State of Wisconsin
DEPARTMENT OF NATURAL RESOURCES
3911 Fish Hatchery Road
Fitchburg WI 53711

Tony Evers, Governor
Preston D. Cole, Secretary
Telephone 608-266-2621
Toll Free 1-888-936-7463
TTY Access via relay - 711

June 18, 2020

Rock Koshkonong Lake District
Mr. Alan Sweeney, Board Chair
11327 North Casey Road
Edgerton, WI 53534

Expedited delivery via email: **alan.sweeney@co.rock.wi.gov**

Subject: Water Level Order IP-SC-2019-54-01639 for Lake Koshkonong and the Indianford Dam
Field Investigation of Impacts from Increased Water Levels

Dear Mr. Sweeney:

The purpose of this letter is to provide you with an update on the status of the water level order for the Indianford Dam.

As required by the current water level order for the Indianford Dam, docket number IP-SC-2019-54-01639, the Department was to complete a field investigation to determine the impacts of the first of two potential increases in the maximum ordered water level. The first increase allowed the maximum water level to increase from 776.33 to 776.55. The water level order then required a field investigation to determine the impacts of this increase prior to granting the second increase, which would potentially allow the maximum to increase to 776.75.

Due to high water levels, the field investigation was delayed until September 2019. This investigation showed severe adverse impacts to wetlands. Therefore, the maximum water level for the Indianford Dam will remain at 776.55 at this time.

The Department acknowledges that water levels have been significantly above the maximum water level for a very long time, which makes an evaluation of the wetland impacts very challenging. It is very difficult to know if the cause of the severe adverse impacts was the water level increase to 776.55, or if it was the long amount of time that lake levels have been significantly above the maximum allowable water level, even with the dam fully open.

Based on the acknowledged difficulty to determine the cause of the impacts, the intent of the Department is to treat this as a "stay" of the current Order and not a final closure of the matter. The Department has not yet been able to determine that the 776.55 water level has not resulted in, or significantly contributed to severe adverse impacts to wetlands as required in the order for the second increase to 776.75, but also has not definitively determined that it has.

Attached to this letter is the Lake Koshkonong 2019 wetland quality monitoring results as well as the assessment methodology and benchmarks that were implemented. This report summarizes the results of the 2019 wetland condition surveys compared to the baseline surveys completed in 2016 and 2017. The Department commits to performing another field investigation in the future when conditions allow. Ideally, this will require water levels to be at or below the maximum water level for an entire growing season (May through October), and then again in the first few months of the following growing season, starting at frost out through when a survey can be conducted between June and September. While some deviation could be tolerated, these are representative of the type of conditions the Department needs to make a fair evaluation.

We look forward to continuing our collaborative work with RKLD and continuing to strengthen our working relationship.

Sincerely,

Mark D. Aquino

Mark Aquino
Secretary's Director, South Central

Encl: Lake Koshkonong 2019 wetland quality monitoring memo

Copy to: Robert R. Davis, PE – Dam Safety and Floodplain Section Chief
David C. Rowe – Region Team Supervisor
Michael Sorge – Basin Supervisor
Travis Schroeder – Basin Supervisor
Uriah Monday, PE – Water Management Engineer
Shelly Allness – Acting Field Integration Leader

State of Wisconsin

CORRESPONDENCE/MEMORANDUM

DATE: March 3, 2020

TO: Mark Aquino

FROM: Christopher Noll, Sally Jarosz

SUBJECT: Lake Koshkonong 2019 Wetland Quality Monitoring Results

Introduction
This memo is intended to summarize the results of 2019 wetland condition surveys compared to baseline surveys completed in 2016 and 2017. The wetlands around the Lake Koshkonong system are in various conditions states and are showing differing trends. The system has been experiencing large fluctuations in water level and, as noted after baseline surveys, those swings in water levels make it difficult to assess wetland condition changes as a result of dam order changes.

2019 Sampling
The wetland survey efforts were led by four field botanist leads and all botanist leads attended a "calibration day" training event where a they collectively surveyed a local wetland not included in the 2019 resurvey to ensure relative consistency in survey methods. Surveys were completed between September 9th and 20th. According to the USGS gauge station at Newville, WI, the lake was roughly one to two feet higher than the 30-year average for much of the spring and summer and peaked at around 3.5 feet above the average in the early spring. This extremely high water-level at the beginning of the growing season would likely have impacted wetland community species composition. At the time of the sampling, the water levels were a few inches above the 30-year average. The hydrographs from Lake Koshkonong for 2016, 2017, and 2019 are attached to this memo.

Methodology
We retained the same methodology as the 2005 "baseline" survey which is to utilize timed meander surveys (DNR, 2016) to quantify wetland quality. This tool is used to calculate Floristic Quality Assessment metrics: weighted Mean C and weighted Floristic Quality Index. Nearly all vascular plants in Wisconsin have been assigned a "Coefficient of Conservatism", often abbreviated as a C-value. Weighting of C-values is calculated using percent cover estimates. The result of these surveys will be a Floristic Quality Assessment (FQA), a quantitative tool to measure vegetation diversity and quality. Using the FQA, we will be able to compare various vegetation metrics across wetland location and type. Importantly, this method is roughly compatible with the 2005 assessment, allowing us to track changes in floristic quality dating back to the 2005 baseline.

Analysis Limitations
While wetland plant community composition typically follows a long-term trajectory in response to hydrologic inputs, soils, and disturbance, it is also affected by short term changes which can easily obscure the signal of long-term trends As a floodplain system, Lake Koshkonong water levels fluctuate dramatically in response to the amount of precipitation the watershed has received. Terrestrial wetland species composition also shifts in response to annual variations in hydrology especially where early season flooding is concerned. Therefore, the Lake Koshkonong wetlands' composition can be quite different from year to year depending on how wet or dry the system was during the growing season. A normal wetland's composition will also shift over the growing season according to the phenology of individual species, with different species reaching peak cover at different times of year. When reviewing

this data, the reader needs to be mindful of the fact that the baseline surveys and 2019 surveys were conducted at different times of the year (some in spring and some in fall) and experienced different hydrologic conditions over those years. Some of the increases and decreases in species composition that we observed from the “Baseline” surveys to the 2019 surveys are likely a result of different phenological conditions and different weather conditions or lake levels.

In addition to observing different species compositions from year-to-year from weather or seasonality, there is an inherent variability to the Timed Meander Survey. This protocol does not require re-sampling the exact same locations from year-to-year as a plot-based survey might; instead the surveyor is supposed to stay within the bounds of a particular wetland community type and follow a meandering walking path until they feel confident they have observed the vast majority of plant species present. Due to this, there is always the possibility that the different surveyors assessing the same wetland will take different paths and observe slightly different species and/or estimate different species’ cover.

Finally, the replicability of our dataset from the “Baseline” to the 2019 surveys was limited as we are relying on permissions from landowners. There were three wetland communities that were sampled in the “Baseline” that we did not receive permission from the current landowner to resample in 2019 (sites 2.3, 3.3, and 3.5 were sampled in 2017 but not in 2019). Not having access to the same sites year-after-year reduces our ability to track community trends over time.

Results

In general, we are observed many shifts in the community tier rank (see Appendix B for the Wisconsin Floristic Quality Benchmark for this region) – we observed one 2-tier shift and four 1-tier shift improvements and three 1-tier shift degradations. We also observed eight assessment areas showing an increase in native species richness and three showing a degradation. Two assessment areas showed minor increases in invasive species and two areas showed a reduction in invasive species cover. Two floodplain forest areas showed a decrease in non-ash tree percent cover. And finally, one assessment area was categorized as a sedge meadow in the “Baseline” surveys but was determined to be an emergent marsh in the 2019 survey – a severe degradation on paper, however it appears the change is more related to vegetation classification semantics than a fundamental shift in the nature of this wetland.

There are ecological narratives underlying most of these changes that can be applied to the various types of ecological communities present. Below are selected narratives describing the ecological context for a subset of survey results.

Forested Wetlands

Forested wetlands around Lake Koshkonong are generally of two types – floodplain forests and hardwood swamps. Floodplain forests generally occur on flat plains that are incised by sloughs and adapted to periodic inundation, which historically could be expected to last for a few days to weeks in spring. The ground layer usually contained a mix of annual and perennial vegetation that could withstand shorter periods of inundation. Around Lake Koshkonong there appears to be a shift toward more frequent periods of extended inundation during the growing season in response to heavy rainfall and/or snowmelt in the Rock River basin. At the time of the September 2019 wetland surveys, Lake Koshkonong floodplain forests still showed signs of deep, prolonged growing-season inundation consistent with the USGS hydrograph. In many areas, water rings on trees were several feet off the ground and canopy silver maples appeared stressed on account of sparse leaf density and prematurely-changed color. The ground layer within extensively flooded areas was comprised almost entirely of fast-growing annual floodplain species like beggars ticks (*Bidens* sp.), clearweeds (*Pilea* sp.), barnyard grasses (*Echinochloa* sp.), and others.

In terms of floristic metrics, the net effect was not all bad, however this change does not necessarily equate to an increase in ecological integrity.

At survey site 3.8, a dramatic increase in the cover of bog clearweed (*Pilea fontana*), an annual herb with a C-value of 7, and a corresponding decrease in common invasive species like reed canary grass (*Phalaris arundinacea*) and creeping charlie (*Lysimachia nummularia*) in response to extended flooding appears to have boosted weighted mean C from 1.8 to 3.7 and led to a three tier increase in condition class. The significance of this increase is arguable, because while it is no doubt good that invasive species cover dropped in this wetland in 2019, it is likely that invasive species will readily recolonize. Further, despite a relatively high C-value of 7, *Pilea fontana* often grows just as well in high quality wetlands as it does in disturbed wetlands. It is not uncommon for *Pilea fontana* to grow right next to its cousin *Pilea pumila* which has a C-value of 3. While the numerical ranking of the wetland increased, it was largely due to the proliferation of a species with a dubiously high C-value and a temporary decrease in invasive species cover.

Hardwood swamps situated on seasonal or continuously-saturated seepage slopes (typically 0.5 – 2% grade) are the other type of forested wetland present. The only survey of this type was "New Survey #3" at Rock County Park. The upper half of this site appeared to be fed by a groundwater seepage while the lower half appeared subject to flooding. Overall change in the non-ash tree cover metric appears due to differences in swamp white oak (*Quercus bicolor*) estimation, possibly due to differing meander paths, along with shifts in the composition of the ground layer.

Emergent Wetlands (Floating sedge meadow / cattail marsh mats, Southern Sedge Meadow, Emergent marsh)

Emergent wetlands around Lake Koshkonong come in several forms and broadly fall under the guise of floodplain marshes, floating sedge & cattail mat, groundwater fed-marshes, sedge meadow, and ruderal fresh wet meadow.

Floodplain marshes were represented by sites "New Survey 1", "New Survey 2", 1-2, 2-3, 1-4, 3-12, 3-13, and 3-15. They tend to form on silt deposits and are subject to inundation. Where river bulrush (*Bolboschenous fluviatilis*), bur-reed (*Sparganium* sp.), and lake sedge (*Carex lacustris*) dominate the herbaceous layer, these emergent marshes retained an overall native-species dominated character. Several emergent marshes contained early-stage colonies of hybrid cattail (*Typha x glauca*) and had giant reed (*Glyceria maxima*) starting to invade. For these marshes to maintain their current cover of native species, landowners will need to employ active management techniques to kill the invasive plant populations.

Site 4-7 represents a floating sedge meadow and marsh. Unlike a floodplain marsh, these wetlands have a tendency to grow on a floating mat of organic soils, peat, and plant roots. This floating character is not a natural condition, but the result of the Indianford Dam. Prior to dam construction, this wetland likely had a gently sloping character that allowed groundwater to percolate through the sedge tussocks and soil until it reached the former marsh bottom. After Lake Koshkonong was created through impoundment, the outer edges of this mat would have floated up to the new water level. Over time, the combined physical and biological stress of floating, altered hydrology, flooding, and invasive species invasion has apparently caused many acres of floating mat to break up and dissolve, yielding shallow open water marsh in its place. From an ecological perspective, this shift from emergent floating mat to shallow open water marsh represents a significant degradation of the wetland community, however this shift has been occurring for many years and was not captured in our two vegetation surveys but is easily seen with aerial photography (see attachment #4). It is also impossible to say from the survey data whether any degradation was the result of higher baseline water levels or severe flood events. Regardless, we expect this trend of wetland shoreline erosion to continue in this marsh and likely in similar situations around Lake Koshkonong.

Site 4-4 is a groundwater-fed emergent marsh. Located outside of the normal floodplain (but not above extreme flood stage), this wetland is largely fed by abundant groundwater which allows for characteristic marsh species to grow in the absence of surface water inundation. The net effect is an emergent wetland with highly saturated, deep muck soils. The weighted mean C score at this site dropped from 5.8 to 4.3, mostly as a result of far less hard-stem bulrush (*Schoenoplectus acutus*) and sweet-flag (*Acorus americanus*) being recorded. It is unclear if this is the result of a slightly different area being surveyed or a shift in the larger community type composition.

Site 4-3 represented an emergent fresh wet meadow. This site has long been degraded due to stream channelization and historic attempts at cultivation. Reed canary grass dominated the vast majority of this site with the exception of relatively lower areas that partially drained along the former bed of Otter Creek where limited reestablishment of native species has taken place.

Site 3-15 represented a case of perceived community type shift from sedge meadow to emergent, a potential severe degradation according to criteria set prior to resurvey efforts (see attachment #2). This categorical shift of community types is problematic, however, as the community dominants of *Carex lacustris* and *Sparganium eurycarpum* remained the same, we are not considering this a "severe" shift in community type. The decrease of weighted mean C from 5.1 to 4.4 can be largely explained by a shift of estimated percent cover of *Sparganium eurycarpum* from 40% to 20%, and a relative doubling of the cover of invasive cattails (*Typha angustifolia* and *Typha* X *glauca*). This assessment area is undoubtedly in the process of degradation from the expansion of a strong invasive species like *Typha* X *glauca,* which expands clonally and outcompetes native vegetation for sunlight with tall leaves and thick residual litter layer. Rates of hybrid cattail invasion is likely accelerated by inputs of sediment and dissolved nutrients in floodwater.

New Survey #2 represented a potential case of mistaken relocation of the 9/15/2016 floodplain emergent marsh survey. Inspection of the original survey results suggests that it was conducted within a limited spatial area adjacent to a narrow peninsula of land that had likely been intentionally planted with a mix of native seeds. The 2019 survey was conducted in a larger area of natural, unplanted emergent marsh south of the peninsula and is bordered by submerged rip-rap and cobbles next to the lake in an apparent effort to stabilize shoreline erosion. Because of the spatial mismatch in survey areas and planted vs natural wetland community, the decrease in native species richness of the 2019 survey likely does not represent a valid comparison. Regardless, the 2019 survey found a floodplain marsh dominated by river bulrush (*Bolboschoenus fluviatilis*) and other native species. Small, incipient populations of hybrid cattail (*Typha* X *glauca*) represent a threat to this wetland if not controlled.

Shrub Wetlands

Only one shrub wetland was surveyed in 2019, site 4-2. Adjacent to site 4-3, this wetland was severely degraded due to historic land use, drainage, and nearby stream channelization. The shrub component largely consisted of sandbar willow (*Salix interior*), a weedy pioneer species of disturbance areas. There was minimal change in weighted mean C and little can be inferred from the 2019 repeat survey. It may be worth noting that Otter Creek was overflowing its banks in parts of this survey area and was at a slightly lower elevation than 4-3, which would make it more prone to flooding.

Conclusions

At this time, we do not feel confident that any individual site survey in 2019 would qualify as a "severe" degradation. There were multiple wetland communities that nonetheless exhibited concerning signs of significant degradation and large shifts in community quality and composition. While site 3.15 did have two criteria meeting a "severe" degradation limit (as defined in the degradation assessment criteria tables dated 4/23/2019; see attachments), we feel the shift in community type is more the result of a discrepancy in categorical definition of wetland types than a "severe" shift in wetland quality. The differences between an emergent marsh and a sedge meadow were not clearly defined prior to this study and occupy a compositional spectrum that intergrade and can be difficult to differentiate – often being left to professional opinion between different wetland ecologists. Therefore, we are recommending a slight shift in the assessment criteria tables: we propose changing the first criteria to read "structural wetland type" instead of "community type". With this slight change, a community would qualify for the "severe" degradation limit if it shifted from forested to non-forested, herbaceous to open water, etc. We feel that a true degradation from a southern sedge meadow or high to moderate quality emergent marsh to an invasive-dominated emergent marsh will meet at least two of the remaining metrics and will be accurately captured as a severe degradation.

This activity has also called out holes in our methodology such as identifying likely degradations such as those occurring at site 4-7, where the boundary of persistent emergent wetland vegetation is retreating and leaving open water in its wake. In subsequent samplings, we propose looking into the ability to utilize some aerial photography analysis or on-the-ground methods to measure the loss of vegetated area of this site (and other similar sites) into open water.

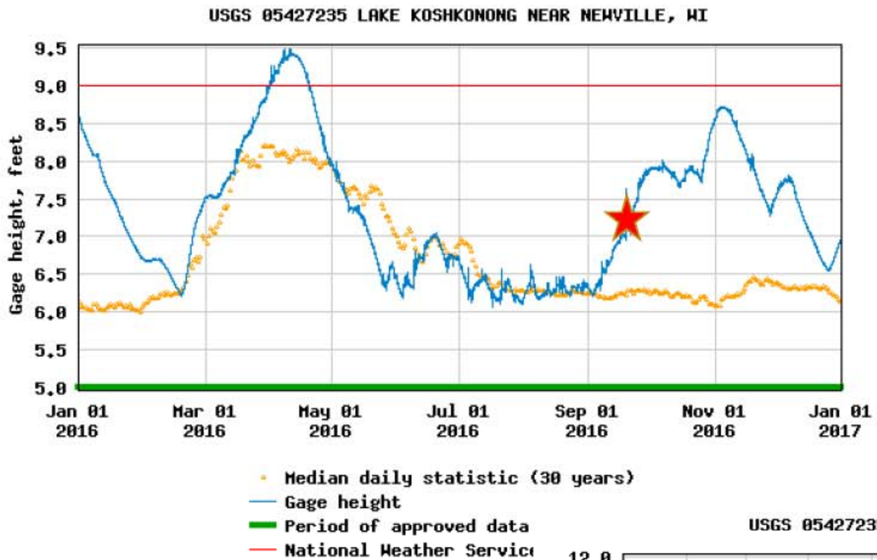
Attachments:

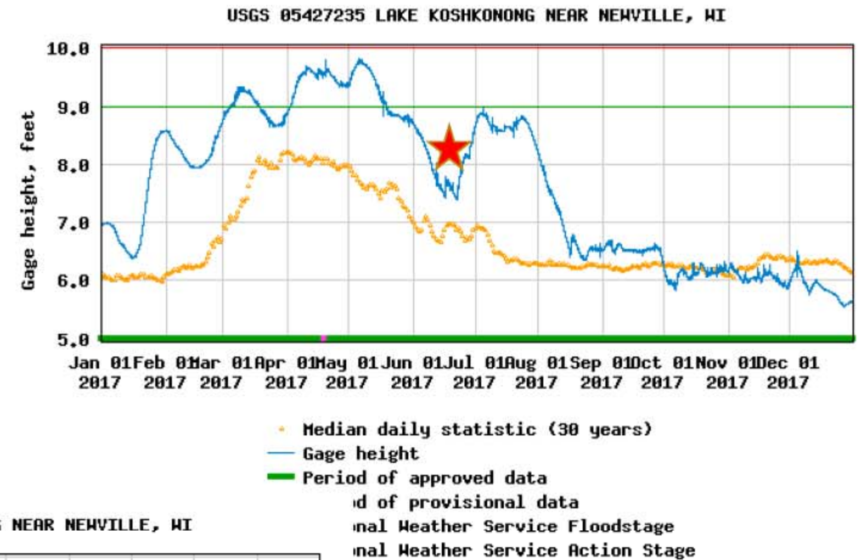
1) Baseline years (2016, 2017) and 2019 hydrographs
2) "Severe" degradation assessment criteria
3) Data summaries from "Baseline" assessments (2016/2017) to 2019
4) Historic time series of site 4-7

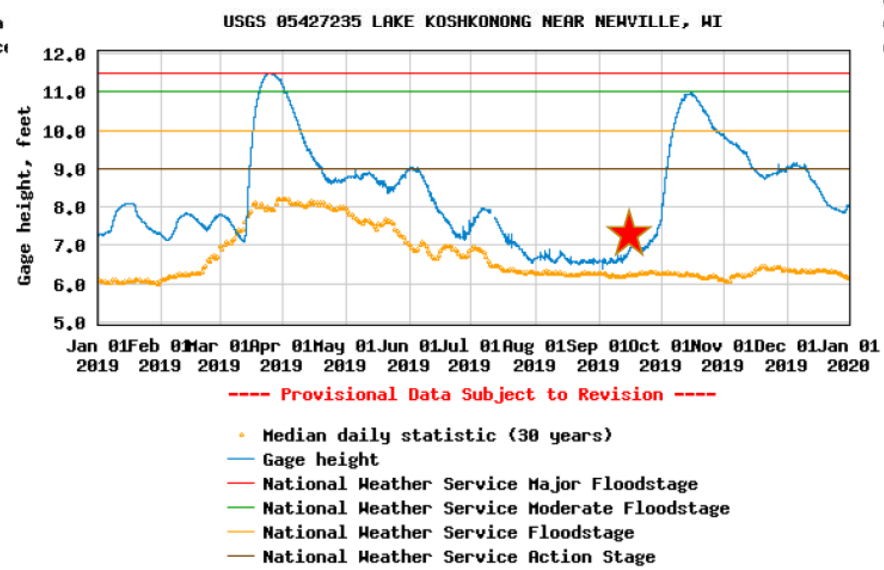
Hydrographs from 2016, 2017, and 2019 based on USGS data from the Newville Station

Red star indicates approximate timing of vegetative sampling completed during that year.

Note that y-axis is not the same across years.







Lake Koshkonong Wetlands Quality Assessment 4/23/2019

- Methodology
  - Timed Meander Survey in ~ 17 sites (pending landowner permission)
  - Biennial survey to compare to "baseline" data from 2016-2017
  - Assess current vegetative condition and any changes from "baseline"

Table 1. How to determine if the Lake Koshkonong Wetlands have experienced a "severe" degradation		
	2-year change: Each sample area must experience 2 of the following criteria to be deemed "severe"	**10-year change: Each sample area must experience 3 of the following criteria to be deemed "severe"**
Wetland Type**	Reduction in type of wetland (e.g. sedge meadow converted to an herbaceous marsh)	Reduction in type of wetland (e.g. sedge meadow converted to an herbaceous marsh)
Relative Cover of Invasive Species	25% increase	25% increase
Weighted Mean C	2 "tier" drop according to Table 2 below	2 "tier" drop according to Table 2 below
Native Species Richness	20% decrease	20% decrease
Living Non-Ash Tree Percent Cover	25% decrease	25% decrease
**Have to be cognizant of the timing of sampling and current water levels. Monitoring in early spring may result in a mis-identification of the wetland type (e.g. a sedge meadow is flooded out and/or vegetation has not had a chance to leaf out).		

Table 2. Floristic Quality Assessment benchmarks using cover-weighted Mean Coefficient of Conservatism scores for SE Wisc. Till Plains Ecoregion					
	Least Disturbed			**Most Disturbed**	
Plant Community	**Tier 1 "Excellent"**	**Tier 2 "Good"**	**Tier 3 "Fair"**	**Tier 4 "Poor"**	**Tier 5 "Very Poor"**
Calcareous Fen	> 7.0	6.2 - 7.0	3.6 - 6.1	2.2 - 3.5	< 2.2
Emergent Marsh	> 5.7	4.1 - 5.7	2.1 - 4.0	1.0 - 2.0	< 1.0
Floodplain Forest	> 4.0	3.4 - 4.0	2.3 - 3.3	2.2	< 2.2
Northern Hardwood Swamp	> 6.2	5.4 - 6.2	3.6 - 5.3	3.4 - 3.5	< 3.4
Northern Wet Mesic Forest	> 6.5	6.5	5.8 - 6.4	5.3 - 5.7	< 5.3
Shrub Carr	> 5.1	4.7 - 5.1	3.2 - 4.6	2.3 - 3.1	< 2.3
Southern Hardwood Swamp	> 4.7	4.0 - 4.7	2.9 - 3.9	2.0 - 2.8	< 2.0
Southern Sedge Meadow	> 6.3	5.6 - 6.3	3.8 - 5.5	1.0 - 3.7	< 1.0
Wet-Mesic Prairie	> 5.5	4.6 - 5.5	3.1 - 4.5	1.9 - 3.0	< 1.9

- If severe degradation is observed, DNR will first investigate external land use causes.
- **2-year Assessment**: If any wetland assessment areas meet the "severe" criteria listed above over any given 2-year period, then the wetland team will look to identify any localized land use changes that may have resulted in the wetland degradation unrelated to the water level increase. If no external impacts can be identified, the DNR will make a determination regarding the water level order.
- **10-year Assessment**: If any wetland assessment areas meet the "severe" criteria listed above over any given 10-year period, then the wetland team will look to identify any localized land use changes that may have resulted in the wetland degradation unrelated to the water level increase. If no external impacts can be identified, the DNR will make a determination regarding the water level order.

Summary of results from "Baseline" and 2019 Sampling of Lake Koshkonong wetlands

Preliminary assessment of Lake Koshkonong wetland water quality from 2016/17 "Baseline" suvey to the first sampling year of 2019.

Site Name	Baseline Community Type	Wetland Type Change	Relative Cover Invasive Species (>25% increase)	FQA condition (2 tier drop)	Native Species Richness (>20% decrease)	Non-Ash Tree Percent Cover (>25% decrease)
1.2	Emergent Marsh	No change	2% decrease	Up 1 tier	50% increase	1% increase
1.3	Floodplain Forest	No change	10% decrease	No change	38% increase	12% decrease
1.4	Emergent Marsh	No change	3% decrease	No change	45% increase	No change
3.8	Floodplain Forest	No change	28% decrease	Up 3 tiers	17% increase	2% increase
3.12	Emergent Marsh	No change	2% increase	No change	25% decrease	No change
3.13	Emergent Marsh	No change	2% decrease	Up 1 tier	22% increase	No change
3.15	Sedge Meadow	Degraded*	11% increase	Down 1 tier	36% decrease	1% increase
4.2	Shrub Carr	No change	6% increase	No change	17% increase	8% decrease
4.3	Sedge Meadow	No change	12% increase	Down 1 tier	No change	7% decrease
4.4	Emergent Marsh	No change	No change	Down 1 tier	6% increase	1% increase
4.7	Emergent Marsh	No change	8% decrease	Up 1 tier	45% increase	No change
New Site #1	Floodplain Forest	No change	6% decrease	Up 1 tier	26% increase	8% decrease
New Site #2	Emergent Marsh	No change	7% decrease	No change	53% decrease**	6% decrease
New Site #3	Floodplain Forest	No change	4% increase	No change	40% increase	22% decrease

Notes:

The above table shows negative trends only. Orange boxes indicate negative trends that did not hit the "Severe" tresholds we set in Table 1. Red boxes indicate "Severe" changes as we established in Table 1.

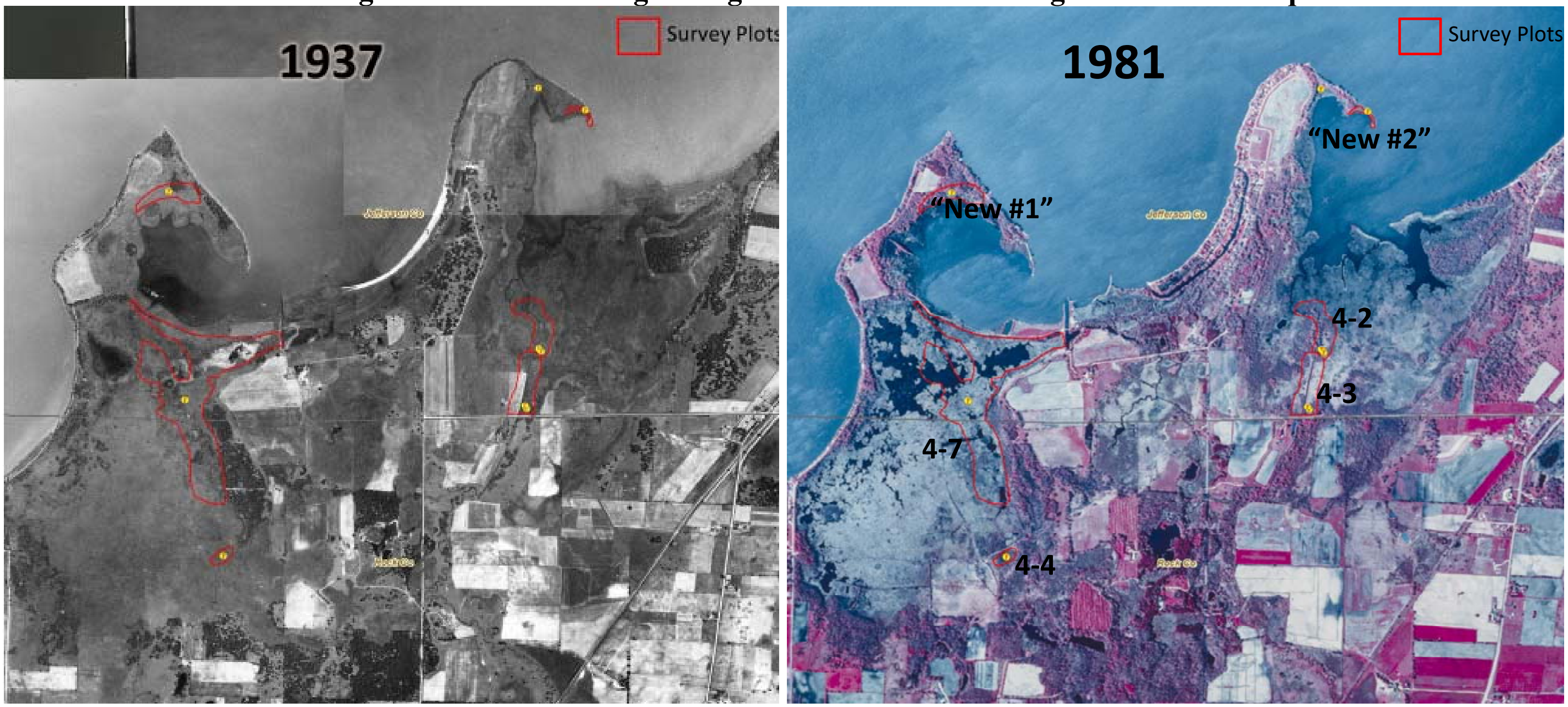
* While the plant community at site 3.15 did experience a change from southern sedge meadow to emergent marsh, the ecologists noted many similar dominant species. This has called our attention to a possible issue with Table 1 (how to assess severe changes). At this time, we feel this community would not be deemed a severe change but it is exhibiting a concerning trend and should be watched closely in the next round of surveys.

** A vastly different portion of the marsh at site #2 was measured in 2019 than when the baseline was surveyed - this may be leading to such a drastic difference in native species richness.

In general, 2019 was an incredibly wet year with sustained high water levels in the spring which likely negatively impacted wetland plant establishment.

Some wetland survey points were not resampled due to lack of landowner permissions.

Historic time series showing conversion of emergent vegetation to shallow emergent marsh and aquatic bed



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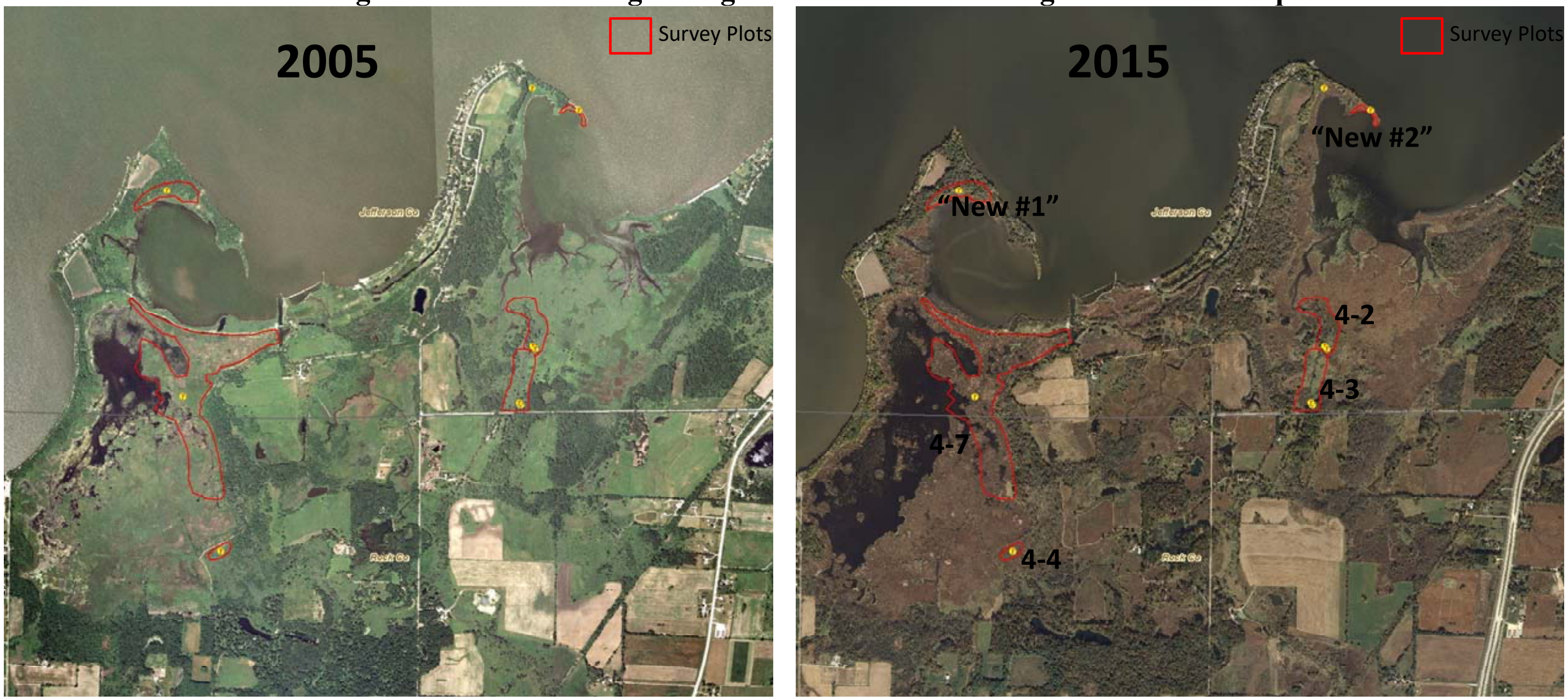

Historic time series showing conversion of emergent vegetation to shallow emergent marsh and aquatic bed