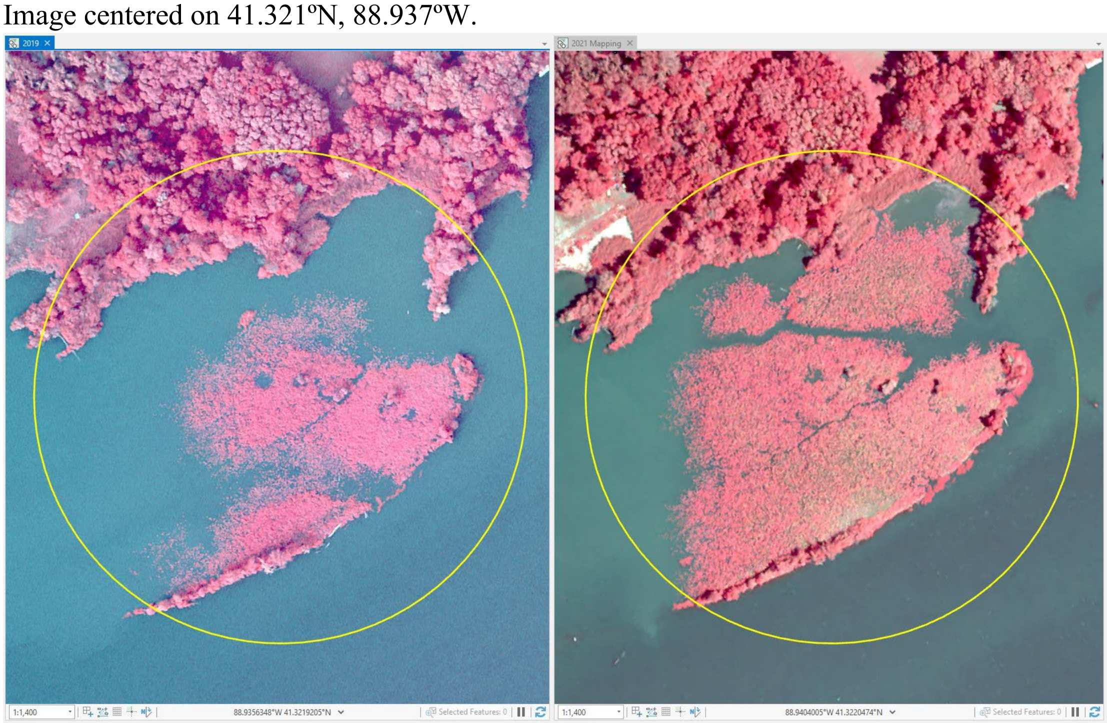

Figure 17. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at Lone Point in Starved Rock Pool along the main navigation channel of the Illinois Waterway showing increased submersed and emergent aquatic vegetation cover over the two years. Area of interest outlined in yellow. Image centered on 41.315ºN, 88.947ºW.

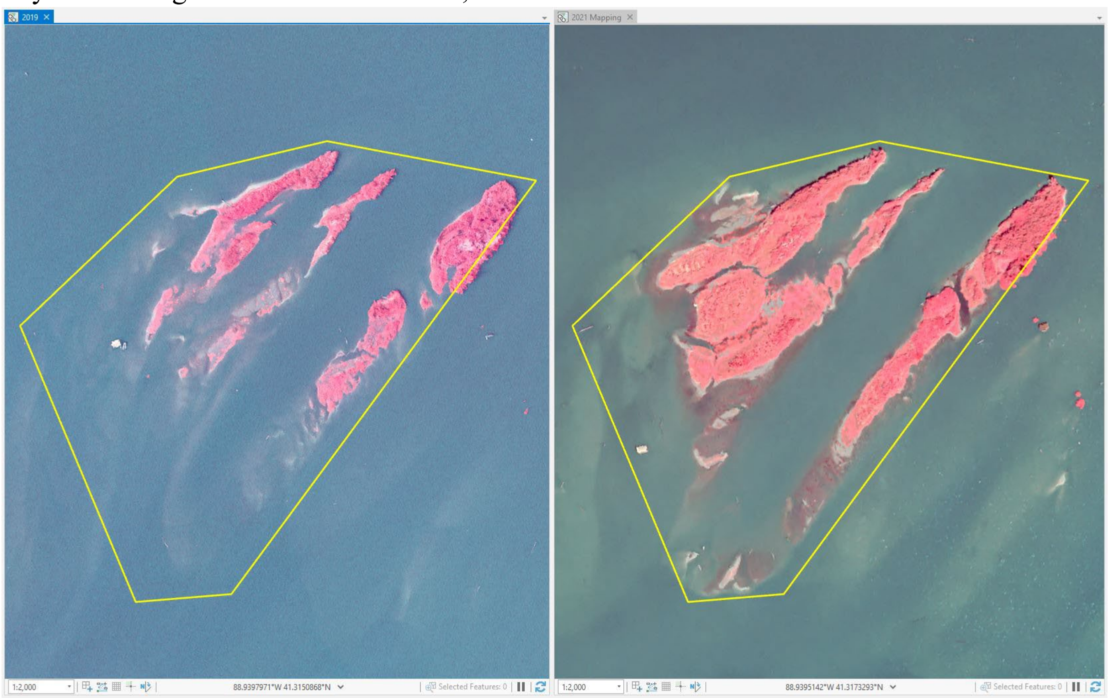

Figure 18. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) along the Des Plaines River just upstream from the confluence in Brandon Pool in the side channels of the Illinois Waterway showing increased SAV cover over the two years. Area of interest outlined in yellow. Image centered on 41.563ºN, 88.080ºW.

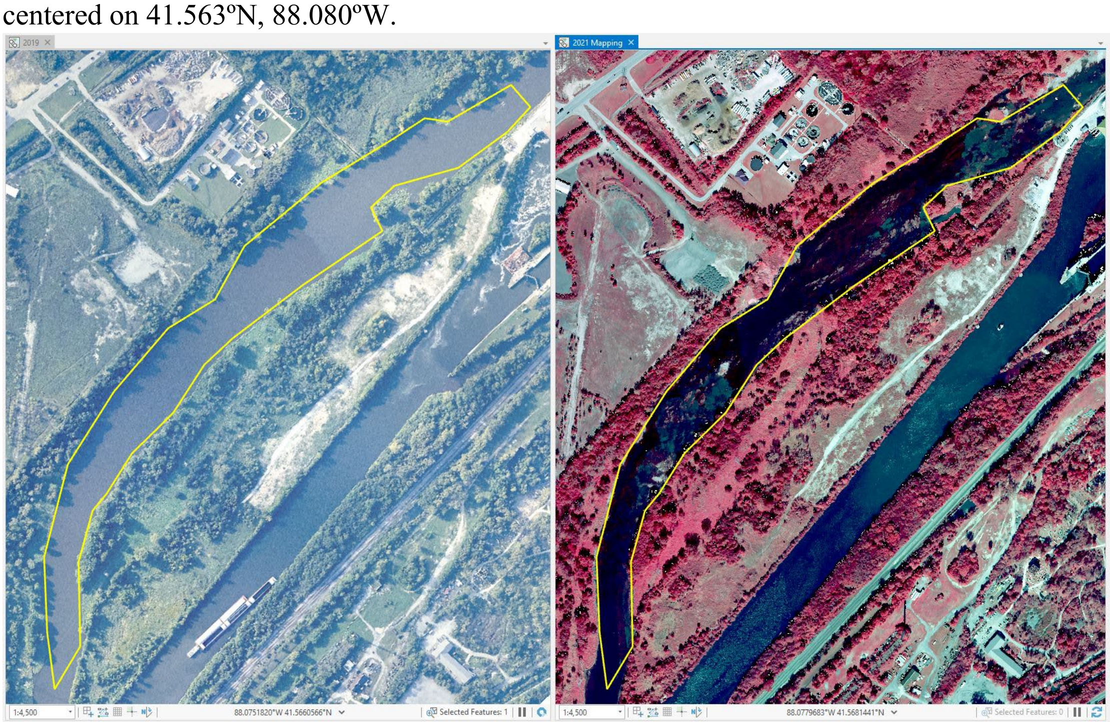

Figure 19. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at Treat Island in Dresden Pool in the side channels of the Illinois Waterway showing decreased EAV and increased SAV cover over the two years. Area of interest outlined in yellow. Image centered on 41.433ºN, 88.172ºW.

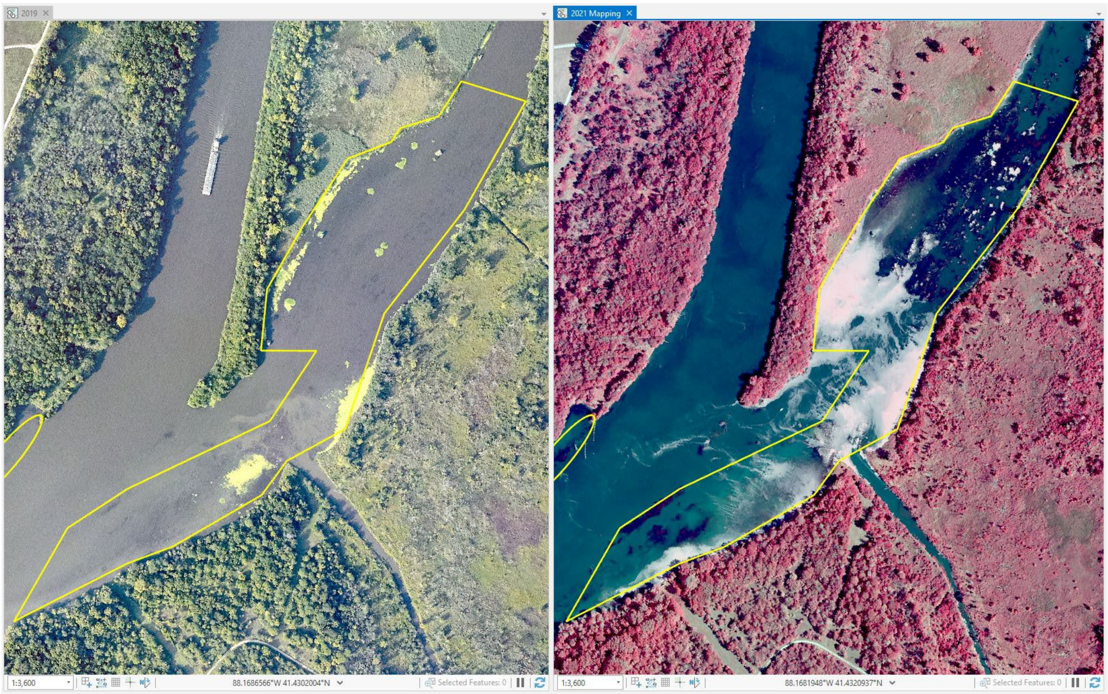

Figure 20. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at Conroy Island in Dresden Pool in the side channels of the Illinois Waterway showing decreased SAV and EAV cover over the two years. Area of interest outlined in yellow. Image centered on 41.404ºN, 88.226ºW.

Figure 21. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at Clark Island in Marseilles Pool in the side channels of the Illinois Waterway showing increased SAV and EAV cover over the two years. Area of interest outlined in yellow. Image centered on 41.318ºN, 88.693ºW.

Figure 22. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at Moores Island in Starved Rock Pool in the side channels of the Illinois Waterway showing substantial infill and modification over the two years. Area of interest outlined in yellow. Image centered on 41.341ºN, 88.795ºW.

Figure 23. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) near Huse Lake in Peoria Pool in the side channels of the Illinois Waterway showing substantial infill and modification over the two years. Area of interest outlined in yellow. Image centered on 41.325ºN, 89.102ºW.

Figure 24. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) in northern Depue Lake in Peoria Pool in the side channels of the Illinois Waterway showing increased EAV cover over the two years. Area of interest outlined in yellow. Image centered on 41.321ºN, 89.297ºW.

Figure 25. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) in southern Depue Lake in Peoria Pool in the side channels of the Illinois Waterway showing increased EAV cover over the two years. Area of interest outlined in yellow. Image centered on 41.312ºN, 89.322ºW.

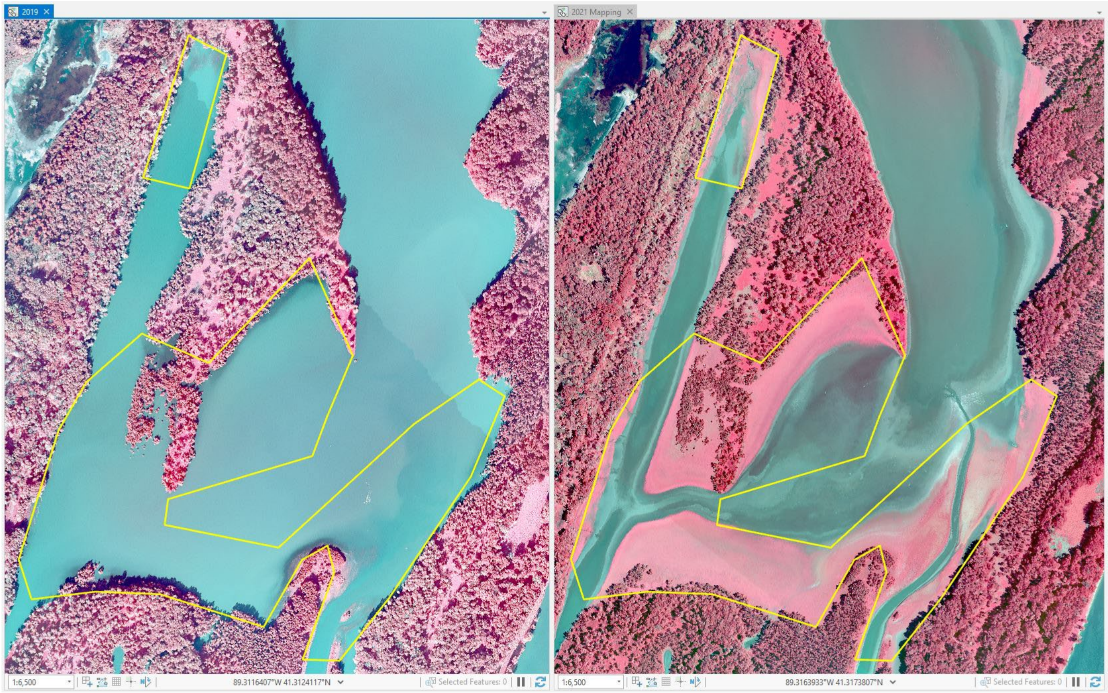

Figure 26. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at Spring Lake in Peoria Pool in the side channels of the Illinois Waterway showing increased SAV and EAV cover over the two years. Area of interest outlined in yellow. Image centered on 41.301ºN, 89.346ºW.

Figure 27. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at the mouth of Big Bureau Creek in Peoria Pool in the side channels of the Illinois Waterway showing increased EAV cover over the two years. Area of interest outlined in yellow. Image centered on 41.228ºN, 89.376ºW.

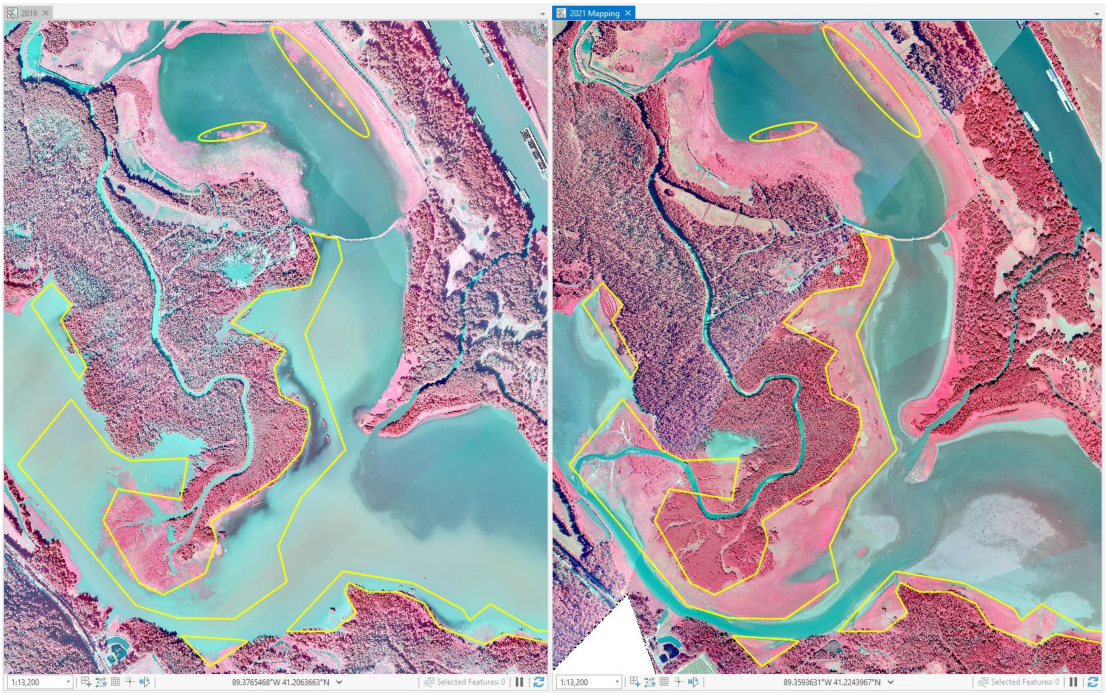

Figure 28. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) in the Senachwine Lake area in Peoria Pool in the side channels of the Illinois Waterway showing increased EAV cover over the two years. Area of interest outlined in yellow. Image centered on 41.205ºN, 89.378ºW.

Figure 29. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at Dixon Waterfowl Refuge in Peoria Pool in the side channels of the Illinois Waterway showing increased SAV and EAV cover over the two years. Area of interest outlined in yellow. Image centered on 41.214ºN, 89.339ºW.

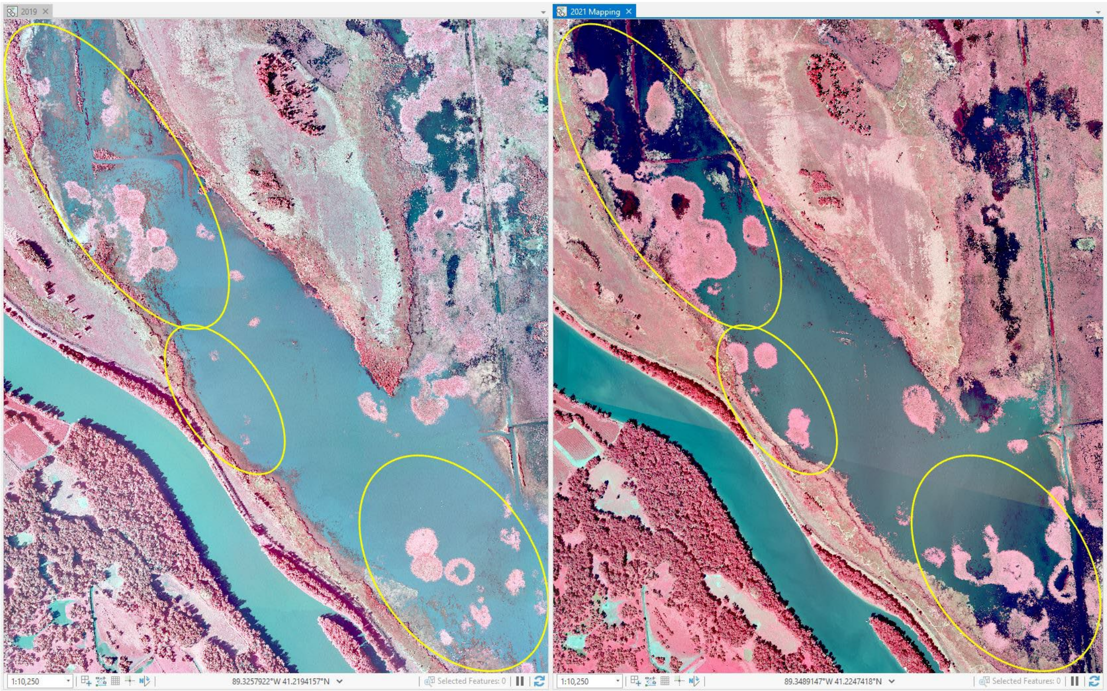

Figure 30. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at Swan Lake in Peoria Pool in the side channels of the Illinois Waterway showing increased EAV cover in the left area and decreased EAV cover in the three right areas over the two years. Area of interest outlined in yellow. Image centered on 41.168ºN, 89.318ºW.

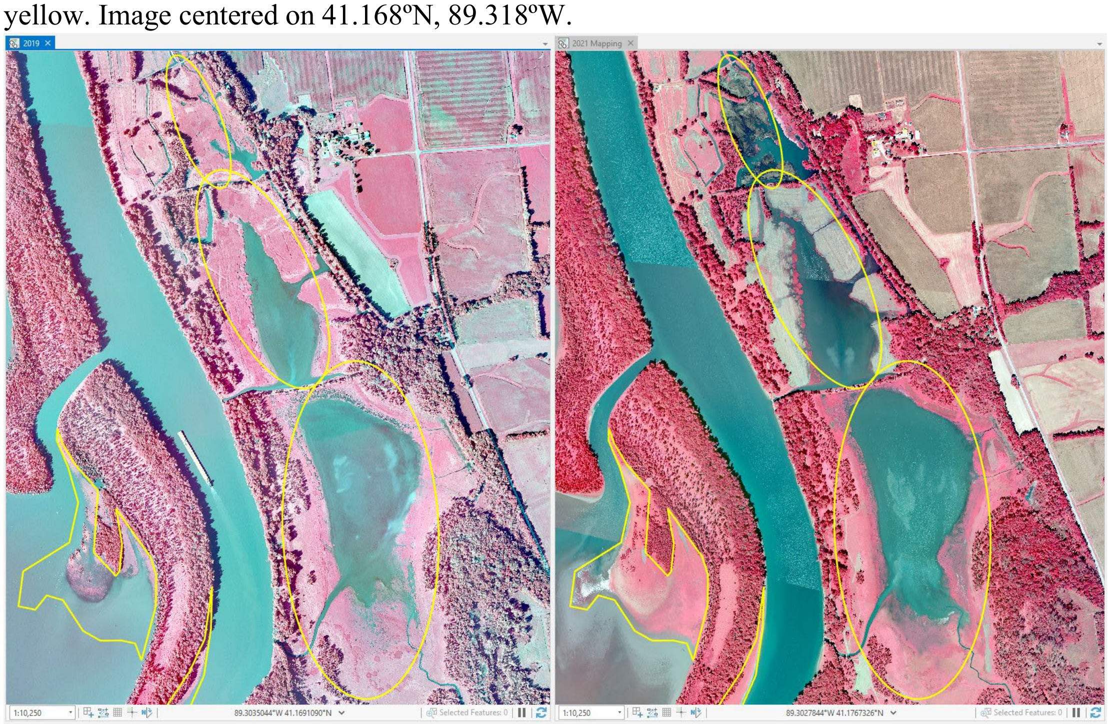

Figure 31. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at Sawmill Lake in Peoria Pool in the side channels of the Illinois Waterway showing increased EAV cover and exposed sediments over the two years. Area of interest outlined in yellow. Image centered on 41.124ºN, 89.324ºW.

Figure 32. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) north of Henry Bay in Peoria Pool in the side channels of the Illinois Waterway showing increased EAV cover and exposed sediments over the two years. Area of interest outlined in yellow. Image centered on 41.118ºN, 89.342ºW.

Figure 33. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at Whitney Lake in Peoria Lake in the side channels of the Illinois Waterway showing decreased EAV cover and increased exposed sediments in the upper area, increased EAV cover in the middle right area, and increased SAV cover in the lower left area over the two years. Area of interest outlined in yellow. Image centered on 41.102ºN, 89.363ºW.

Figure 34. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at Merdian Lake and Newhaven Lake in Peoria Pool in the side channels of the Illinois Waterway showing increased EAV cover over the two years. Area of interest outlined in yellow. Image centered on 41.091ºN, 89.378ºW.

Figure 35. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) in northern Bilsbach Lake in Peoria Pool in the side channels of the Illinois Waterway showing increased EAV cover and exposed sediments over the two years. Area of interest outlined in yellow. Image centered on 41.088ºN, 89.357ºW.

Figure 36. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) in southern Bilsbach Lake in Peoria Pool in the side channels of the Illinois Waterway showing increased EAV cover and exposed sediments over the two years. Area of interest outlined in yellow. Image centered on 41.082ºN, 89.375ºW.

Figure 37. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at Weis Lake in Peoria Pool in the side channels of the Illinois Waterway showing increased EAV cover and exposed sediments over the two years. Area of interest outlined in yellow. Image centered on 41.070ºN, 89.398ºW.

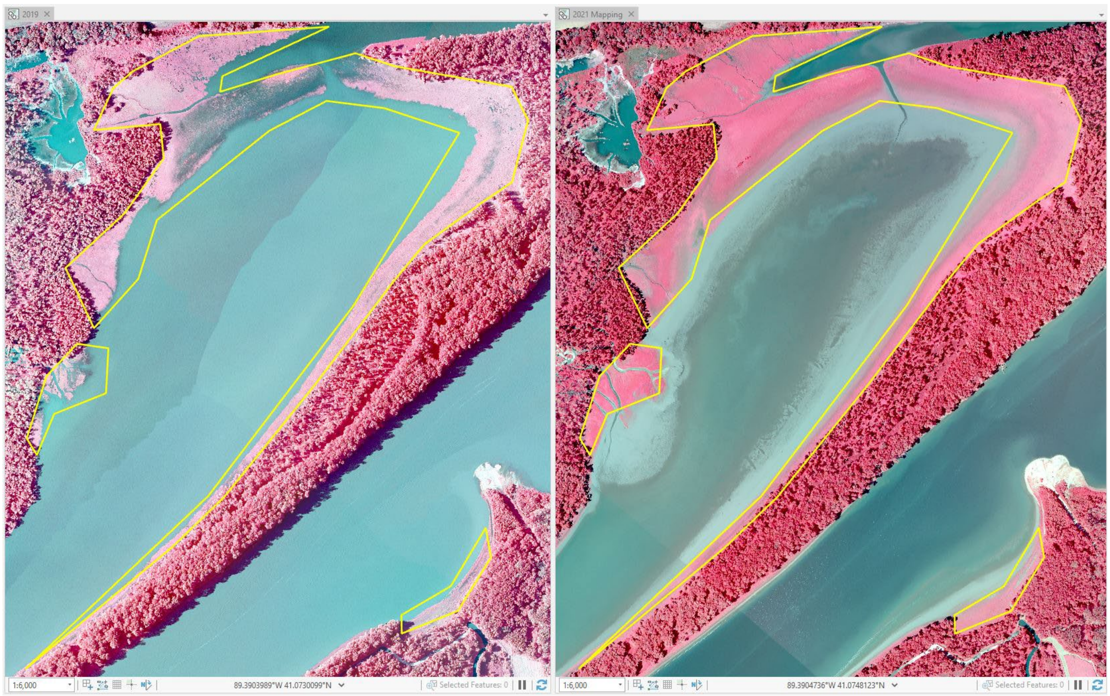

Figure 38. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at Goose Lake south of Cameron National Wildlife Refuge in Peoria Pool in the side channels of the Illinois Waterway showing increased EAV cover and exposed sediments over the two years. Area of interest outlined in yellow. Image centered on 41.049ºN, 89.419ºW.

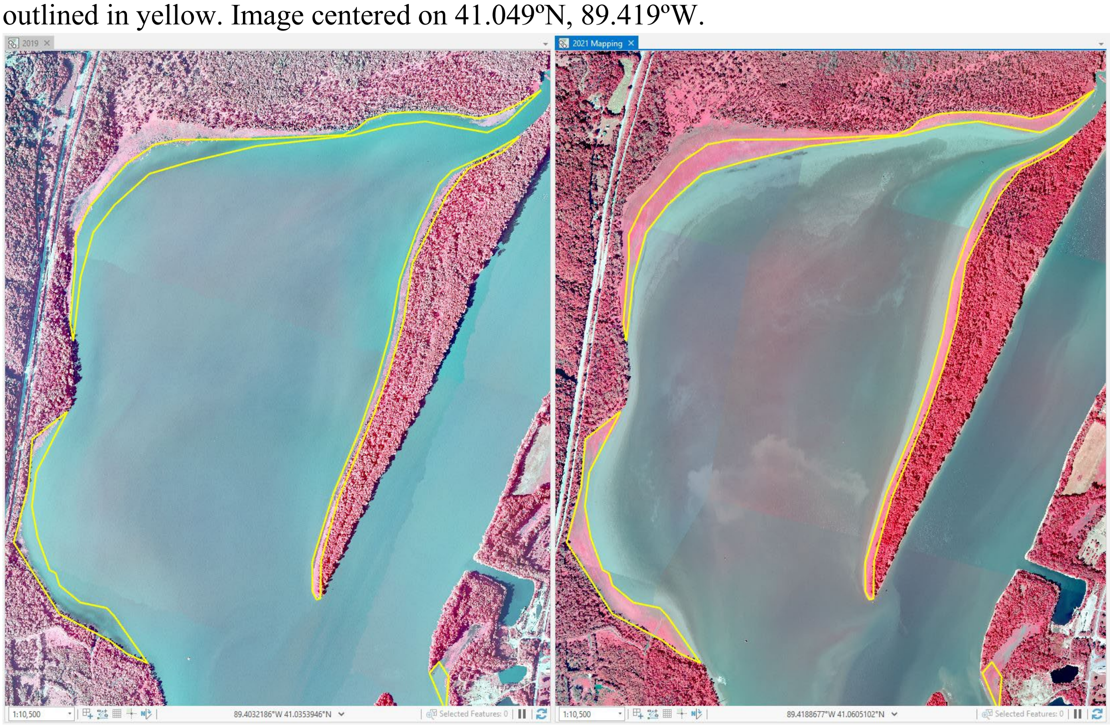

Figure 39. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at Lacon Quarry in Peoria Pool in the side channels of the Illinois Waterway showing increased SAV and EAV cover over the two years. Area of interest outlined in yellow. Image centered on 41.058ºN, 89.392ºW.

Figure 40. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at Wightman Lake in Peoria in the side channels of the Illinois Waterway showing increased EAV cover over the two years. Area of interest outlined in yellow. Image centered on 41.016ºN, 89.430ºW.

Figure 41. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right in northern Sawyer Slough in Peoria Pool in the side channels of the Illinois Waterway showing increased EAV cover and exposed sediments over the two years. Area of interest outlined in yellow. Image centered on 41.006ºN, 89.419ºW.

Figure 42. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) in southern Sawyer Slough in Peoria Pool in the side channels of the Illinois Waterway showing increased EAV cover over the two years. Area of interest outlined in yellow. Image centered on 40.989ºN, 89.425ºW.

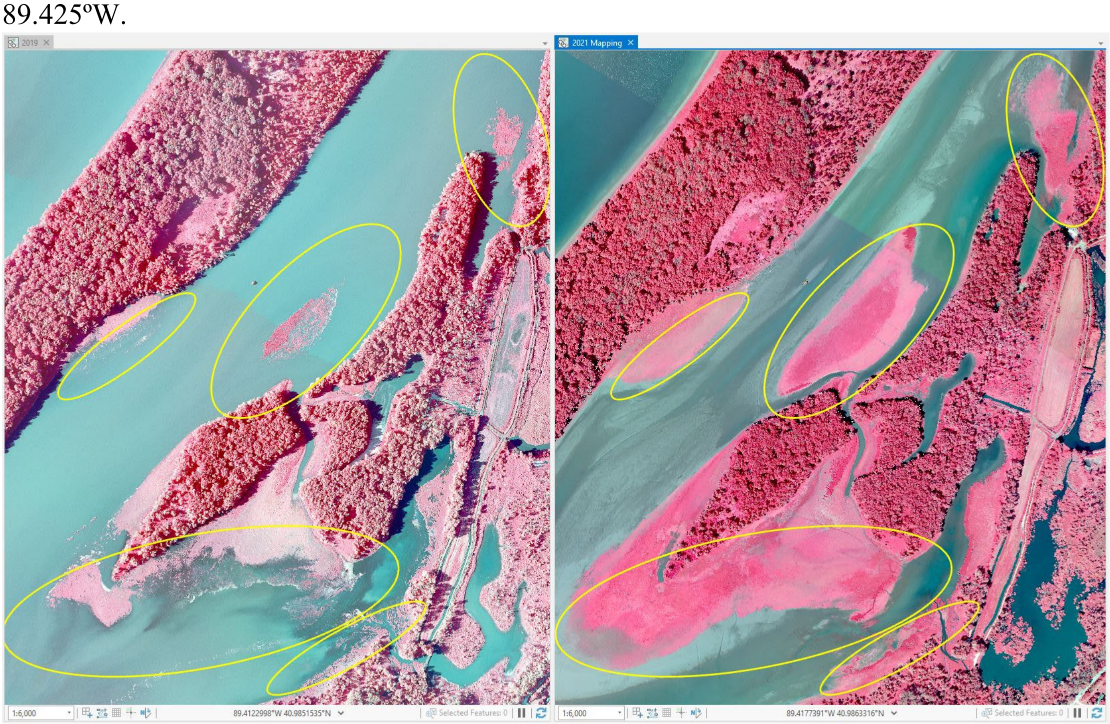

Figure 43. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at Upper Goose Lake in the Woodford County State Conservation Area in Peoria Pool in the side channels of the Illinois Waterway showing increased EAV cover and increased exposed sediments over the two years. Area of interest outlined in yellow. Image centered on 40.919ºN, 89.464ºW.

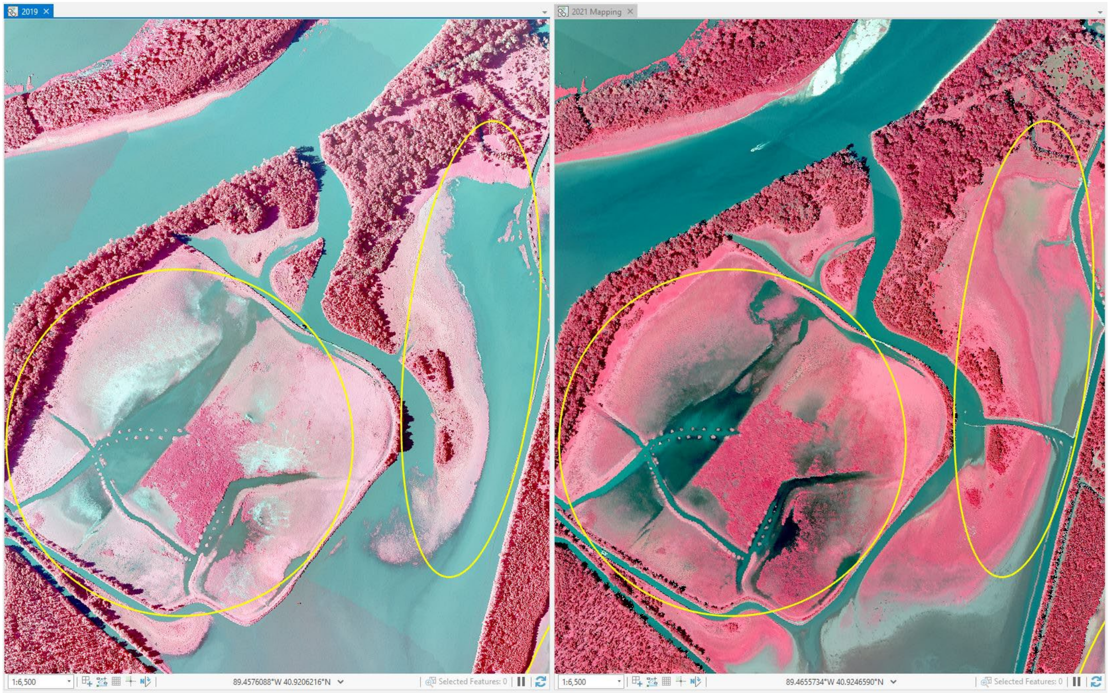

Figure 44. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) near Chillicothe Island in Peoria Pool in the side channels of the Illinois Waterway showing increased EAV cover over the two years. Area of interest outlined in yellow. Image centered on 40.897ºN, 89.482ºW.

Figure 45. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) across from the confluence of the Illinois River and Kickapoo Creek in Peoria Pool in the side channels of the Illinois Waterway showing increased EAV cover and exposed sediments over the two years. Area of interest outlined in yellow. Image centered on 40.657ºN, 89.609ºW.

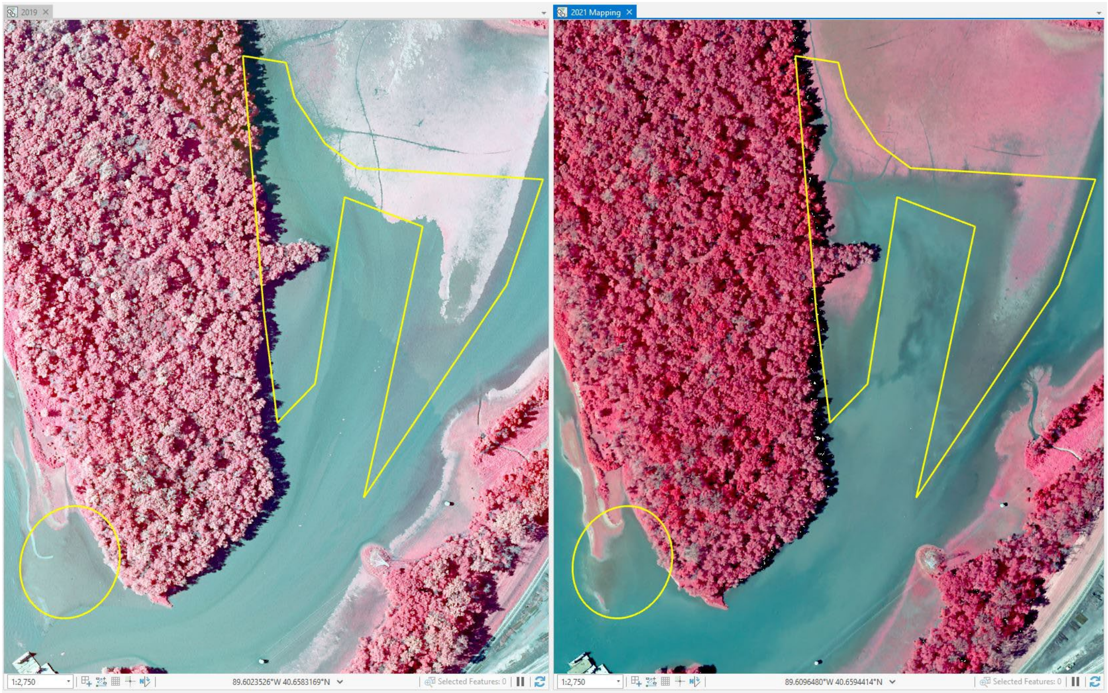

Figure 46. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at Pekin Lake in La Grange Pool in the side channels of the Illinois Waterway showing increased EAV cover and exposed sediments over the two years. Area of interest outlined in yellow. Image centered on 40.586ºN, 89.651ºW.

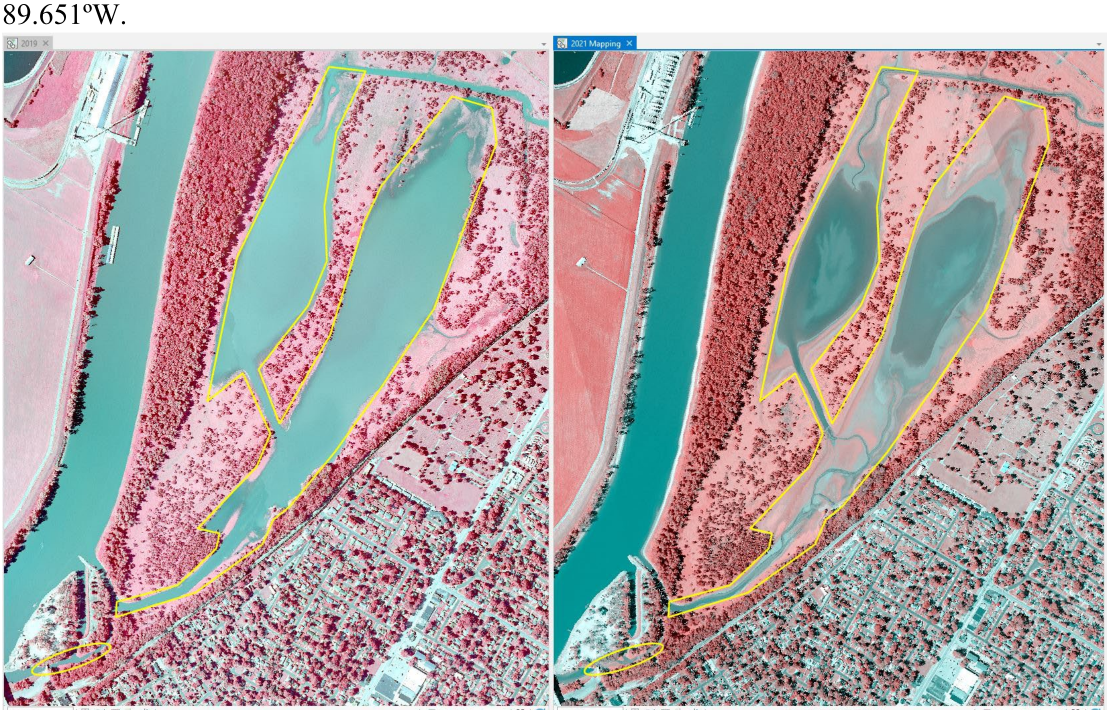

Figure 47. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at the Quiver Creek outlet in La Grange Pool in the side channels of the Illinois Waterway showing a minor increase in EAV cover and major increase in exposed sediments over the two years. Area of interest outlined in yellow. Image centered on 40.337ºN, 90.041ºW.

Figure 48. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at Bath Lake in La Grange Pool in the side channels of the Illinois Waterway showing a minor decrease in EAV cover in the lower left and a major decrease in EAV in the upper right over the two years. Area of interest outlined in yellow. Image centered on 40.207ºN, 90.133ºW.

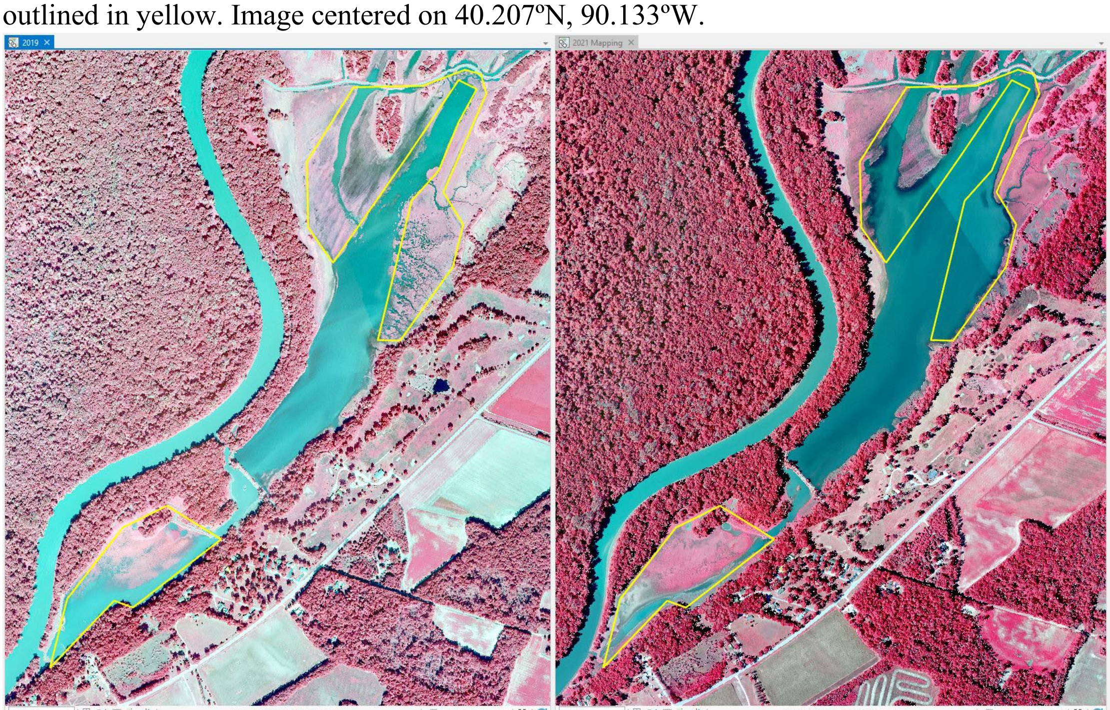

Figure 49. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at Grass Lake in La Grange Pool in the side channels of the Illinois Waterway showing increased EAV cover over the two years. Area of interest outlined in yellow. Image centered on 40.205ºN, 90.157ºW.

Figure 50. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at Moscow Lake in La Grange Pool in the side channels of the Illinois Waterway showing increased SAV cover and decreased EAV cover over the two years. Area of interest outlined in yellow. Image centered on 40.182ºN, 90.159ºW.

Figure 51. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at Jacks Lake in La Grange Pool in the side channels of the Illinois Waterway showing increased EAV cover over the two years. Area of interest outlined in yellow. Image centered on 40.185ºN, 90.191ºW.

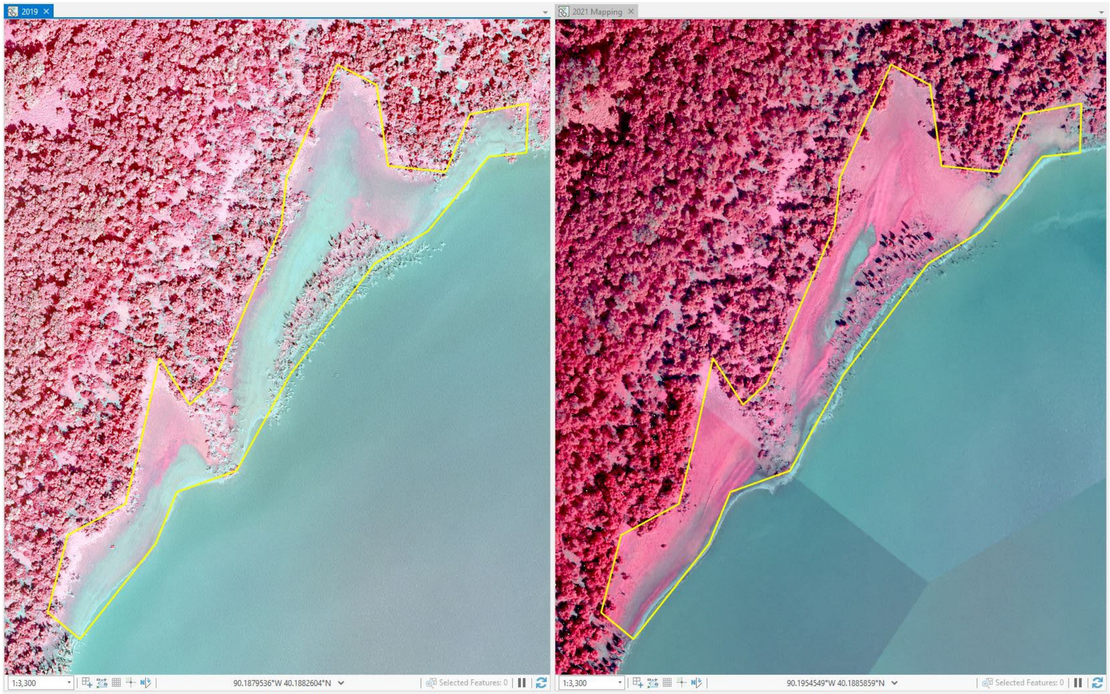

Figure 52. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at Chain Lake in La Grange Pool in the side channels of the Illinois Waterway showing increased EAV cover in the left area and decreased EAV cover and exposed sediments in the right area over the two years. Note that the area on the right does not have a direct hydrologic connection to the IWW and may have managed water levels. Area of interest outlined in yellow. Image centered on 40.127ºN, 90.320ºW.

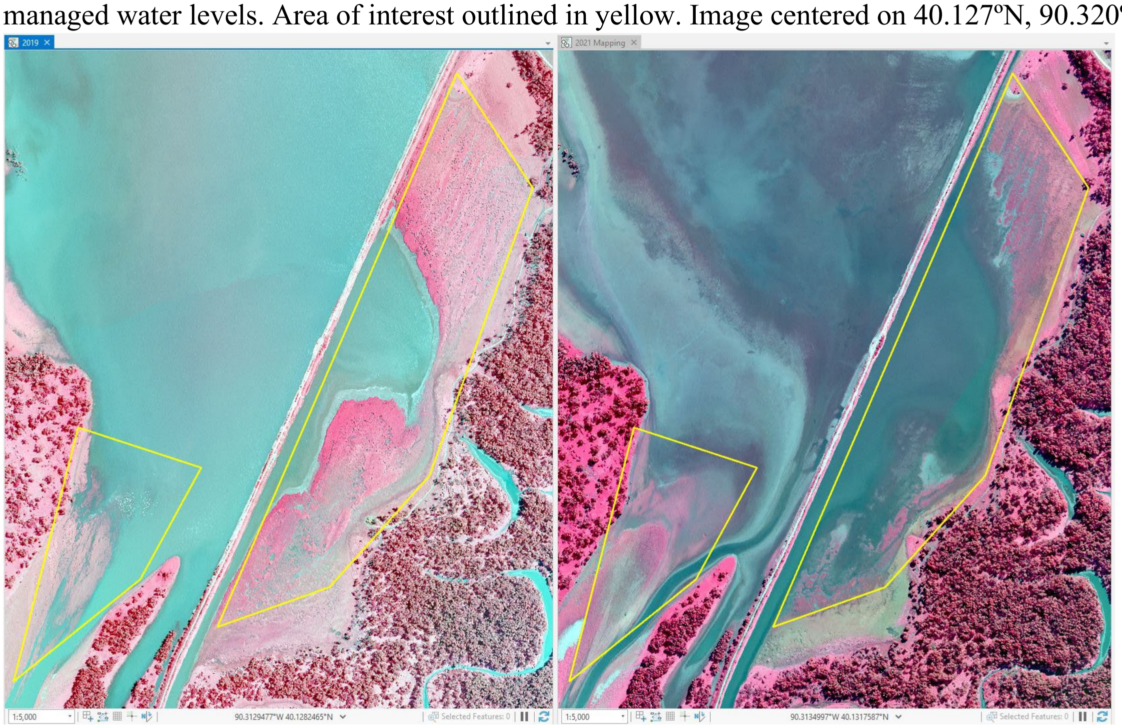

Figure 53. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at Sangamon Bay area in La Grange Pool in the side channels of the Illinois Waterway showing increased EAV cover and exposed sediments in the upper left area and decreased EAV cover and exposed sediments in the lower right area over the two years. Area of interest outlined in yellow. Image centered on 40.109ºN, 90.378ºW.

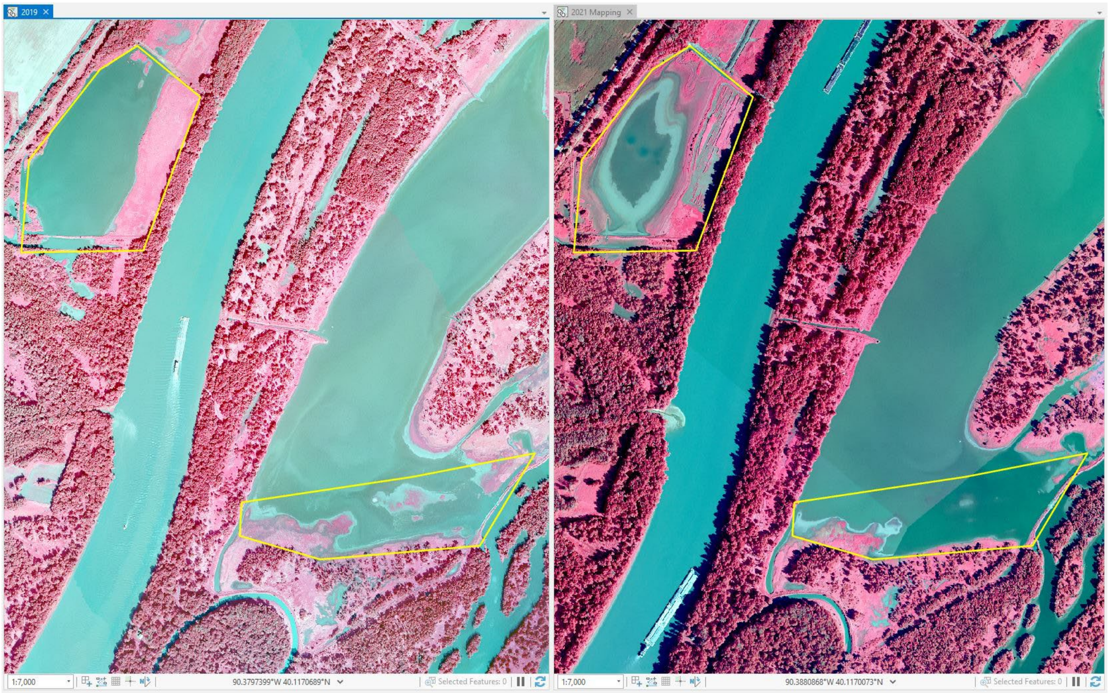

Figure 54. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at Treadway Lake in La Grange Pool in the side channels of the Illinois Waterway showing decreased EAV cover and increased exposed sediments over the two years. Area of interest outlined in yellow. Image centered on 40.084ºN, 90.374ºW.

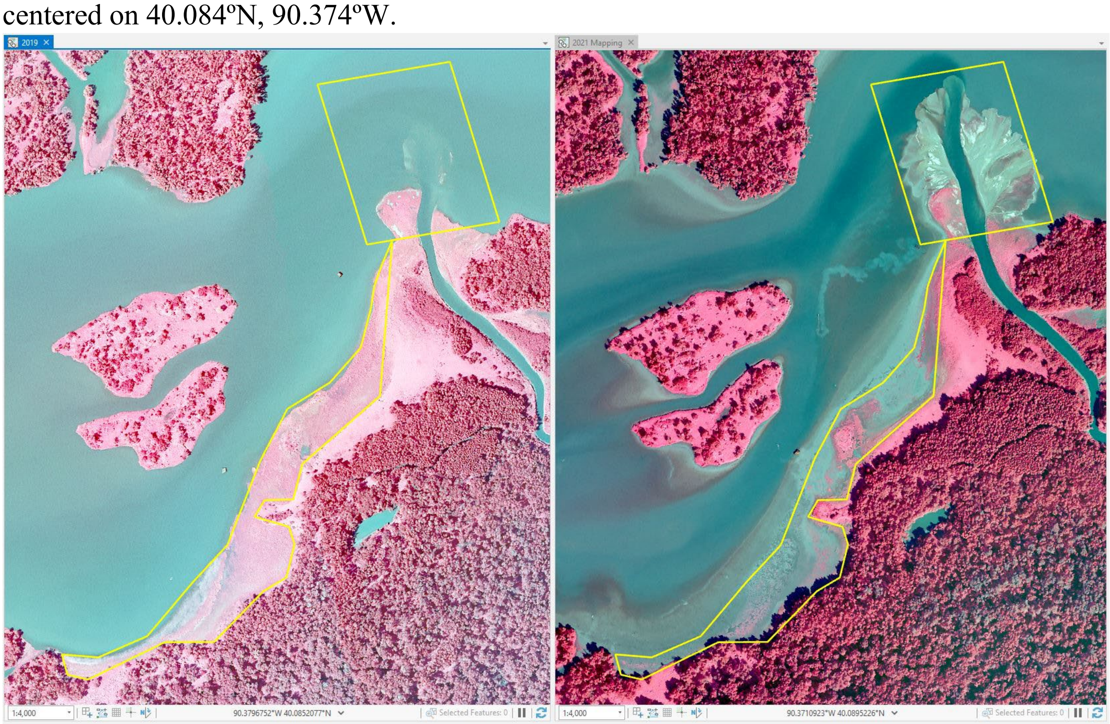

Figure 55. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at Boujan Swale in La Grange Pool in the side channels of the Illinois Waterway showing increased EAV cover and exposed sediments over the two years. Area of interest outlined in yellow. Image centered on 40.053ºN, 90.413ºW.

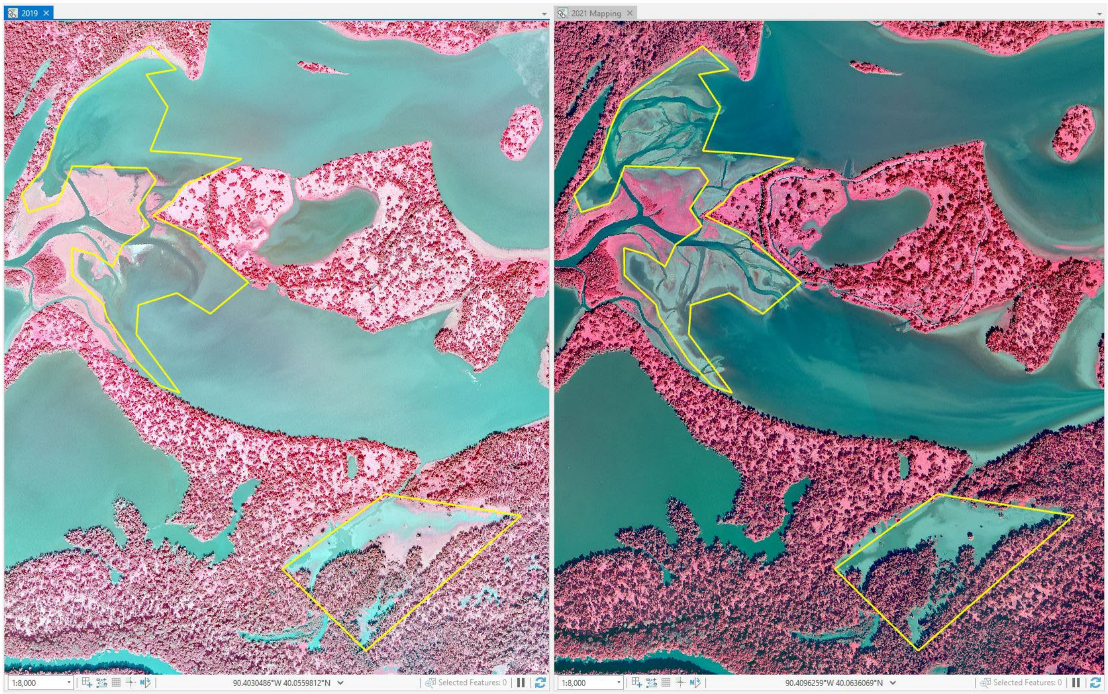

Figure 56. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at Big Lake in Le Grange Pool in the side channels of the Illinois Waterway showing increased EAV cover and exposed sediments over the two years. Area of interest outlined in yellow. Image centered on 39.967ºN, 90.522ºW.

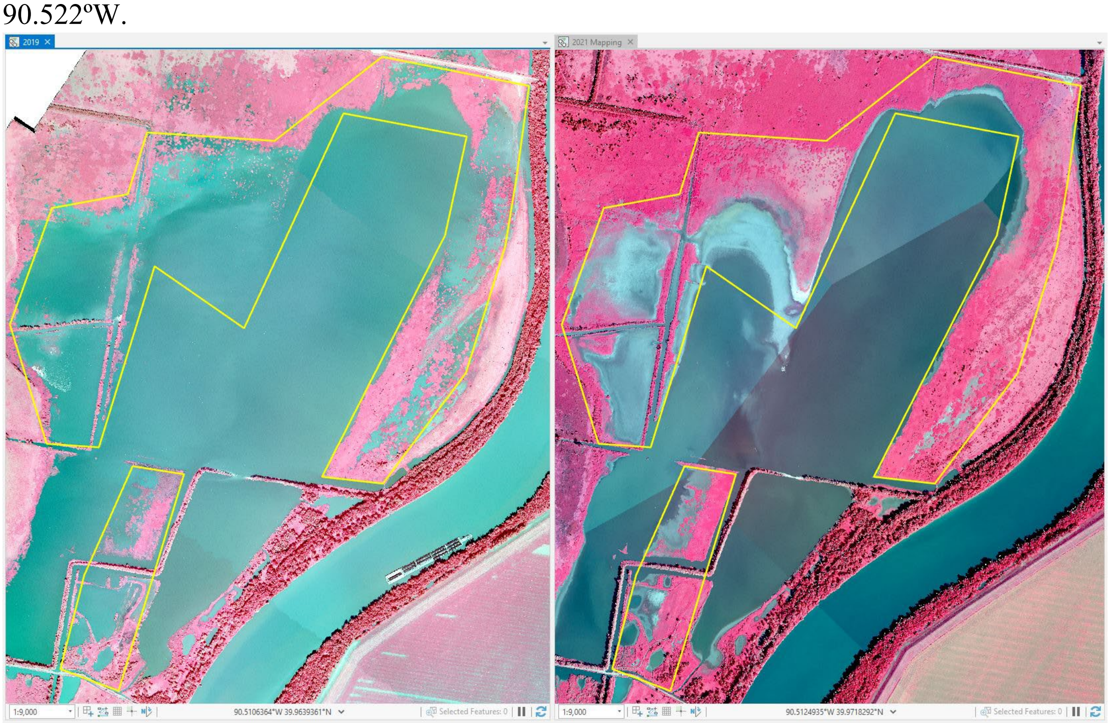

Figure 57. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) wetlands along Highway 34 in Starved Rock Pool in the side channels of the Illinois Waterway showing decreased EAV cover and increased SAV cover over the two years. Area of interest outlined in yellow. Image centered on 41.327ºN, 88.975ºW.

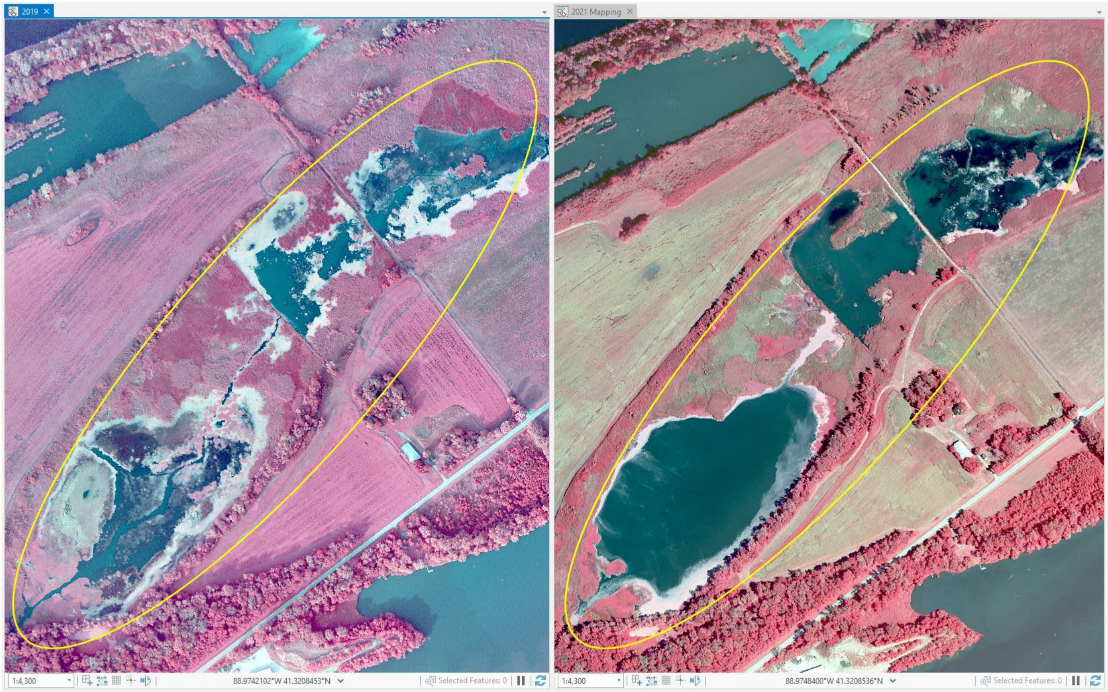

Figure 58. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) along I-39 in Peoria Pool in the side channels of the Illinois Waterway showing increased EAV cover and exposed sediments over the two years. Area of interest outlined in yellow. Image centered on 41.314ºN, 89.082ºW.

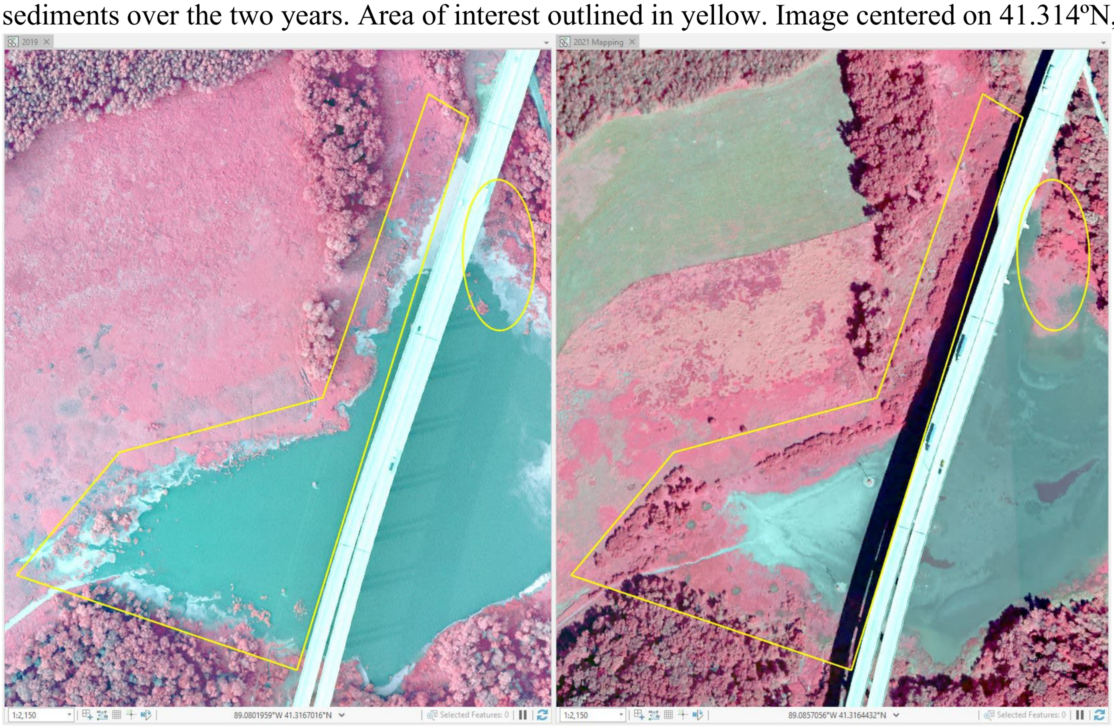

Figure 59. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) near Lyons Lake in Peoria Pool in the side channels of the Illinois Waterway showing increased EAV cover over the two years. Area of interest outlined in yellow. Image centered on 41.310ºN, 89.280ºW.

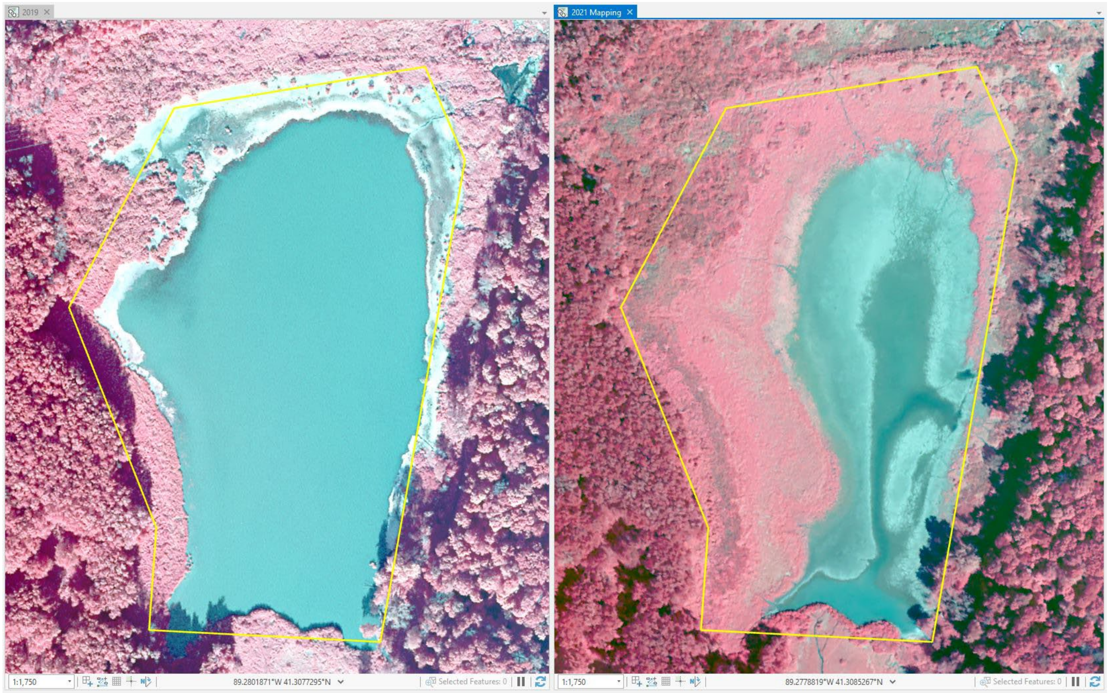

Figure 60. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at Douglas Lake in Peoria Pools in the side channels of the Illinois Waterway showing both increased SAV and EAV cover over the two years. Area of interest outlined in yellow. Image centered on 40.913ºN, 89.447ºW.

Figure 61. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at a pond near North Pekin, Illinois in Peoria Pool in the side channels of the Illinois Waterway showing increased EAV cover and exposed sediments over the two years. Area of interest outlined in yellow. Image centered on 40.626ºN, 89.625ºW.

Figure 62. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) in northern Miserable Lake in La Grange Pool in the side channels of the Illinois Waterway showing increased EAV and SAV cover, and increased exposed sediments over the two years. Area of interest outlined in yellow. Image centered on 40.485ºN, 89.921ºW.

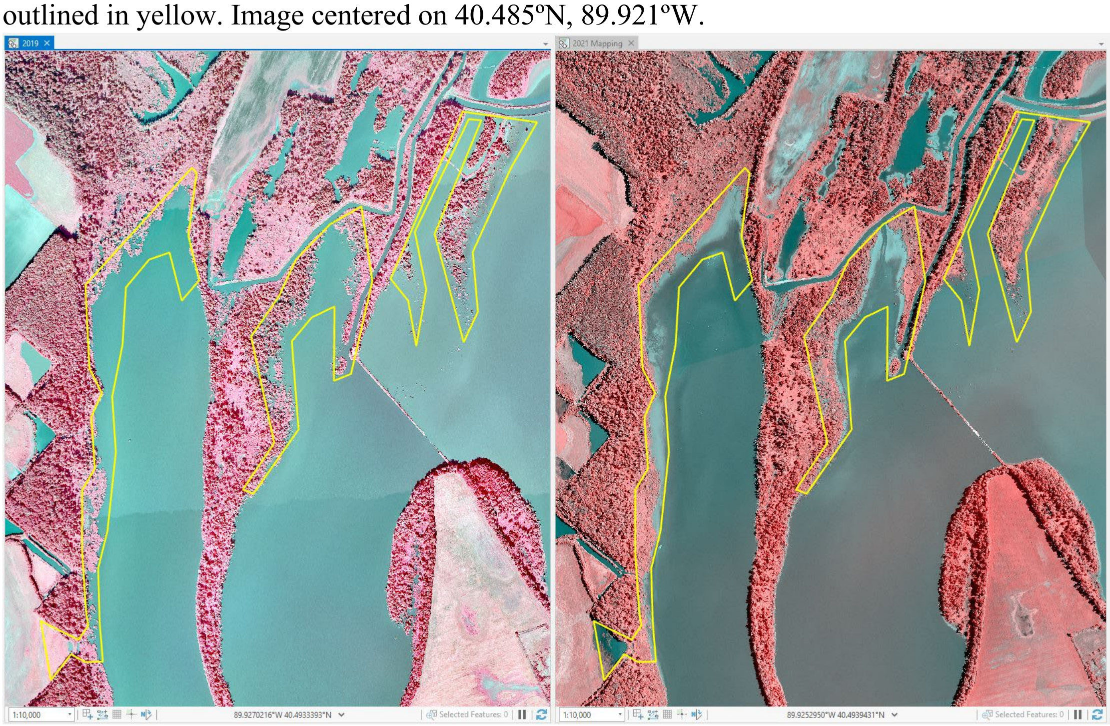

Figure 63. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at Miserable Island in La Grange Pool in the side channels of the Illinois Waterway showing increased EAV cover over the two years. Area of interest outlined in yellow. Image centered on 40.467ºN, 89.942ºW.

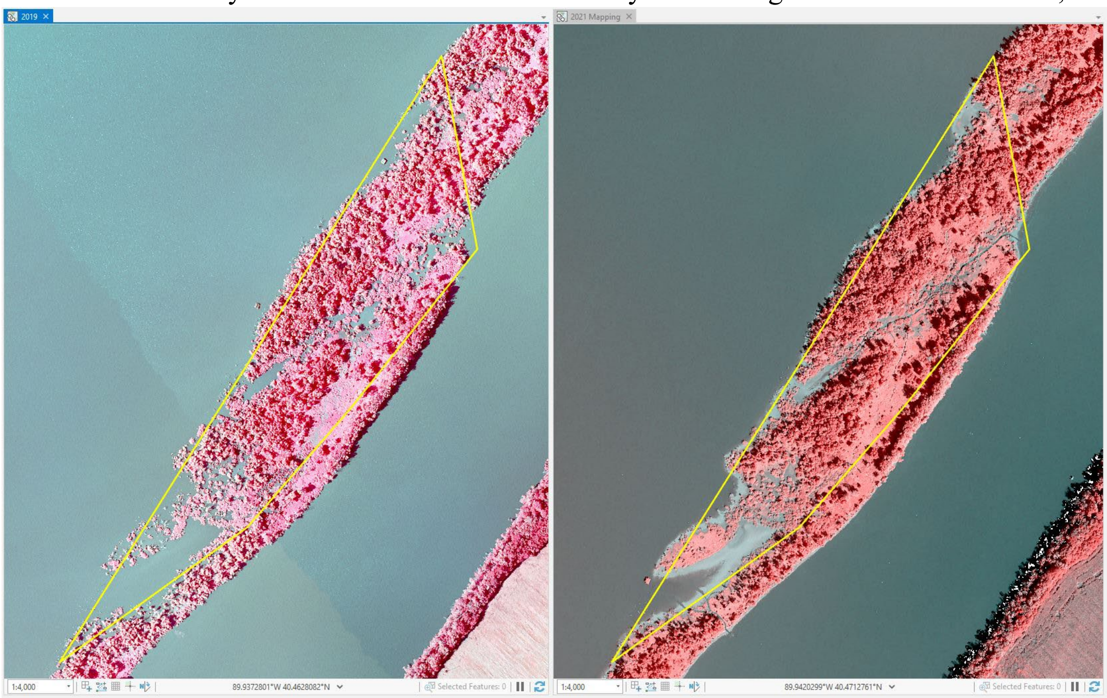

Figure 64. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) in southern Miserable Lake in La Grange Pool in the side channels of the Illinois Waterway showing increased EAV cover over the two years. Area of interest outlined in yellow. Image centered on 40.449ºN, 89.953ºW.

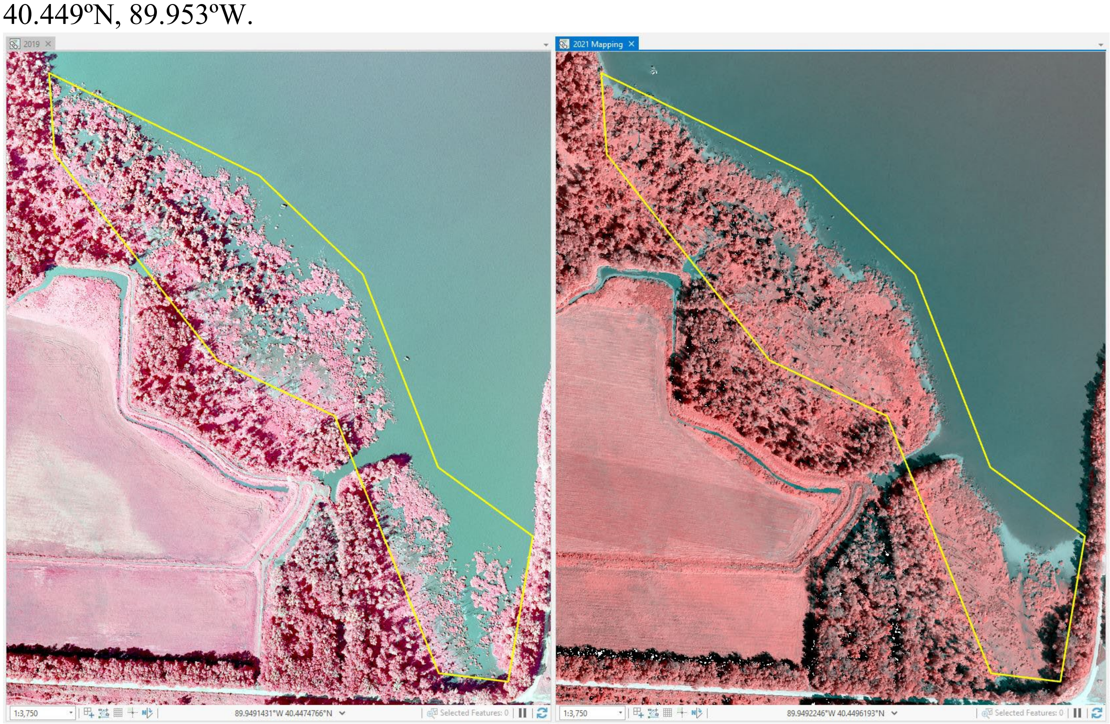

Figure 65. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at Beebe Lake in La Grange Pool in the side channels of the Illinois Waterway showing increased EAV and SAV cover over the two years. Area of interest outlined in yellow. Image centered on 40.449ºN, 89.932ºW.

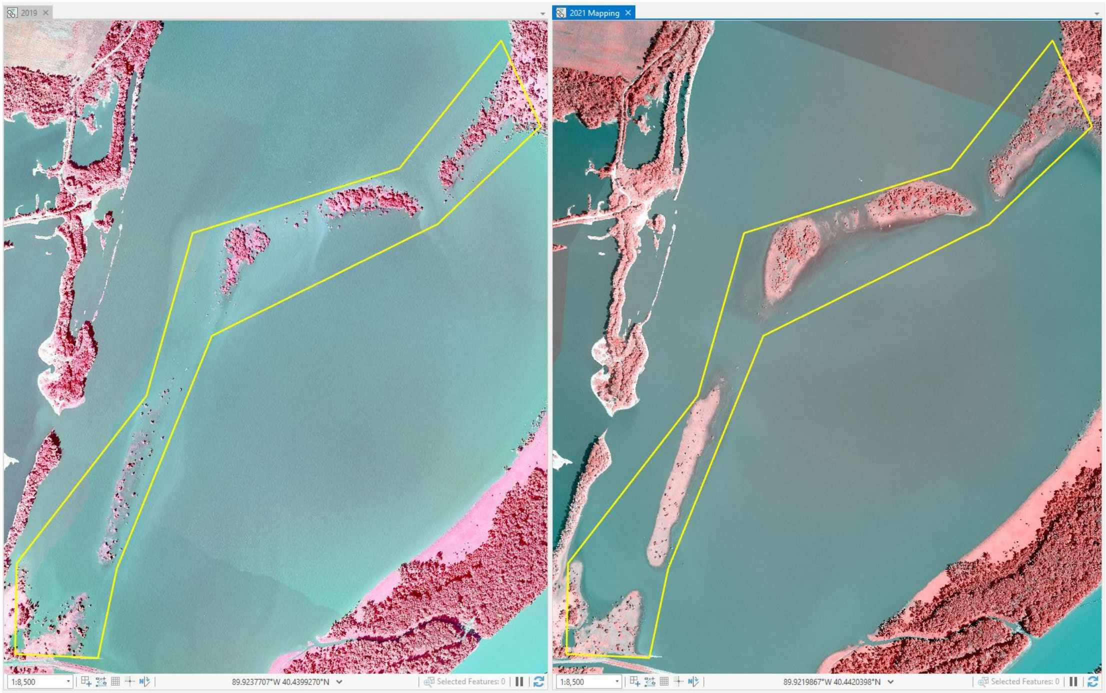

Figure 66. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at the northern end of Quiver Lake in La Grange Pool in the side channels of the Illinois Waterway showing increased EAV cover over the two years. Area of interest outlined in yellow. Image centered on 40.415ºN, 89.926ºW.

Figure 67. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at the southern end of Quiver Lake and northern end of Chautauqua Lake in La Grange in the side channels of the Illinois Waterway showing conversion of EAV to bare sediment in the lower area and a large decrease in EAV cover in the upper area over the two years. Area of interest outlined in yellow. Image centered on 40.388ºN, 89.975ºW.

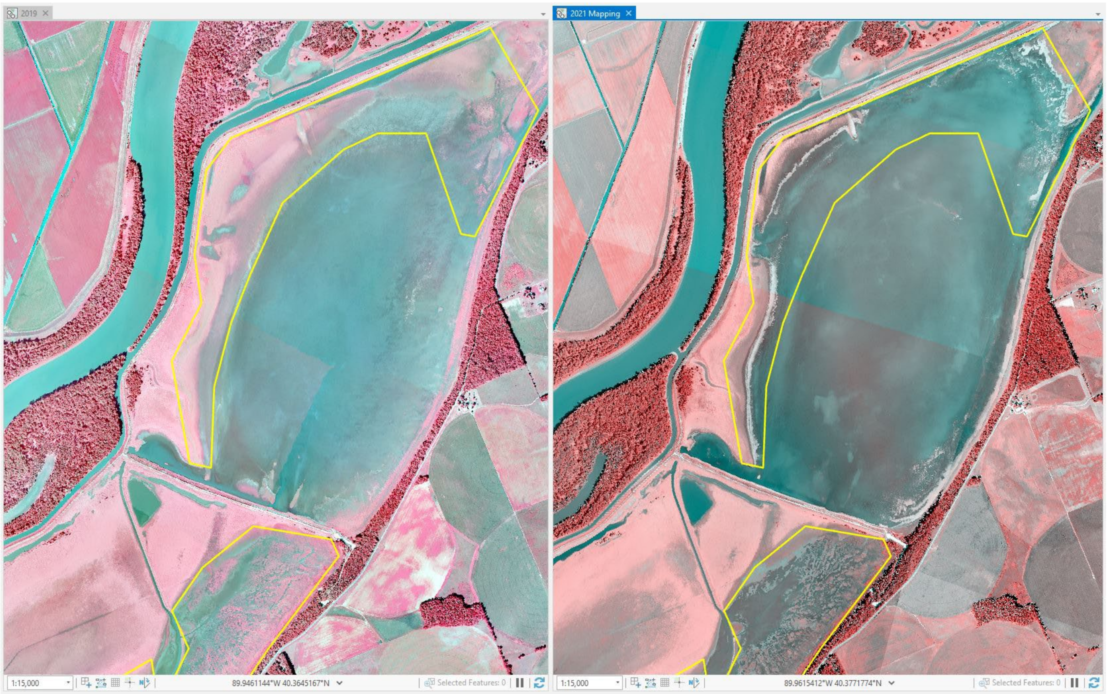

Figure 68. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) at Chautauqua Lake in La Grange Pool in the side channels of the Illinois Waterway showing a large conversion of EAV to SAV cover over the two years. Area of interest outlined in yellow. Image centered on 40.364ºN, 90.018ºW.

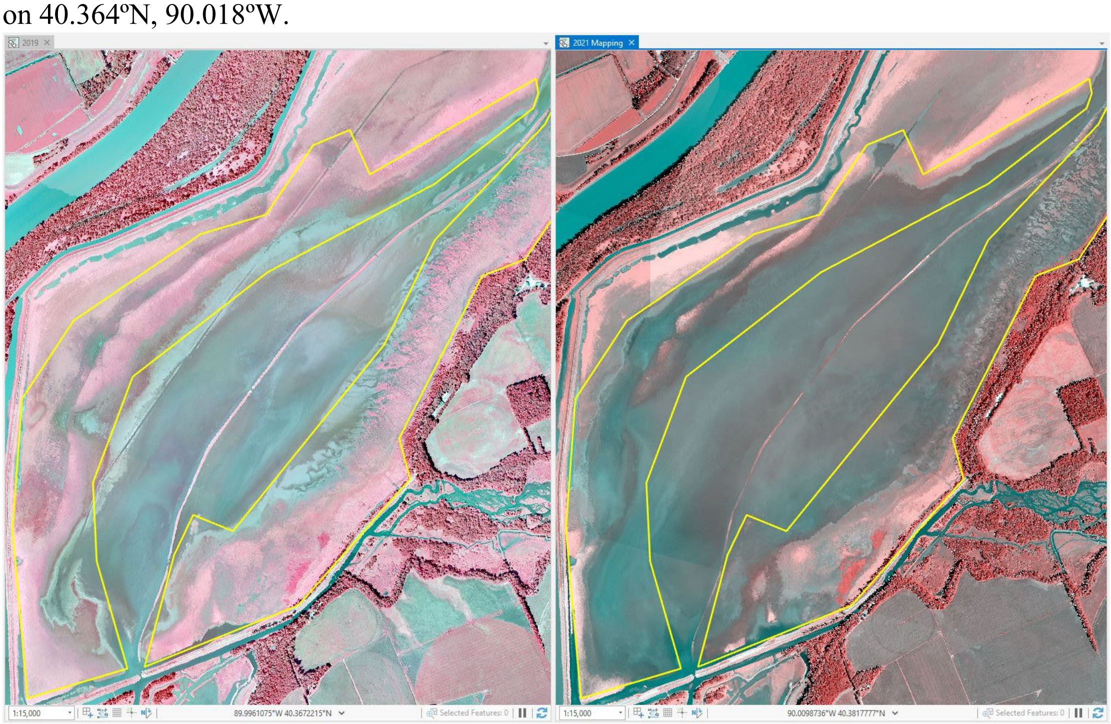

Figure 69. A screen capture comparing the 2019 vegetation (left) to the 2021 vegetation (right) in the Elm Creek area in La Grange Pool in the side channels of the Illinois Waterway showing increased EAV cover over the two years. Area of interest outlined in yellow. Image centered on 40.149ºN, 90.291ºW.