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MEMORANDUM

Date: March 13, 2017 (via e-mail)

To: Barb Agnew, Environmental Impact Assessment Committee for the Northeast Quadrant of the County Grounds

From: Gary S. Casper, Ph.D.

Subject: Potential environmental impacts from the proposed development of "Sanctuary Woods" as part of the Wauwatosa Life Sciences District

RE: This memorandum was prepared for the Milwaukee County Board of Supervisors, as requested in Board Resolution 16-532, to assist with assessing potential wildlife habitat and population impacts of the proposed development of "Sanctuary Woods" as part of the Wauwatosa Life Sciences District (per the "Wauwatosa Life Sciences District: 2016 Master Plan", January 12, 2017 DRAFT).

Figure 1: Proposed development in the Sanctuary Woods area of the Milwaukee County Grounds. (Source: Wauwatosa Life Sciences District: 2016 Master Plan (January 12, 2017 DRAFT)

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Potential Environmental Impacts from the Proposed Development of “Sanctuary Woods” as part of the Wauwatosa Life Sciences District

Executive Summary

This memorandum provides recommendations for performing a professional assessment of potential impacts to wildlife populations and habitats when considering any proposed developments in the Milwaukee County Grounds area, including Sanctuary Woods. In this region wildlife populations and habitats have been designated as federally "impaired" by the Milwaukee Estuary Area of Concern (MEAOC) program. The area supports protected species and their habitats. The MEAOC program may provide funding to address these impairments in the future, which could contribute to the development of the envisioned "Life Sciences District". The methods outlined here provide a means to discover what impacts might occur, how to address mitigation, and how to credibly balance ecological with social goals. Shortcomings of the existing approach are addressed, and improved methods provided with examples. In addition, a rich trove of data, collected and vetted over the past three years by the Great Lakes program of the U.S. Environmental Protection Agency, is mined to provide the empirical evidence needed to properly assess environmental impacts to wildlife species and their habitats. Rare species and habitats present are reviewed. The availability of these data and methods provide a unique opportunity for planning to proceed with confidence in outcomes.

Southern Flying Squirrel, a rare species in the region selected for conservation action.

1. Introduction

To assist with assessing potential wildlife habitat and population impacts from the proposed development of “Sanctuary Woods” (per the “Wauwatosa Life Sciences District: 2016 Master Plan”, January 12, 2017 DRAFT), conservation assessment methods developed for the Milwaukee Estuary Area of Concern, and Ozaukee County Planning and Parks, were applied. Since this is only a memorandum, not a fully developed professional assessment, the focus is on appropriate methods, while providing available data for the project site that has been collected by other studies to date. As will be shown, ecological assessments must be performed within the context of their surrounding landscape.

The proposed development footprint (Figure 1) can be fitted to a landscape scale shown in Figure 2. Habitat supports wildlife populations irrespective of parcel ownership, based on existing conditions. The methods and data provided below are intended to begin the process of open discussion on preserving or enhancing these natural resources (species habitat and populations), by understanding what species can be supported on the overall landscape, then drilling down to how changes within any particular parcel might affect overall habitat suitability. This process also allows for open acknowledgement of which natural resources will not be preserved. Because of the complexity of predicting impacts of development to wildlife populations, open acknowledgement of an inability to support species is not common. However, planners must be very careful not to overstate benefits by inappropriately ignoring probable impacts, or by making overbroad claims that resources are being preserved when cumulative or indirect impacts indicate otherwise. For example, preserving part of an old growth forest may avoid cutting down a particular grove, but if the overall extent of the forest is reduced, edge effect will change the character and microclimate of the forest, and many wildflowers, birds, insects, mammals, and amphibians are likely to disappear, and this must be openly acknowledged by planners to maintain public trust and confidence. Assessment of what wildlife species are likely to be or not be preserved is possible by coupling well known ecological processes with species natural history and habitat requirements. This allows the community to balance natural resource preservation against potentially conflicting social objectives in an open and informed manner. It is fairly easy to ask the community to accept that children will not be able to see ducks or frogs when a wetland is proposed to be filled, but the public often does not intuitively realize that butterflies or meadowlarks will disappear if those species particular habitats are not preserved. These more subtle effects can be discovered and communicated by our methodology, leading to more informed decision making, thereby avoiding a replay of the Tragedy of the Commons. It is often fairly easy to balance social and biological objectives in planning to achieve good outcomes for the health and well being of the community, but only if thorough background research is performed and professional ecological standards applied.

Figure 2: Green space represents approximate existing wildlife habitat. (Source: Wauwatosa Life Sciences District: 2016 Master Plan (January 12, 2017 DRAFT)

1.1 Avoiding Common Pitfalls

--don't paint your cabinets before you know what color your walls will be--

A common deficiency in conservation planning is to limit the spatial scope of assessment, usually to a political boundary. This is particularly problematic when assessing mobile natural resources such as most animal life. By avoiding such spatial limits, potential impacts to animals whose home ranges and life cycles extend beyond the project boundaries can be discovered and addressed, and should be a component of planning. Often a project boundary is only a part of a critical habitat component for a wildlife population, and rare species can disappear regionally simply because they were not addressed in local planning, and "piecemealed to death." Spatially limited assessments can even be considered invalid by the normal standards and practices of the conservation biology profession. Imagine asking an auto mechanic to perform a safety check, but to limit the check to only the rear drive train. Would the car be considered safe?

A second common mistake is to assume that plant community assessments address animal community needs. There is often poor correlation or spatial overlap between critical habitat needs for plants vs. animals. For example, in a recent assessment for Ozaukee County, we found that combining the Natural Areas, Critical Species Habitat, and Critical Aquatic Habitat layers from regional planning, which are based mostly on plant community assessments (Southeastern Wisconsin Regional Planning Commission 1997, 2010), accounted for only 12% of the rare wildlife occurrences in the county (Struck et al. 2015). This obviously has implications for conservation planning, and planners must recognize that preserving viable wildlife populations requires a more comprehensive approach. Similar discordance is expected in Milwaukee County, where more than 40% of the biodiversity in the county has already been lost (Casper 2008, Leitner et al. 2008).

Finally, a third pervasive problem is the typically poor data coverage and quality available for assessing wildlife. For example, many regulatory reviews restrict data searches to one source — the Natural Heritage Inventory (NHI) database managed by the Wisconsin DNR. Like any single source, this database is incomplete, and requires expert vetting to address Type I and Type II errors. Moreover, its conservation ranking system is performed at a statewide scale, which is poorly suited to understanding conservation issues at regional, county, or local scales. Planners should understand that as a database developed primarily for regulatory review, the use of the NHI for conservation planning is predictably limited, and that these two objectives (regulatory review vs. conservation planning) are not mutually exclusive nor inclusive. For example, in Ozaukee County, 55% of species considered to be of county-scale conservation concern are not state listed (Struck et al. 2015). This difference is only slightly less when considering Species of Greatest Conservation Need in the State Wildlife Action Plan (58%; Struck et al. 2015). Moreover, critical habitat needs for wildlife species are often poorly known, requiring extensive literature searches and expert advice to properly address. Imagine an engineer tasked to design a safe bridge, but who lacks knowledge of what the span length should be, the tensile strength of the materials to be used, and how materials will degrade with freeze-thaw cycles. That is the level of baseline knowledge deficiency a conservation biologist must often deal with, researching these issues case by case to perform due diligence.

Most often lack of attention to these issues is simply the result of planning teams not having conservation biologists on staff, and having limited access to sound advice and data. Principled planning avoids these mistakes by taking a measured, open, and comprehensive approach, with expert advice input where needed. In the current context, the Master Plan has identified preservation and enhancement of environmental resources as a high priority, describing a large environmental area as comprising the most critical district in the Plan. This objective requires that a spatially broad review encompasses the full

habitat needs for supporting viable wildlife populations. To do anything less would ignore fundamental principles of population biology and ecology, and result in wasted effort and expense preserving portions of habitat that may not actually support the species intended to live there.

1.2 Assessment Approach

The Milwaukee County Grounds contains several verified populations of sensitive wildlife species as well as critical species habitat features. The habitat proposed to be impacted by the proposed construction (Figure 1) falls within the federally designated Milwaukee Estuary Area of Concern (AOC; see http://dnr.wi.gov/topic/greatlakes/milwaukee.html and https://www.epa.gov/milwaukee-estuary-aoc). For this memorandum, data and products under development for the Milwaukee Estuary AOC were utilized, which identified Beneficial Use Impairments (BUI) of loss and degradation of fish and wildlife habitat and populations. In order to address the federal delisting of these BUIs, the Milwaukee County Department of Parks, Recreation & Culture (DPRC) and University of Wisconsin-Milwaukee Field Station (UWMFS) have collected baseline data on historical and existing wildlife populations and habitat conditions throughout the AOC, and, in cooperation with the Fish and Wildlife Technical Team for the AOC (administered by the Wisconsin DNR Great Lakes Office), have identified Species of Local Conservation Interest (SLCI) that are considered to be impaired and may be eligible for recovery actions. On the Milwaukee County Grounds critical species habitats have been confirmed within the proposed development site, including snake denning areas, grassland nesting bird habitat, forested avian roosting and foraging habitat, migratory stopover habitat, and ephemeral wetlands. Additionally, state-listed species and Species of Local Conservation Interest have been confirmed on the site and are described below. Preservation of these key resources should be of high priority. Impacts to these species and their associated habitats can be evaluated following a "first do no harm" principle, which first avoids impacts through plan modifications, and then mitigates any necessary impacts based on critical habitat needs of the affected species.

The ongoing Milwaukee Estuary AOC study addresses fish and wildlife habitat and population impairments by collecting and vetting wildlife occurrence data, and developing species checklists that identify which species are of conservation concern. Then the spatial extent of these species' existing habitats can be assessed with an eye towards better defining the impairments, and recommending how and where these impairments can be remediated through habitat and population projects, ultimately leading to delisting of the BUIs. The AOC team therefore has acquired comprehensive knowledge of species and habitats that could be addressed in planning for the Milwaukee County Grounds, including that area commonly referred to as Sanctuary Woods.

It is important to understand that this memorandum is not a comprehensive study such as would normally be included in a Master Plan, but merely guidance on issues that should be addressed in conservation planning. Each issue will likely need further research and development to inform planning specifications in detail. Moreover, the Milwaukee Estuary AOC study assessments are limited to the following species groups: all vertebrates, dragonflies and damselflies, primary burrowing crayfish, and mussels. Two additional species groups which should be assessed are mentioned below (butterflies and moths, and pollinators), as well as two physical environmental issues particular germane to urban planning (noise and light pollution), and some unique habitat issues. Notably, this memo does not address plant communities, for which use of SEWRPC data is recommended.

Finally, any comprehensive plan should give attention to the social health and well being of its residents, including the benefits to be derived from integrating green space and functional natural communities into neighborhoods, in a manner where both children and adults can reap the benefits. Something as simple as children having the ability to catch frogs, or adults observing colorful birds nesting, in their neighborhood rather than miles away in preserves they rarely visit, has substantial benefits to health and well being, making communities attractive and vibrant. The benefits of interacting with nature are well documented

and experts in this subject area can be engaged (e.g., Louv 2005). Without explicit and comprehensive planning, most communities will lose these benefits by passively allowing the "Tragedy of the Commons" to proceed (see https://en.wikipedia.org/wiki/Tragedy_of_the_commons).

1.3 Assessment Conceptual Framework

The conceptual framework for the Milwaukee Estuary AOC study addresses the problem of beneficial use impairments by recognizing how natural resources and their recovery potential are constrained. This framework is useful for any conservation planning. Two sets of constraints apply to any successful wildlife conservation program, a paradigm developed by Dodd and Seigel (Dodd and Seigel 1991, Seigel and Dodd 2000, Dodd 2001).

> *Biological Constraints* are the immutable requirements for a species survival imposed by its adaptation to the environment over long evolutionary periods (thousands to millions of years). These include food preferences, dietary needs, specific habitat requirements, social behaviors, environmental tolerance limits (i.e., temperature), predator tolerance, life table parameters, and more. If a species requires a certain type and amount of habitat to support a viable population, or a specific diet, no amount of human desire will change those requirements. We cannot simply tell the eagle to eat wheat, or the fish to live on land.
>
> *Social Constraints* describe the limits within which human activities are able to perform. These constraints include finances, manpower, public support, political support, habitat availability, logistics, and many other factors associated with implementing conservation programs. While important, these constraints are usually flexible, sometimes wildly so based on human desire to prioritize resources. They are always more flexible than the *Biological Constraints.*
>
> If the *Biological Constraints* are breached, then regardless of our best intentions the conservation program will fail. These constraints are not “negotiable”, being set by evolution and the physical limits of the species. Moreover, if the *Social Constraints* are inadequate, or are used to override or compromise the *Biological Constraints*, then the program will fail, no matter how noble the intentions of the human participants.

Recognizing these basic constraints is vitally important to successful wildlife conservation, yet they are easily lost when forced to make decisions in the imperfect real world. The ability to recognize where these constraints cannot be met is just as important as the ability to adhere to them when they can be met, in order to direct scarce resources to successful projects. Conservation biologists must often make informed decisions on the limits of the *Biological Constraints* where they are not known with firm certainty. This is common with rare species where life history tables have not been developed and funding for basic research is scarce for delineating parameters such as minimum viable population size or critical habitat needs. This makes work challenging for gaining public acceptance when conservative plans must be implemented despite a lack of comprehensive data. For this reason, many conservation plans rely upon surrogates, and umbrella or focal species concepts, for achieving and communicating the *Biological Constraints* to conservation for poorly studied species. Focal species concepts are being utilized in the Milwaukee Estuary AOC study, and methods and definitions are available.

2. Potential Impact Assessment

2.1 Species of Local Conservation Interest (SLCI)

This local conservation ranking system developed for the Milwaukee Estuary AOC study identifies species that meet criteria for Species of Local Conservation Interest (SLCI), which are recommended for attention in local conservation planning. The lists were developed initially from a review of species occurrence and status information, then vetted by local and regional species experts. As noted above, this is necessary because conservation planning on this geographic scale is not well served by using statewide conservation ranks. SLCI are species that are at least one of the following: a) listed as either state or federally Endangered, Threatened, or Special Concern; b) listed as Species of Greatest Conservation Need in the State Wildlife Action Plan; c) considered to be locally rare or declining (by regional species expert groups and this status supported by the available empirical data); or d) are of social value to stakeholders and considered to be desirable to the community.

For the Milwaukee County Grounds, the following species have been defined as SLCI (note this list will be reviewed again in late 2017) and are known to occur, or have the potential to occur with reasonable habitat restoration (* = species with reliable recent records). For the purpose of this memorandum, the extent of the area considered in this context is roughly that shown in Figure 2 above. While SLCI for this area are called out below, the full Species Checklists for the Milwaukee Estuary AOC study list every species known for each group, along with their status rankings and critical habitat requirements, and are used to select Focal Species. These checklists are currently in draft form and circulating among stakeholders and experts, and will be updated at the end of this year. They provides a more comprehensive understanding of full suites of species that are associated with habitat types that may be part of a particular project. Note that the proposed project will affect several habitat types, which these species depend upon to varying extents. The habitats impacted include grassland, shrub, forest edge, mature closed canopy hardwood forest, and several wetland types. All habitats are in varying existing states of degradation, but nevertheless currently support, or are likely to support with appropriate management, the following SLCI.

Mammals:

American Mink, Big Brown Bat, Common Gray Fox, Coyote*, Eastern Fox Squirrel, Eastern Red Bat, Ermine, Hoary Bat, Least Weasel, Little Brown Bat, Northern Long-eared Bat, Silver-haired Bat, and Southern Flying Squirrel*.

Breeding Birds:

American Redstart*, Bobolink*, Brown Thrasher, Chimney Swift*, Common Nighthawk, Dickcissel*, Eastern Meadowlark*, Field Sparrow*, Grasshopper Sparrow, Great Blue Heron*, Henslow's Sparrow* (2012, not since), Least Flycatcher* (2012, not since), Long-eared Owl* (wintering), Peregrine Falcon*, Sora*, Virginia Rail, Willow Flycatcher*, Wood Thrush*, and Yellow-billed Cuckoo.

Amphibians & Reptiles:

Blue-spotted Salamander, Boreal Chorus Frog, Butler’s Gartersnake *, Central Newt , Common Gartersnake*, Eastern Milksnake*, Eastern Tiger Salamander, Gray Treefrog*, Green Frog*, Midland Brownsnake*, Northern Leopard Frog*, Spring Peeper, and Wood Frog.

Fishes:

Not applicable unless in-stream Menomonee River is considered in planning.

Dragonflies & Damselflies:

During the course of this study, it became clear that SLCI cannot be designated for this group, owing to a lack of status information. We found many species considered to be new and rare in the AOC, reflecting a lack of prior survey effort. Therefore, the AOC study will be publishing a list of known species for the region, which can be used for future assessments of how species occurrence might change. Meanwhile, odonate critical habitat needs, while varied, can be addressed on a species group basis. We have to date documented the following species at Milwaukee County Grounds: Autumn Meadowhawk, Band-Winged Meadowhawk, Black Saddlebags, Blue Dasher, Calico Pennant, Common Baskettail, Common Green Darner, Dot-Tailed Whiteface, Eastern Forktail, Eastern Pondhawk, Familiar Bluet, Marsh Bluet, Northern Spreadwing, Ruby Meadowhawk, Sweetflag Spreadwing, Tule Bluet, Twelve-Spotted Skimmer, Wandering Glider, White-Faced Meadowhawk, and Widow Skimmer.

Primary Burrowing Crayfish:

Prairie Crayfish

Mussels:

Not applicable unless in-stream Menomonee River is considered in planning.

2.2 Cumulative and Off-site Impacts

The concepts of home range, habitat patch size, habitat fragmentation, and habitat connectivity are recommended to be addressed. As shown in Figure 2, habitats are currently fairly well connected, but some disconnections could be addressed, and further fragmentation should be avoided. It should be recognized that impacts to any part of an animal's home range will affect the entire population, which often ranges beyond project boundaries. To illustrate, the Southern Flying Squirrel is a SLCI, with one of four known populations in the AOC present at Milwaukee County Grounds. Individuals have been observed and photographed at Milwaukee County Grounds, but the mature forest patches with mast trees which they depend upon as critical habitat (including Sanctuary Woods) are fragmented, and squirrels must move from one to the other across hostile terrain where they are more exposed to predators (e.g., crossing Swan Blvd., or open grassland areas). Therefore, a reduction in the size of Sanctuary Woods, or further compromising its connectivity to other forested areas, would have a cumulative, and off-site impact, to the entire squirrel population including future generations. Conversely, planting forested corridors that connect two forest patches would be beneficial to these squirrels. Some planners in the tropics have even provided aerial bridges over roadways to allow for safe road crossings for arboreal species (e.g., monkeys, tree squirrels).

This example illustrates how many species can be indirectly impacted by habitat changes. Each species has unique requirements and capabilities for habitat connectivity and movement capacity (e.g., salamanders have trouble crossing roads, birds do not), habitat patch size requirements (e.g., Wood Thrush needs a larger patch of woods than Gray Treefrog), and particular critical habitat components (e.g., treefrogs must have a breeding pond, snakes a winter denning site, many insects require a particular species of nectar or larval food plant). These particular requirements and impacts should be evaluated for each SCLI expected to be impacted to find a least harm alternative, and to select remediation choices that benefit the most species.

2.3 Mammals

Several mammal SLCI have been confirmed, including Coyote and Southern Flying Squirrel. The Southern Flying Squirrel requires mature forest with mast bearing trees, and will be impacted by any reduction in mature forest canopy or mast bearing trees. New roadways would also increase mortality for both species. Light pollution remediation is a concern for the nocturnal squirrels, as well as for bats.

The Milwaukee Estuary AOC study has collected bat data and found bat activity levels to be quite high during the maternity season, especially around the ponds and along forest edges. Some bat species require tree cavities and loose bark retreats under closed canopy foliage for raising young, conditions typical of mature hardwood forest such as Sanctuary Woods. Acoustic bat data collected are currently being analyzed for species identifications at the University of Illinois, which should yield a preliminary species list later this year. Most bat species in Wisconsin are Threatened or Special Concern, and one is federally listed as well (Northern Long-eared Bat, which should be present at Milwaukee County Grounds only in migration). At this time we can say that bat activity is high in this area making bat conservation a high priority, and that Sanctuary Woods and wetlands are critical habitats. The area is similarly important as migration habitat for bats in spring and fall. Bats also provide considerable social value in the enormous number of insects they consume.

2.4 Breeding Birds

The Milwaukee County Grounds contains approximately 50 acres of grassland habitat, intermixed with pockets of shrubland and transitional plant communities adjacent to the woodlands located within the southeastern section. Grassland ecosystems are extremely rare and often degraded within urban areas such as Milwaukee County because they are frequently developed and/or fragmented. According to the United States Fish and Wildlife Service, results from the national Breeding Bird Survey indicate that grassland bird populations are declining at a faster rate than any other group of North American birds. Recent survey data collected by the DPRC and UWMFS, as well as by other local experts, confirm the presence of several grassland bird species utilizing the grassland habitat during their breeding season including Boblink, Dickcissel, Field Sparrow, Eastern Meadowlark, and Vesper Sparrow. Each of these species are SLCI and are listed as Species of Greatest Conservation Need in the Wisconsin Wildlife Action Plan (WDNR). Additionally, historical records harvested from eBird and miscellaneous observations by UWMFS surveyors also indicate that other grassland dependent bird species may have recently attempted to breed on site, including the State Threatened Henslow's Sparrow, Grasshopper Sparrow, and Special Concern Dickcissel. Marsh associated SLCI are also present (Sora Rail, Virginia Rail).

In order to conserve the unique breeding bird populations and critical grassland habitat within the site, any form of fragmentation, or infrastructural projects leading to increased mortality (vehicle collisions, increased predator activity along roads) should be carefully assessed and avoided if possible. Most species have minimum area requirements, below which breeding success is compromised. Light and noise pollution remediation should also be addressed, as well as habitat quality management. While specific proposals are beyond the scope of this memorandum, control of invasive species, and establishment of more native and diverse plant communities, would enhance breeding bird habitat with increased food, shelter, and protection from predators. For ground nesting birds, strict enforcement of dog leash laws would also prove beneficial. Breeding birds are very popular with the public and therefore have significant social and human health value as well. A full list of grassland associated species (not restricted to SLCI) can be gleaned from the Species Checklists for benefit analyses of any proposed habitat projects.

2.5 Amphibians & Reptiles

The Milwaukee County Grounds currently supports four snake species qualifying as SLCI: Butler's Gartersnake, Common Gartersnake, Eastern Milksnake, and DeKay's Brownsnake. The Butler's Gartersnake is also a state listed Special Concern species in Wisconsin and a Species of Greatest Conservation Need in the State Wildlife Action Plan. Butler's Gartersnake has been the focus of a long-term population recovery effort conducted by Dr. Gary S. Casper (UWMFS) and the Milwaukee Metropolitan Sewage District. Significant public funding and resources have gone into salvaging snakes prior to construction of the retention basins, and habitat management and monitoring of snakes to ensure recovery, since 2007. The area proposed for a new roadway has been verified to contain habitat features that are critical to this and other snake species survival within the site, including breeding habitat and snake denning areas. While snake dens can be recreated elsewhere, this is expensive, success is not

guaranteed, and in this case dens are multi-generational with adults marking pathways to the dens with pheromones so that naive young snakes can find these traditional den sites. Mating also occurs when snakes are congregated at the dens, and has been witnessed by Dr. Casper and his assistants on several occasions at the site proposed for a new road. Relocating adults typically results in high mortality as they inevitably attempt to find their familiar traditional areas. Therefore, preference should be given to preserving existing denning areas, as the resources required to create new snake denning areas and monitor their effectiveness can often exceed the benefits, particularly when suitable denning areas are already present. Maintaining habitat connectivity between the dens and the grassland and detention basin wetland habitats is also critical. Currently, the proposed roadway locations would directly destroy dens, and would constitute new barriers to movement, both of which would likely to result in severe mortality and a population crash.

Historical and recent survey data collected by the DPRC and UWMFS also confirm the presence of Northern Leopard Frog, Green Frog, and Gray Treefrog within the project area, all currently ranked as SLCI. These same studies confirm that all salamander species, also SLCI, are now extirpated from this area, but potential exists to repatriate them. Historical records demonstrate that they were formerly present. Partners in Amphibian and Reptile Conservation (PARC) describe roads as having the potential to substantially impact the viability of many amphibian and reptile populations due to increased mortality and habitat fragmentation, and the Milwaukee Estuary AOC study identifies habitat fragmentation and road mortality as major impairments throughout the AOC and at County Grounds. PARC recommends that road placement should take into account the locations of sensitive habitats, such as ephemeral wetlands and denning areas, and avoid them. Minimizing habitat loss and avoiding new roads into existing habitat areas is expected to be a key element recommended for achieving delisting of BUIs in the AOC, including at the County Grounds. In particular, destruction of existing critical habitat components supporting SLCI, such as snake dens, would be viewed as counter-productive without effective remediation achieved, and in this case, as devaluing public investment expended since 2007 to recover this particular snake population.

A number of habitat and population enhancements for amphibians and reptiles could be considered at the County Grounds and Sanctuary Woods. While detailed proposals are beyond the scope of this memo, chief among these actions would be the creation of more suitable breeding ponds, protected from roadway runoff (including salt). If achieved, such ponds could enable the repatriation of salamanders in this area, as well as additional frog species. This would have a cascading ecological effect, providing for more dragonfly, snake, mammal, and bird habitat as well. A full list of wetland associated species (not restricted to SLCI) can be gleaned from the Species Checklists for benefit analyses of any proposed habitat projects. Moreover, ponds are highly suitable to enabling public nature observation and immersion, thereby providing social and recreational benefits as well.

2.6 Dragonflies & Damselflies

Surveys by the UWMFS have identified 20 species to date at the Milwaukee County Grounds: Autumn Meadowhawk, Band-Winged Meadowhawk, Black Saddlebags, Blue Dasher, Calico Pennant, Common Baskettail, Common Green Darner, Dot-Tailed Whiteface, Eastern Forktail, Eastern Pondhawk, Familiar Bluet, Marsh Bluet, Northern Spreadwing, Ruby Meadowhawk, Sweetflag Spreadwing, Tule Bluet, Twelve-Spotted Skimmer, Wandering Glider, White-Faced Meadowhawk, and Widow Skimmer. These species forage over wetlands, grasslands and forest edges, and are important components of the ecosystem both as foragers on other insects, and as important seasonal prey for amphibians, birds, and bats. Too little is known about this group to designate species' conservation status, but they are subject to road mortality which would increase with road density. Conservation planning should focus on quality habitats, especially for the aquatic larvae which are sensitive to chemical contaminants.

2.7 Primary Burrowing Crayfish

No primary burrowing crayfish are yet known to be established at Milwaukee County Grounds, but the area is suitable for repatriation of Prairie Crayfish. This SLCI is a keystone species, which builds deep burrows that provide critical habitat for dragonflies, amphibians, and reptiles. These burrows serve as drought refuges and winter dens. Repatriation of Prairie Crayfish is a fairly obvious conservation objective at Milwaukee County Grounds, including at the forested wetland within Sanctuary Woods. The most important limiting factor may be runoff contaminants entering these wetlands.

2.8 Light Pollution

Light pollution has a variety of effects on wildlife and human health. Many nocturnal animals can have their activities compromised and stress levels raised by excessive night lighting, particularly lighting in the blue spectrum. Recent research on humans has resulted in a "night shift" setting available on some smart phones, which reduces the harmful effects of screen light by changing the light spectrum and intensity after sunset. Similar research on street and security lighting is available, with best practice remedies available such as shielding light emissions (to direct light only where it is needed), changing emission spectrums, effective placement, and utilizing motion sensors to avoid constant emission. Many of these innovations save energy costs as well. An analysis of lighting effects, and recommended solutions, is well beyond the scope of this memo, but it is strongly recommended that this subject be given thorough consideration, especially given the presence of nocturnal SLCI in the project area.

The American Medical Association has adopted guidance to reduce harm from high intensity street lights (https://www.ama-assn.org/ama-adopts-guidance-reduce-harm-high-intensity-street-lights). The Urban Wildlands Group has made available a bibliography of night lighting literature (http://www.urbanwildlands.org/nightlightbiblio.html). Additional information is available from the International Dark-Sky Association (http://darksky.org/). The following references also provide some background on this issue: Arble et al. 2010, Baker & Richardson 2006, Blackwell et al. 2015, Cloyed & Eason 2015, Delhey & Peters 2017; Gaston et al. 2013, 2014; Hale et al. 2015, Hölker et al. 2010, Kyba et al. 2011, Longcore 2006, Schoeman 2016, Spoelstra et al. 2015, and Wright et al. 2013.

2.9 Noise Pollution

An analysis of noise pollution effects, and recommended solutions, is well beyond the scope of this memo, but it is strongly recommended that this subject be given thorough consideration in planning, especially given the presence of many SLCI in the project area that communicate acoustically. Excessive noise is well documented to have detrimental effects on humans, making remediation of, and planning for, reduced noise an often neglected public health issue. Noise and human health has been addressed by the World Health Organization (http://www.euro.who.int/en/health-topics/environment-and-health/noise), and the following references address some effects on animals: Bee & Swanson 2007, Cardoso 2014, Cunnington 2015, Francis et al. 2011, Hanna et al. 2014, McClure et al. 2016, Troïanowski et al. 2017, and Vargas-Salinas et al. 2014.

2.10 Stopover Habitat

In addition to serving as crucial breeding habitat for declining bird species, the entire Milwaukee County Grounds area and connected river corridors provide essential stopover habitat for migratory birds, mammals (bats), and invertebrates (e.g., Monarch Butterfly, dragonflies and damselflies). To date, 142 species of birds have been documented utilizing the Milwaukee County Grounds for either breeding or migratory stopover habitat (eBird), 48 of which are identified as priority species for conservation in Wisconsin's "All Bird Conservation Plan". Some key planning components to consider for stopover habitat are: refueling by providing sufficient food resources, shelter from predators for exhausted migrants, habitat extent and connectivity (size is important, fragmentation reduces this beneficial use), and light pollution (affects predation, stress, and discovery of habitats from the air).

For more information on this subject:
http://wglbbo.org/what-we-do/midwest-landbird-migration-monitoring-network
http://greatlakes.audubon.org/landing/migratory-stopover-habitat
http://glmigratorybirds.org/

2.11 Roosting Habitat

The Milwaukee County Grounds provides one of only three known winter roosting habitat areas for Long-eared Owls in the Milwaukee Estuary AOC. These owls are a Special Concern species and SLCI. They require safe daytime roosts, typically in dense brushy woods, adjacent to adequate winter foraging areas (large grasslands). Few such areas remain in urban settings. Any conservation planning should address maintaining this critical habitat feature. The owls are also popular with the public and have social value.

2.12 Pollinators and Butterflies

Milwaukee County Grounds is well known as an important Monarch Butterfly habitat. Other butterflies and moths are supported as well. Habitat for butterflies and other pollinators, such as bees, depends upon the availability of quality native forage plants, both during migration and throughout the active season. There is some evidence that the Federally Endangered Rusty-patched Bumblebee occurs in the area (it was documented nearby in 2012), and Milwaukee County Grounds could easily provide habitat for this rare species. Habitat goals for these groups overlaps with habitat goals for grassland birds to a large degree. Planning should address preserving and enhancing this resource through maintenance of wildflowers that provide nectar and pollen. These habitat features provide social and recreational benefits as well.

For further information:
http://www.xerces.org/pollinators-great-lakes-region/
http://greatpollinatorproject.org/management/stopover-habitat
https://www.fws.gov/pollinators/
https://www.fs.fed.us/wildflowers/pollinators/index.shtml
http://www.dnr.state.mn.us/pollinator_resources/index.html

2.13 Habitat Connectivity

Overall habitat connectivity is also a very important feature to maintaining populations of most wildlife, and for providing adequate habitat resources. Any proposed new roadways or development should avoid further isolating habitats patches. Features such as ecopassages can be considered to reconnect currently isolated habitats, and be incorporated into new design as well.

2.14 Notes on Some Other Critical Habitat Features

Ephemeral Wetlands

There is several ephemeral wetlands present in the Milwaukee County Grounds, and one in Sanctuary Woods. Ephemeral wetlands are critical breeding habitat for native amphibians and invertebrates, important foraging habitat for many birds, and are not delineated on WDNR wetland maps. Ephemeral wetlands have been defined by the WDNR as “depressions with impeded drainage (usually in forest landscapes), that hold water for a period of time following snowmelt and spring rains but typically dry out by mid-summer. They flourish with productivity during their brief existence and provide critical breeding habitat for certain invertebrates, as well as for many amphibians such as frogs and salamanders. They also provide feeding, resting and breeding habitat for songbirds and a source of food for many mammals.” These wetlands can easily be degraded by surface water runoff from roads and the destruction of critical upland habitat surrounding them. Roads and trails should be located away from ephemeral wetlands and

transitional zones into upland habitats. Ephemeral wetlands provide critical habitat for several SLCI and state listed species at Milwaukee County Grounds, and should be preserved and enhanced.

Area Containing State-threatened Species (Forked Aster)

The Southeastern Wisconsin Regional Planning Commission (SEWRPC) conducted vegetation surveys in the area from 1975 through 1998. These surveys confirmed the presence of Forked Aster (*Eurybia furcata*), resulting in the designation of an Isolated Natural Resource Area. Additional vegetative surveys conducted by the DPRC reconfirmed the presence of Forked Aster within the site in 2012. The Forked Aster is a State Threatened species, therefore negative impacts to its populations within the site should be avoided and are regulated. To avoid impact, a well designed Master Plan should designate specific habitat preservation and management areas, and habitat buffers, to ensure survival of this rare species.

3. Conclusions

As planning moves forward, the major themes outlined here are appropriate elements for inclusion in a Master Plan that will address both *social* and *biological constraints* to develop a balanced plan that serves the community as a whole. The most fundamental message is that both *social* and *biological constraints* must be defined, with planning recognizing that the *biological constraints* are not negotiable, while the *social constraints* are. In the end, it comes down to addressing the specific critical habitat requirements of the species intended to be supported, then reframing *social constraints* to achieve that objective. This process usually begins by initially selecting a suite of desired Focal Species that represent the habitat features considered to be feasible within the expected social constraints, then planning proceeds around the *biological constraints* to support the full life cycle requirements of the selected Focal Species. If conflicts arise, either biological expectations must be reduced, or *social constraints* eased.

For example, the community may decide that preserving a viable Flying Squirrel population is a goal, and use the squirrels as a Focal Species to represent a vibrant and sustainable mature forest community, that includes wellness trails. The *biological constraints* then include maintaining mature trees with cavities, nut bearing trees and shrubs, a minimum forest extent without fragmentation, forested corridors connecting forest patches, control of invasive species, subdued nighttime lighting (avoiding the blue light spectrum), and nest boxes as a habitat feature. The planning team then realizes that it takes little more effort to introduce a wetland feature, so that other forest dependent species can also be supported, perhaps Wood Frog and Blue-spotted Salamander, or Wood Thrush and a variety of tree roosting bats. Minor adjustments add additional features to the plan to support these new species, including attention to maintaining a good duff layer by controlling browsing and establishing wildflowers. At some point funding (a *social constraint*) for maintaining a proposed deer exclosure cannot be achieved, so the proposed establishment of a trillium population (a regionally rare wildflower) is abandoned.

A similar scenario could unfold for grassland habitats. The point here with this example is that the process of planning for wildlife habitat that supports viable populations is feasible, with a little help from conservation biologists, and would enable a plan that truly integrates the natural environment with desired social benefits.

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