



July 15, 2024

Michael Budd, Refuge Manager
Big Stone National Wildlife Refuge
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Odessa, MN 56276-2062
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RE: U.S. Fish & Wildlife Service's Draft Compatibility Determination for Haying and Grazing, Big Stone National Wildlife Refuge

Dear Mr. Budd:

The Environmental Law and Policy Center ("ELPC") appreciates the opportunity to comment on the proposed Compatibility Determination for Haying and Grazing, Big Stone National Wildlife Refuge ("Draft CD") that was published in the Grant County Review on June 11, 2024 ("*Big Stone National Wildlife Refuge Seeks Public Input*"). ELPC is a public interest legal and policy advocacy organization focused on environmental issues in the Midwest and with a long history of working to protect our National Wildlife Refuges.

I. INTRODUCTION

Big Stone National Wildlife Refuge (the "Refuge") is one of the ecological treasures of the Midwest. While just 1% of North America's native tallgrass prairie remains, Big Stone contains at least 1,200 acres of remnant prairie. *See* Draft CD at 17. Similarly, while the vast majority of wetlands in the Prairie Pothole Region are gone, the Refuge contains thousands of acres of wetlands. Those wetlands provide an important resting ground for migratory birds. *See* Big Stone National Wildlife Refuge Comprehensive Conservation Plan at 32.

ELPC submits these comments to express our concerns that the Draft CD does not establish sufficient protections for habitat and wildlife. The 1997 National Wildlife Refuge System Improvement Act (the "1997 Refuge Act") establishes that the mission of the National Wildlife Refuge System is the "conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States." 16 U.S.C. § 668dd(a)(2). To that end, the 1997 Refuge Act prohibits the Service from "expand[ing], renew[ing], or extend[ing] an existing use of a refuge, unless [the Service] has determined that the use is a compatible use and that the use is not inconsistent with public safety." 16 U.S.C. § 668dd(d)(3)(A)(i). In order to determine that a particular use is compatible, the Service must find that it "will not materially interfere with or detract from the fulfillment of the mission of the System or the purposes of the refuge." 16 U.S.C. § 668ee(1).

Five different statutory provisions establish the Big Stone National Wildlife Refuge's purposes. Among other things, these provisions identify "conservation and protection of fish and

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wildlife resources” and “use as an inviolate sanctuary, or for any other management purpose, for migratory birds” as refuge purposes. 16 U.S.C. § 3901(b); 16 U.S.C. § 715d. Agriculture is not one of the Refuge’s statutory purposes.

In fact, both haying and grazing are among the uses identified by refuge managers as “harmful” uses occurring in our nation’s refuges as part of the survey of refuge managers conducted by the General Accounting Office (“GAO”) at the request of Congress. Of the refuge managers who regarded haying and grazing as harmful to their refuge, 55% believed that haying should be discontinued entirely and 60% supported altogether discontinuing grazing as a use. *See* U.S. Gov’t Accountability Off., GAO/RCED-89-196, National Wildlife Refuges: Continuing Problems with Incompatible Uses Call for Bold Action 3, 20, 21 (1989). In light of this acknowledgment by refuge managers that both practices are “harmful” uses, we urge the Service to give strong consideration to ELPC’s six recommendations below.

Indeed, the documentation of these “harmful” uses in the 1989 GAO Report “ignited a new wave of reform efforts to conserve refuge resources,” ultimately leading to the 1997 Refuge Act. The compatibility determination process set forth in the 1997 Refuge Act is the “touchstone for determining what uses may be allowed in refuges,” and was intended by Congress to be “the key mechanism to ensure that the conservation mission of the System” effects real change to protect against incompatible uses within the System. Robert L. Fischman, *The National Wildlife Refuge System and the Hallmarks of Modern Organic Legislation*, 29 Ecology L.Q. 457, 496, 498-99, 547 (2002).

ELPC recognizes that agricultural activities like haying and grazing can have ecological benefits as a management tool in some circumstances. But the Draft CD lacks specific provisions to ensure that the benefits of haying and grazing outweigh the ecological costs. Although the Refuge’s current management may intend to follow best practices that do not appear in the Draft CD, ELPC is concerned that the Refuge might depart from those practices in the future if they are not set forth in writing in a final Compatibility Determination. In the discussion below, ELPC details the following six recommendations:

1. Add specific limitations and mitigation measures to ensure that haying and grazing do not damage habitat and wildlife.
2. Provide for more extensive oversight of haying and grazing on the Refuge.
3. Conduct a more thorough analysis of endangered and threatened pollinators on the Refuge and provide greater protection for those species.
4. Evaluate less disruptive alternatives such as prescribed burning and native grazers.
5. Incorporate an updated Region 3 haying and grazing guidance after the Service issues it.
6. Provide greater public notice by publishing in a regional newspaper and on the federal register.

ELPC urges the Service to revise and reissue the Draft CD in accordance with these recommendations. ELPC also requests that the Service assess or re-assess its Draft CD in light of the Service’s proposed rule on Biological Integrity, Diversity, and Ecological Health earlier

this year. *See* National Wildlife Refuge System; Biological Integrity, Diversity, and Environmental Health, 89 Fed. Reg. 7345 (proposed Feb. 4, 2024) (to be codified at 50 C.F.R. pt. 29).

II. DISCUSSION

A. The Draft CD does not contain sufficient limits or mitigation measures, and improperly relies on special use permits to fill in key details.

Haying and grazing on the Refuge are not compatible uses absent clear limitations and conditions. The Service’s regulations require that all compatibility determinations must detail “the nature and extent of the use,” and the “stipulations necessary to ensure compatibility[.]” 50 C.F.R. § 26.41(a). Under the Service’s “policy for determining compatibility,” these stipulations “must be detailed and specific.” 603 FW 2.12(A)(11). Moreover, “[i]f the use cannot be modified with stipulations sufficient to ensure compatibility, the use cannot be allowed.” *Id.*

Stipulations are particularly important in the context of the Draft CD because of the substantial ecological damage that haying and grazing can inflict on sensitive Refuge lands. The Draft CD itself recognizes the potential harmful effects of haying and grazing on wildlife and habitat. For example, the Draft CD explains that “[l]ivestock directly impact shoreline or riparian habitat through vegetation removal and trampling, which could lead to changes in water quality.” Draft CD at 21. Similarly, the Draft CD discusses the many ways that haying and grazing can “have a substantial impact on soil properties.” *Id.* at 22. With respect to endangered species, the Draft CD states that “[h]aying and grazing activities could temporarily displace individual animals and possibly crush vegetation or habitat.” *Id.* at 16.

Despite the importance of limiting and mitigating the effects of haying and grazing, the Draft CD contains very few express conditions on the proposed use. Pages 28 and 29 set forth “Stipulations Necessary to Ensure Compatibility.” Draft CD at 27. But these stipulations lack the necessary specificity and instead rely on “special use permits” to fill in key details. For example, general stipulation 5 states that “Special use permits will address unique local conditions.” *Id.* at 28. And general stipulation 7 states that “[h]aying and grazing activities will be restricted to minimize wildlife disturbance” but does not explain *how* those activities will be restricted. *Id.*

With respect to grazing, the Draft CD recognizes that limitations on “grazing intensity, timing, frequency, and the livestock species” are particularly important for the protection of habitat and wildlife. Draft CD at 12. Yet the Draft CD contains just one express limitation on grazing intensity or frequency, stating that grazing may not occur “more than three out of five years.” *Id.* at 28. Elsewhere, the Draft CD offers a contradictory discussion of *potential* grazing parameters. It indicates Big Stone would employ “spring flash grazing” (high stocking rate, 4-6 weeks or less) in native prairie and “summer grazing” (moderate stocking rate, 10-12 weeks) in low-diversity seeded grasslands. *Id.* at 5-6. In another section, it recommends allowing livestock to remain in an area for just one week to protect grassland birds during nesting season. *Id.* at 13. The Draft CD does not adopt any of these practices; instead, the Service will determine which to deploy when it issues special use permits.

Likewise, the Draft CD discusses other potential numerical limits for haying and grazing but does not commit to them in stipulations. For example, the Draft CD states that Big Stone “would typically issue” three permits per year, yet the stipulations contain no numerical limit. *Id.* at 6. It claims that limiting haying and grazing to 30% of any given habitat would “provid[e] sufficient refugia” for disturbed wildlife, but the stipulations do not codify this maximum. *Id.* at 13. Similarly, while the Draft CD states that it may allow grazing on “up to 3,000 acres” annually, it does not establish that figure as a hard limit in the stipulations. *Id.* at 3. Nor does it contain any acreage limit on haying.

The Draft CD also lacks controls to protect sensitive areas, including wetlands and riparian zones. The document explains how livestock may cause “erosion, soil compaction, bank sloughing and rutting,” which affect water quality through increased runoff, sedimentation, and turbidity. *Id.* at 21. Yet, the proposed program would not restrict livestock from these areas; to the contrary, in previous years, Big Stone invited permittees to use wetlands and ponds as a water source for livestock. *See* U.S. Fish and Wildlife Service, 2023 Grazing Package for Big Stone National Wildlife Refuge 7, 8, 11, 14 (Jan. 19, 2023). The Draft CD indicates that Big Stone may limit livestock access to these areas “if necessary” but does not explain how to assess necessity. Draft CD at 21. It indicates that the Refuge will rely on permit conditions to mitigate harm to these areas but does not commit to any particular limitations. *Id.* at 21.

The absence of specific restrictions or mitigation measures in the Draft CD’s and the Draft CD’s reliance on special use permits to fill in those key details is improper and contrary to law. While ELPC understands that special use permits may provide some details regarding a particular instance of haying or grazing, permit conditions should not do the heavy lifting. A particular permit’s mitigation measures could make the difference between haying and grazing as a compatible management tool versus haying and grazing that harms wildlife and habitat. Hence, it is entirely possible that permits will allow for an approach to haying and grazing that is not compatible with the Refuge’s purpose, in conflict with the 1997 Refuge Act.¹

The Service should accordingly revise the Draft CD to describe the specific limitations and mitigation measures that every special use permit must include. At minimum, the Service should adopt detailed restrictions on grazing intensity, frequency, and duration. The Service should also limit livestock access to wetland and riparian areas. And the Service should adopt hard caps on the total allowable acreage of haying and grazing on the Refuge.

B. The Draft CD contains inadequate oversight measures.

Oversight of a proposed use is a necessary requirement for a compatibility determination. According to the Service’s policy for determining compatibility, “[m]onitoring of the use must be sufficient to evaluate compliance with stated conditions and swift action must be taken to correct or respond to any serious deviations.” 603 FW 2.12(A)(11)(b). Absent adequate monitoring, a user (such as a livestock owner) may repeatedly violate conditions on a particular use, which in turn may damage habitat and wildlife.

¹ To provide just one example, the Refuge could allow continuous grazing on any tract in the Refuge for three consecutive years without violating any of the express stipulations in the Draft CD. Such overgrazing could prove ruinous to ecology of any tract on which it occurred.

The Draft CD does not establish an adequate monitoring regime. Instead, it proposes to make the permittee responsible for implementing many of the controls necessary to ensure compatibility, including “control and maintenance of livestock,” “fencing, water supply and other livestock management infrastructure needs,” cleaning equipment “prior to entering the refuge,” and removing windrowed grass and hay bales. Draft CD at 28-29. In fact, the only specific monitoring practice that the Draft CD establishes is to make agricultural equipment “subject to inspection.” *Id.* at 28. The Draft CD further states that monitoring will “occur under the existing grassland monitoring program.” *Id.* at 8.

ELPC recommends that the Service set forth additional monitoring mechanisms to ensure that permittees do not violate the terms of their permits. Among other practices, the Service should regularly survey ongoing haying and grazing activity and inspect livestock management infrastructure (e.g., fencing) on the Refuge.

C. The Draft CD understates the potential harm of haying and grazing to endangered and threatened pollinators.

The Draft CD fails to demonstrate that haying and grazing will align with the National Wildlife Refuge System mission or Refuge goals relating to the conservation and restoration of endangered species. The Draft CD offers only a cursory assessment of potential impacts on endangered, threatened, or otherwise jeopardized pollinators. In some cases, the Draft CD relies on circular logic to support its conclusions, taking the species’ scarcity as evidence that haying and grazing will not cause harm. In fact, the Service should ensure that haying and grazing are not occurring in habitats that support such species precisely given their scarcity.

A compatible use must “not materially interfere with or detract from fulfillment of the National Wildlife Refuge System mission or the purpose(s) of the national wildlife refuge.” 50 C.F.R. § 25.12. The National Wildlife Refuge System mission includes the “conservation, management, and where appropriate, restoration of...wildlife...and their habitats[.]” 16 U.S.C. § 668dd. The Big Stone National Wildlife Refuge goals include similar directives. *See* 16 U.S.C. § 742(f)(a)(4); 16 U.S.C. § 664. The Refuge’s purposes also include the imperative that land be “suitable for...the conservation of endangered species or threatened species[.]” 16 U.S.C. § 460k. Additionally, Big Stone’s Habitat Management Plan explains that pollinators, which serve critical ecosystem functions, have faced decades of decline, so “[m]anagers must consider impacts to pollinator species” when making habitat management decisions. U.S. Fish and Wildlife Service, Habitat Management Plan for Big Stone National Wildlife Refuge 42 (Sept. 2021).

We are concerned that the proposed haying and grazing program would undermine the Refuge’s obligations to at least four butterfly species. The Big Stone Habitat Management Plan identified three butterfly species among the endangered and threatened species at Big Stone: the federally threatened Dakota skipper; the federally endangered Poweshiek skipperling; and a state species of concern, the Regal fritillary. *See* Habitat Management Plan at 42. The Draft CD also noted the Monarch butterfly, a candidate for listing under the Endangered Species Act. *See* Draft CD at 14.

The Draft CD glosses over the risk of material harm that haying and grazing pose to these at-risk pollinators. It acknowledges haying and grazing can negatively impact pollinators by removing their food sources, disturbing or displacing individuals, disrupting feeding or mating behaviors, and causing injury or death to eggs and larvae. Draft CD at 15. Yet it characterizes these risks as short-term or unlikely to cause more damage than has already been done. *Id.* at 16.

That assessment is particularly deficient with respect to the Poweshiek skipperling and the Dakota skipper. The Draft CD notes recent surveys have not identified these butterflies within the refuge, and concludes, “[d]ue to the low occurrence of listed species on the refuge, adverse impacts would be unlikely or minimal.” *Id.* at 15-16. This analysis overlooks the prospect that butterflies may remain in small numbers, may return, or may flourish if reintroduced under conducive conditions. *See, e.g.,* Samantha Knight et al., *Management Practices Benefit Endangered Poweshiek Skipperling (Oarisma poweshiek) in Manitoba Tall Grass Prairie* 9 Facets J. 1, 10 (discussing Poweshiek skipperling reintroduction programs); Kelsey Seidle et al., *Extent of Dakota Skipper, Hesperia dacotae, Distribution in Southeastern Saskatchewan, Canada*, 24 J. Insect Conservation 1073, 1079 (2020) (identifying potential Dakota skipper reintroduction sites). The scarcity of these species should not signify a green light for further economic activity, but rather should underscore the need for caution when engaging in activity that may cause harm.

The analysis also neglects the possibility that haying and grazing practices over the past decade have contributed to the decline of the Poweshiek skipperling and Dakota skipper, and could continue to harm these or other pollinator species. Haying and grazing may help to support Poweshiek skipperling and Dakota skipper populations, but only under narrowly prescribed circumstances. *See, e.g.,* U.S. Fish and Wildlife Service, *Dakota Skipper Conservation Guidelines* 5-6 (Sept. 2016) (warning against mowing before flight period has ended, leaving less than 8 inches of stubble for over-wintering larvae, haying or grazing in consecutive years, and over-grazing floral nectar resources); Knight, *supra*, at 3, 9 (recommending a five-year cycle and low stocking rate).

ELPC has additional concerns about the Draft CD’s inattention to the Monarch butterfly and the Regal fritillary. The Draft CD describes monarchs as common on the refuge. Draft CD at 15. However, we remain concerned despite this abundance, given the decades-long trend of pollinator decline and the Service’s finding that “monarch viability is declining and is projected to continue declining over the next 60 years.” U.S. Fish and Wildlife Service, Monarch (*Danaus plexippus*) Species Status Assessment Report, version 2.1 iii (Sept. 2020); *see* Habitat Management Plan at 42. Additionally, the Draft CD makes no mention of the Regal fritillary, even though these butterflies rely exclusively on native prairies like those at Big Stone for their habitat. *See* Minn. Dep’t of Nat. Res., Argynnis idalia *Regal Fritillary*, Rare Species Guide, <https://tinyurl.com/y7eud9t3> (last visited July 8, 2024) (citing Diane Debinski and Liesl Kelly, *Decline of Iowa Populations of the Regal Fritillary (Speyeria idalia) Drury*, 105 J. Iowa Acad. Sci. 16 (1998)).

We recommend that the Service revise the Draft CD’s analysis of endangered species on the Refuge. The Service should assess whether haying and grazing methods over the past decade have contributed to the decline of populations of the Poweshiek skipperling and the Dakota skipper. The Service should also adopt measures designed to support and protect each of the four

pollinators discussed above and include those measures in the stipulations necessary for compatibility.

D. The Draft CD disregards alternative management tools.

Under the Service's regulations, a Refuge should resort to Cooperative Agriculture Agreements as a management tool "[o]nly when we cannot meet our resource management objectives through maintenance, management, or mimicking of natural ecosystem processes or functions of the particular NWRS land area[.]" 620 FW 2.8(C). Agriculture on refuge lands should be a last resort, not a primary management tool. The Draft CD nonetheless contains almost no analysis of the non-agricultural management tools that the Service evaluated before opting for haying and grazing.

A variety of disturbance regimes may reduce incursions of introduced species and improve biodiversity on remnant and restored prairies. Prescribed burning has received consistent support from the scientific literature and has in at least some cases proven more effective than grazing. *See* Marissa Ahlering et al., *Cooperatively Improving Tallgrass Prairie with Adaptive Management*, *Ecosphere*, Apr. 2022, at 1, 13 (finding clear improvement in prairie condition with prescribed fire but uncertain outcomes with grazing); Sarah Anderson et al., *Passerine and Secretive Marsh Bird Responses to Cattail Management in Temperate Wetlands*, *27 Wetlands Ecology Mgmt.* 283, 289 (2019) (finding methods involving prescribed burning more effective at reducing invasive cattail biomass than grazing alone); Julia Leone et al., *Adult Monarch (Danaus plexippus) Abundance is Higher in Burned Sites Than Grazed Sites*, *Frontiers Ecology and Evolution*, Nov. 14, 2019, at 1, 9-10. We understand that Big Stone may already employ prescribed burning, *see* Habitat Management Plan at 68, but the Draft CD does not explain why prescribed burning alone cannot meet habitat management needs.

Similarly, the Draft CD outlines a plan to restore native grazers like elk and bison to Big Stone in addition to allowing livestock grazing, *see* Draft CD at 4, but does not explain why native grazers alone could not achieve a result comparable to livestock. The Draft CD itself recognizes that reliance on native grazers would constitute a "nature-based solution[]" for prairie grassland resiliency." Draft CD at 7. While livestock would detract from the visitor experience, reliance on native grazers "would likely enhance the prairie aesthetic and could provide a unique viewing opportunity for visitors." Draft CD at 24. Despite these straightforward benefits of native grazers, the Draft CD does not analyze using native grazers alone rather than livestock.

Furthermore, the Draft CD does not explore alternatives among haying and grazing methods that may prove more effective and less harmful than conventional methods. Steve Apfelbaum, senior ecologist and founder of the Applied Ecological Institute, Inc. (whose *curriculum vitae* is attached to this comment as Exhibit 1), warns that the multiple passes required for conventional haying as opposed to one-pass chopping operations may disperse the after-ripened seeds of invasive species, rather than limiting their spread. Mr. Apfelbaum also has noted that Adaptive Multipaddock Pasture Management, which involves intensively grazing small tracts for brief periods followed by a year-long recovery, better emulates the grazing patterns of large native herds than conventional grazing. *See* Steven Apfelbaum et al., *Vegetation, Water Filtration, and Soil Carbon Response to Adaptive Multi-Paddock and Conventional Grazing in Southeastern USA Ranches*, 308 *J. Env't Mgmt.* 114576, 8 (Apr. 15,

2022). Mr. Apfelbaum has observed this method generate greater floral diversity than conventional grazing, and he and other researchers have identified additional improvements to soil carbon, water infiltration, and arthropod diversity. *See id.* at 8, 10 (soil carbon, water infiltration); Ryan Schmid et al., *Adaptive Multipaddock (AMP) Pasture Management Increases Arthropod Community Guild Diversity Without Increasing Pests*, *Rangeland Ecology and Mgmt.* 94 (2024) 141, 146-47 (arthropod diversity).

The Draft CD itself acknowledges many potential harms from conventional grazing. Particularly given these drawbacks, the Service should explain why Big Stone must employ haying and livestock grazing to meet its management objectives. We recommend that the Service give due consideration to alternative management methods and revise the Draft CD to reflect that analysis.

E. The Service should reissue the Draft CD after it publishes a new haying and grazing guidance.

The Draft CD relies on the Service’s Region 3 haying and grazing program guidance (Region 3 Guidance) to inform “best management practices” the Service would follow in order to “minimize and mitigate impacts to refuge resources.” Draft CD at 9. The proposed stipulations likewise state that the Service “will adhere to Region 3 haying and grazing guidance.” Draft CD at 28. The Service issued the Region 3 Guidance in 2014. Since then, the Service has made numerous updates to relevant policies, including issuance of its Cooperative Agriculture Use policy in 2017, *see* 620 FW 2, and its proposed rule on Biological Integrity, Diversity, and Ecological Health earlier this year. *See* National Wildlife Refuge System; Biological Integrity, Diversity, and Environmental Health, 89 Fed. Reg. 7345 (proposed Feb. 4, 2024) (to be codified at 50 C.F.R. pt. 29). Moreover, according to a deputy refuge supervisor with Region 3, the Service is currently drafting a revision to the Region 3 Guidance.

The Service’s reliance on the outdated Region 3 Guidance increases the risk that the Service will not follow current best practices for mitigating the impacts of haying and grazing on the refuge. By relying on the outdated Region 3 Guidance, the Service also makes it difficult for the public to understand exactly what mitigation practices the Service intends to follow over the 10-year life of the Compatibility Determination. That compounds the opacity, described above, of the Service’s reliance on special use permits to set forth specific mitigation measures.

The service should not issue a final Compatibility Determination before issuing an updated Region 3 Guidance. Instead, the Service should revise the Draft CD in accordance with the updated guidance. The Service should reissue the Draft CD after publishing the updated guidance and ensure that the reissued Draft CD reflects the best practices described in the updated guidance.

F. The Service should publish the Draft CD and other complex compatibility determinations on the federal register.

The Draft CD is the second draft compatibility determination on which ELPC has commented in the past year. In November, 2023, ELPC submitted a comment on the Sand Lake National Wildlife Refuge’s “Compatibility Determination for Public and Private Buried Utility

Lines, Road and/or Bridge Improvements, or Temporary Road ROW Expansions Occurring on FWS Easement Properties or Fee-Owned WPAs” (Draft Sand Lake Compatibility Determination). Among other issues, ELPC noted that the notice the Service provided for the Sand Lake Compatibility Determination did not meet the requirements of the Service’s policy manual, 603 FW 2.12.A(9). The Draft Sand Lake Compatibility Determination concerned a complex use, but provided notice appropriate for an “incidental, one-time use” under the manual. The Service responded to ELPC’s comment by withdrawing the Draft Sand Lake Compatibility Determination.

This Draft CD on haying and grazing in Big Stone National Wildlife Refuge likewise provided inadequate public notice. The Draft CD states that “[t]he public will be made aware of this comment opportunity through newspapers, radio, postings at local libraries, letters to potentially interested people such as adjacent landowners, states and tribes, public meetings, federal register, or other places and media outlets.” Draft CD at 27. But contrary to that statement, the Service did *not* publish the Draft CD on the Federal Register. Nor could commenters find any evidence that the Service published the Draft CD in regional newspapers such as the Star Tribune. Instead, to our knowledge, the Service published the Draft CD on its website, through one local newspaper (the Grant County Review),² and with a physical hard copy at the headquarters.

Given the scope and complexity of the Draft CD, this level of notice is inadequate. The Draft CD sets forth a highly impactful policy that will remain in effect for at least the next ten years. In addition to the likely impact of that policy on wildlife and habitat within the Refuge, that policy will have a substantial effect on visitors to the Refuge. For example, visitors will be unable to access parts of the Refuge when haying and grazing is in effect.

ELPC accordingly urges the Service to publish a revised Draft CD on the Federal Register and in regional newspapers. Publishing on the Federal Register will ensure the minimum public notice expected for most federal actions subject to notice and comment requirements. And publishing in a regional newspaper like the Star Tribune will increase the likelihood that interested members of the public receive actual notice of the Draft CD. This level of notification would then comply with the Service’s guidance for complex uses. Providing broader notice will also align with the spirit of the 1997 Refuge Act, which emphasizes the opportunity for “public review and comment” on all compatibility determinations. § 668dd(d)(3)(B).

For those same reasons, we urge the Service to adopt a policy of publishing draft compatibility determinations in the Federal Register as a default. While certain one-off uses may not be appropriate for publication in the Federal Register, the Service should err on the side of too much notice rather than too little.

² *Big Stone National Wildlife Refuge Seeks Public Input*, Grant County Review, June 11, 2024, <https://www.grantcountyreview.com/content/big-stone-national-wildlife-refuge-seeks-public-input>.

III. CONCLUSION

The Environmental Law & Policy Center appreciates the opportunity to provide input on the proposed Compatibility Determination for Haying and Grazing on Big Stone National Wildlife Refuge. We encourage the Service to revise the Draft CD in accordance with the recommendations above.

Respectfully submitted,

/s/ Wendy Bloom

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/s/ Nicholas Wallace

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c: Howard Learner, Executive Director, ELPC via hlearner@elpc.org

Exhibit 1
to Environmental Law & Policy Center
Comment on Big Stone Refuge Draft
Compatibility Determination re: Haying
and Grazing



Steven I. Apfelbaum, M.S.

Senior Ecologist | Founder | Applied Ecological Institute, Inc



EDUCATION

M.S., Biology, University of Illinois at Urbana-Champaign, 1978

B.S. (L.A.S.) in Zoology, University of Illinois at Urbana-Champaign, 1976

PROFESSIONAL INFORMATION

Certified Senior Ecologist, Ecological Society of America, 1991 - Present

Appointed to Editorial Advisory Board, *Ecological Restoration Journal*, 2015 - Present

Qualified Wildlife Biologist Certification, Embry-Riddle Aeronautical University, 2014

Airport Wildlife Hazard Management Specialist Certification, Embry-Riddle Aeronautical University, 2010

Appointed to U.S. Forest Service Scientific Roundtable on Biological Diversity

AWARDS AND HONORS

Recipient of Fellow from Ecological Society of America, 2017

Recipient of Friends of Ryerson Woods Award for Distinguished Leadership in the World of Nature, 2012

Recipient of John T. Curtis Award for Career Excellence in Ecological Restoration, 2010

Recipient of Bill Clinton Global Sustainable Cities Initiative Award for Don River Project (Toronto), 2007

SUMMARY OF EXPERIENCE

Since the late 1970s, Steve Apfelbaum has conducted ecological research, designed award-winning projects and contributed his uniquely creative scientific expertise and enthusiasm to over 9,000 projects throughout North America and beyond. Apfelbaum received his Master's degree in Ecology under Dr. Alan Haney at the University of Illinois in 1978. His early work involved research conducted in many different regions including the boreal forests of Canada, the prairies of Kansas and North Dakota, the deserts of Utah and the tropical rain forests of Central America. He returned the Midwest in the late 70s and founded Applied Ecological Services (AES) in rural Wisconsin in 1978.

In December 2021, Steve retired as the chairman of AES and started Applied Ecological Institute, Inc, a 501 C 3 non-profit ideation, acceleration and commercialization organization to develop and deliver ecological solutions to some of our most pressing challenges. As a founder of the Prairie Enthusiasts, a multistate non-profit organization, for thirty years he has been focused on protecting and restoring prairie remnants across the Midwestern USA.

Steve also is the co-founder of the Southern Wisconsin Land Conservancy and as its president has helped organize the protection and purchase of dozens of private properties. The latest program involves the purchase of a former country club (www.threewatersreserve.com) that has been protected and restored as public park, with a "field station nature center", an operating event center. The protection of this land has leveraged gifts of additional protected land from neighboring property owners.

Steve currently is involved in land conservation and planning for SE USA through collaborations with SE Grassland Initiative, Paint Rock Forest Reserve Center, and has recently completed a major program with farmers and ranchers through Arizona State University to use improved livestock grazing to restore SE USA grasslands (see "Soil Carbon Cowboys" film series on Vimeo) and related Great Plains land conservation and restoration as featured in Patagonia's movie "Unbroken Ground".

Apfelbaum has been involved (and is currently leading) some of the largest land conservation projects in the USA. With Alaska Natives he is the lead on a protection project to secure the protection of the largest walrus haul out location in North America. This involves 90,000 acres of land protection and securing alternative sources of revenues for the Inupiat eskimo community.

With The Conservation Fund, Apfelbaum and team have helped create the Greenseams model for Milwaukee Metropolitan Sewerage District as a new way to management stormwater and consent decree CSO waters. This program has become a model for other municipalities around the world.

With The Conservation Fund and UW Fish and Wildlife Service, Apfelbaum led to program to prioritize and secure \$30 million dollars in funding to purchase and protect inholdings in the Wood Tic Chic Wilderness, Dillingham, AK.

At Prairie Crossing Apfelbaum helped establish the nations first conservation community and the Liberty Prairie Reserve (www.prairiecrossing.com) that involves more than 50 cross conservation easement agreements, bargain sales of remainder values, among other program features.

Steve has worked on the protection, restoration and creation of innovative



AFFILIATIONS

American Museum of Natural History
 American Society of Photogrammetry
 American Association for the Advancement of Science
 Cooper Ornithological Society
 Green County Conservation League, Appointed a Director
 Nature Conservancy Natural Areas Association National
 Wildlife Federation
 North American Lake Management Association Sierra Club
 Society of Wetland Scientists
 Wisconsin Prairie Enthusiasts, 1986-ongoing.
 Co-Founder of non-profit organization; Served as a Director

POSITIONS HELD

2021-present, Director, Applied Ecological Institute
 1981 - 2021 Chairman of the Board, Research and Senior Consulting Ecologist, and President, Applied Ecological Services, Inc., and Taylor Creek Restoration Nurseries, Brodhead, WI
 1981 - 1994, Research Associate, Ecological Research Services, Inc., Iron River, MI
 1979 - 1981, Staff Ecologist and Owner, Applied Ecological Services, Roosevelt, UT
 1978 - 1979, Staff Ecologist, Ecological Research Services, Inc., Iron River, MI
 1976 - 1978, Botany Instructor, University of Illinois, Urbana Champaign, IL
 1974 - 1976, Plant Chemist Lab Assistant, Department of Botany, University of Illinois, Urbana, IL
 1974, Field Research Assistant, Illinois Natural History Survey, Urbana, IL
 1972 - 1974, Microbiologist Lab Assistant, W.R. Harper College, Palatine, IL
 1966 - 1974, Naturalists Aid and Volunteer, River Trail Nature Center, Cook County Forest Preserve District, IL

alternative revenues streams for several thousand clients over the past 40 years from across the USA, Canada, and many projects in South and Central America.

Steve and his partner also have permanently protected and fully endowed the farm they live on that is featured in NY Times featured book, "Natures Second Chance" (Beacon press) and three other farms which includes the nations largest native plant nursery—Taylor Creek Restoration Nursery.

He has been instrumental in advancing the concepts and philosophies behind ecological restoration through his direct connection to mentors and pioneers in the environmental movement including Sigurd Olson, Luna Leopold and many other key scientists, conservationists and policy makers. As AES has grown, Apfelbaum has played an increasing role in educating and mentoring the next generation of ecological professionals.

Apfelbaum has been the ecological leader in many pioneering projects. His work on conservation communities established Low Impact Development as a marketplace and regulatory precedent. His work on alternative stormwater management and in developing the Stormwater Treatment Train™ has contributed to changing the stormwater management industry nationwide. And his ecological restoration approaches on mining projects and brownfield reclamation and remediation have set new industry standards and win-win outcomes for all involved parties.

Apfelbaum has also been a leader in the developing marketplace for ecosystem services concepts. Beginning in the early 1990s, he helped develop regulatory frameworks for the first private wetland mitigation bank in the Midwest. More recently, he has led the development of a methodology to quantify carbon in soils and he has helped develop a framework for conservation biomass.

He has authored and peer-reviewed hundreds of technical studies, papers, books and reports, including ecological restoration plans and regulatory monitoring and compliance reports. His book, *Nature's Second Chance* (Beacon Press), won accolades from the New York Times, and was listed as one of the "Top 10 Environmental Books of 2009." Apfelbaum's recent book, *Restoring Ecological Health to Your Land* – co-authored with Dr. Alan Haney as part of a two-volume series – has won praise as the first comprehensive "how-to" restoration book for landowners.

Apfelbaum is also a much sought-after speaker at educational events focusing on ecological restoration, ecosystem assessment, alternative stormwater management and conservation development. He currently lectures at Harvard University, University of Illinois, University of Wisconsin, and over the years has taught in dozens of other educational and research institutions through the U.S., University of Paris at Madam Curie Institute and elsewhere.

Apfelbaum has won the John T. Curtis lifetime achieve award from the Aldo Leopold Foundation for Ecosystem Restoration, and was honored with the Ryerson Lifetime Conservation Award. Prior shared recipients of this award include Wes Jackson of The Land Institute in Salina, Kansas, and famed ornithologist Roger Tory Peterson.



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AFFILIATIONS

American Museum of Natural History
 American Society of Photogrammetry
 American Association for the Advancement of Science
 Cooper Ornithological Society
 Green County Conservation League, Appointed a Director
 Nature Conservancy
 Natural Areas Association
 National Wildlife Federation
 North American Lake Management Association
 Sierra Club
 Society of Wetland Scientists
 Wisconsin Prairie Enthusiasts, 1986-ongoing. Co-Founder of non-profit organization; Served as a Director

POSITIONS HELD

2021-present, Director, Applied Ecological Institute
 1981 - 2021 Chairman of the Board, Research and Senior Consulting Ecologist, and President, Applied Ecological Services, Inc., and Taylor Creek Restoration Nurseries, Brodhead, WI
 1981 - 1994, Research Associate, Ecological Research Services, Inc., Iron River, MI
 1979 - 1981, Staff Ecologist and Owner, Applied Ecological Services, Roosevelt, UT
 1978 - 1979, Staff Ecologist, Ecological Research Services, Inc., Iron River, MI
 1976 - 1978, Botany Instructor, University of Illinois, Urbana Champaign, IL
 1974 - 1976, Plant Chemist Lab Assistant, Department of Botany, University of Illinois, Urbana, IL
 1974, Field Research Assistant, Illinois Natural History Survey, Urbana, IL
 1972 - 1974, Microbiologist Lab Assistant, W.R. Harper College, Palatine, IL
 1966 - 1974, Naturalists Aid and Volunteer, River Trail Nature Center, Cook County Forest Preserve District, IL

MAJOR CONSULTANTSHIPS, AWARDS, FUNDED PROJECTS, RESEARCH GRANTS & FELLOWSHIPS

AMP SE Region Production Management, Soil Carbon Study, Project and Production Coordination, 2018. Sampling for Wendy Taheri soil samples for Arbuscular Mychhorizal Fungi research for SE AMP. All core samples collected represented and approximated the first four sampled locations where prior giddings meter depth soil core samples were collected (and vegetation samples). All sites were samples. Sites north of Lyons were very wet to moist and from Lyons south were excessively dry and very challenging to sample (like pounding into concrete). Even with the retainers in the soil probes it was nearly impossible to obtain full one foot samples. The second set of transects at the new garret paired site has very rocky soils and is not a good match for the Lyons site soils. Really beat up the soil probe tip even trying to get samples in this site.

Blair Pond Enhancement, Lake, Pond, and Shoreline Restoration Design, 2018. Laboratory personnel collected surface water samples from Blair Pond at the Gathering Place at four locations on July 2, 2018. Nutrients and general water quality were determined. These data were provided to the team on July 10th. Field measures of water quality were taken by The Smart Group (TSG) at seven locations in the wetlands and the pond on July 4, 2018. Surface and bottom measurements were taken from locations in the pond. Field measures included vertical profiles of water temperature, dissolved oxygen, specific conductance and pH. We also evaluated Test Well data from October 2014 in wells two through seven relative to Total Phosphorus concentrations.

New Buffalo Shoreline Protection, Natural Resource Inventory - Assessment, New Buffalo, MI, 2018. AES collaborated with Edgewater Resources, LLC. to conduct a Natural Resource Inventory for the New Buffalo Shoreline Alliance. The Alliance contracted Edgewater Resources, LLC. to help design, permit, fund, and construct shoreline protection for several miles of the Lake Michigan shoreline south of New Buffalo, Michigan. AES conducted an extensive literature review to characterize the historic and existing lake bottom, beach, and dune ecosystems of southern Lake Michigan and identify potential future benefits of restoration of these systems.

Tom Lee Park, Memphis, TN, (Studio Gang Architects), Ecological Consulting, 2018. SGA invited AES to partner as ecological consultant for a master plan creating a new sustainable highly aesthetic riverfront park, Tom Lee Park in Memphis, TN.

The Forge Adventure Park (Ronan Architects, LLC). 2018. AES completed a natural resource inventory and mapping of the Phase I area of the proposed Forge project. This report summarizes with brief descriptions and mapping, the findings of the natural resources present. The focus of the AES scope was confined to: a) identifying, delineating, and GPS surveying flagged boundaries of any found wetlands; b) identifying, delineating, and GPS surveying flagged boundaries of any found natural areas; and c) identifying and GPS surveying of any longer lived more durable trees that may be worth protecting as a part of the site development plans.

River Hills Conservation Development and Phase II. Conservation Development Design, Restoration Design, River Hills, WI, 2016 and 2018. Met with Mandel Group team to discuss a new conservation community in River Hills, WI that integrates agricultural food production.



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TEACHING: WORKSHOP AND COURSES

Lecturer, Harvard University Graduate School of Design, Department of Landscape Architecture, Cambridge, MA, 2010-2018

Lecturer/Training Instructor: San Antonio River Authority (SARA) – “Ecosystem Restoration, a two day training for staff. 2014; 2017

Land Trusts and Science-based Stewardship, Nature and Associates Workshop at National Conference and for Southwest MI Land Trusts and Trust for Public Lands, 2005

Co-recipient of a grant through the WI Educational Association to teach field ecology and restoration to teachers and to co-design an outcome based curriculum, Brodhead High School, Brodhead, WI, 1992-1993

Restoration Ecology, University of MN Extension, 1991-1995

Instructor, Botany, University of IL at Urbana-Champaign, 1976-1978

Lecturer, Watershed Restoration: Andomojo River, Guanacaste, Costa Rica. University of VT, Gund Institute

Lecturer, Reclamation and Ecological Restoration, University of WI-Platteville

Cedar Strip Canoe Design and Construction

Ecological Diversity Seminar, University of IL

Edible Wild Plant Workshops (held in various locations of the country)

Ecological Restoration, Hennepin County parks, Minneapolis, MN

Ecological Restoration, National Conference prepared and presented for The National Arbor Day Foundation

Wetland Ecology and Plant Identification (co-presented with G. Wilhelm at the Morton Arboretum, Lisle, IL)

Wilderness Ecology of the Quetico Superior Region

MAJOR CONSULTANTSHIPS, AWARDS, FUNDED PROJECTS, RESEARCH GRANTS & FELLOWSHIPS *(continued)*

Council Bluffs River Concept and Missouri Riverfront Revitalization (Office of James Burnett), Master Planning, Park and Open Space Planning 2017 - 2018.

AES collaborated with a private community group and planners from the lead firm, Office of James Burnett (OJB), to re-imagine and expand the public realm while catalyzing economic development along the riverfront. Foremost in the effort was the conservation of natural vegetation and improvement of habitats in an urban riverfront setting. AES was given the task of incorporating ecological ideas and restoration concepts across the large riverfront planning district.

Phosphorus Trading Plan, Ecological Consulting, Albany, WI, 2018.

Evaluating options for satisfying the Phosphorus Credit Needs of the Village.

Ecological Consulting, Hawaii Sugarlands, 2017.

AES conducted: 1) a natural resources inventory of the entire property to identify rare or restorable habitats for protection and restoration; 2) a watershed hydrology assessment to identify ditching and other irrigation infrastructure needed for future agricultural activities and water supplies; and 3) an assessment of the soils as well as agricultural productivity and production capacity.

Dead Pike Lake, Development Natural Areas Management, Water Systems Consulting, 2017.

AES contributed to improving technical understanding of Powell Marsh Pike Lake hydraulic, hydrologic, water quality, and eco-toxicity issues. Assisted in design solutions to incorporate into the management plans for Powell Marsh/Dead Pike Lake.

Katy Prairie Eco-Vision, 2016. AES provided ecological consulting services in three phases: 1) Define an ecological value of Katy prairie land holdings for ~20,000 to ~50,000 acres; 2) Develop and deliver a strategy based on the valuation, to protect KPC lands now and in the future; and 3) Develop and deliver a strategy for mobility that protects and expands the land and offering to protect Katy Prairie ecosystem and existing KPC lands.

777 Bison Ranch Soil Carbon, 2016. AES provided conducted a soil carbon sequestration, water infiltration and vascular vegetation baseline assessment for a bison ranch near Hermosa, South Dakota. AES focused on sampling and measuring baseline soil carbon levels in the grasslands grazed by bison, comparing various settings, site conditions, bison grazing habits, and conditions of the land. The baseline measurements data was used to calculate the contribution to greenhouse gas (GHG) emissions and improvements in soil carbon levels, created under the bison grazing program.

AGGP Grazing & Soil Carbon Sequestration, Canada, Vancouver Park Master Plan, 2016.

In this study, scientists measured whether Adaptive Multi-Paddock improves: (1) soil organic carbon stored; 2) water infiltration rates; and 3) the diversity of vegetation in the paddocks – when compared to the two continuous grazing regimes.

Chica Two Fish Island (SWA), 2016. AES invited to team with SWA Group (SF office) serving as a consultant to cooperate with SWA to provide soil analysis and remediation/planting strategy for the project (soil report will be provided by the client).



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MAJOR CONSULTANTSHIPS, AWARDS, FUNDED PROJECTS, RESEARCH GRANTS & FELLOWSHIPS *(continued)*

Dix Park Plan, Master Planning, 2016. AES created a framework for a park that serves Raleigh and the surrounding areas, and is a draw for a national audience. The Master Plan will guide future design work in improving connections with adjacent and distant neighborhoods; establishing programs that build the park's constituency while meeting existing needs; improving the ecological and infrastructural functionality of the site; honoring the historical legacy of Dorothea Dix and Dix Hill; and creating mechanisms for sustaining the new park for future generations in the context of a growing metropolitan area.

Tulsa Mitigation, Construction Oversight and Monitoring, Tulsa Blair Ponf WQ Study, Ecological Consulting, 2014, 2016.

UT Waller Creek Framework, Urban-Green Infrastructure Design, 2016. AES was retained by Michael Van Valkenburgh and Associates (MVVA) to provide ecological recommendations to the design and ensure that proposed restoration and improvements were ecologically appropriate, technically feasible, and contributed to the project's many goals. Big Red Dog Engineering provided utility and infrastructure services for the project.

Colombia Watershed Planning, 2015. Industrial Ecology Capital Management Business Development collaboration to contribute to the development of opportunities for water treatment and reuse, watershed master planning, watershed ecological-restoration and ecology and water sensitive agriculture enterprise opportunities.

Riverline (Hoerr Schaudt), Urban-Green Infrastructure Design, 2015.

Denton Landfill Site Master Plan, Landfill End-Use Planning, 2015.

O'Brien Ranch / Patagonia Ranch Soil Carbon Sampling, 2015. Patagonia contracted with AES to understand the baseline soil carbon levels on the O'Brien Ranch in South Dakota. AES focused on sampling and measuring baseline soil carbon levels in upland terrestrial grasslands now being grazed by bison that is used to create a Patagonia Bison Jerky project line.

Lihue Airport Wildlife Hazard Assessment, Lihue, HI (Island of Kauai) 2015. AES was contracted to conduct an FAA assessment of wildlife populations (diversity, abundance, seasonal movements, and habitat preferences) and a thorough review of wildlife attractants on and around the Airport Operations Area (AOA) at the Hawaii Lihue Airport. The year long assessment and survey schedule produced sound solutions to minimize and/or eliminate current hazards. The project required that AES staff were certified by the FAA to conduct the assessment.

Shell Alberta, Canada Ranch Soil Carbon Pre-Sampling, 2015.

K2/Alverson Farm Soil Carbon, 2015. AES focused on sampling and measuring baseline soil carbon levels in K2 Farms lands. For comparison purposes, various settings on the K2 Farms that represent differing site conditions, lengths of time in various tillage methods, and antecedent tillage and cropping conditions of the land prior to commencing these activities will be identified and sampled on the property. The baseline measurement data will be used to calculate the contribution to greenhouse gas (GHG) emissions and improvements in soil carbon levels, created under the current tillage program. These same data will then be used to monitor future GHG and climate mitigation strategies as improved soil carbon levels.

Salt Lake City Open Space Lands Program, 2015. AES worked with the Salt Lake City Open Space Lands Program to develop a comprehensive Natural Lands Stewardship Plan for 1,200 acres of city-owned park property. This baseline study provides OSLP with a scientific basis to manage their natural lands for lower cost management and improved ecological and cultural conditions.

Palouse Shepherd's Grain Agricultural Production, 2015. As part of a project team, AES researched Palouse Shepherd's grain agricultural production. The team received grant funding from the USDA-NRCS Conservation Innovation Grant Program to measure and quantify soil health through a rigorous scientific process, emphasizing soil carbon and nitrogen levels on Palouse area agricultural soils.

Clean Wisconsin, 2014 - 2015. AES was retained by Clean Wisconsin to evaluate the ecological impact of the American Transmission Company Morgan Station to the Appleton, WI, (ATC 137) power line program. AES evaluated the site by conducting low aerial flights, performing on-the-ground wetland surveys, assessing the Right-of-Way (ROW) for potential of Threatened and Endangered (T&E) species occupation, and evaluated the environmental impacts of various ROW options reviewed by the applicant. AES prepared testimony in support of alignments using the ecological understandings gained from the field work.

Thoughtful Balance Urban Development, 2014. AES was retained by Thoughtful Balance architects (Pittsburgh, PA) to help in early due diligence and development planning for a 130-acre urban development, "Village Farm Site." AES performed a preliminary evaluation of the site's geology, hydrology and ecology, and worked to develop plans for evaluating the potential for using the site for urban farming, housing, and park uses.

Sasaki Associates, 2013 - Ongoing. As AES Project Director, worked closely with design team led by Sasaki Associates to create a master plan for the University of TX campus near Waller Creek, an urban stream flowing through downtown Austin (TX). AES provided recommendations to improve stream stability and contributed to naturalized stormwater management techniques.



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MAJOR CONSULTANTSHIPS, AWARDS, FUNDED PROJECTS, RESEARCH GRANTS & FELLOWSHIPS *(continued)*

SEH Engineers, 2013 - 2014. AES was retained by SEH engineers (Minneapolis, MN) and the City of La Crosse (WI) planning department as the team ecologist to design the La Crosse riverside redevelopment north of the City's downtown. This process involved a one-week design charrette with community stakeholders, and an expanded design team that resulted in the creation of a development and conservation plan for this property.

Soil Carbon and Climate Change, 2013 - 2014. AES was retained and partnered with Peter Byck, film producer at the AZ State University, Walter Cronkite School of Journalism, under a grant from Shell "Gamechanger," to evaluate the potential role of soil carbon in addressing climate mitigation needs on earth. This process involved extensive interviewing of thought leaders around the USA and elsewhere in the world. From there, the team took the 2,000+ ideas shared by others and refined them to develop 20 business models to advance the understanding and role of soil carbon in addressing climate mitigation needs.

Manning Architects, 2013. AES was retained by Manning Architects (New Orleans, LA) to assist in the design of a new airport terminal at the Louis Armstrong International Airport in New Orleans. AES worked with architect teams and airport designers to evaluate ways to incorporate regional ecological, cultural and architectural characteristics into the design of the new terminal. This process involved interviewing a diverse suite of stakeholders, analyzing the ecological setting, and designing indoor and outdoor place-making. The design integrated art, culture, and ecology, using native vegetation and alternative stormwater management, to tell the story of this great city and region.

Max Environmental, 2013. AES was retained by Max Environmental to evaluate the potential to use alternative ecological restoration strategies to manage landfill leachate and stormwater. For two landfills, AES prepared conceptual leachate biofilter programs and alternative stormwater management programs. The plans addressed existing and post-closure operation and management cost-saving strategies, such as eliminating the water treatment plants and converting landfill plantings to long-lived, durable native vegetation systems.

Forever Green Real Estate Company, 2013. AES was retained by Forever Green Real estate company (Atlanta, GA) to manage, evaluate, and advance the protection of the Donald Shooke properties near Rome, GA. AES worked with the Shooke family to develop and impress a conservation easement in favor of a southeastern U.S. land trust and worked with the family to ensure tax deductions were obtained through the IRS. This project protected an important property with Native American heritage, groundwater springs and streams, and which provided a buffer to an adjacent national forest/ national wilderness area.

MICA Environmental, 2012. AES was retained by MICA Environmental (France) to develop a biodiversity evaluation manual containing standard operating procedures to be used by hard rock mining companies when evaluating and screening sites for potential mines. This manual included GIS analytics to evaluate and prioritize land being reviewed for a potential mine to avoid impacts to biodiversity. The manual also has standard procedures for developing mitigation programs for adverse unavoidable impacts to biodiversity that may be result from proposed mining projects.

Quaterra Mining Company, 2012. AES was retained by Quaterra Mining Company (Yerington, NE) to conduct ecological inventories for threatened and endangered plant species and for select wildlife species associated with the six-thousand-acre MacArthur copper mine. AES authored the technical report that is being used to develop the mining permitting package for expanding this mine.

BP, 2012. AES was retained by BP through a grant award to TEP, LLC to evaluate the potential for harvesting invasive woody plant biomass as a part of gulf coastal wetland restoration. AES performed detailed analyses of the caloric and chemistry signatures of specific woody (Chinese Tallow, Chinaberry trees) and non-woody (*Phragmites*, among others) invasive plant species found on levees, dykes, and also colonizing the coastal wetlands. As a part of this program, AES flew the entire gulf coastal wetlands from Corpus Christi, TX, to Mobile, AL, and mapped the highest-density areas of colonization of these invasive species. AES also visited representative areas of these high-density colonies and collected samples of the plant tissue for plant caloric, ash, chlorine, salt, and other chemical analysis.

Michael Van Valkenburgh & Associates , 2011 - Ongoing. As AES Project Director/Senior Ecologist, worked closely with a national design team led by Michael Van Valkenburgh & Associates to re-think and re-design Waller Creek – a degraded urban stream that flows through downtown Austin (TX). AES' contributions focused on streambank stabilization, re-vegetation strategies, restoration of aquatic habitats, and naturalized stormwater management.

50-Acre Riverside Park, 2011 - Ongoing. AES teamed with Michael Van Valkenburgh & Associates (MVVA), winning a competition to design an innovative, 50-acre riverside park in Tulsa, OK. Funded by the George Kaiser Family Foundation, the park will include a recreational pond, lawns, gardens, extensive playgrounds, trails, and athletic facilities. As AES Project Director/Senior Ecologist, worked closely with the design team to model the pond (Blair Pond) and ensure it has high-quality water (enhanced with a recirculation and wetland filtration system). AES also contributed to naturalized stormwater management techniques as well as design and permitting of the mitigation area, which will entail restoration and enhancement of >10 acres of riparian habitats along the Arkansas River.



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Route 53/120 Consulting (Burke Engineering), 2011 - 2014. AES was retained by Illinois Toll Highway Authority and various subcontractors to help design and advance a conservation design for a 22-mile Tollway extension for IL Route 53 in Lake County, IL. AES did the conceptual design for a state-of-the-art "conservation roadway" utilizing alternative strategies for stormwater management, deicing (not using any salts), and in-pavement LED lighting. AES also prepared a detailed program and budget plan for habitat mitigation, land conservation, and land stewardship, and contributed to the creation of an endowment of \$80 million dollars for unforeseen impacts to regional ecology.

BP and Atlantic Richfield, Wetland Mitigation, 2011 - 2014. AES was retained by BP and Atlantic Richfield to assist in the design of a wetland mitigation program for the Anaconda/Butte, MT, Superfund sites. AES designed and implemented a comprehensive wetland analysis process and helped secure agency support and approval for the protection and enhancement of the ~3,900-acre Dutchman wetland to satisfy some of the requirements associated with previous copper mining impacts at this site. AES helped prepare the restoration, management and monitoring plans, and also helped negotiate with the federal agencies to accept the program to satisfy mitigation requirements.

Clare Family, Conservation Community, 2010. AES was retained by the Clare Family to evaluate the design a conservation community on a property containing a cold-water trout stream and other sensitive resources. AES designed the development/infrastructure plan, worked with the local land trust to protect important open space resources, and designed an alternative stormwater and ecological restoration program for the site. AES helped obtain all approvals for this conservation community located in Platteville, WI.

Organic Valley, Organic Dairy vs Conventional Dairy on Soil Health, 2010. AES was retained by Organic Valley to evaluate the differential effects of organic dairy production versus conventional dairy production on soil health, soil carbon and greenhouse gas emissions. AES evaluated soils on Organic Valley members' dairy farm fields in WA, VT, and WI, and compared these with reference areas containing unaltered soils and in conventional dairy farm field soils across the fence from Organic Valley operations.

U.S. Department of Energy, 2009 - 2014. AES was awarded a grant from the U.S. Department of Energy to determine the value and use of constructed wetlands to provide auxiliary water-cooling functions for coal-fired power plants. AES performed a detailed literature review, model development and model calibration. This involved creation and instrumentation of a 15-acre wetland through which heated power plant effluent waters were routed. We were able to achieve an 8-15 degree Fahrenheit cooling benefit, a 2-point pH drop with the demonstration wetland. AES' partner Duke Power is constructing a 256-acre scaled-up demonstration cooling wetland. The team learned that wetland cooling is practical, more efficient and cost-effective, as it is significantly less expensive than cooling towers.

Newmont Mining Company, 2009 - 20011. AES was retained by Newmont Mining Company to evaluate options for reclamation of the Yanacocha gold mine (Cajamarca, Peru), the largest gold mine on earth. After conducting extensive bilingual interviews with local individuals and organizations, AES and partners prepared a conceptual plan for closing the mine and converting it to a new "High Andes National Park." This recommendation continues to be in discussion at this time.

Sustainable Food Laboratory, 2009. AES and the Sustainable Food Laboratory (VT) received a grant from the Packard Foundation (CA) to evaluate soil carbon in Heinz tomato production land in CA, lands managed for improved livestock grazing by Country Natural Beef Coop in OR, and Shepherds Grain in WA. This screening level study documented that, when done correctly, Shepherds Grain and the grazing programs created a net improvement in the carbon levels in soils.

Middlebury College, 2009. AES was retained by Middlebury College (Middlebury, VT) to assess their supply of biomass stock, used to fire up the college gasifier for campus district heating. Work included detailed vegetation mapping, soil carbon measurements and preparation of a comprehensive assessment of the college firing fuel supply and greenhouse gas emissions. AES also provided alternative fuel supply suggestions for the college to grow their own biomass on their rental farm lands, helping them to achieve carbon neutrality.

The Earth Partners, LLC., Soil Carbon Study, 2008. Working with The Earth Partners, LLC, AES measured soil carbon on large ranches and reserves in Chile, Argentina and Costa Rica. AES performed carbon sampling demonstrations and testing on a 170,000-acre ranch in Patagonia, Chile, and a 700,000-acre ranch in Argentina. AES worked with noted ecologist Dan Janzen to measure soil and vegetation standing crop carbon in a protected reserve of dry tropical forest in northeastern Costa Rica.

Urban Design Institute, Essar House, 2008. AES was retained by Urban Design Associates (Pittsburgh, PA) and Essar House (Mumbai, India) to design a new city in Jamnagar, India. AES provided planning services related to land, ecology, comprehensive stormwater and utilities and restoration for the highly-disturbed landscapes selected as the location for this new city. The planning effort involved several weeklong design meetings trips to India to work with local architects and engineers in addition to Essar House Oil Company management team and owners.



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MAJOR CONSULTANTSHIPS, AWARDS, FUNDED PROJECTS, RESEARCH GRANTS & FELLOWSHIPS *(continued)*

Big Darby Accord Master Plan, 2008 - 2009. AES was retained by the City and County of Columbus (OH), to assist Urban Design Associates (Pittsburgh, PA) in the development of detailed master plans for the Big Darby Accord planning area southeast of Columbus. AES provided the alternative stormwater management and design, the ecological restoration planning and design, and assisted in the design of development plan layouts for the several thousand acres of land included in this area. AES also assisted in obtaining OH EPA and U.S. Army Corps of Engineers approvals for the master plan.

City Creek Mall, 2007 - 2012. AES was retained by SWA Planners (San Francisco, CA) to assist in the ecological design of the City Creek Mall project in Salt Lake City, UT. AES was specifically involved in the design of the stream and native plantings within the open-air mall. AES measured reference-area mountain streams and developed the native planting palette through stream inventories conducted along City Creek and reference streams emanating from the Wasatch Front in Salt Lake City. The mall and the restored stream, which contains large cutthroat and rainbow trout, has become an esteemed amenity and cultural destination.

Wisconsin Dells Development Proposal for Cambria Resort, 2007. AES was retained by Garvey Law Firm (Madison, WI) to evaluate the WI Dells development proposal for Cambria Resort. AES was then retained to document and prepare expert testimony and support litigation against this project based on the ecological impacts AES documented as concerned with the project. AES' team won the case, which resulted in significant changes to the design of the project and the eventual withdrawal of the developer's application.

Restoring Soil Carbon to Address Climate Mitigation, 2007 - Ongoing. AES and two investors founded The Earth Partners, LLC (TEP) to explore ways to connect markets, policies, and science around the importance of restoring soil carbon on earth to address climate mitigation. AES contributed to the authorship of the first standard measurement method for soil carbon and other greenhouse gas emission from agricultural, conservation and restoration lands, which was approved through the double validation process with the Verified Carbon Standard (VCS) Association. AES also created the value proposition and need for the harvesting of invasive woody plant biomass as a part of the restoration of grasslands and spun off The Earth Partners, LP, and converted The TEP, LLC into a new organization, The Soil Partners, LLC (TSP). Under TSP, AES undertook large projects in North, Central, and South America to measure soil carbon at landscape scales. These projects provided proof of the practical and cost-effective VCS TEP method from diverse field settings. TEP, LP has received a secondary round of investor financing and AES is a service provider in support of the TEP, LP conservation biomass ventures.

Illinois Natural Areas Inventory, 2007 - 2011. AES helped to conduct a statewide natural areas inventory in the state of Illinois in collaboration with the IL Department of Natural Resources, the IL Natural History Survey and the University of Illinois. The project included identification of new natural areas and development of a digital database including ecological community maps, quantitative vegetative data and assessment data regarding natural community quality.

Redevelopment and Reuse of Don Lands, 2007 - 2010. AES was part of the winning team led by Michael Van Valkenburgh Associates for an international competition sponsored by the Toronto Waterfront Corporation to design the redevelopment and reuse of the Don Lands, a large area of eastern waterfront in the city of Toronto (Ontario, Canada). Of the competition's 126 total entries, AES staff members were on not only the winning team but also two of the other four finalist teams. AES provided ecological, hydrological and other expertise related to Don Lands' river mouth design and harbor lands redesign.

Rockcliffe Community Restoration and Redevelopment, 2007 - 2009. AES was hired by Canada Lands Company to assess restoration and beneficial redevelopment of Rockcliffe Community, a former Canadian military base in Ottawa, Canada. As part of a team including Greenberg and Associates (Toronto) and others, AES took a leadership role in assessing geological issues, stormwater recharge and stormwater planning needs and in the design of daylighting a formerly buried stream and associated wetlands and other restoration elements as a central organizing feature of this new green development east of the downtown. This project is slated to be the most integrated and innovative high-density developments in Canada.

Saskatchewan River Life Cycle Analysis, 2007. AES was retained by Scientific Certification Systems of Oakland, CA, to perform a development of life cycle analysis for Saskatchewan River Hydropower operations, Saskatchewan, Canada. AES evaluated the ecological impacts of the multiple hydropower operations on the Skagit River and operational impacts in riparian and in-stream fish and other biotic communities. This analysis was used, along with greenhouse gas emission data and material impacts associated with construction and on-going operations, to prepare and score the life cycle costs of these operations.

Flambeau Copper Mine, 2007. AES was retained as an expert witness to assist Flambeau Mining Company in obtaining regulatory approval that its 190-acre Flambeau copper mine was reclaimed successfully under Wisconsin's rigorous mining laws. AES, along with attorneys from Dewitt and Ross, Foth and Van Dyke, and others were successful in obtaining the first accepted closure for a heavy sulfide ore mine in Wisconsin. Flambeau Mine was also one of only a few mines in the country to meet the U.S. Environmental Protection Agency's stringent national environmental requirements.



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MAJOR CONSULTANTSHIPS, AWARDS, FUNDED PROJECTS, RESEARCH GRANTS & FELLOWSHIPS *(continued)*

Viridian Development, Natural Resource Management Plan, 2006 - 2014. As AES team member, helped to develop a Natural Resource Management Plan for the Viridian Development, a 2,000-acre residential conservation community lying within an urbanized landscape and also bordering natural areas along the West Fork of the Trinity River in Arlington, TX. AES worked with developers, site managers, and Audubon International staff to facilitate achievement of Signature Gold Certification through Audubon International—the first such in Texas—in recognition of planning and construction efforts that significantly reduce environmental impacts and conserve valuable natural open space throughout the life of the development.

City of Albany's Rapp Road Landfill, Albany, NY, 2006 - Ongoing. AES provided assistance in the development of conceptual and detailed ecological restoration and mitigation plans associated with expansion plans for the City of Albany's Rapp Road Landfill, Albany, NY. AES was retained by the city to develop and coordinate integrated plans with the adjacent Albany Pine Bush Reserve, working with the Pine Bush Commission, The Nature Conservancy, and numerous others. AES conducted detailed quantitative ecological, hydrological and water quality assessments of impact areas and proposed restoration locations and contributed to the development of an EIS through the NY State Department of Environmental Conservation SEQUR process. The plan involves over 200 acres of restoration, including an additional ~100 acres of conversion of the eventual landfill cap to restored pine bush community to support special status butterflies and many other federal and state special status plant and animal species.

Representative of Village of Prairie Grove (IL) in the redesign and negotiation of the improved design with the developer, Westminster Swanson, 2006 - 2014. AES was retained by the village to take a leadership role in redesign of this 1,200-acre mixed-use conservation development to make it a national model project. The final design included nearly 800 acres of open space, restoration plans, and restoration funding commitments, a new metro train station and new town center, and a pedestrian trail network throughout the community. As a result of the redesign, the developer was granted a density bonus and considerable flexibility, and approval of the redesign won unanimous approval by citizens and policy makers. AES led the redesign of the layout, plat, stormwater management, restoration, park and trail design, and contributed to the covenant to ensure the future of this project.

Avian and Bat Surveys, Huron County, MI, 2006. AES was retained to assist RMT, Inc in the siting of a wind power facility in Huron County, MI. AES was directly involved in assessing potential migratory bird, raptor, and migratory bat impacts of the proposed wind farm. To do this, AES conducted extensive avian and bat surveys of the proposed 25 square miles included in the wind farm.

Andamogo Watershed, 2005 - Ongoing. Andamogo Watershed, neo-tropical migratory bird grant recipient for co-developing and implementing restoration projects in mangrove, riparian-gallery forests, and dry tropic forests of Guanacaste province, Costa Rica. The project involved baseline condition assessment of the 10,000-ha watershed, development of a conceptual restoration plan for the entire watershed, and detailed plans to be implemented by local citizens, including using grant funds to hire a local watershed director. This project won the Rainforest Alliance's award for best monitoring and science-based restoration plan in 2006.

Conservation and Restoration Development, Pennsauken, NJ, 2005 - Ongoing. Assessment of very complex oil refinery and dredged disposal island in the Delaware River, Pennsauken, NJ, for Cherokee Northeast, LLC, involved in evaluating cleanup, redevelopment and conservation uses of the island. AES was retained to evaluate conservation, restoration and conservation development opportunities for the property and to participate in a public process to help develop consensus around a conceptual plan to restore 70% of the island's open space. This was a less expensive and more effective strategy to clean up site conditions to contribute to ecological and human health.

Seneca Meadows Landfill, Seneca Falls, NY, 2005 - Ongoing. Provided assistance in development of conceptual and detailed ecological restoration and mitigation plans associated with the expansion plans for the Seneca Meadows Landfill, Seneca Falls, NY. AES was retained by the landfill company, SMI and IESI, to develop and coordinate integrated plans with numerous agencies, NGOs and citizens, which resulted in the approval of 70 acres of impact to existing degraded wetlands within the expansion footprint (old clay borrow sites grown back to wetland) and the restoration and protection of over 1,200 acres as mitigation for impacts. AES conducted detailed quantitative ecological, hydrological, and water quality assessments of impact areas and proposed restoration locations. AES also contributed to the development of an Environmental Impact Statement through the NY State Department of Environmental Conservation SEQUR process. The plan involves over 850 acres of restoration, including an additional 350 acres of enhancement of degraded existing forested floodplain community to support special status species, including Indiana Bats.

Sandler Company and LRK, Indigo Dunes Waterfront Development, Virginia Beach, VA, 2005 - Ongoing. AES was retained by the Sandler Company and LRK to provide design considerations and engineering services for the Indigo Dunes waterfront development in Virginia Beach, VA. AES provided ecological, alternative stormwater management concepts and some engineering services to both prepare and participate in a community charrette process for this very high-density coastal waterfront project. AES changed the nature of the community by determining that instead of land-consuming detention ponds, the void space in sand-backfilled soils could be used to raise the location of the land to provide water volume management. We also designed a wetland mitigation program that integrated an overall site restoration program.



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Johnson Creek Restoration, Arkington, TX, 2005 - Ongoing. AES was hired by Steiner and Associates, the Dallas Cowboys, and the Texas Rangers (baseball team) to assist in the planning, design, permitting, and other elements of the move of the Dallas Cowboys team stadium from Irvine to Arlington, TX. The project also involved creation of the Johnson Creek corridor restoration between the stadium and the Glory Park lifestyle center new town development. AES provided stream restoration design and engineering, permitting, and fundraising for the restoration. AES continues to monitor the restored Johnson Creek stream corridor.

Seegmiller Marsh Restoration, St. George, UT, 2005 - 2006. Design of conceptual plan for Seegmiller Marsh Restoration, St. George, UT, with Natural Channel Design. AES was retained to assist in development of restoration plans for this marsh on the Virgin River, and to include recreational and wildlife observation opportunities. AES co-conducted the field work in support of the planning and worked with a local water utility to develop plans.

Wood-Tikchik State Park, Dillingham, AK, 2005. Ecological assessment and appraisal of the ecological values of 107 private Native American in holdings in the 1.7 million-acre Wood-Tikchik State Park, Dillingham, AK. Working with The Conservation Fund (TCF), AES received a grant from the AK Coastal program and US Fish and Wildlife Service to visit and document the conservation value of each of the in holdings in this remote wilderness area, reachable only by canoe and float plane. The conservation strategy plan served as the basis for a Gordon and Betty Moore Foundation Grant received by TCF for protection of the highest priority lands.

Wheeler Road Quarry, Rockford, IL, 2004 - Ongoing. Assistance in siting, design, and defense of the Wheeler Road quarry for Quality Aggregates of IL, Rockford, IL. AES was retained to assist in design, permitting, and legal defense of a limestone quarry operation near Belvidere, IL. AES provided technical design, evaluated effects, and designed and implemented mitigation for potential effects on the adjacent IL Flora Nature Preserve, and designed the eventual closure plan for the quarry to be a 100-acre complement to the 10-acre preserve, through restoration of vegetation systems in buffers around the quarry and creation of reclaimed landscapes such as waste rock and overburden slopes to native prairie vegetation.

Penterra Conservation, Carlisle, PA, 2004 - Ongoing. Penterra conservation and traditional neighborhood development, Carlisle, PA. AES was retained to design the open space, conservation, restoration and stormwater management plans and to obtain approvals for each plan for this 900-acre development. The project's stormwater management program served to undergird PA's new stormwater management policies, which are encouraging alternative strategies such as AES' trademarked Stormwater Treatment Train.

Stormwater Management, Kansas City, MO, 2004 - 2007. AES was subcontracted through Black and Veatch Engineering to participate in the development of a new stormwater management policy (called "KC-1"), funding, and on-the-ground practical package of alternative lower cost solutions for the City of Kansas City, MO. Called KC-1, AES and the team helped to develop a region-wide program for strategically deploying green solutions to address stormwater management functions. This project was supported by the City.

Bear Creek Development, Columbia, MO, 2004 - 2006. Assessment, leadership, design, alternative stormwater engineering, restoration planning, open space, and conservation planning and assistance in entitlement for a co-op traditional neighborhood housing and conservation development plan with the Sherri DeRouse family at Bear Creek development, Columbia, MO.

Development Camden, NJ Greenway, Camden, NJ, 2004 - 2005. Development of Camden, NJ, greenway with Trust for Public Lands. AES was retained to provide GIS and field support to identify, evaluate and prioritize each of the potential parcels needed to create an urban greenway system for this city. We also identified and designed several example start-up projects where the priority parcels could be used for providing alternative stormwater management benefits to solve existing stormwater problems.

Brownfield Field Mine Site Redevelopment, New Morgan, PA, 2004 - 2005. New Morgan traditional neighborhood redevelopment (~600 acres) of a brownfield mine site and industrial site, New Morgan, PA. AES was retained by Arcadia Land Company to design the stormwater management system; prepare the associated engineering plans; conduct endangered and threatened species inventories and natural resources inventories; assist in the design of mined-feature reclamation needs (e.g. beneficial re-use of a tailing basin and waste materials piles, etc); integrate alternative stormwater management into restoration plans and open space conservation plans; and assist in obtaining state, federal, and local entitlements.

Zaca Preserve Conservation Development, CA, 2004 - 2005. AES was retained by Terravant Land Company (Solvang, CA) to design the Zaca Preserve conservation development. AES conducted natural area inventories, prepared and implemented a community charrette to developed consensus around the potential conservation development with neighbors, and worked with regulators to obtain approvals for early submitted plans.



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Land-Use/Water Relations Evaluation, Santa Barbara County, CA, 2004 - 2005. AES conducted detailed evaluation of the land-use/water relations and value of the agricultural operations for 8,000 platted lots in Santa Barbara County, Santa Ynez Valley, CA. This investigation documented that larger lots were not producing the most valued or highest volume of agricultural commodities and were using the most water, and smaller farm operations were the most productive, profitable and had the highest valued specialty crops (and used less water). In addition, the Zaca Preserve project, a conservation development, was found to have a net contribution to ground water recharge unlike all other developments at all other residential platted parcel scales.

Mallard Ridge, Landfill Expansion Development, Delavan, WI, 2004 - 2005. Development of landfill expansion plans for Republic Services, Inc at their Mallard Ridge operations, Delavan, WI. AES was retained to evaluate current operations and modify previous land management, restoration, and monitoring program plans in preparation for new submissions for a landfill expansion.

Life Cycle Analysis of Hydropower Operations, Skagit River, WA, 2004. Development of life cycle analysis for Seattle Power and Light's Skagit River hydropower operations, WA. AES was retained by Scientific Certification Systems of Oakland, CA, to evaluate the ecological impacts of multiple hydropower operations on the Skagit River and operational impacts in riparian and in-stream fish and other biotic communities. This analysis was used, along with greenhouse gas emissions and material impacts associated with construction and on-going operations, to prepare and score the life cycle costs of these operations.

Regent Park, Toronto, ON, Canada, 2004. Technical reviewer in design and development of the new urban community of Regent Park, Toronto, Canada. AES was retained to provide technical review for the Toronto Community Housing Corporation's design process for this very high-density urban development. AES focused on steering the design to incorporate ecological solutions for stormwater management, sanitary water management, energy savings and production using photovoltaic systems, and in-energy conservation strategies. This development is a Canadian model for green re-development of a former brownfield site.

Ecological and Stormwater Management Design, Amherst College, MA, 2004. AES was retained by architect Perkins Eastman to provide ecological and stormwater management design engineering for a 40-acre conservation development for returning alums to Amherst College, MA. AES worked closely with the team in addition to college professors and administrators, and local technical experts to develop development and ecological plans. Plans included restoration of streams, floodplain forests, and other habitats, and creation of teaching opportunities for students and curricula at the college.

Carbon Sequestration, 2003 - Ongoing. With 12 other partners, prepared a detailed carbon sequestration regional partnership proposal for the U.S. Department of Energy to utilize terrestrial ecosystems and land management alternatives in agricultural settings for sequestering carbon to alleviate carbon dioxide emissions and global warming.

Habitat Conservation Plan, IL, 2003 - Ongoing. Development of Habitat Conservation Plan (HCP) and foundation scientific investigations for the Federally endangered Hines Emerald Dragonfly (HED), and state listed species—bog and Blanding's turtles, and leafy prairie clover. AES, working with Hanson Material Service, the U.S. Fish and Wildlife Service, the Army Corps of Engineers, and the IL Department of Natural Resources, prepared a "roadmap" for development of a multi-species multiple-partner HCP covering nearly 23,000 acres of tributary watershed (surface and presumed ground water recharge areas) to offer protection to springs and their water sources that are utilized by HED. AES prepared proposals and received for the process a \$370,000 grant from the USFWS to engage communities having jurisdiction over tributary lands in the process. Primary partners included Midwest Generation, Commonwealth Edison, and Hanson Material Service. Secondary partners included each surrounding municipality, departments of transportation, Port Authority, Lewis University, Will County Forest Preserve District, rail organizations, and others.

Habitat Conservation Plan, Romeoville, IL, 2003 - Ongoing. Development of science basis and restoration planning for Hanson Material Service (HMS) company land holdings, Romeoville, IL. AES conducted detailed habitat mapping, Threatened and Endangered species surveys, wetland mapping, surface hydrological analysis, historic analysis of changes in ecological conditions to develop restoration, and land management plans for inclusion in Habitat Conservation Plans necessary for HMS to potentially obtain mining permits and wetland impact permits. As a part of the compensation for mining impacts on habitat, HMS may protect and restore nearly 800 acres of critical habitat for federally endangered animal and plant species, and perpetually commit finances to support science based stewardship and monitoring. Through the HCP process, HMS will also partner with other landowners to increase the area of protection and restoration into other parcels.

Ecological Consultant, Hanson Material Service, Romeoville, IL, 2003 - Ongoing. Consultant to Hanson Material Service (HMS), Romeoville, IL, to evaluate the conservation potential for properties owned by this corporation. The work involved detailed field examination of a dozen sites followed by prioritization of conservation benefits and outcomes. Restoration plans, cost appraisals, and proposals were prepared so that HMS could evaluate their conservation vision.



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Stormwater Management, Kansas City, MO, 2003 - Ongoing. Consultant to Black and Veatch Corp., Kansas City, MO, awarded the Kansas City Metro KC-One Project to develop integrated stormwater management plans for 33 watersheds in the Kansas City metro area. With Patti Banks Associates and other partners, AES is insuring that green stormwater management planning is a prime focus of the effort.

Inspiration Conservation Development, Bayport, MN, 2003 - 2006. Provided technical support, entitlement support and restoration contracting services for the Bayport, MN, Inspiration Conservation Development. AES was retained to stem controversy between the CPDC company over past development proposals for the 325-acre parcel and to design this project as a very environmentally-sensitive conservation development. AES designed the layout, plat, alternative stormwater management, restoration and landscaping plans, grading plans, and was a lead in the entitlement process that resulted in this project gaining approval. The project integrated a state scientific area, Indian burial mounds, reduced existing down-gradient flooding, and connected public lands and trails. The resulting project protected and restored nearly 200 acres as a public amenity.

Open Sapce Tax Review, IL, 2003 - 2006. Development of ecological assessments in support of Open Space Tax review for large corporate campus lands in the Chicago region for O'Keefe, Lyons, and Hynes, Attorneys. AES was retained to evaluate under IL tax code and open space definitions if open space lands included in large corporate campuses in Illinois met the open space tax code definitions, and if so, what property tax relief might be provided as a result. AES' assessment provided the precedent case for these large landowners to receive tax relief. This work was conducted for Square "D", Quaker Oats, Motorola, Allstate Insurance, and other large landowning corporations.

Stream Asset Inventory, Johnson County, KS, 2003 - 2005. Technical assistance in development and deployment of stream asset inventory for Johnson County, KS. AES was retained to develop the stream assessment inventory process for the entire county, working closely with the county board and public to develop ordinances and programs for protection, buffering, stewardship and finance, and mapping the conditions of all streams in the county to show current conditions. These maps were incorporated into zoning and ordinance regulations to offer water quality and stream protection in the future.

Sahbra Farms, Streetsboro, OH, 2003 - 2005. Retained by GSI Architects and Sahbra Farms, Streetsboro, OH, to evaluate the opportunities to develop a unique town center and integrated open space reserve system. AES provided GIS analysis, natural resource mapping of the 320 acres of property and the 25-square-mile town, stormwater management planning and expert services related to the design and public review process.

Natural Resource Inventory Plan and Conservation, Kansas City, MO, 2003 - 2005. Retained by the Mid-American Regional Council and other partners—including the U.S. EPA—to develop a single, unified Natural Resource Inventory Plan and Conservation Vision for the 4,000-square-mile Kansas City metropolitan area. AES developed the methodology and implemented the remote sensing, GIS analysis and detailed field inventory work. Participated in the public design process, providing workshops for both professionals and community citizens. Developed public policy information to assist all communities in the metro area with understanding the usefulness of the natural resource inventory products. AES developed a single, unified stream and waterway buffer vision plan for the entire metro area, coordinated the products from the natural resource inventory with the KC-One process to understand "green" stormwater management strategies, and provided a natural resource basis for rethinking stormwater management planning.

Watershed Analysis, Jackson County, MO, 2003 - 2004. Retained by Jackson County, MO, the City of Independence, MO, and Shockey Consultants Services to develop detailed analyses of three watersheds in Jackson County: one completely urbanized, one urbanizing, and one rural watershed. Evaluated alternative stormwater management needs, ecological restoration, and stream buffer needs and participated in the development of stream buffer ordinances and developed costing appraisals for a county-wide stormwater management program utilizing ecological restoration and land protection strategies.

Watershed Stormwater Master Plans, Jackson County, MO, 2003 - 2004. AES was contracted (with funding from a USEPA grant given to Jackson County, MO) to develop three model alternative watershed stormwater master plans, where previous conventional engineering master plans had been completed. This work, conducted for Jackson County Public Works, MO, was completed to evaluate the economic, hydrological, water quality, and flood damage reduction benefits of alternative stormwater management and watershed restoration.

Schubert Family Farms, Lafayette County, WI, 2003 - 2004. Retained by Duxstad, Vale & Bestul, S.C. to assist in evaluating stream impacts and designing stream restoration plans to mitigate and negotiate regulatory settlements for violations to about one mile of stream by the Schubert Family Farms, Lafayette County, WI. AES eventually was retained to oversee and implement the majority of the stream restoration activities.



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Wetland Permitting, Stormwater Management, Conservation Planning, Roberts, WI, 2003 - 2004. Consultant for County Materials Corporation, Roberts, WI, to assist in a concrete product yard expansion project by doing wetland permitting, alternative stormwater management design and conservation planning for the property. AES was successful in obtaining local and state permits for the expansion project, and developing a plan that significantly improved water quality and reduced runoff from this facility.

Hydrology and Development Infrastructure, Madison, WI, 2003. Retained by Tradewinds Business Center, Monona, WI, to evaluate the hydrology and development infrastructure of Outlot 55 along Highway 12/18 in Madison, WI. Conducted six months of surface and shallow groundwater hydrology and vegetation analyses, and assisted in the design of alternative development strategies for this former confined dredge facility.

Jim Cargill Estate and Portico Conservation Development, Minnetonka, MN, 2003. Consultant to Keith Waters & Associates in the redevelopment of the Jim Cargill Estate and Portico Conservation Development, Minnetonka, MN. Assisted in the development of conservation development plans that integrated important natural resources and created opportunities for the restoration of degraded areas, including the lawns, in the five-estate facility. AES' work included an ecological inventory, design, permitting, construction oversight, and restoration.

Life Cycle Evaluation of Limestone Generating Facility on the Nelson River, Winnipeg, Manitoba, Canada, 2003. Consultant to Scientific Certification Systems, Oakland, CA, and Manitoba Hydro-Electric Corp., Winnipeg, Manitoba, in the evaluation of the life cycle impacts and ecological costs of their Limestone Generating Facility on the Nelson River in Northern Manitoba. Provided ecological field services and a field review to assist in measurement of the ecological impacts of the hydropower facility.

Consultant and Expert Witness, Burnsville, NC, 2003. Consultant and Expert Witness retained by the Mountain Air Corp., Burnsville, NC, in review of litigation allegations and development of expert witness services and testimony. Formulated an erosion and sedimentation control plan and stream study for mountain streams potentially impacted by Mountain Air Golf Course.

Threatened and Endangered Species Surveys, McHenry County, IL, 2003. Retained by Tamarack Farms of Richmond, McHenry County, IL, to provide ecological planning for a 1,200-acre property. Conducted threatened and endangered species surveys, detailed wetland delineations, breeding bird surveys, and environmental planning and ecological restoration plans for protection, restoration and redevelopment of the entire landscape.

Rush Creek Watershed Management Plan, Platte County, MO, 2003. Retained by Rush Creek Partners Watershed Partnership Group in the Kansas City metropolitan area (Platte County, MO) to assist in development of a Rush Creek Watershed management plan and to facilitate formation of a partnership to work with adjacent landowners, corporations and others to implement the plan.

Jelkes Creek and Mink Creek, Wetland Mitigation Banks, IL, 2002 - Ongoing. Retained by Land and Water Resources, Inc. to design, permit, and construct two wetland mitigation banks in IL: Jelkes Creek Wetland Bank (Sleepy Hollow, IL) and Mink Creek Wetland Bank (Romeoville, IL). Both banks involved extensive field investigations, hydrology modeling, development and design for improved water quality entering these agricultural lands being restored to wetlands. Both were constructed in 2003. AES continues to monitor natural areas around Jelkes Creek.

South Milwaukee Public School District, South Milwaukee, WI, 2002 - Ongoing. Retained by the South Milwaukee Public School District, South Milwaukee, WI, to provide technical and regulatory assistance—and eventually native landscape construction implementation services—in the design and permitting of the development of a new \$45 million school complex in a former gravel quarry adjacent to sensitive woodlands and habitat for a state endangered plant and snake. AES prepared conservation plans pursuant to the regulatory requirements for the endangered animal and plant, and provided wetland permitting and wetland mitigation restoration. Consequently, AES was hired to implement all restoration activities and formal landscaping. In addition, AES was retained to assist school teachers in designing curriculum and materials to use the restored open space as a living laboratory.

Noisette Preserve, 2002 - 2005. Retained by the Noisette Company, North Charleston, SC, to assist in the design and redevelopment of a 3,000-acre surplus Navy facility and adjoining lands. AES conducted reconnaissance ecological and hydrologic inventories of the property and worked with Rolf Sauers & Associates, Philadelphia, PA; BMI Architects, Inc., Kansas City, MO; Harry Gordon Architects, Washington, DC; and John Knott to develop a master plan for this area. The plan proposed a large reserve system combined with redevelopment, fostering major investments in both development and restoration and open space protection.



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Rivers Edge, St. Paul, MN, 2002 - 2005. AES was retained by DR Horton Development to participate in the design of a 600-acre development, Rivers Edge, in St. Paul Park, MN. AES' work encompassed the following items: stormwater management design; restoration plans; open space and conservation plans; in-field inventory; Endangered species analyses, and expertise provided during entitlement and as an expert witness in subsequent litigation to defend the annexation agreement, zoning, and other approvals obtained through the municipality that were challenged by environmental and citizen advocacy groups. This project takes in hundreds of acres of Mississippi River islands and bluffs that were included in the AES conservation plans. In addition, AES conducted geological investigations to define the use of geological fracturing to infiltrate clean stormwater and to maintain recharge to importance springs along the river.

Prairie Crossing Campus, Grayslake, IL, 2002 - 2004. Consultant to Lake Forest (now Northwestern Memorial) Hospital for their Prairie Crossing Campus in Grayslake, IL. Developed conceptual and final designs, stormwater engineering, landscaping plans, and aided in obtaining regulatory permits with federal, state, county, and local agencies. Eventually implemented native landscaping, wetland and woodland restoration, and stormwater management for the facility. The design received several national awards from the APA and NAIA.

Zona Rosa Development, Kansas City, MO, 2002 - 2004. Retained by the Zona Rosa Development, Kansas City, MO, to design, implement, permit and construct an alternative stormwater management facility in a federal highway right-of-way with the MO Department of Transportation. The stormwater management facility was designed to alleviate downstream erosion problems and water quality impacts created by highway runoff.

West Rock Neighborhood, North Urban, CT, 2002 - 2004. AES was retained by Urban Design Associates, Pittsburgh, PA, to assist in the design of open space, natural resource, and stormwater management plans for the West Rock Neighborhood in North Urban, CT. Participated in several public design charrettes, open presentations and master plan preparation for this 80-acre HUD housing redevelopment.

Stream Protection Plans, Lenexa, KS, 2002. Retained by the City of Lenexa, KS, to design model stream protection plans for restoration of streams in the city. With partner Patti Banks Associates, conducted detailed stream inventories using methods designed by AES and used throughout the U.S. The program resulted in the development of model stream restoration and riparian buffer plans, a model ordinance and a financial program that credited stream mitigation opportunities, allowing for restoration of stream impacts.

Clear Creek Watershed, Management Plan, 2002. Retained by Black & Veatch to contribute to the development of a watershed management plan for the Clear Creek watershed in the City of Lenexa, KS. This included development of strategies for alternative stormwater management, and riparian and upland restoration ahead of projected development impacts. AES also provided a prospectus for stream and wetland mitigation banking for this watershed.

White River, Wetland System Restoration, Muncie, IN, 2002. Consultant to the City of Muncie, IN, to develop and participate in a charrette to design a wetland system restoration along the White River in Muncie. AES conducted field reconnaissance and participated in the design charrette by teaching students and other participants about wetland restoration design process.

Menomonee River Basin, Milwaukee, WI, 2002. Consultant along with Jones & Jones Architects, Seattle, WA, in an international design competition for the Menomonee River Basin, Milwaukee, WI. AES was included in five of the finalist teams, including the winning team headed by Wenk & Associates, Denver, CO. AES provided ecological design, restoration and stormwater planning, and open space and trail planning, integrating designs with adjacent neighborhoods and historic interests within the community near the Milwaukee Brewers Stadium in Milwaukee.

Pena Boulevard, Denver, CO, 2002. Finalist teamed with Field Operations of Philadelphia, PA, in a national design competition supported by the City of Denver, CO, for the 10-mile long Pena Boulevard from Denver to the new airport. Provided an award-winning design including 2,500 acres of landscape restoration, quarries, restored riparian areas and alternative stormwater strategies to manage runoff from the Boulevard and developed facilities. AES was runner-up in this national design competition.

U.S. Military Facility Housing, 2002. Retained by the Lend Lease Acutus, LTD. and Looney Ricks Kiss (LRK) in five competitive redevelopment projects for U.S. Military facility housing. AES conducted ecological evaluations and assisted in redesign of the barracks facilities, including design of stormwater management facilities, and open space and trail systems at Fort Bragg, Fort Belvoir, Fort Bliss, and several other facilities.

Hydraulic and Water Quality Impacts on Rush Creek, Kansas City, MO, 2002. Retained by the Zona Rosa Development, Kansas City, MO, to assess pre-development, construction, and post-development hydraulic and water quality impacts on Rush Creek. The investigation showed that properly designed development would actually improve water quality and reduce existing hydraulic problems in the stream, thus improving the downstream environment.



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South Village Conservation Development, South Burlington, VT, 2001 - Ongoing. Technical design, expert witness, entitlement assistance for South Village Conservation Development, South Burlington, VT. AES was retained by Retrovest Companies to develop ecological solutions for stormwater management and agricultural re-use (including CSA and conservation nursery and orchard operations). AES also worked with Looney Ricks Kiss to develop and entitle the site plan for this development. As a result of legal challenge by a neighbor, AES was an expert witness in the VT Act 250 process. The project has successfully endured legal and entitlement challenges, and AES will be involved in building the restoration and stormwater management elements of this project.

Monroe Center Quarry, Ogle County, IL, 2001 - 2003. Expert witness retained by Attorney David North in Ogle County vs. Jim McKnight, Monroe Center Quarry. AES served as a technical expert in the design of stormwater management facilities and design of a mine phasing plan for a lime rock quarry in Monroe Center, IL, resulting in the county ruling in favor of the quarry operation.

Virgin River, Zion National Park, AZ, 2001 - 2003. Retained by the Grand Canyon Trust to assist in technical studies and designs for restoration of the Virgin River in Zion National Park. Worked closely with the Grand Canyon Trust, Natural Channels of Flagstaff, AZ, the National Park Service and other partners in the evaluation of Freemont cottonwoods regeneration threats in Zion Canyon. Additional work included understanding the fluvial changes associated with revetments and other stream improvements installed by the Civilian Conservation Corps (CCC) in the 1930s. Developed support for reversing many of the CCC improvements to the river and restoring the Virgin River and Zion Canyon to foster use by endangered and threatened fishes while reestablishing regeneration of the increasingly uncommon Freemont cottonwood populations within the canyon.

Virgin River Recovery Plan, AZ, 2001 - 2003. Retained by the Grand Canyon Trust to work with BioWest and UT State University on the Virgin River Recovery Plan, evaluating and developing plans for the complete restoration and future location for Virgin River Spinedace and other federally endangered fishes. Provided ecological restoration, stream survey and restoration strategies and worked closely with Natural Channel, Flagstaff, AZ, and others to design this project.

Lake Cook Road Project, Environmental Assessment, Lincolnshire, Lake County, IL, 2001 - 2002. Retained by the Village of Lincolnshire, IL, and Liesch Environmental Services, Madison, WI, to assist legal counsel and the village in an environmental assessment of proposed IL Department of Transportation (IDOT) road-widening of Lake Cook Road through the Village. Conducted extensive tree surveys, biological investigations, breeding bird surveys, noise surveys, contaminant water studies, and stormwater impact studies and models. Assisted in development of alternative road alignments and road construction strategies to alleviate impacts associated with the IDOT proposal.

Bailey Property, Woodbury, MN, 2001 - 2002. Retained by Bancor Corporation of Minneapolis to assist in the development, community charrette public process and environmental permitting for the development of the Bailey property, a 300-acre parcel in Woodbury, MN. Conducted wetland and other ecological investigations, provided alternative stormwater management planning and assisted in permitting and the public approval process.

Fresh Kills Landfill, Staten Island, NY, 2001. Included on two short-listed design teams to design a closure plan and future park for the 2,400-acre Fresh Kills Landfill, Staten Island, NY. AES was part of the winning Field Operations team, and we were hired by the City of New York to design plans for landfill closure and restoration. As part of this process, AES conducted detailed substrate chemistry analysis and physical analysis of the capping material on the landfill, detailed natural area reference, and quantitative vegetation and hydrology studies for the adjacent natural areas that would be appropriately recreated and restored in and around the landfill. We generated a series of technical reports to support the final process and participated in the development of the final plan for the landfill.

Alternatives to Major Regional Flood Damage Reduction Proposal, Shorewood Hills, WI, 2001. Retained by the Village of Shorewood Hills, WI, to assess alternatives to a major regional flood damage reduction engineering investment proposed by a local engineering firm that involved installation of a half-mile-long, 90-inch-diameter pipe from a floodplain area directly into Lake Mendota. Developed alternative plans upstream in the floodplain area for storage and used ecological restoration strategies to reduce the amount of stormwater generated and received in the floodplain area. AES was successful in providing technical support to the Village Board's decision to not proceed with the pipeline project.

River Des Peres Project, MO, 2001. Retained by the Green Center, a non-profit organization of St. Louis, MO, to design a restoration plan for the River Des Peres project. This involved woodland riparian forest restoration and remediation for the re-created stream, managing runoff from a community composting facility and native landscaping of a golf course facility.

Restoration Plans, Grayslake, IL, 2001. Retained to design and develop restoration plans for the George and Vicky Ranney residence, Grayslake, IL. Put together a 15-year program with annual exhibits, budgets, and tasks to restore 40 acres of land to wetland, prairie, and savanna coordinated with native landscaping near the residence.



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Stream Mitigation Plan, NC, 2001. Retained along with Resource Data, Inc. and Warren Wilson College by Vaughn & Melton and Canton Motor Sport Park, NC, for a stream mitigation plan involving 7,000 lineal feet of restoration. Provided a field ecological and hydrological assessment of the existing degraded streams that were going to be destroyed as part of the mitigation program and permitted the stream mitigation plan with the NC Department of Environmental Management, U.S. Army Corps of Engineers and other agencies.

Reclamation and Restoration Plans, St. Cloud, MN, 2001. Retained by DSU to develop reclamation and restoration plans for the Bauerly Quarry in St. Cloud, MN. This involved the development of conceptual and final quarry design plans and closure reclamation/restoration plans for the facility.

Cow Skin Creek Park, Wetland and Prairie Restoration, Wichita, KS, 2001. Retained by Steven Parker & Associates in the City of Wichita, KS, to assist in the design and permitting of the Cow Skin Creek Park, a new 90-acre wetland and prairie restoration along Cow Skin Creek in the Arkansas River watershed. Worked closely with the public works department involved in a new sewage treatment plant facility and other partners to design and finalize construction lines and specifications and costing for this new park.

Redevelopment Planning, Caracas, Venezuela, 2001. AES was retained by the Metropolitan University in Caracas, Venezuela, to participate in a review of the 23 communities impacted by devastating coastal mud slides where 50,000 people lost their lives. AES participated in field inventories of the stream systems that conveyed the mud flows to the metropolitan areas and a design charrette at the Harvard Graduate School of Design, to assist in redevelopment planning for the impacted communities. AES proposed the establishment of floodplain environments in contrast to the 100-foot-wide concrete channels that were being used to convey mud and water from the coastal mountain range to the ocean.

Schuster Properties, Conservation Community, Sun Prairie, WI, 2001. Retained by Executive Management Inc., Madison, WI, to design development plans for a conservation community at Schuster properties, Sun Prairie, WI. The design included a 150-acre wetland mitigation bank and restoration project, and reduced the scale of development activities to a minor acreage compared to the overall restoration and open space protection benefits of the project.

Busse Woods Nature Preserve, Cook County, IL, 2001. Consultant to the Cook County Forest Preserve District to evaluate hydrologic impacts to the Busse Woods Nature Preserve from a proposed IL Department of Transportation change to the outlet control structure on the dam at Busse Lake in Schaumburg, IL. This involved three years of hydrology data collection, monitoring, and ecological field data gathering on the existing hydrologic and biodiversity relationships. This information was used to project likely impacts.

Wetland Restoration, Moonshine Lake, MN, 2001. Retained by the National Audubon Society and JOR Engineers in the evaluation of a 1,000-acre wetland restoration at Moonshine Lake, MN. Provided ecological and stormwater management and vegetation expertise in the conceptual design of the ecological restoration project.

Impacts of Limestone and Aggregate Quarry Operation, Belvidere, IL, 2000 - Ongoing. AES was retained by Quality Aggregates of IL in the review of the impacts of their proposed limestone and aggregate quarry operation located in Belvidere (IL) on the adjacent Flora Prairie Nature Preserve and other downstream environments. AES was the key technical consultant in the redesign of the quarry operation, including the stormwater management plan, and in the development of reclamation and restoration plans and coordination of future landscapes with the protection and restoration needs specific to a quarry. AES was also an expert witness in circuit and appellate court proceedings in Boone County vs. Quality Aggregates of Illinois. AES' client won both cases with unanimous support from the judges, and the IL Supreme Court ruled that the integrated designs employed by AES for this particular project would have no significant negative environmental impacts and would actually improve ecological and hydrological systems.

Dean Lake/Southridge Community Areas, Master Plan, MN, 2000 - Ongoing. AES was retained by the Shakopee Parks Department (MN) to develop and implement a master plan for the Dean Lake/Southridge Community areas. AES conducted a field evaluation of existing ecological conditions and designed restoration management plans for 1,500-acre area. AES also participated in community charrettes and public meetings to guide the community census on the future of this master plan. The community and land developer (Ryan Incorporated of Minneapolis) retained AES to design the Dean Lake Service Park. AES also performed permitting and built wetlands, prairies and savannas, and incorporated other features into the ecological design, including a stormwater management plan for the business park, which is coordinated with the Dean Lakes open space master plan.

Life Cycle Impacts of Glen Canyon Dam, 2000 - Ongoing. Consultant to Scientific Certification Systems and Western States Power Administration in the evaluation of the ecological impacts of the Glen Canyon Dam and 17 other power generator facilities. AES was retained to assist and develop an evaluation of the ecological and life cycle impacts for these facilities.



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Wild Meadows Conservation Development, Medina, MN, 2000 - 2009. AES was retained by Conservation Development LLC and DSU, Minneapolis, to design, permit, and eventually build the Wild Meadows conservation development in Medina, MN. AES, working with DSU and other partners, created the development design and ecological restoration and land management plan for 200 acres of open space and was retained to build the restored landscapes. In addition, AES obtained a Metropolitan Council grant to measure the ecological and water quality benefits of the alternative stormwater management design utilized by this project, another example of the AES' stormwater treatment train design used instead of NURP designs.

Lake Waconia Park, Master Plan, Waconia, Carver County, MN, 2000. AES was retained by Brauer and Associates, Ltd. to design a master plan for Lake Waconia Park (Waconia, Carver County, MN) along the lake's shoreline. AES conducted field evaluations of the ecological conditions and designed restoration management plans for the uplands and the lakeshore environments, including large restored wetlands and stormwater management facilities associated with the new master plan.

Lebanon Hills Regional Park, Scott County, MN, 2000. AES was retained by Scott County (MN) Parks and worked with Brauer and Associates, Ltd. in the design of a master plan for the 1,300-acre Lebanon Hills Regional Park to provide an evaluation in previous hydrologic studies and recommendations provided by SEH Engineers. AES did detailed field evaluations of existing conditions of hydrology and ecological resources, and developed the restoration management plan for the park. AES was also retained in the development of final construction plans for a new nature center at this facility. AES contributed to the budget for implementation, capital budgets for the nature center and park and worked closely as part of the design team for the nature center facility to design the landscaping layout of the nature center facility. The design included stormwater management to utilize natural systems in the area. AES was also hired to revise the stormwater management plan and damage reduction plan for the Lebanon Hills Park.

Little Switzerland Project, Minnetonka, MN, 2000. AES was retained by the City of Minnetonka, MN, and Ron Clark Development, and worked with Brauer and Associates, Ltd. to do ecological evaluations, stormwater management planning, conduct neighborhood meetings, provide permitting, and assist in the final design and construction, documentation, and specifications for the Little Switzerland project in Minnetonka, MN. AES was further retained to oversee the construction of the facilities.

National Pollution Discharge Elimination System, St. Paul, MN, 2000. AES was retained by the MN Center for Advocacy (the Center) to provide a technical review of the National Pollution Discharge Elimination System permit proposals and monitoring plans of the City of St. Paul, MN. We provided expert testimony to assist the Center in helping the City improve its overall plan.

Lake and Water Fowl Management Programs North Heron Lake, MN, 2000. Consultant for the North Heron Lake Game Produce Association in their review of lake and water fowl management programs in North Heron Lake, MN. AES was retained by the Association and the MN Chapter of The Nature Conservancy to provide educational workshops on alternative stormwater management, ecological restoration, and assist the association in beginning a process of rethinking their lake management program.

Reuse of Quarry Facilities, Oshkosh, WI, 2000. AES was retained by Michels Materials Corporation of WI to evaluate the Oshkosh, WI, quarry site as potential location for a single-family residential development and stormwater management facility. AES worked with other partners to develop and get approval for conceptual and beneficial reuse of these quarry facilities.

Tax Reduction Strategies for Conservation Lands, Cook and DuPage County, IL, 2000. AES was hired by Mayor, Brown, & Platte Attorneys in Chicago, IL, to evaluate tax reduction strategies for conservation lands in three Chicago area properties. We evaluated the public values associated with the privately-held open space at the Quaker Oats Company in Barrington, IL, the Square D Company in Palatine, IL, and a confidential property in Naperville, IL, under tax appeal. At the Square D Company, we helped resolve litigation and provided technical support for providing tax relief for each of these privately-held lands as they provided significant public open-space values and opportunities.

Craig Friar Pier Permit, Egg Harbor, Door County, WI, 2000. AES was retained by Quarles & Brady Attorneys, Madison, WI, in the evaluation and contested hearing proceedings of the Craig Friar pier permit, Egg Harbor, Door County, WI. For this project, AES conducted detailed field work on the potential threat of the proposed pier to aquatic plant species invasions, zebra mussels, shoreline erosion, and deposition, and participated in a wave energetic analysis with other partners to evaluate the impacts of this pier on Lake Michigan shoreline. AES conducted aquatic plant inventories using scuba diving and underwater mensuration techniques and developed technical reports describing our detailed analysis and conclusion.

Expert Witness to Alleged Wetland Fill Violation, WI, 2000. Consultant to Dewitt, Ross & Stevens in WI Department of Natural Resources vs. Scudder family, Tapowingo Family Trust. AES was retained in the litigation project to evaluate wetlands and waters of the U.S., shoreline zoning, and ordinary high water levels considerations for an alleged wetland fill violation. AES provided technical supporting data including detailed topographic and correlated botanical and hydrological surveys of the subject area and participated in the contested trials providing expert witness services.



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Screening and Buffer Plan, Schaumburg, IL, 2000. Consultant to ABB Energy Ventures, Inc. in the design of fiscal and visual buffering to their Schaumburg, IL, regeneration power generating facility within the Tri-County Park. AES was hired to design buffer plans for the power facility from the adjacent neighborhoods and integrate a screening and buffer plan with the restoration activities in the regional park. AES was subsequently retained to build the restoration strategies associated to buffering Tri-County Park.

Ecological Impacts of Hydropower, Brazil, 2000. AES was hired by Hydropower Partners, Belahorizonte, Brazil, to evaluate the impacts of several proposed run of river, hydropower facilities and assist the partners in reducing ecological impacts of the hydropower. AES also developed a standard approach to evaluate hydropower proposals within Brazil and was invited to present this methodology to FEOM, the Brazilian equivalent of the U.S. EPA.

Reducing Flood and Improving Water Quality, Topeka, KS, 2000. AES was retained by the City of Topeka's Water Pollution Control Department to participate in a design charrette to evaluate the opportunities for reducing flooding and improving water quality in three separate project locations within Topeka, KS. One location was along the Main Street between the Capitol and Kansas River. AES participated in the design of the boulevard concept to daylight and integrate a currently buried stream as an alternative to a costly repair of an undersized storm sewer contributing to recent flooding in the downtown area, saving significant dollars with this alternative strategy.

Pabst Farm Development, Oconomowoc, WI, 1999 - Ongoing. AES was retained by WisPark in the evaluation and conceptual design of the 1,600-acre Pabst Farm development in Oconomowoc, WI. AES assisted American Survey and Engineering Company in designing alternative stormwater management strategies that would infiltrate stormwater to replenish ground water supplies and base flow conditions in local streams and lakes. AES also evaluated potential impacts from this development to water quality in adjacent lakes and also conducted wetland delineations and natural resource inventories for this project. Additional work included design of standard construction drawings and specifications for infiltration facilities and ecological restoration in native landscaping programs within the development.

Cloverdale Ranch, Half Moon Bay, CA, 1999 - Ongoing. AES was retained by Peninsula Open Space Trust, a non-profit organization located in San Francisco, CA, to evaluate the technical issues associated with restoration of 6,000 acres of Cloverdale Ranch (Half Moon Bay, CA). As part of this process, AES did reconnaissance analysis of the ecological conditions of the coastal prairies, the redwood forested settings, pasture lands, riparian systems and steep eroded bluffs and head lands along this coastal property. We worked closely with the land management team to design strategies and evaluate possible opportunities for restoration and financial cost-sharing for restoration strategies.

City of Woodstock, IL, Master Plan, 1999. AES, along with Land Planning Services, was retained by the City of Woodstock, IL, to design a master plan for the Woodstock community. We were responsible for evaluating, mapping, and prioritizing ecological conditions present within the 50-square-mile planning area. AES provided detailed GIS mapping of resources, identified ecological restoration and land stabilization opportunities, participated in community design charrettes, and prepared the master plan, which was unanimously adopted by the City.

Busse Park, Prior Lake, MN, Planning, 1999. AES was retained by the City of Prior Lakes (MN) Parks Department, and worked with Brauer and Associates, Ltd., to design a plan for Busse Park, a large soccer and baseball complex. AES participated by meeting with local landowners to work through the concerns and developed an ecologically-based plan with to restore the park's ecology and create passive walking trails. We implemented alternative stormwater management strategies in the restoration plan, using native landscaping plan to clean water before entering a downstream lake in the community holdings.

Lake Nokebay, Riparian Restoration, Northeastern WI, 1999. AES was retained by the environmental attorney Paul Kent (Madison, WI) to evaluate and negotiate riparian rights for piers on Lake Nokebay, northeastern Wisconsin. AES evaluated the aquatic plant communities and the potential impact of piers proposed by the riparian and developed alternative pier designs, and the arguments for mitigating the impacts that were associated with the original pier designs.

Mountain Bethel Bends, PA, 1999. AES participated with the PA chapter of The Nature Conservancy in the evaluation of the Mountain Bethel Bends and their restoration potential. As part of this process, AES met with chapter representatives, and their restoration specialists evaluated the existing conditions of the Mount Bethel Fens and made recommendations on strategies for restoration of the areas.



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Kankakee Sands Restoration, Enos, IN, 1999. AES was retained by the IN chapter of The Nature Conservancy (TNC) to design and eventually build the first 2,000 acres of the 7,300 acres Kankakee Sands restoration near Enos, IN. AES provided detailed investigations of existing ecological conditions, soils and seed banks present. AES also modeled hydrology to understand and evaluate the flood damage reduction benefits and up-and-down stream impacts of restoring 7,300 acres of land. AES did the construction drawings, specifications and permitting, and was retained to construct the first 2,000 acres of this facility, which included 5,200 acres of wetland restoration, 1,700 acres of prairie restoration and 200 acres of oak savanna and dune restoration. The restoration involved the following: re-vegetating the area through the collection of approximately 320 locally-derived native species seeds; returning the hydrology through disabling thousands of miles of tiles and ditches; and performing the ecological management necessary to provide the restored setting. AES also implemented education and community outreach, a restoration monitoring program and worked with the local high schools to train students who were retained by AES to collect seed and do other activities. AES established a project-specific office and managed the Kankakee Sands project restoration activities for a period of four years, while also training and hiring future TNC employees and staffing the project for TNC.

Wetland Mitigation, City of Monona, WI, 1999. AES was hired by the City of Monona (WI) Parks Department and Public Works to assist and obtaining a permit for filling and mitigating for the filling for several hundreds of an acre of wetland occurring in a ditch, which represented a safety access risk to the City's Ahuska Park. In the City's initial plans, the ditch was supposed to have been filled and utilized for emergency access, but the WI Department of Natural Resources objected to filling this created and highly-damaged wetland. AES participated with a hired environmental attorney and was successful in obtaining the permits necessary for this emergency access.

Anoka County Park, Master Plan, MN, 1999. AES was retained by the Anoka County Parks and Brauer and Associates, Ltd. to design a master plan for Anoka County Park (MN), a 2,500-acre sand, berm and prairie complex with bogs and lakes, a regional parks facility for the Parks Department, miles of trails for equestrian facilities and other active and passive park use and operations. AES did detailed ecological analysis of the land, reviewed the offsite impacts for hydrology and water quality within the parks, lakes, wetlands and streams, and evaluated and made recommendations and plans for restoration of the ecological settings within the park. AES also participated in several community meetings to share the intent and goals of the environmental ecological plans for this park and worked with the parks department board to finalize and get approvals for the plan, which was later implemented.

Threatened and Endangered Species Evaluation, 1999. AES was retained by Land and Lake Company by Mary Margaret Cowhey in the evaluation of threatened and endangered species issues – in particular Hines Emerald Green dragonfly and other endangered species associated with dolomite bedrock prairies in their Lemont Landfill operations. AES did extensive literature review and field analysis of the existing and proposed expansion areas for the landfill on behalf of this project and worked closely with federal and state regulatory agencies to assist in developing a consensus conclusion that the landfill operations and expansions were not going to have any impact on endangered or threatened species.

GIS and Field Analysis, Johnson County, KS, 1999. AES was retained by Thompson Dyke & Associates, Ltd. to assist in doing ecological evaluations of Johnson County, KS, park holdings and future land acquisition areas. AES did extensive GIS and field analysis to develop an understanding of existing conditions and made restoration and land management recommendations in each of the existing and proposed land acquisition areas. Throughout the county, AES determined other potential land acquisition priorities based on ecological connectivity and riparian and stream buffering needs, and participated in the development of the county's 20/20 plan, which has won unanimous county-wide and region-wide recognition as a model project for parks.

Broad and Broad River Watersheds, Wetland and Stream Mitigation, NC, 1999. AES and Resource Data, Inc. (RDI) of Asheville, NC, were retained by the NC Department of Transportation (DOT) to evaluate two watersheds (Broad and Broad River) for their wetland and stream mitigation potential. AES and RDI conducted extensive GIS analysis and field reviews of thousands of potential properties for their wetland and stream restoration potential, which generated detailed mapping and technical reports for the DOT.

Heritage Park Redevelopment, Minneapolis, MN, 1999. AES was retained by the City of Minneapolis and SRS Consulting Group in the conceptual design and final design of the Heritage Park (former Near Northside Area), a major redevelopment in downtown Minneapolis, MN. AES was retained for stormwater management planning, natural resource planning and design, and water quality modeling/management planning. We conducted inventories of the several hundred-acre brownfield and redevelopment area and worked closely with a large team to firm up conceptual and final designs.

Wood Creek North Development, Oconomowoc, WI, 1999. AES was retained by Bielinski Development Corporation to evaluate the formal impacts of the Wood Creek North development on Rosenow Creek, a cold-water trout stream in Oconomowoc, WI. AES conducted and prepared field evaluations over a course of a three-year period during which we measured existing water quality and thermal loads on Rosenow Creek with field measurement equipment. We designed infiltration strategies, developed final plans and construction specifications, and obtained permit approvals from the regulatory agencies to install infiltration stormwater management systems within the Wood Creek North development to support coldwater base ways to the stream.



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John Mellancamp's Property on Lake Monroe, Shoreline Stabilization, Bloomington, IN, 1999. AES was retained by Civil and Environmental Consultants in Bloomington, IN, to design shoreline stabilization strategies for rock legend John Mellancamp's property on Lake Monroe, located south of Bloomington. AES evaluated the hydrology and hydraulic characteristics of the lake environment, which we did using modeling and projections provided by other consultants. AES also worked with the landowner and regulatory agencies to design strategies for stabilizing the highly eroded banks (20-30-feet) that had established.

Black Dog Amphitheater Development, MN, 1999. AES was retained by DSU Planners (Minneapolis, MN) to conduct a review of the Black Dog Amphitheater development site and make recommendations on how to integrate the Black Dog Amphitheater facility within a landfill and quarry complex. This evaluation involved field analysis, planning, review and coordination with local regulatory agencies and citizens to understand the potential of integrating the development in the quarry complex.

Lauderdale Lakes, Elkhorn, WI , Restoration and Monitoring, 1999. AES was retained by Reinhart Attorneys in a litigated lake shoreline violation at Lauderdale Lakes near Elkhorn, WI. This was a dredging violation for a pier before receiving a cease and desist order from the U. S. Army Corps of Engineers and the WI Department of Natural Resources. AES was retained to negotiate a settlement and design and implement a restoration plan for the area that was impacted by the dredging, and to provide annual monitoring reports on the success of the planting.

Conservation Development, Lino Lakes, MN, 1999. AES was retained along with Brauer and Associated, LTD. through the City of Lino Lakes, MN, to work with four developers to model conservation developments. AES did a community-wide charrette, using several of the developments as working examples during the charrette process to show how alternative stormwater management and conservation design could be utilized to achieve design goals of a rural, environmental atmosphere, open space and park creation, and natural resources conservation.

Conservation Development, Southeastern Wisconsin, 1998 - 2003. AES was retained by Bielinski Development Corporation (Waukesha, WI) in the design and construction of 15 conservation developments in southeastern WI. AES conducted natural resource inventories, wetland delineations, and did conceptual design for over 30 developments, and refined the designs and created construction drawings and specifications for 13 projects. AES was then retained to build the stormwater management restoration areas and monitor the effectiveness of such activities in 5 developments.

St. Harbor Hydro-Power Facility on the Susquehanna River, Life Cycle Analysis, 1998. AES was retained by Scientific Certification Systems and Safe Harbor Water Power Corporation (Conestoga, PA) to do a life cycle analysis of the impacts at the St. Harbor Hydro-Power Facility on the Susquehanna River. This involved detailed analysis of the impacts of the facility on the fish passage on river and aquatic habitats, and on the shoreline and upland forested system impacted by the construction community facilities and power facility. The efforts resulted in the development of a new standard ecological footprint measurement for hydro-powered impacts that is now being implemented globally.

MN Audubon Society and the Snake River Watershed Drainage District (MN), 1998. Consultant to the MN Audubon Society and the Snake River Watershed Drainage District (MN) in the co-design and to negotiate the Hegeland combined flood damage reduction and biological enhancement project. This four-square-mile flood damage reduction facility was initially designed by the Drainage District as a facility with thirty-foot surrounding dikes. Through AES ecological and engineering design negotiations, we re-designed the hydraulic performance and pre-treated water entering the facility so that biodiversity enhancements were possible.

Lino Lakes Town Center, Lino Lake, MN, 1998, Consultant to the City of Lino Lake, MN, in the design, permitting, and construction oversight of their Lino Lakes Town Center. AES worked with Peter Calthorte and Associates to design the transportation-based town-center facility for this municipality, which, prior to this project, had no distinct geographic center. AES also designed the stormwater management and ecological restoration plans for the facility.

Life Cycle Analysis, Mokelumne River Hydro Power Facilities, 1998. AES was retained by Pacific Gas & Electric (PG&E) and Scientific Certification Systems (CA) to review the Mokelumne River Hydro Power Facilities, which included seven dams and diversions for other uses (irrigation, tolerable water uses, etc.), and provide a life cycle assessment of ecological impacts of the existing facilities operated by PG&E.

Hidden Springs Development, Boise, ID, 1998. AES was retained by the Grossman Family Properties to review and participate as consultant in one early formative meeting in the design of their Hidden Springs Development near Boise, ID. AES provided a critical review of the existing plans and the regulatory requirements for the plan.

Town of Fort Sheridan Company Redevelopment, Fort Sheridan, IL 1998. AES was retained by Red Seal Development Corporation to do stormwater management, ecological restoration planning and endangered species consultation and permitting for the Town of Fort Sheridan Company redevelopment of the historic military base in Fort Sheridan, IL. AES evaluated stormwater management impacts under existing conditions to ravines along Lake Michigan and the bluffs, evaluated and obtained permits for incidental takes for Threatened and Endangered Species impacts developed, engineered and installed stream



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stabilization and ravine stabilization plantings, and designed and installed native landscaping within the redeveloped area. AES worked closely with Lake County, Lake County Forest Preserve District, adjoining communities, and military operations personnel to achieve this world-class project.

Herring Creek Farm Trust on Martha's Vineyard, MA, 1998. AES was retained by the attorneys with a Boston, MA, law firm to assist in developing discovery and trial preparation materials for the Herring Creek Farm Trust on Martha's Vineyard, MA. This 400-acre estate on Martha's Vineyard was proposed to be developed into single-family residential homes. AES, along with local firms, was retained to evaluate the impacts and redesign the development strategy to mitigate and minimize avoid impacts to wetlands, coastal dunes and other resources, including sand prairies and barrens within the property. AES' ecological expertise and testimony helped the landowner negotiate a settlement and an eventual condemnation settlement that was the highest-ever (at the time) for any project nationally. The settlement resulted in the protection and restoration of the estate's ecological communities, including the rare sand prairies.

Harriet Island, St. Paul, MN, 1998. AES was retained by SRF Corporation of Minneapolis in the design, engineering, shoreline stabilization strategies, alternative stormwater strategies and the overall park plan for Harriet Island across from downtown St. Paul, MN. Along with Wallace, Roberts, and Todd (Philadelphia, PA), AES, SRS, and other local partners redesigned the entire park and participated in all stages, from the conceptual design to the final construction drawings and specifications and assisted in early stages of construction activities. This plan resulted in the development of the wonderful new regional park, which is maintained using ecological strategies.

White River, Minnetrista Cultural Center, Greenway Plan and Restoration, Muncie, IN, 1998 - 2002. AES was retained by the Minnetrista Cultural Center and Ball State University (Muncie, IN) to design and implement over several years seminars and community education opportunities to foster the development of the greenway plan and restoration program for the White River in Muncie, IN. This process involved 4 major educational and design charrette events over a period of 5 years and included students in the implementation of the restoration strategies. The process led to a very successful program.

Cane Creek Watershed, NC, 1998. AES and Resource Data, Inc. (RDI) of Asheville, NC, were retained by Cross Creek Ranch to evaluate historic and existing ecological conditions of Cane Creek (350,000-acre watershed). The watershed originated in the Appalachian Mountains and had high-quality brook trout populations, but after it descended into the valley, a process of degradation in water quality and stream erosion resulted in the loss of native brook trout and other fishes. AES and RDI developed detailed GIS and field analysis of the existing conditions of the watershed, evaluated the changes that occurred leading up to the existing conditions and provided a restoration vision for the entire watershed in a technical report.

Lake Calumet Area Restoration, Chicago, Cook County, IL, 1998. AES was retained by the City of Chicago's Department of Environment to develop ecological restoration plans for the Lake Calumet area, highly-industrialized brownfield acreage involving dozens of sites. AES conducted ecological inventories, wetland delineations, and developed restoration management plans and concepts for 1,000s of acres of land included in the Lake Calumet holdings.

North Pond, Lincoln Park, Washington Park, Chicago, Cook County, IL, 1998. AES was retained by Thompson Dyke & Associates, Ltd. to design and permit restoration plans for the North Pond and Lincoln Park and Washington Park for the City of Chicago's Department of Parks. AES conducted evaluations of existing conditions in each park including water quality hydrology, park-use behavior and existing vegetation and shoreline stabilization conditions around the lagoons in each of these parks. We then developed construction documentations and specifications to restore the lagoon systems, the shoreline and surrounding upland buffers, and tributary drainageways to these lagoons. AES was also retained to oversee the construction and implementation of these programs. After years of neglect and abuse, both park lagoons have become favorite educational and recreational facilities for Chicago residents.

Plain Dealer Zero-Discharge Printing Facility, Brooklyn, OH, 1998. AES was retained by the Cleveland Plain Dealer and Austin Companies and worked closely with Sasaki Associates (Watertown, MA) to assist in the design, permitting, construction plans, and implementation for the new Plain Dealer zero-discharge printing facility in Brooklyn, OH. AES helped build the native landscaping compound into a world-class facility featuring a day-lighted stream, a "green" building and low-maintenance native landscaping. We also worked closely with the publisher of the Plain Dealer to train their grounds maintenance personnel in native landscape maintenance.

Pigeon River Fund, Five Counties, Western NC, 1998. AES and Resource Data, Inc. of Asheville, NC, were retained by the Pigeon River Fund in NC and TN to evaluate existing stream and wetland conditions in five mountain counties in western NC and identify and prioritize high-quality stream and wetland restoration opportunities. This process started with a detailed GIS analysis and field reconnaissance survey of each of the potential locations followed by development of the technical report for the project.



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Ditch 83, Thief River, MN, 1998. AES was retained by MN Audubon Society to provide technical advice in the Thief River, Ditch 83 dispute near Thief River, MN. Proponents of a channel dredging and channelization project for the river alleged that flood damage reduction opportunities required re-channelizing the river section referenced as "Ditch 83," which had initially been channelized (70 or 80 years earlier). The stream had since re-meandered and attained significant biological integrity. AES worked closely with landowners and others to evaluate and provide advice on how to proceed.

Wetland Study, McHenry County, IL, 1998. AES was retained by the IL Department of Natural Resources to study and evaluate the existing status of approximately 500 wetlands within McHenry County, IL. This involved reconnaissance GIS analysis to identify the wetlands and field botanical and hydrological investigations to understand the existing conditions.

Rich Lake, Twin Lakes Park, Master Plan, Lino Lakes, MN, 1998. AES was retained by Brauer and Associates, Ltd. (Hopkins, MN) to develop a master plan for Rice Lake, Twin Lakes Park in Lino Lakes, MN. AES conducted a detailed GIS analysis and field inventory mapping of the 3,000-acre park followed by development of a restoration plan and integration of restoration with park maintenance programs. In addition, AES designed, engineered, and permitted new parking lots and stormwater management facilities that infiltrate stormwater to groundwater.

Niobrara River National Wild and Scenic River, NE, Restoration and Management Plan, 1998. AES was retained by a large Washington, D.C. law firm representing the American Canoe Association and several other national non-profit conservation organizations in a suit filed against The National Park Service (NPS) over the alleged mismanagement of the Niobrara River National Wild and Scenic River, NE. AES conducted field inventories to review allegations, prepared testimony favoring the perspective of the plaintiff and assisted in presenting the case in federal court. The Court found NPS negligent and required NPS to be responsible for creating the restoration and management plan for the river.

Miller Park and Hank Aaron Trail, Landscape Plan, Milwaukee, WI, 1998. AES was retained by the WI Department of Natural Resources (WDNR) to design a landscape plan for the development of the New Brewers baseball stadium in Milwaukee, WI, along the Hank Aaron Trail. The National Park Service's Rails-to-Trails program, along with WDNR, retained AES to evaluate native landscaping and floodplain restoration opportunities and to develop concepts for restoration and for the trail corridor along the Brewer Stadium.

Middle Platte Wetland Mitigation Bank, Boulder, CO, 1997 - 2004. AES, along with Land and Water Resources (LAWR), conducted a detailed evaluation of wetland mitigation banking opportunities in CO. The team identified key pieces of property, met with landowners and did preliminary evaluations for the potential opportunities for wetland mitigation banks. One property in particular had high opportunity rankings. As a result, AES and LAWR developed the Middle Platte wetland mitigation bank, a 70-acre wetland mitigation bank located just east of Boulder. The wetland mitigation bank includes senior-most water rights, water that was reallocated through water quarts through the wetland restoration and that included habitat for water birds, wetland birds, and grassland birds, and also cleansed water (particularly nitrogen) associated with the water source in the Boulder ditch districts holdings.

Red River Basin, Flood Damage Mediation, Northwestern MN, 1997 - 2000. AES was retained to provide technical representation on a technical science advisory committee that was organized as part of a flood damage reduction mediation agreement within the Red River Basin in northwestern MN. AES was retained for our ecological and ecological engineering expertise to represent the National Audubon Society and MN Center for Environmental Advocacy in a multi-year, court-ordered flood damage mediation process whereby existing stakeholders in a working group were to address their technical information needs for resolution of outstanding issues. AES participated by providing detailed knowledge about alternative flood damage reduction engineering and ecological strategies including the use of wetlands, restored prairies, open space landscapes and the resulting benefits from reducing flood damage. AES also developed and undertook detailed technical studies of the effects of hydraulic bounce on biological diversity and wetlands. Investigations on the use of on-channel storage strategies for flood damage reduction evaluated alternative strategies for re-establishing floodplains environments, including the use of set back levees in agricultural studies. We also assisted in detailed investigations to evaluate and develop basin-wide strategies for flood damage reduction and biodiversity enhancement, which were documented in a technical report titled "Basin Strategy for Flood Damage Reduction." This project involved 12 million acres of land in MN and produced a national, precedent-setting mediation process.

Kilbuck Creek Wetland Mitigation Bank, Rockford, IL 1997. Consultant in the design, permitting, and landowner and regulatory negotiations for the Kilbuck Creek wetland mitigation bank, south of Rockford, IL. AES and Land and Water Resources, Inc. (LAWR) co-designed, developed and administered this 90-acre wetland mitigation bank. This project created 30 acres of a new floodplain forest in former drained agricultural lands, a riparian forest corridor along Kilbuck Creek, and reestablished seeps and strains along the floodplain valley wall of Kilbuck Creek.



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Garfield Farms, Master Plan, La Fox, IL, 1997. Consultant to Garfield Farms (La Fox, IL) in the design of an overall master plan for restoration for this living history farm. AES conducted ecological inventories and surveys of soil and ecological conditions present in land currently owned by Garfield Farms and in lands anticipated to be purchasable to evaluate the restoration potential of wetlands, prairies and savannas.

Mann Brothers Excavating and Earth Moving, Conservation Development Strategy, Williams Bay, WI 1997. Consultant to Mann Brothers Excavating and Earth Moving (Elkhorn, WI) in the inventory and design of a conservation development strategy for a mined aggregate quarry (sand and gravel) in Williams Bay, WI. AES was retained to do the site analysis, ecological evaluations and design ecological restoration strategies. Restoration strategies included stormwater management to reestablish groundwater recharge to maintain seeps, streams and trout streams associated with the Keepataw Preserve, directly downstream of the proposed lands redevelopment.

University of New Brunswick, Ecological and Ecosystem Restoration, Monkton, NB, Canada, 1997. AES was retained to design and deliver a lecture series for the University of New Brunswick (Monkton, NB) on ecological and ecosystem restoration. This was a bilingual series to educate students and environmental groups as part of a conference series for the Maritime Region of Northeastern Canada.

Cleveland University Hospital, Cleveland, OH, 1997. Sub-consultant to GSI Architects in the design and siting of Cleveland University Hospital satellite operations in Cleveland, OH. AES was retained to conduct wetland delineations, analyze stream conditions, evaluate restoration potential, and design a high-quality, restored natural setting for integration of the University Hospital facility.

Good Samaritan Wellness Center, Ecological Inventory, 1997. AES was retained by the Pierce Downers Heritage non-profit group in Downers Grove, IL, to evaluate ecological impacts of the Good Samaritan Wellness Center proposal adjacent to Lyman Woods Nature Preserve. AES conducted ecological inventories and prepared detailed studies of the potential impacts to Lyman Woods and met with the hospital facilities staff to encourage alternative strategies for design and layout of the facility.

Barrington Middle School "Prairie Campus", Planning and Design, Barrington, IL, 1997. AES was retained by Barrington, IL, school district in the design, siting, and permitting of their Barrington Middle School "Prairie Campus." This new school facility was developed as a green building with native landscape including many acres of restored prairie, wetland, and forest savanna. The design won a National American Planning Association Award for design.

Decatur Parks Department, Master Plan, Decatur, IL, 1997. Consultant to Thompson Dyke & Associates, Ltd. in the ecological planning component of a master plan for the Decatur, IL, Parks Department. AES was retained to conduct ecological inventories and develop conceptual restoration plans and costing for 20 miles of Sagimon River greenway and other streams, and for each of the existing and new proposed parks and trails in the Decatur area.

Girl Scout Camps, Master Planning, MN and Northwestern WI, 1997. AES was retained by Brauer and Associates (Hopkins, MN) in the evaluation and master planning and facilities review of four Girl Scout camps in MN and northwestern WI.

Nerstrand State Park, Prairie and Reforestation Strategies, Southeastern MN, 1997. AES was retained by the MN Department of Natural Resources to evaluate their prairie and reforestation strategies at the Nerstrand State Park, a large woodland project in southeastern MN. AES provided a field review and a technical letter as a work product.

William O'Brian State Park, St Croix, MN, 1997. AES was retained by the MN Department of Natural Resource and State Parks Department to evaluate the ecological and hydrological restoration opportunities at William O'Brian State Park, Marine on the St Croix, MN. This park's system hydrology had been modified over many years to dewater, tile and ditch muck and peat soils that now grew exotic plant species such as canary grass and *Phragmites*. AES was assisted in the design of restoration plans for the hydrology and natural resources.

Lake of the Isles, Minneapolis, MN, 1997. Consultant to the City of Minneapolis Parks Department in the design and public process for lakeshores along Lake of the Isles, Minneapolis, MN. AES was retained to assist in a controversial public process resulting from high water levels that killed trees and other vegetation around the perimeter of this lake. The design included restoration of native wetland and upland systems that were not vulnerable to flood durations, and which could simultaneously reflect the aesthetic desires of the community's residents while providing shoreline stabilization for the lake.

Sibley Preserve Restoration, Sibley, IL, 1997. Consultant to the IL Chapter of The Nature Conservancy (TNC) on the design of wetland and savanna restorations for TNC's Sibley Preserve, Sibley, IL. AES along with TNC designed grading plans, hydrologic restoration plans, and vegetation restoration management plans for a 60-acre restoration that has become a center piece in the Sibley community.



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Wetland and Prairie Restoration Geneva, IL, 1997. AES was retained by the City of Geneva, IL, in a competitive design for a 500-acre wetland and prairie restoration. The project was designed as a regional growth corridor to help set limits on western migration of the Chicago suburbs. AES designed and constructed the first 100 acres of the restored uplands around the facility.

Deonstration Test Plots, Minnetonka, MN, 1996 - 2003. AES was retained by the City of Minnetonka Parks and Public Works Departments in the establishment of demonstration test plots for restoration of five parcels within the City of Minnetonka, MN. AES installed test plots to evaluate invasive species removal strategies for buckthorn and reed canary grass, and also tested savanna re-vegetation and prairie restoration strategies. This process helped AES evaluate the methodological effectiveness, cost, and labor utilization for restoration programs applicable to many other projects.

Wetland Mitigation Bank, Lemont, IL, 1996 - 2002. Consultant to Vulcan Materials Corporation in the design and construction of a 100-acre wetland mitigation bank to compensate for impacts in their Lemont, IL, quarry operations. AES worked closely for a period of one year to find and help purchase a property known the "Book Property," and was awarded a contract to build, manage, and monitor the wetland mitigation bank.

Wetland Restoration and Mitigation, Chicago, Cook County, IL, 1996 - 2000. Consultant to Chicago Department of Environment in conducting ecological analysis of 700 parcels of land located within the city for their wetland restoration and mitigation potential. In coordination with the City's Department of Aviation, AES was retained to assist the Department of Environment in finding and designing conceptual wetland mitigation opportunities for impacts to existing wetlands that were anticipated with expansions at O'Hare Airport.

Detroit Reinvestment Plan, Detroit, MI, 1996 - 1999. AES was retained by Urban Strategies (Toronto, Canada) to assist in developing a reinvestment plan for five-square miles of downtown Detroit, MI. AES evaluated the ecological and hydrological conditions for the setting between Belle Island and the Ambassador Bridge to Canada along the Detroit River. This evaluation, along with work conducted by others (e.g. transportation studies, economic analysis, housing and office, commercial properties investigation), provided the basis for the plan. The work was conducted on behalf of the Greater Downtown Partnership, an association of ANR Pipeline, Cummings Diesel Engines, General Motors, and proposed revitalization of the Detroit River front area, among others.

Liberty Prairie Reserve, Ecological Inventory, Grayslake, IL, 1996 - 1999. AES was retained by the Liberty Prairie Conservancy (Grayslake, IL) to conduct detailed mapping and ecological inventories for their 3,000-acre Liberty Prairie Reserve. AES conducted detailed breeding bird surveys, plant surveys, and threatened and endangered species surveys. In addition, AES evaluated contaminant loading in area waterways and projected loads for the proposed Highway 355 expansion through the Reserve. AES then prepared an ecological restoration management plan encompassing all public lands that were surveyed.

Stormwater Management, Madison, WI, 1996. AES was retained by American Family Insurance (AFI) in Madison, WI, to evaluate options for addressing severe hill slope erosion problems adjacent to a new office complex constructed by AFI. AES evaluated the stormwater runoff from the new building and parking lots and provided and constructed a solution to re-stabilize a drainage way that had eroded a 20 to 30-foot- wide by 8 to 10-foot- deep channel within a period of one year.

Conway Farms Development, Lake Forest, IL, 1996. Consultant to the Conway Farms Corporation, Lake Forest, IL, in the final design and review of the existing plans for wetland restorations, golf course native landscaping and open space native landscaping in the Conway Farms development.

National Gypsum Corporation, Mining Facilities Expansion, Northeastern MI, 1996. AES was retained by National Gypsum Corporation and RMT, Ann Arbor, MI, to assist in the assessment of existing conditions, wetlands, threatened and endangered species, and potential water quality impacts associated with the expansion of National Gypsum's Gypsum mine. AES provided permit documentation National Gypsum used in the expansion of their mining facilities in northeastern MI.

Mine Study, Mesabi Iron Range of MN, 1996. Consultant in a detailed field study to access life cycle impacts of wood stud production versus steel stud production. AES conducted detailed studies of iron mining and steel production impacts and mining life cycle impacts in the Mesabi Iron Range of MN. We established 40 mine study sites to evaluate re-vegetation in reclaimed lands and did GIS remote sensing analysis of the ecological footprint of the mining operations and hydrologic analysis of the mining impacts over 400,000 acres of land in MN. This, along with a study of forest impacts associated with wood stud production, was compared to impacts in a million and a half acre forest in Finland, and served as the basis of a technical report provided to steel recycling industries in Pittsburgh, PA.



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Crandon Mining Operation, Crandon, WI, 1996. Consultant to Exxon Corporation for review of documentation and development of critical path regulatory requirements for their proposed Crandon Mining Operation (Crandon, WI). AES, along with RMT (Madison, WI), were retained to analyze potential ecological, hydrological, surface and groundwater impacts, threatened and endangered species of the Crandon Mining project, and to identify strategies and solutions for minimizing or mitigating any of the impacts identified.

Great Lakes Basin, Southeastern WI, 1996. Grant recipient from the Great Lakes Protection Fund for a project study to document ecological, hydrological and biological diversity impacts in a comparison of three conservation developments and two conventional developments in southeastern WI. AES, with Apfelbaum as prime scientist, was awarded a \$396,000 grant to study conditions before, during, and after (for a period of three years) construction, and to create guidance and policy in the Great Lakes Basin for new development strategies.

Strawberry Island, Lac Du Flambeau, WI, 1996. Consultant to Lac Du Flambeau Indian Tribe (Lac Du Flambeau, WI) to review the ecological importance of Strawberry Island, a sacred place for the tribe, which was proposed to be developed. AES ecologists conducted a quick review of issues and field conditions and developed a brief report for the tribe to use in negotiations with the developer.

St. Paul Riverfront, St. Paul, MN, 1996. AES was retained by the St. Paul Riverfront Corporation and later Major Norman Coleman, along with a larger team that included many local planning firms and Urban Strategies (Toronto, Canada), to research ways to stimulate economic investment, development, and re-greening opportunities for the formerly industrial St. Paul Riverfront (St. Paul, MN). AES provided ecological inventories, design solutions to address stormwater contamination, and participated in design charrettes with local neighborhood groups.

Master Plan, Bloomington, IL, 1996. Sub-consultant to Thompson Dyke & Associates, Ltd. (TDA) to perform ecological surveys of lands in the Bloomington, IL, park holdings. AES conducted inventories and mapping of all of the existing parks and potential park expansionary areas, and worked with TDA to propose a master plan for the park system in Bloomington.

WisDOT Highway 51 Improvements, Pug Lake, WI, 1996. Consultant to the WI Department of Natural Resources (WDNR) and WI Department of Transportation (WisDOT) to assess water quality impacts associated with WisDOT Highway 51 improvements near Pug Lake, WI. AES conducted a watershed review and analysis of WisDOT impacts in the watershed from construction and ongoing maintenance and operations of the new four-lane interstate. Sediments entering the lake were found to have nothing to do with the road improvements construction. Instead, AES discovered that several years of drought had dewatered a large bog that contained extensive deposits of bog iron (reddish color sediment). After the drought ended, re-saturation and heavy rains liberated this iron material, which ran into Pug Lake. Homeowners around Pug Lake were preparing for litigation with WisDOT until our report disclosed these findings.

Native Planting Demonstration Plot, Interstate 90, Beloit, WI, 1996. Voluntary consultant for the WI Department of Transportation (WisDOT) for the development of a demonstration roadside native planting along Interstate 90 in Beloit, WI. AES worked closely with WisDot in Madison, WI, and Janesville, WI, to evaluate potential for planting one-half to three-fourths of a mile along the northbound interstate right-of-way with native wildflowers.

Metra, Ecological Consultant, IL, 1996. Consultant to Chicago Metra (IL) in evaluating ecological impacts and regulatory needs of a new double track siding project and then a new north line. AES was retained to conduct wetland delineations, threatened and endangered species inventories, and prepare environmental documentation and negotiations associated with expansion of the transportation rail line.

St. Paul Riverfront and Harriet Island, Ecological Consultant, St. Paul, MN, 1996. Consultant to the City of St. Paul in design and implementation of an ecological charrette for the St. Paul Riverfront and Harriet Island in St. Paul, MN. AES was retained to design and deliver an ecological charrette to an attendee list of 70-90 persons knowledgeable about the riverfront. The results served as a blueprint for redevelopment and reinvestment plan for the riverfront.

Greenway Racetrack, Toronto, ON, Canada, 1996. AES was retained by the City of Toronto (Ontario, Canada) Parks Department to evaluate and assist in the design of the Greenway Racetrack, a former horse-racing track that was abandoned and was going to be redeveloped in a private/public partnership with the City. AES did an ecological analysis, prepared stormwater management and restoration plans, and coordinated with Toronto Parks for the design of passive and active open space systems.

Lulea River Basin Assessment, Sweden, 1996. AES was retained by Scientific Certification Systems (Oakland, CA) to develop a prototype for how to evaluate and document the ecological impacts of hydropower production. The locations chosen for the assessment included Lulea River Basin (including seven dams on the river) in Sweden. AES worked closely with a larger team of scientists to develop evaluation methodologies and streamline methods that are now being finalized for the American Society for Testing and Materials (now ASTM International) as global standards for assessing ecological impacts of industrial operations.



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Mackinaw River Watershed, Cary, IL, 1995 - 2001. Consultant to The Nature Conservancy in the development of science-based and specific plans for landowners in the Mackinaw River watershed, Cary, IL. AES was retained to evaluate ways to protect and maintain the biodiversity in the Mackinaw River and its tributaries and to develop demonstration projects throughout the watershed. AES designed and constructed two major stream restoration and wetland projects. One was the Red River stream realignment project, where the stream had eroded a local county road. AES was retained to do ecological and engineering design for 3,000-4,000 lineal feet of realigned stream using soil bioengineering techniques, rather than the hard engineering techniques that had been used a number of times but failed.

Chicago's Metropolitan Commuter Train (Metra), 1995 - 2009. Principal consultant in the design and development of general and regional permits for Chicago's Metropolitan Commuter Train (Metra). Involved negotiations with federal and state agencies, evaluation of proposed categories of ecological and wetland impacts, site and field studies to evaluate the extent of the ecological impacts, and co-development of permitting packages to address the restoration opportunities.

Aldo Leopold Nature Center, Ecological Consultant, Monona, WI, 1995. Consultant to the Sand County Foundation in the development of a review of the ecological conditions and shallow groundwater conditions in association with Aldo Leopold Nature Center, Monona, WI. AES developed an ecological assessment of the 70-acre site and monitored groundwater resources.

Stormwater Management, The Ohio State University, Columbus, OH., 1995. Co-investigator in alternative stormwater options and natural landscaping options for the new stadium at The Ohio State University, Columbus, OH. Work conducted as a subcontract with Sasaki Associates, Watertown, MA.

Restoration and Wetland Mitigation Plans, Burnsville, MN, 1995. Co-investigator in the finalization and design of restoration and wetland mitigation plans for a 75-acre nature preserve, Burnsville, MN. Conducted under subcontract with Barr Engineering (Minneapolis, MN) and Edward Kraemer and Sons (Burnsville, MN).

Wetland Delineation, Brodhead, WI, 1995. Principal investigator in wetland delineation for a sanitary sewage treatment facility expansion. Conducted for the City of Brodhead, WI.

Stream Stabilization and Restoration, DuPage County, IL, 1995. Co-investigator and principal consultant in subcontracts with Rust Infrastructure and Environment through the DuPage County of Environmental Concerns to evaluate design options for stabilization and restoration of streams in DuPage County, IL. This project included several contracts and focused on over 12 miles of stream reach including along Springbrook #1, Springbrook #2, Willowway, and several other county streams. Detailed plans and specifications were prepared for potential future construction phase of this project.

Minnetonka Park District, Minnetonka, MN, 1995. Principal consultant in the evaluation of restoration opportunities for five parks and stream systems in the Minnetonka, MN, park system. Involved extensive field works, evaluation of conditions and restoration opportunities, and the design of restoration plans, programs, schedules, and cost projections. Conducted under subcontract with Brauer and Associates, Minneapolis, MN, for the Minnetonka Park District.

Prairie Wolf Slough (IL) Wetland Restoration 1995. Co-investigator and designer in the evaluation of restoration opportunities and design and engineering of plans for the Prairie Wolf Slough (IL) wetland restoration. Conducted under subcontract with Christopher B. Burke Engineering, Friends of the Chicago River, U. S. Fish and Wildlife Service, Lake County Forest Preserve District, and others.

Wetland Restoration, Libertyville Township, IL, 1995. Principal investigator in the design, permitting, and implementation of a wetland restoration program involving 13 acres in Libertyville Township, IL. Conducted in coordination with Land and Water Resources, Inc. and Christopher B. Burke Engineering.

Stormwater Management, Faribault, MN, 1995. Investigator in site review and evaluation of restoration and management, and alternative stormwater management options for a proposed residential development immediately adjacent to a federal endangered plant and its habitat. Conducted under subcontract with The Nature Conservancy, Minneapolis, MN, for a project in Faribault, MN.

T&E Study, Mill Creek, Lake County, IL, 1995. Subcontractor in the evaluation of breeding birds and rare and endangered plants along a proposed sanitary interceptor line, Mill Creek, Lake County, IL. Conducted under subcontract with Hey and Associates (Chicago, IL) under contract with the Lake County Department of Public Health.

Countryside Landfill, Wetland Mitigation, GraysLake, IL, 1995. Consultant for the design of a large wetland mitigation project for USA Waste, Houston, TX, at their Countryside Landfill (Grayslake, IL). AES was retained to evaluate and develop conceptual ecological and engineering plans for a 200-acre wetland restoration to offset impacts associated with a consent decree and settlement agreement associated with impacts from the landfill.



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T&E Study, Antioch, IL, 1994. Principal consultant in the reconciliation of regulatory problems between the Village of Antioch, IL, the U.S. Army Corps of Engineers, and U.S. Fish and Wildlife Service. This project involved field analysis of alleged endangered plant species habitat followed by negotiation of a settlement that allowed for a rail/coach yard to be installed within Village limits, rather than out of town.

Chicago Commuter (METRA), Wetland Mitigation, Natural Area Inventory, IL, 1994. Principal investigator and consultant for Chicago Commuter (METRA) Rail System in the evaluation of wetland and natural area impacts associated with rail improvements, coach yards, rail connections, and other infrastructure changes and modifications over 70 miles of WI Central Rail lines in northern IL. Involved extensive fieldwork, site evaluation, permitting, negotiation with agencies, and development of wetland mitigation programs. Conducted under subcontract with T. Y. Lin International Bascor, Chicago, IL. This project has also involved with design of a wetland mitigation bank explicitly for METRA's future use associated with improvements along their WI Central Rail line.

Green Valley Project, Wetland Mitigation, IL, 1994. Ecologist in the design of wetland mitigation plans for the IL Toll Highway Authority in the re-design of their Green Valley project. Conducted under subcontract with Christopher B. Burke Engineering, Rosemont, IL.

Karner Blue Butterfly, T&E Study, MI, 1994. Co-investigator in conducting critical literature review on the ecology, management, and status of the federally endangered Karner blue butterfly. Conducted for the Fish and Wildlife Foundation under subcontract with Whitewater Associates, Amasa, MI.

Harry Viner and family, Ecological Consultant, La Crosse, WI, 1994. Consultant to Harry Viner and family (La Crosse, WI) concerning a wetland violation and future development interests at the confluence of the Black and Mississippi rivers. Conducted in coordination with DeWitt, Porter, Ross, and Stevens, Madison, WI.

Fairway Farms Conservation Development, Green Oaks, IL, 1994. Co-investigator in the final design, permitting, and negotiations for the Fairway Farms conservation development, Green Oaks, IL. Conducted on behalf of Residential Homes of America, Inc.

Ecological Consultant, Cambridge, Ontario, Canada, 1994. Consultant in the evaluation of significance of several parcels of oak woodland and savanna near Cambridge, Ontario, Canada. Involved fieldwork and reporting, and was conducted as a subcontract through Jim Dougan and Associates, Cambridge, Ontario.

Prairie Lakes Development, Homewood, IL, 1993 - 1994, 1997 (Phase I); 2009 - 2010 (Phase II). Co-researcher in the evaluation of the efficiency and effectiveness of wetland biofiltration systems at Prairie Lakes Development, Homewood, IL. Project involved detailed hydrologic, hydraulic, and chemistry monitoring and analysis and monitoring of the vegetation in the 6.5-acre wetland biofilter, which was created to enhance water quality in an adjacent lake. Conducted in coordination with the Village of Homewood and involved graduate student from the University of IL, Champaign, IL. As part of Phase II, AES designed a wetland and pond complex as an extension of the biofilter to provide additional stormwater storage and water quality treatment. AES prepared construction documents and specifications, a grading plan, a native wetland and upland prairie planting plan and an Opinion of Probable Cost. AES also prepared a Natural Resources Inventory and subsequent management specifications for the existing 70 acres of restored wetlands and prairies at the site.

Countryside Landfill, Ecological Consultant, Grayslake, IL, 1993 - 2000. Principal ecologist in final design and oversight of native landscape plantings and in preparation of planting plans for a proposed landfill expansion for the USA Waste Services, Countryside Landfill (Grayslake, IL). Conducted in cooperation with Peter Walker, William Johnson and Partners (Berkeley, CA).

Restoration and Management Plan, Toronto, ON, Canada, 1993 - 1999. Principal scientist in detailed seven-year analysis of significant oak woodland systems for the City of Toronto's (Ontario, Canada) Department of Parks and Recreation. This program involved an extensive study of the condition of existing woodlands, establishment of demonstration and experimental plots, and a community consensus-driven restoration and management planning process for over 300 acres of oak savanna, mixed hardwood and northern hardwood forests.

Door County Landfill, Bird Hazard Study, Door County, WI, 1993 - 1994. Principal investigator in a bird hazard study to evaluate the potential threats represented by Door County Landfill expansion on bird use at the adjacent Cherryland Airport. Involved banding, die marking, trapping and tracking in addition to detailed evaluation of bird use at both facilities. Conducted for Door County, WI. Subcontract with Robert E. Lee and associates, Green Bay, WI.



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Lemont Quarry, Wetland Mitigation, Lemont, IL, 1993. Principal consultant in resolving wetland permitting needs resolving regulatory conflicts and designing comprehensive mitigation programs for Vulcan Materials Corporation (Countryside, IL) at their Lemont Quarry (Lemont, IL). This program involved the identification of wetland mitigation options; design, engineering, and permitting of a large wetland mitigation project; and design and implementation of a study and program for restoration of habitat for a threatened turtle (spotted turtle). The study also involved overseeing researchers involved in surveys of the federally-endangered Hine's emerald dragonfly.

Burnsville Prairie, Ecological Consultant, MN, 1993. Principal investigator in detailed analysis of the Burnsville Prairie and impacts of a proposed landfill expansion and quarry operation. This project involved detailed sampling of plant species composition, threatened and endangered species, soils, topography, and shallow groundwater hydrology to evaluate impacts of the proposed land uses. Conducted for Barr Engineering, Minneapolis, MN.

Harness Racetrack Re-Development, Washington Park, Homewood, IL, 1993. Principal ecologist in the design, implementation, and oversight of a conservation development associated with the re-development of a harness racing track at Washington Park, Homewood, IL. This project involved detailed design and permitting for a 137-acre development featuring Best Management Practices and water quality enhancement programs integrated with light industrial development. Conducted for the Village of Homewood, Mackie Engineers, and Rust Environment and Infrastructure through three project phases.

Picardy Place Wetland Mitigation, Wheeling, IL, 1993. Principal consultant in design of wetland mitigation program and performance monitoring program for the Picardy Place Wetland Mitigation project, Wheeling, IL. Conducted for Joseph Freed and Associates, and United Homes Development Corporation, IL. Work involved permitting, negotiation with agencies, oversight of the installation of the constructed wetland and the planting, monitoring, and maintenance programs.

Chicago Reclamation District Stickney Sewage Treatment Facility, Native Landscaping, 1993. Design and installation of alternative landscaping treatment for berms around the Chicago Reclamation District Stickney Sewage Treatment Facility. This was a long-term study to evaluate the performance of the planting strategies and to evaluate costs associated with a native landscaping treatment. This project involved controlled, replicated Latin square sampling design and testing of three planting treatments, three seed mixes, and detailed monitoring and data analysis.

Amoco Car Wash, Lincolnshire, IL, Wetland, Stormwater Management, 1993. Principal investigator in identification of opportunities and design/installation of best management practices for Amoco Car Wash, Lincolnshire, IL. Involved wetland permitting, alternative stormwater management planning, and engineering. Conducted in coordination and under subcontract with Mackie Consultants, Lincolnwood, IL.

Wausau Paper, Wetland Delineation, WI, 1993. Co-investigator in wetland delineations, functional assessment, quality analysis, and permitting for proposed waste paper sludge landfill expansion for Wausau Paper. Conducted under subcontract with RMT, Madison, WI.

Bishop Tract, Wetland Assessment, Madison, WI, 1993. Principal investigator in wetland functional assessment and condition analysis for the Bishop Tract, Madison, WI. Conducted under contract with the University of WI Arboretum.

Skokie River, Streambank Restoration, IL, 1993. Principal designer and investigator in the program to design and implement streambank restoration stabilization programs for 4,900-lineal-foot reach of the Skokie River at the Chicago Botanic Garden. Involved extensive design oversight and installation of restoration programs, and delivery of educational events (design of video and written educational materials). Conducted under contract with Chicago Horticultural Society and in coordination with U.S. IL Environmental Protection Agency, Chicago Botanic Garden staff, and Northeastern IL Planning Commission.

Savanna Systems Evaluation, WI, Upper Peninsula MI, 1993. Sub-consultant in the evaluation of ecological condition of savanna systems in six large blocks of public and privately owned property within WI and the Upper Peninsula of MI. Conducted on behalf of the University of WI, Stevens Point (UWSP), Fort McCoy, the Sand County Foundation, U.S. Department of Defense, and the Legacy Research Project, conducted under the direction of Dr. Alan Haney (UWSP).

Lake Arlington Recreational Park, Arlington Heights, IL, 1993. Principal consultant and researcher in evaluation of design options for the Lake Arlington Recreational Park, Arlington Heights, IL. This project involved the evaluation of the existing natural resources and provision of design options for restoration and management for lakeshore environments and upland systems. Conducted for the Parks Department, City of Arlington Heights, IL.

Appleton Papers, Wetland Permitting, Lock Mills, WI, 1993. Co-investigator in the evaluation in permitting options for proposed landfill project and design of wetland permitting for Appleton Papers, Lock Mills, WI.



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Sand County Foundation's Femrite Drive Property, Monona, WI, 1993. Co-investigator for the design of existing surface and groundwater features of the Sand County Foundation's Femrite Drive property. The project involved installation of piezometers and initial sampling of surface and shallow groundwater resources and wetlands. Conducted on behalf of the Sand County Foundation, Monona, WI.

Department of Military Affairs, Habitat Study, Fort McCoy, WI, 1993. Principal consultant in the evaluation of impacts to vegetation and the habitat of reptiles and Karner blue butterflies (KBB) associated with construction of the new state police training center, Fort McCoy, WI. This involved analysis of existing habitat conditions and surveys for KBB, legless lizards, and rare and threatened plants. Conducted for the Department of Military Affairs, Fort McCoy, WI.

North Heron Lake Watershed, Planning and Management, North Heron Lake, MN, 1993. Educator in the development of programs to involve people at North Heron Lake, MN, in the conceptual design of watershed management planning for the North Heron Lake watershed. This involved several presentations to community groups, the Heron Lake Waterfowl Association and various agency personnel. Conducted on behalf of The Nature Conservancy, Minneapolis, MN.

Savanna Restoration, WI, 1993. Co-investigator for project to explore the opportunities for viewing large-scale savanna restoration in WI. Hired as a team member to evaluate opportunities and help prepare proposals for procuring funding for the Legacy Savanna Project conducted through the Sand County Foundation, Madison, WI.

Stormwater and Watershed Management, DuPage County, IL, 1993. Principal ecologist in the evaluation of stormwater and watershed management planning options for the Pleasantdale (IL) subdivision. Conducted under contract with Albert Half and Associates (IL) with the DuPage County (IL) Department of Environmental Concerns. Study involved detailed analysis of watershed conditions, opportunities and options for integrating stormwater management alternatives, ecological restoration, and landscape treatments.

Prairie Crossing Development, Grayslake, IL, 1992 - Ongoing. Consultant, researcher, and design team member for the Prairie Crossing Development (Grayslake, IL), a national conservation development model that integrates agricultural land uses, natural features (prairies, wetlands, savannas), and opportunities for enhanced human lifestyles. The project involved the design and implementation of a 660-acre plan where over 60% of the land will be restored. Conducted with William J. Johnson and Associates (Ann Arbor, MI), the Lannert Design Group, the Gaylord and Dorothy Donnelley family, the George and Vicki Ranney family, Shaw Homes Development Group, and others.

St. Charles Park District, Wetland Mitigation Bank, St. Charles, IL, 1992 - 1999. Co-developer in the design, permitting, and implementation of the US' first fully-constructed private wetland mitigation bank. Conducted in conjunction with Land and Water Resources, Inc., and Christopher Burke Engineering for the St. Charles Park District on a 56-acre parcel of property, St. Charles, IL. The project involved extensive permitting, negotiation with agencies, the design of governing documents to facilitate the wetland mitigation banking program in northern IL, and oversight of restoration and management techniques and strategies.

Brodhead, WI, 1992 - 1993. Co-recipient of a grant through the WI Educational Association to teach field ecology and restoration to teachers and to co-design an outcome based curriculum, Brodhead High School, Brodhead, WI.

Falk Foundry Landfill, Wetland Delineations, Milwaukee, WI, 1992 - 1993. Co-investigator in wetland delineations and natural resource surveys of the Falk Foundry Landfill (Milwaukee, WI). Involved design of permitting strategies and preparation of permit applications for future management needs of the landfill and for expansion of detention and stormwater facilities.

Great Lakes Chapter of the Sierra Club, Ecological Consultant, Chicago, IL, 1992 - 1993. Consultant in the assessment of existing surface water quality standards in the State of IL and in the design of new standards before the IL Pollution Control Board, IL Environmental Protection Agency, and others. Contract with the Great Lakes Chapter of the Sierra Club, Chicago, IL.

Brewery Creek, Stream Stabilization, Mineral Point, WI, 1992. Contract through the WI Department of Natural Resources to design and implement a stream stabilization planting plan for Brewery Creek, Mineral Point, WI.

Nicolet and Chequamegon National Forests, WI, 1992. Appointed participant in scientific round table sponsored by the Nicolet and Chequamegon National Forests (both in WI) to provide scientific recommendations and research suggestions to maintain, conserve, and enhance biological diversity on the national forests. This was an intensive, three-and-a-half-day session composed of scientists from around the country. The result of this planning session was the production of a guidance manual for forestry practices, which was intended to be a national model.

IL, 1992. Team researcher in literature review and preparation of an information brochure on ecological buffers. Conducted for IL Department of Conservation, Springfield, IL.



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Vegetation and Avian Surveys, McHenry County, IL, 1992. Co-investigator in vegetation and avian surveys of approximately 500 wetlands to provide basic data for endangered and threatened species consultation process in IL. Conducted under contract with IL Department of Conservation, Springfield, IL. Wetlands were located in eight townships throughout McHenry County, IL.

Landfill Assessments, Brown County, WI, 1992. Consultant to Robert E. Lee and Associates (Green Bay, WI) in the assessment of Clean Water Act and WI NR103 impacts of two landfill proposals in Brown County, WI. This study involved resource assessments, wetland delineations, modeling of hydrology, and assistance in permitting.

Countryside Landfill, Grayslake, IL 1992. Design team member in closure planning to include native vegetation at the Countryside Landfill, Grayslake, IL. Contract with William B. Johnson and Associates and U.S.A. Waste.

Resource Assessment and Wetland Delineation, Brookfield, WI, 1992. Consultant in resources assessment and wetland delineation for property where land value was being contested, Brookfield, WI. Conducted through Ben Southwick, Attorney, Richland Center, WI.

Butterfield Creek, Stream Restoration, Matteson, IL, 1992. Consultant, co-designer, and team member in Matteson Commons Development, which integrated three-fourths of a mile of stream restoration (Butterfield Creek, Matteson, IL) for Transcontinental Properties, Des Plaines, IL.

Cereal City Landfill, Battle Creek, MI, 1992. Consultant in studies of existing wetland and other natural resource features of Waste Management's Cereal City Landfill (Battle Creek, MI). Sub-contracted through RMT, Madison, WI.

Bad River Indian Reservation, Northern WI, 1992. Co-investigator in evaluation of potential impacts of lead-based paint and highway bridge paint overspray on the Bad River (Bad River Indian Reservation, northern WI). Sub-contract through RMT with the WI Department of Transportation, Madison, WI.

IL Department of Conservation along Butterfield Creek, Cook County, IL, 1992. Consultant, designer, and contractor in implementation of a demonstration streambank stabilization program for the IL Department of Conservation along Butterfield Creek, Cook County, IL.

Plant Policy Legislative Committee, 1992. Participant in Plant Policy Legislative Committee with WI Department of Natural Resources and other agencies.

Algoma Landfill (a Superfund site), Algoma, WI, 1992. Sub-contract through Residual Management Technology (RMT) to investigate options for clay borrow sources for the Algoma Landfill (a Superfund site), Algoma, WI. This task included preliminary analysis of WI NR103 issues and other applicable environmental regulations.

Emerald Park Landfill Proposal, Mukwonago, WI, 1991 - 1993. Expert witness before the WI Department of Natural Resources in hearings concerned with the Emerald Park Landfill proposal, Mukwonago, WI. Contract through Creative Resource Ventures, Madison, WI, and Costain, Ltd., Britain, UK. Involved extensive field research and the development of legally-defensible arguments on hydrology, wetland issues, WI state law NR103, and assistance in state and federal permitting.

Medallion Golf Course, Columbus, OH 1991 - 1993. Consultant to Champion Development Corporation in integration of natural features (i.e., savanna, wetlands, prairies) in the 800-acre Medallion Golf Course and residential development near Columbus, OH.

Northwest Municipal Conference of Communities, Balefill Landfill, Bartlett, IL, 1991 - 1993. Consultant to the Northwest Municipal Conference of Communities in the design and re-application for the proposed Balefill Landfill, Bartlett, IL. This included detailed proposals for evaluating impacts of the landfill on an adjacent nature preserve including long-term monitoring packages and negotiations with various agencies through the application preparation.

Rusk County Landfill, Inc., Ladysmith, WI, 1991 - 1993. Consultant to Rusk County Landfill, Inc. in the natural resources assessment, evaluation of impacts, wetland delineations, and permitting associated with a proposed landfill and clay borrow site near Ladysmith, WI. Involved stream invertebrate and fish sampling, vegetation analysis and wetland studies, and WI NR103 analysis.

Cook County Forest Preserve District, Skokie Lagoons, Chicago, IL, 1991 - 1992. Researcher for the Cook County Forest Preserve District (Chicago, IL) in assessment of natural resources and opportunities for restoration of the 1,200-acre Skokie Lagoons. A report was prepared and provided technical guidance to the county on future opportunities for restoration and priorities. Note: Our report and resource maps were fundamental to a design charrette held by the IL Chapter of the American Society of Landscape Architects to evaluate design opportunities for integrating recreational uses and restoration at Skokie Lagoons.

Sundance Homes, Exner Marsh, Lake in the Hills, IL, 1991 - 1992. Consultant to Sundance Homes in the assessment of impacts of a development on Exner Marsh, Lake in the Hills, IL. Involved site visits, assessment of existing environmental impacts, and design of remediation and planting plans to reduce impacts.



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- National Arbor Day Farms, Big Muddy Workshop, Omaha, NE, 1991 - 1992.** Research scientist in resource analysis of uplands and stream systems at the National Arbor Day Farms (Nebraska City, NE) conducted as a sub-contract through Big Muddy Workshop (Omaha, NE). The data was provided to design interpretive trail systems and used for master planning and restoration of ecological resources at the Arbor Day Farm, National Arbor Day Foundation, Lincoln, NE.
- Niagara Group, Sunflower Landfill, KS, 1991.** Consultant to the Niagara Group in the conceptual design of closure plantings for the Sunflower landfill, KS.
- Stolley Prairie, Omaha, NE, 1991.** Consultant in assessment of existing conditions and opportunities for restoration and integration of a new passive recreational park at Stolley Prairie, Omaha, NE. Coordinated with Ciacco Design Group (Omaha) and resulted in a conceptual design for a new city park.
- Landfill Operation, Houston, TX, 1991.** Consultant in the assessment of expansion feasibility for a proposed paper sludge landfill operation in Houston, TX, by Consolidated Paper Company. Sub-contract through RMT, Madison, WI.
- Self-Build Development Proposal Elkhorn, WI, 1991.** Consultant on wetland delineations, permitting, and negotiations with landowner/developer and FMHA on a low-income/self-build development proposal, Elkhorn, WI.
- Tork Property, Tork Trucking, Wisconsin Rapids, WI, 1991.** Co-investigator in the delineation of wetlands and natural resources at the 1,000-acre Tork Property, Tork Trucking, Wisconsin Rapids, WI.
- Tork Clay Borrow Site, Wisconsin Rapids, WI, 1991.** Co-researcher in the assessment of the impacts of the Tork Clay Borrow Site on greater prairie chickens and Blandings turtles. Involved literature review and assessment of the site conditions to evaluate the opportunity for use by these species and for restoration to enhance habitat for these species.
- Assess Contamination of a Stream, Amerock Corporation, Rockford, IL, 1991.** Research scientist in evaluation of data to assess contamination of a stream by the Amerock Corporation, Rockford, IL. The tasks included analysis and review of data provided by Amerock and consultants, an evaluation of the sufficiency of sampling, and recommendations to the legal staff on how to proceed in hearings with the IL Pollution Control Board. Sub-contract with RMT.
- Wetland Delineations, Champaign County, IL, 1991.** Consultant in wetland delineations and permitting considerations for two proposed landfill sites, Champaign County, IL. Sub-contract through RMT, Madison, WI.
- Wetland Mitigation, Haryan Farms Development, Grayslake, IL, 1991.** Consultant and designer in the development of plans with specifications for mitigation of wetland modifications for the Haryan Farms Development, Grayslake, IL. Conducted under contract with Kimball Hill Development Corporation, Rolling Meadows, IL.
- Lake Argyle (Macomb, IL) and Siloam Springs (Clayton, IL) State Parks IL State Water Survey, 1991.** Contract with IL State Water Survey (Peoria, IL) and IL Department of Conservation to study the ecological conditions and vegetation associated with streams tributary to lakes in Lake Argyle (Macomb, IL) and Siloam Springs (Clayton, IL) State Parks. This study documented existing conditions and evaluated proposals for construction of in-line wetland/sediment traps to control siltation.
- Natural Resource Assessment and Wetland Delineation Haeger Property, Elgin, IL, 1991.** Consultant in natural resource assessment and wetland delineation in initial design phase for the Haeger Property (Elgin, IL). Conducted as a sub-contract through Thompson Dyke Ltd., Northbrook, IL.
- Windfield Development Project Properties, Dane County, WI, 1991.** Consultant in natural resources surveys for the several hundred-acre Windfield development project properties (Dane County, WI). The study was conducted to provide basic information for further planning to integrate natural resources as key features in the development. Conducted for Simon Developers, Madison, WI.
- Educator, University of MN, 1990 - 1994.** Educator in the University of MN continuing education classes on ecological restoration and management programs for the MN Department of Natural Resources personnel and other agencies, Minneapolis and St. Paul, MN.
- Busse Woods Nature Preserve, Cook County, IL, 1990 - 1993.** Consultant in studies on the potential effects of modifying the Busse Lake dam and control structure on the Busse Woods Nature Preserve. The study involved vegetation and surface and shallow ground water sampling and modeling to determine the effects of raising adjacent lake water levels on shallow ground water levels in the Busse Woods Nature Preserve. Contract through Cook County Forest Preserve District, IL.



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Barrington Middle School Project, Barrington, IL, 1990 - 1992. Consultant to architect Ruck, Pate, and Associates to design and integrate natural resources with the Barrington Middle School project (Barrington, IL). AES' responsibilities included conducting initial resource surveys, conducting all environmental permitting, preparing specifications for natural landscaping, and overseeing all natural landscaping at the site. This project later won the highest award for design and integration of nature from the IL Association of Education.

Rainbow Creek Stabilization, Sleepy Hollow, IL, 1990 - 1991. Consultant in assessment and design for methods of stabilization of Rainbow Creek. Included preparation of grading specifications, re-vegetation specifications, and woody plant management specifications. Conducted for Sleepy Hollow, IL.

Lake Elizabeth, Natural Resource Assessment and Wetland Delineation, Kenosha County, WI, 1990 - 1991. Consultant, researcher, and negotiator in natural resource assessment and wetland delineation for preparation of a gift of 47 acres of wetland on Lake Elizabeth, Kenosha County, WI. The gift was negotiated as a settlement for a fine to resolve a wetland violation with U.S. Environmental Protection Agency; recipient of the land was the WI Department of Natural Resources. Conducted for Stumpf Realty, Twin Lakes, WI.

Wetland Lake System, Bloomfield Hills, MI, 1990 - 1991. Consultant in analysis of impacts of a proposed development on a wetland lake system in Bloomfield Hills, MI. Organized through Swanson Engineering (Farmington, MI). This project created a document, "The Impacts of Development on Ecological Systems," and served as basis for hearings and public education on the threats of development to wetlands and lakes.

Anita Stone Community Center, Flossmoor, IL, 1990 - 1991. Consultant to the Anita Stone Community Center (Flossmoor, IL) in the design of wetland restoration, pond design, and construction planning and oversight of wetland planting for use as an educational facility by school groups.

Sedgewood Cove Subdivision, Deep Lake, IL, 1990 - 1991. Consultant in the natural resource inventory, wetland delineation, and basic planning for the design of the Sedgewood Cove Subdivision, which integrates natural resources and includes over a mile of lake frontage in Deep Lake, IL. Conducted for Red Seal Development Corporation.

Healey Prairie Relocation, Dundee, IL, 1990. Consultant, permit negotiator, and co-designer of the field plans to re-locate Healey Prairie, Dundee, IL. This project was cooperatively undertaken with The Nature Conservancy (Chicago, IL) along with help from hundreds of volunteers. AES co-initiated the plan for moving the threatened prairie remnants and negotiated the permits with the various agencies to allow for the construction and the trans-location of this rare prairie. Featured in National Geographic Magazine, The New York Times, Chicago Tribune, and others.

Cook County Forest Preserve District, Chicago Ridge, IL, 1990. Expert witness for hearings on the impact of a development on adjacent forest preserves district property in Chicago Ridge, IL. Hired by the Cook County Forest Preserve District to assess impacts to forest preserve areas adjacent to the subdivision.

Camp and Center Lake, Salem Township, WI, 1990. Study of existing condition and management opportunities for the watersheds and lake systems, Camp and Center Lake, Salem Township, WI. This study was conducted for the Camp and Center Lake Rehabilitation District and included funding from the WI Department of Natural Resources Lake Grant Program. The study included sediment mapping, chemical analysis, watershed hydrologic modeling and sediment yield modeling; work also included participation in several hearings and presentations and preparation of report recommendations.

Ravine System Stabilization, Highland Park, IL, 1990. Consultant, designer, and contractor in the implementation of a program to stabilize a ravine system (Highland Park, IL) that was de-stabilized by installation of a sewer line. Involved meetings, design, and implementation of plantings and erosion control. The program served as a model of how ravines might be managed.

Apple Canyon Lake Community, Apple Canyon, IL, 1990. Co-investigator on sub-contract to develop a master plan for the Apple Canyon Lake Community, Apple Canyon, IL. Included provision of all environmental data for planning issues and land management issues for the planning process; sub-contract through Camiros, Ltd., Madison, WI.

Natural Resource Study, One Corporate Center, Addison, IL 1990. Consultant in natural resources studies at the One Corporate Center site, Addison, IL, and Principal in project that moved 3.7 acres of wetland and created nine acres of wetland and prairie.

Watershed Study, Voltz Lake System, Salem Township, WI, 1990. Study of existing conditions in the watershed and the Voltz Lake system, Salem Township, WI. Conducted for the Voltz Lake Rehabilitation District and WI Department of Natural Resources' Lake Grant Program.



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Lemont Quarry, Martin Marietta Corporation, Lemont, IL, 1990. Co-investigator in rare plant and general botanical surveys, and wetland quality potential impact and character surveys for the Lemont Quarry, Martin Marietta Corporation, Lemont, IL. Conducted in cooperation with SCS Consultants, Cincinnati, OH.

Interlake and Big Marsh, Lake Calumet Area, 1990. Researched vegetation and birds of the Interlake and Big Marsh, Lake Calumet area. Subcontract through Integrated Site, Inc. and Waste Management, Inc.

Wolf Road Prairie Preserve, Westchester, IL, 1990. Co-investigator in research on historic, existing and future watershed and hydrologic conditions and management considerations for Wolf Road Prairie Preserve, Westchester, IL. Conducted for Save the Prairie Society in support of condemnation cases by IL Department of Conservation and Cook County Forest Preserve District.

Site Resource Inventories and Comprehensive Design, Lake Forest, IL, 1989 - 1994. Consultant and designer in site resource inventories and comprehensive design to integrate natural resources with a low-density residential development in Lake Forest, IL. Conducted under contract with Fairway Farms Trust, Chicago, IL.

Reconnaissance Study, Tower Lake Fen Wetland Preserve, Barrington, IL, 1989 - 1990. Co-investigator in reconnaissance study of hydrologic changes and vegetation of Tower Lake Fen Wetland Preserve, Barrington, IL. Study also investigated relationships between springs and land development. Study conducted under contract with Citizens for Conservation.

Lakeview Industrial Park, Erosion Control Plantings, 1989 - 1990. Consultant to Lakeview Industrial Park in design and implementation of erosion control plantings in the Industrial Park, Pleasant Prairie, WI.

James Woolworth Prairie Preserve and West Chicago Prairie Preserve, DuPage County, IL, 1989 - 1990. Co-investigator in cooperative program to characterize existing and pre-settlement hydrology and correlation with vegetation and soils in James Woolworth Prairie Preserve and West Chicago Prairie Preserve. Program included installation of monitoring program to field-calibrate hydraulic and hydrologic models. Funded by University of IL and DuPage County Forest Preserve District.

Village Homes, Antioch, IL, 1989. Wetland delineation, mitigation, and permitting for two parcels of land for Village Homes, Antioch, IL.

Savanna Restoration, The Grove National Historic Site, IL, 1989. Consultant under contract in design and implementation of two-acre savanna restoration for Glenview Park District at The Grove National Historic Site, IL.

Habitat Restoration, Halter Wildlife Refuge and Des Plaines River Conservancy, Kenosha, WI, 1989. Leader in voluntary management and prescribed burning at Halter Wildlife Refuge and Des Plaines River Conservancy land near Kenosha, WI. Involved design and implementation of a 600-700-acre prescribed burn for habitat restoration of savanna, wetland, and prairies.

Prairie Restoration, Oakton Community College, Des Plaines, IL, 1989. Consultant under contract in design and implementation of 10-acre prairie restoration for Oakton Community College, Des Plaines, IL.

Reclamation Plans and Monitoring Programs, Gravel Quarry Operation, Bartlett, IL, 1989. Principal consultant in design of reclamation plans and monitoring programs for a gravel quarry operation proposed by Earth, Inc. in Bartlett, IL. Project included presentation before Cook County (IL) zoning board and negotiation related to wetland mitigation proposals and permitting with the U.S. Army Corps of Engineers.

Wetland Mitigation, Round Lake Industrial Park, Round Lake, IL, 1989. Wetland delineation, mitigation, and permitting for the fourth addition to Round Lake Industrial Park for Magna Tec, Inc., Round Lake, IL. Mitigation plan included creation of a wetland plant nursery.

Management and Monitoring Specifications, Emerald Park, Inc. Landfill, Muskego, WI, 1989. Designer of management and monitoring specifications for preservation and restoration of existing wetlands, prairie, and savanna at proposed Emerald Park, Inc. Landfill, Muskego, WI. Contract with Residuals Management Technology, Inc. and Creative Resource Ventures, Inc.

Wetland Mitigation, Bensenville, IL, 1989. Wetland delineation, mitigation, and permitting of two parcels for Earth, Inc., Bensenville, IL.

Regency Woods Subdivision, Waukegan, IL, 1989. Wetland delineation of Regency Woods Subdivision, Waukegan, IL, for Bleck Engineering, Inc., Lake Forest, IL.

Chesapeake Subdivision, Lake Barrington, IL, 1989. Wetland delineation for Chesapeake Subdivision for the Village of Lake Barrington, IL.

Crossroads Parkway, Crossroads Business Park, Bolingbrook, IL, 1989. Wetland delineation at Crossroads Parkway, Crossroads Business Park, Bolingbrook, IL; subcontract to Trammell Crow Company for Albert Half Associates.



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The Grove National Historic Site, Glenview, IL, 1989. Co-investigator in studies and preparation of report titled "Wetlands and other Ecological Systems of The Grove National Historic Site and Adjacent Property." Subcontract through Woolpert Consultants, Dayton, OH; contract with the Village of Glenview, IL. Report evaluated existing Village ordinances germane to protection of the National Historic Site.

Wetland and Stream Corridor Integration, Algonquin, IL, 1989. Natural resource analysis, permitting, and study to design opportunities for integration of a wetland and stream corridor as a greenway in a development in Algonquin, IL, for United Development Corporation, Wheeling, IL. Included several presentations and hearings.

Amberfield Lakes Development, Lake County, IL, 1989. Field research, planning, environmental permitting, and installation of created wetlands at the Amberfield Lakes Development, Lake County, IL.

Round Lake Marsh, Round Lake, IL, 1989. Researcher in study titled "Evaluation of Proposed Use of Round Lake Marsh for Storm Sewer Discharge" for Round Lake Area Park District, Round Lake, IL. Study included hydrologic and sediment yield modeling and evaluation of existing and future condition of wetland under various options.

Wetland Mitigation, Bedford Park, IL, 1989. Preparation of joint application, mitigation plan, and wetland delineation for Transcontinental Properties (Des Plaines, IL), Bedford Park, IL.

Wilke Wetland Site, Palatine, Cook County, IL, 1989. Co-investigator in study titled "Vegetation, Birds, Site Hydrology and Management, and Monitoring Discussions for the Wilke Wetland Site, Palatine, Cook County, IL." Subcontract with Camiros, Ltd., Chicago, IL.

Hillcrest Country Club, Long Grove, IL, 1989. Designer and contractor for several wildflower beds in and around golf course fairway, Hillcrest Country Club, Long Grove, IL.

Wetland Mitigation Program, One Corporate Center Industrial Park, Addison, IL, 1988 - Ongoing. Designer of wetland mitigation program to integrate wetland and prairie plantings in One Corporate Center Industrial Park, Addison, IL. Project involved moving 3.6 acres of existing wetland to a newly designed and constructed basin. Monitoring programs were included to study long-term results of the program. Project included development of permits and negotiations with the U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, and the Village. Project financed by American Electric Corporation, Chicago, IL.

Wetland Restoration, IL Toll Highway 355, 1988 - 1994. Researcher and consultant in the evaluation of accomplishments in 120 acres of wetland restoration along the IL Toll Highway 355. This was an involved assessment of the conditions that had contributed to problems and failure of the Tollway wetland restoration. Contract with the IL Toll Highway Authority.

Lakeview Industrial Park, Pleasant Prairie, WI, 1988 - 1994. Consultant to WI Chapter of The Nature Conservancy (TNC) in assessment of gift property proposed for conveyance by WI Electric Power Corporation at Lakeview Industrial Park, Pleasant Prairie, WI. Project involved site assessment, redesign of U.S. Army Corps of Engineer Permit and negotiation to create a 600+ acre preserve in the Industrial Park setting. A management and monitoring program was also designed. Subsequently, a contract for restoration was granted to AES by TNC, Minneapolis, MN.

Hybernia Subdivision, Highland Park, IL, 1988 - 1993. Researcher, planning team member, consultant, and restoration contractor in study and design of Hybernia Subdivision (Highland Park, IL). Goal of this project was to maximize open space. The development included 71% open space, which included a 27-acre Nature Preserve and integrated prairie, wetland and savanna plantings. Conducted for Red Seal Development Corporation, Northbrook, IL. In 1991, the design and planning of this project won a gold medal award from Chicago Area Homebuilders.

Avian and Vegetation Assessment, Bartlett, IL, 1988 - 1993. Principal investigator in research contract to quantitatively assess avian and vegetation characteristics of proposed Balefill Landfill to be sited on a 300+ acre parcel, Bartlett, IL. Project generated two technical reports used by Patrick Engineering, Inc. in environmental assessment documentation accompanying permit applications to EPA, U.S. Army Corps of Engineers, and local zoning boards.

Mitigation, Re-Vegetation-Reclamation, Bartlett, IL, 1988 - 1993. Co-investigator in design of detailed mitigation, site revegetation-reclamation, and site closure plan for the proposed Balefill landfill, Bartlett, IL. Project included research and monitoring program. Project subcontracted with Patrick Engineering, Inc. for the Northwest Municipal Conference of Municipalities.

Wetland Mitigation, Grayslake, IL, 1988 - 1989. Wetland delineation and mitigation plan for Anest and Anest property, Grayslake, IL, with Federal Development Corporation, Madison, WI.



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Wolf Road Prairie Preserve, Westchester, IL, 1988 - 1989. Co-investigator in modeling of pre-settlement and existing hydraulic and hydrologic characteristics and correlation with vegetation at the Wolf Road Prairie Preserve, Westchester, IL. Also involved assessment and negotiation with FEMA over floodplain water level elevations. Work done for Save the Prairie Society.

Fields of Long Grove Subdivision, Long Grove, IL, 1988. Design and implementation of a planting program for steep slopes associated with a sewage lagoon at the Fields of Long Grove Subdivision, Long Grove, IL. Design used plants able to tolerate seasonal inundation and dry-down.

Wetland Mitigation, Grayslake, IL, 1988. Wetland delineation and mitigation design and permitting for 3 parcels of property on behalf of John Waldenstrom Development Corporation, Grayslake, IL.

Lyman Woods Preserve, Downers Grove, IL, 1988. Principal investigator in research program to document ecological condition in preparation of long-term management and monitoring programs for Lyman Woods Preserve, Downers Grove, IL. Project included detailed assessment of site history, vegetation, soils, water quality, wetland condition, anthropogenic disturbance history and presentation of results in several hearings and public information meetings. Contract with Downers Grove Park District, IL.

Lakeview Industrial Park, Pleasant Prairie, WI, 1988. Co-designer in wetland restoration and nature preserve design for WI Electric Power Corporation's Lakeview Industrial Park (a 1,500-acre development), Pleasant Prairie, WI.

Wetland Restoration, IL Toll Highway Authority, DuPage County, IL, 1987 - 1994. Contract to restore 120 acres of wetland, prairie, and aquatic habitat for IL Toll Highway Authority along new the North-South Tollway extension, DuPage County, IL.

Prairie Restoration, Long Grove Park District, IL, 1987 - 1993. Consultant in design and implementation of 30-acre prairie restoration for Long Grove Park District (IL).

Ecological Assessment, Turner Estate, Florence County, WI, 1987. Consultant in ecological assessment of property included in Turner Estate, Florence Co., WI. Project included investigation of options for tax relief, including alternatives under managed Woodland Act in WI, and land management planning. Assessment conducted for Barbara Turner, Long Grove, IL.

WI Department of Natural Resources, 1987. Contract with WI Department of Natural Resources (WDNR) to harvest 1,200-1,500 acres of prairie grass seed from WI Wildlife Areas. Half of seed was provided to WDNR for use in state parks and other wildlife area plantings. Project involved use of three large combines and over 300 miles of travel.

Prairie Grassland Plantings, IL, WI, 1987. Design and implementation of prairie grassland plantings on 10 parcels of land (IL, WI) enlisted in the Soil Conservation Service, Conservation Reserve Program for a total of 250 acres.

Revegetation Strategies, Dike 14, Cleveland, OH, 1987. Principal investigator in design and implementation of experimental revegetation strategies in confined disposal facilities for dredge spoils. Successfully re-vegetated 60 acres of Dike 14 in Cleveland, OH, with wetland plants able to tolerate and grow up through annual lifts of sediments. This program was designed to change the attractiveness of disposal facilities to shorebirds and waterfowl, which are susceptible to avian botulism associated with anaerobic conditions of shallow pools and bare mud substrates often found in these facilities. After planting, avian species not susceptible to botulism were documented. Contract with Dr. John Simmers, U.S. Army Corps of Engineers, Waterway Experimental Station, Vicksburg, MO.

Woodridge Golf Course, DuPage County, IL, 1987. Expert witness for the Village of Lisle (IL) and their attorney in land condemnation hearings before the DuPage County Forest Preserve District and County Board and U.S. Army Corps of Engineers for the Woodridge Golf Course, DuPage County, IL.

Restoration Strategies, Nachusa Grassland Preserve, Dixon, IL, 1987. Consultant under contract to The Nature Conservancy's IL office (Chicago) in implementation of restoration strategies at 600+ acre Nachusa Grassland Preserve near Dixon, IL.

Stewardship Abstract, 1987. Co-investigator in literature research for development of element stewardship abstract for cattail (*Typha* spp.) for The Nature Conservancy, Minneapolis, MN.

WI Prairie Enthusiasts, 1986 - Ongoing. Co-founder of the WI Prairie Enthusiasts, a non-profit citizen group designed to: 1) educate the public on native landscapes and natural areas; 2) initiate a program for conducting large-scale prairie (and other systems) restorations; 3) design and present legislative initiatives at state and federal levels to support incentives for natural areas establishment, protection, management, and monitoring; and 4) establish a genotype nursery for native plants and to participate in policy governing use of native plants in ecosystem restorations. Group activities have included planting a demonstration prairie (Monroe, WI), workdays for burning and brushing prairie remnants, and more.



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Tefft Sand Savanna Nature Preserve, Jasper-Pulaski Counties, IN 1986 - Ongoing. Co-investigator in baseline studies of the effects of the intensity of prescribed fires on restoration success at the Tefft Sand Savanna Nature Preserve, Jasper-Pulaski counties, IN. Funded by the IN Department of Natural Resources, Division of Nature Preserves.

Dendrochronology Studies of Bur and White Oak Trees, 1986, 1989 - 1990. Co-investigator in dendrochronology studies of bur and white oak trees of Midwestern savanna ecosystems. Study conducted through tree-ring laboratory, AZ State University, with funding by DuPage County (IL) Forest Preserve District, Glenview (IL) Park District, and others. Study focused on quantitative assessment of regional drought frequencies and wildfire events, growth rates, and historic regional climates.

Prescribed Burning Study, Northern IL, 1986 - 1991. Co-investigator/co-recipient of grants to conduct baseline studies of the effects of prescribed burning on oak savanna ecosystem remnants in Northern IL. Included studies of small mammals, avians, vascular vegetation, lichens, bryophytes, and terrestrial leaf-litter invertebrates and other insect groups. Funded by the IL Non-Game Wildlife Fund Grant, The Nature Conservancy, The Max MacGraw Wildlife Foundation, The Morton Arboretum, and Lake and DuPage County Forest Preserve Districts.

Wetland Restoration, Woodstock, IL, 1986 - 1991. Principal investigator in wetland restoration activities on a 47-acre parcel near Woodstock, IL. Work included investigations of soil-seed banks, design and testing of methods to control aggressive introduced plant species, and design and implementation of restoration planting and monitoring of success.

Cornell Lakes Development, Palatine, IL, 1986 - 1989. Principal investigator in baseline ecological assessment of the wetland at the Cornell Lakes Development (Palatine, IL) including seed-bank analysis, chemistry of water and sediments, and vegetation and faunal studies. Design and implementation of wetland restoration activities including sediment and vegetation management, environmental permitting, and vegetation planting, and monitoring for the Lincoln-Pratt Building Corporation, Lincolnwood, IL.

Ecological Studies, Mackinaw County, IL, 1986 - 1987. Co-investigator in ecological studies of the threatened heart-leaved water plantain and its habitat requirements in two adjacent ravines, Mackinaw County, IL. Study included analysis of factors causing declines of populations in one ravine including land-use differences and analysis of meteorological impacts under land-use regimes. Funded by the IL Endangered Species Protection Board through the Morton Arboretum, Lisle, IL.

Graham Zinc-Lead Mine, Galena, IL, 1986. Principal investigator in design and implementation of remedial plantings on floatation tailings piles at the Graham Zinc-Lead Mine, Galena, IL, for Inspiration Mines, Inc., Claypool, AZ.

Reclamation Planting Efforts, Bay City, MI, 1986. Co-investigator in reclamation planting efforts on fly-ash disposal dikes and settling cells at the Karns Coal-Fired Power Plant, Bay City, MI.

Mohave Desert Ecosystem, Ft. Irwin, 1986. Research assistant in continuing studies of the effects of U. S. Military training activities on the central Mohave Desert ecosystem, Ft. Irwin, The National Training Center, near Barstow, CA. Contract with U.S. Army Corps of Engineers Construction Laboratory (Champaign, IL) included investigations of training effects on mammals, breeding birds, vegetation, and ecosystem condition.

Residuals Management Technology, Inc., Baseline Studies, Madison, WI, 1985 - 1989. Co-investigator in baseline studies on the ecology of the endangered water plantain (*Plantago cordata* Michx.) and studies of potential impacts of development on the habitat of this species for Residuals Management Technology, Inc., Madison, WI. Included sediment-water modeling, water quality, land use, and watershed investigations, and population monitoring.

Candlewick Lake, Baseline Studies, Belvedere, IL, 1985-1986. Co-investigator in baseline studies of the nutrient enrichment and sedimentation problem and management options for Candlewick Lake, Belvedere, IL. Included design, permitting, and implementation of lake dredging activities and disposal system design, and construction oversight.

Lichen Collections throughout the U.S., 1985 - 1986. Principal investigator in conducting lichen collections throughout the U.S. for the National Institute of Health's Cancer Research Program, Bethesda, MD, (Contract # 263-MD-530535).

Woodland Caribou Provincial Park, Baseline Studies, Red Lake, Ontario, Canada, 1985. Co-investigator in baseline studies for the Ontario Breeding Bird Atlas in remote areas of the new Woodland Caribou Provincial Park (Red Lake, Ontario, Canada). Cooperative program with the Park, Atlas staff, and Ontario government.

Zinc-Lead Mines, Reclamation and Environmental Monitoring Programs, Southwestern WI, 1984 - 1992. Key person in preparation and implementation of reclamation and environmental monitoring programs for four zinc-lead mines in southwestern WI. Included negotiation, mediation, and permitting on behalf of Inspiration Mines, Inc. (Claypool, AZ) with the WI Department of Natural Resources.



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Multipurpose Range Complex, Ecological Studies, Ft. Riley, KS, 1984 - 1985. Principal investigator in ecological studies of the impacts of construction, use, and maintenance of the Multipurpose Range Complex for track vehicle training activities at Ft. Riley, KS. Included presentation of a planning session workshop and preparation of technical and operational manuals for management, maintenance, and monitoring of the Range. Contracts DACA88-84-M-0410, DACA88-84-M-0520 and CERL-EN-5-098, with the U.S. Army Construction Engineering Research Laboratory, Champaign, IL.

Superior National Forest, Duluth, MN, Ecological Studies, 1984 - 1985. Co-Investigator and researcher in ecological studies of the effects of silvicultural application of the herbicide ROUNDUP, Superior National Forest (Contract 43-63A9-4-1390), Duluth, MN.

Lake Bluff Wetland Nature Preserve, Ecological Studies, Lake Bluff, IL, 1984. Principal Investigator in baseline ecological studies, impact assessment, and design of management recommendations for the Lake Bluff Wetland Nature Preserve. Under contract with the Lake Bluff Park District and Lake Bluff Open Lands Association, Lake Bluff, IL.

Landfill Studies, Ecological Studies, Milwaukee, WI, 1984. Co-investigator in ecological studies for siting a municipal sludge landfill near Milwaukee, WI, and a landfill for boiler ash disposal for the St. Regis Paper Company, St., Regis, MN, under subcontract with Residuals Management, Inc., Madison, WI.

Great Marsh System, IN Dunes National Lakeshore, IN, 1983 - 1984. Principal investigator and researcher in studies of the ecological condition, history of anthropogenic disturbances, and vegetation mapping of the Great Marsh System, IN Dunes National Lakeshore, National Park Service (Contract #CX6000-3-0082).

Landfill Studies, Kent County, MI, 1983. Expert witness to Miller, Johnson, Snell, and Commiskey (Grand Rapids, MI) on behalf of Sparta Foundry (Sparta, MI), Division of Muskegon Piston Ring Company/Division of Goetze Corporation of America, in Kent County, MI, Circuit Court Case #80-35345-AS, *Anderson et al. vs. Sparta Foundry et al.* This was a MEPA case involving landfill siting in contested Prime Agricultural Lands. Performed an evaluation of Prime Agricultural Land Laws and studies of the property.

Ecological Studies, IL Department of Transportation, Lisle, IL, 1983. Consultant to McDonough and Associates (Chicago, IL) to conduct studies for the IL Department of Transportation's proposed Highway (F.A.P. 431) extension along the Morton Arboretum (Lisle, IL). Established a research program to determine ecological conditions of terrestrial and aquatic systems in the proposed highway right-of-way, including analysis of road-related pollutants in plant and animal tissues and in soils. Also designed long-term monitoring programs and prepared "Impact and Mitigation Reports" as a major contribution to the E.I.S for the highway.

Botanical Studies, Dingmans Marsch, MI, 1983. Assistant Investigator in botanical studies at the Dingmans Marsh, MI, for preparation of an Environmental Impact Assessment for peat reserve development. (Subcontract with Ecological Research Services, Inc., Boyne City, MI.)

Peat Reserves, Lower Peninsula MI, 1983. Assistant Researcher of peat reserves at several locations in the northern Lower Peninsula of MI for the Black Forest Peat Moss, Inc., Sheboygan, WI.

Ecological Evaluation, Wilson Access Property, Richmond, McHenry County, IL, 1983. Investigator in an ecological evaluation of Wilson access property (Richmond, IL), land proposed for trade by The Nature Conservancy, Chicago, IL.

Bridgeman South Sand Mine, Bridgeman, MI 1983. Principal Investigator in legal discovery, Hope for the Dunes vs. Martin Marietta Corporation's (Unimin Corporation) proposed Bridgeman South sand mine, Bridgeman, MI. Retained by Hartwig, Crow, Jones and Postelli (St. Joseph, MI), to prepare an evaluation of the quality and significance of the Bridgeman south property. Subcontract with Ecological Research Services, Inc., Boyne City, MI.

Pinyon Canyon, Trinidad, CO, 1983. Principal Investigator in studies of the impacts of track vehicles on botanical features at Pinyon Canyon (Trinidad, CO) and at Fort Carson, CO. Program was established to determine long-term track-vehicle impacts and for design of mitigation and reclamation for military training areas. (Contract #CERL-EN-3-133 with the U.S. Army Construction Engineering Research Laboratory, Champaign, IL.)

IN Dunes National Lakeshore, Lichen/Flora Studies, 1983. Co-Investigator in studies of the lichen/flora and establishment of lichen-air pollution monitoring stations, IN Dunes National Lakeshore, National Park Service. Funded by Friends of the IN Dunes National Lakeshore.

Cowles Bog National Landmark, IN, 1982 - 1983. Principal Investigator in an ecological condition and management opportunity study for the Cowles Bog National Landmark, IN Dunes National Lakeshore, National Park Service (Contract #CS6000-2-0040).

Ecological Studies, Dane County, WI, 1982 - 1983. Principal Investigator of ecological studies for siting three municipal waste disposal sites in Dane County, WI. Subcontract with Residuals Management Technology, Inc., Madison, WI.



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Robert Kennicott Grove National Historic Landmark, Glenview, IL 1982. Voluntary services for preparation of "Potential environmental impacts of proposed land development projects on the management of the 'Robert Kennicott Grove' National Historic Landmark, Glenview, IL" for The Grove Heritage Foundation.

Peregrine Falcon Surveys, Upper Peninsula MI, 1982. Peregrine falcon surveyor at historic nesting locations in the Upper Peninsula of MI. Survey conducted for the Michigan Natural Features Inventory program, MI Department of Natural Resources.

Sparta Foundry Landfill, Ecological Assessment, Sparta, MI 1981 - 1983. Principal Investigator in an ecological assessment of the proposed Sparta Foundry landfill, Sparta, MI. Subcontract with Residuals Management Technology, Inc., Madison, WI.

Vegetation and Insect Monitoring Studies Morton Grove Prairie Preserve, Niles, IL, 1981 - 1982. Principal Investigator in vegetation and insect monitoring studies and management program design for the Morton Grove Prairie Preserve, Niles, IL.

Little Missouri River National Grassland, ND, 1981. Co-Investigator in studies of rangeland condition and animal carrying capacity for the Custer National Forest, Little Missouri River National Grassland, ND.

Exotic Terrestrial Mollusks Surveys, 1981. Principal Investigator and surveyor of southwest U.S./Mexico border and west coast ports-of-entry for exotic terrestrial mollusks, U.S. Department of Agriculture, Animal and Plant Health Inspection Services, Hyattsville, MD (Contract #PO43-3294-1-15).

MI Natural Features Inventory Surveys, Clinton River Basin, MI, 1981. Field biologist in MI Natural Features Inventory surveys of the Clinton River Basin, MI, in coordination with The Nature Conservancy (Lansing, MI).

Ecological Assessment, Ropes Gold Mine, Ishpeming, MI, 1981. Consultant involved in the preparation of an Environmental Impact Assessment for reopening of the Ropes Gold Mine, Ishpeming, MI, for Callahan Mining Company.

Ecological Assessment and Valuation, Lake St. Clair, Fairhaven, MI, 1981. Principal Investigator in ecological assessment and economic valuation of the Blue Isle wetland parcel on Lake St. Clair, Fairhaven, MI; report prepared to mediate value disputes with the MI Department of Natural Resources.

Exotic Weed Plants Surveys, 1980 - 1981. Principal Researcher and surveyor of major U.S./Mexico border and U.S. west coast ports-of-entry for exotic weed plants; contract with the Animal and Plant Health Inspection Services, U.S. Department of Agriculture, Hyattsville, MD. (Contract #53-3294-0-11.)

Ecological Monitoring Studies, San Juan National Forest, CO, 1980 - 1981. Principal Investigator in ecological monitoring studies of rangeland improvement practices, San Juan National Forest, CO (Contract #53-82CS-0-040).

Rangeland Analysis, San Juan National Forest, CO, 1980. Principal Researcher in rangeland analysis to determine conditions in the Dolores Ranger District of the San Juan National Forest, CO (Contracts #53-82CS-0-040 and #53-82CS-0-22).

Ouray National Wildlife Refuge, UT, 1980. Voluntary assistance to the Ouray National Wildlife Refuge in conceptual design of habitat to establish breeding Redhead and Canvasback Ducks, UT.

Sand Dune Studies, MI, 1980. Consultant to Globetrotters Engineering Corp., Chicago, IL, in studies (under contract with U.S. Army Corps of Engineers, Detroit [Contract #DACW-35-80-0004] and MI Department of Natural Resources) of the "effects of sand dunes" on environmental, aesthetic and socioeconomic environments of MI. Contributed data for MI Sand Dune Protection and Management Act (P.L. 281-651- 281-664).

Vegetation Monitoring, James Woolworth Prairie Preserve, Niles, IL, 1979 - 1994. Principal Investigator in long-term vegetation monitoring, management, and ecological research programs for the James Woolworth Prairie Preserve, Niles, IL. Included intensive vegetation analysis, vegetation and statistical mapping, soil and insect studies, development of an electronic database and information retrieval system, and a remote sensing program to monitor vegetation dynamics.

Janet Stevens Woodland Nature Preserve, Wheatland Township, Hillsdale, MI, 1979 - 1980. Principal Researcher and expert witness in Environmental Impact Assessment of timber harvest on the Janet Stevens Woodland Nature Preserve, Wheatland Township, Hillsdale, MI. Involved litigation against a timber thief. (Note [1983]: This was the first MEPA case applied to private lands; AES' client was awarded money to restore the woodland, which is now a dedicated nature preserve.)

Lake St. Clair, Wetlands, MI, 1979. Expert witness to Sigal and Seeligson law firm (Ann Arbor, MI) in *Lottie M. Schmidt vs. MI Department of Natural Resources*; contested hearing involving use of presumed wetlands on Lake St. Clair.

Pere Marquette State Park, Timber Harvest, 1979. Consultant for preparation of legal discovery documentation for the Great Lakes Chapter of the Sierra Club vs. the IL Department of Conservation's Proposed Pere Marquette State Park timber harvest.

Great Lakes Seabird Nesting Surveys, MI, 1979. Participant in surveys of Great Lakes seabird nesting requirements. Involved studies of vegetation and banding. Contract with Bureau of Land Management, Duluth, MN.



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Mine Impact Studies, Black River Falls, WI, 1979. Co-Investigator in studies of the Jackson County Iron Company (Black River Falls, WI) mine impacts on stream, wetland water quality, fauna, and flora; prepared as support for permit proceedings with the WI Department of Natural Resources.

Midway Atoll, Seabird and Vegetation Research, 1979. Co-Investigator in seabird and vegetation research program on Midway Atoll (Hawaiian Archipelago) coordinated with the U.S. Fish and Wildlife Service and the United States Navy. Included banding and intensive vegetation work.

Reclamstion Studies, Black River Falls, WI, 1978 - 1984. Co-Investigator in reclamation success studies, Jackson County Iron Company, Black River Falls, WI; included quantitative analysis of vegetation on waste rock and tailings slopes.

Environmental Impact Assessment, New Buffalo, MI, 1978 - 1980, 1982 - 1983. Principal Investigator in an Environmental Impact Assessment of a proposed coastal wetland condominium development, New Buffalo, MI. Included development of necessary permits and litigation.

Inland Lime and Stone Mine, Reclamation Monitoring Program, Gulliver, MI, 1978. Co-Investigator in a monitoring program of reclamation success on ag-lime and settling pond dikes at the Inland Lime and Stone Mine, Gulliver, MI.

Threatened and Endangered Species Studies, Ottawa National Forest, MI, 1978. Principal Researcher in studies of the management opportunities of three threatened (MI: Cooper's, Red-shouldered and Marsh Hawks) and four federally-sensitive (Goshawk, Sharp-shinned Hawk, Merlin, and the Barred Owl) raptor species for the Ottawa National Forest, MI (Contract #40-56A1-8-1305).

Revegetation and Ecological Studies, Ft. Knox Military Reservation, KY, 1978. Principal investigator in the U.S. Army Construction Engineering Research Laboratory revegetation and ecological studies in the track vehicle training area, Ft. Knox Military Reservation, KY (Contract #CERL-EN-136A1).

Post-Wildfire Studies, Quetico-Superior Wilderness, Northeastern MN, and Ontario, Canada, 1978. Recipient of the Granite City Steel scholarship fund award to study the post-wildfire succession of plants, birds, and insects in the Quetico-Superior Wilderness, Northeastern MN, and Ontario, Canada.

Ecological Studies, Superior National Forest and Quetico Provincial Park, MN, and Ontario, Canada, 1976 - Ongoing (annually). Co-Investigator in studies of the effects of wildfire and silviculture on breeding birds, vascular plants, lichens, and spiders in the Superior National Forest and Quetico Provincial Park, MN, and Ontario, Canada. Studies were funded by a grant from the MN Department of Natural Resources Nongame Wildlife Program in 1984. As of June 2015, this research is ongoing.



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PUBLICATIONS (after 2019, please see www.researchgate.com for additional publications)

2019. E & D Symposium, Volume 1 by Penn State Stuckeman School, https://issuu.com/stuckemanschool/docs/eplud_symposium_vol1_single-pages, *Topic 1: Key Ecological Principles*, David Orr, Oberlin College, William Braham, University of Pennsylvania, Kristina Hill, UC Berkeley, *Topic 2: Useful Collaborative Strategies*, Keith Bowers, Biohabitats, Chris Barnes, SCAPE, Thomas Price, Conservation Design Forum, *Topic 3: Research to Test Performance*, William Mitsch, Florida Gulf Coast University, Steve Apfelbaum, Applied Ecological Services, Wu Hong, Penn State.

2019. Mimi Hillenbrand, Ry Thompson, Fugui Wang, Steve Apfelbaum, Richard Teaguec. *Impacts of holistic planned grazing with bison compared to continuous grazing with cattle in South Dakota shortgrass prairie*. Agriculture, Ecosystems, and Environment. 2/5/2019.

2019. Apfelbaum, Steven, "S" Is for Soils!, R. Schneider Publishers, Stevens Point WI, First Edition, Copyright 2019 Steven I. Apfelbaum, ISBN 978-0936984-27-8.

2018. Steven I. Apfelbaum, Scott Kobal, Rachel Reklau, and Wayne A Lampa, *Using Measured Hydrology and Vegetation Performance from a Reference Natural Area to Design Wetland Restoration Plant Communities in the Soil Saturation Zone: West Chicago Prairie Nature Preserve, DuPage County, IL*, Transactions of the Illinois State Academy of Science, (2018) Volume 111, pp. 17-23.

2018. Apfelbaum, Steven, I. 'I have been meaning to reach out to the Church of the Brethren for 40 years', Church of the Brethren Newsline, June 8, 2018, <http://www.brethren.org/news/2018/i-have-been-meaning-to-reach-out.html>.

2018. Davitt, Carol, Executive Director, Missouri Prairie Foundation, and Editor, Missouri Prairie Journal Missouri Prairie Journal, Vol. 39, No. 2, p. 14-16, "An Interview with Steve Apfelbaum".

2017. Apfelbaum, Steven I., Haney, Alan, Wang, Fugui, & Carlson, Jason. *Old-Growth Southern Boreal Forest Stability Response to a Stand-Replacing Wildfire*. *Natural Areas Journal*, Vol 37 No 4, pp. 474-488, Oct 2017.

2016. W.R. Teague, S. Apfelbaum, R. Lal, U.P. Kreuter, J. Rowntree, C.A. Davies, R. Conser, M. Rasmussen, J. Hatfield, T. Wang, F. Wang, and P. Byck. *The role of ruminants in reducing agriculture's carbon footprint in North America*. March/April 2016, *Journal of Soil and Water Conservation*, 71(2):156-164, www.swcs.org.

2015. Haney, Alan W., and Steven I. Apfelbaum. Forthcoming. *Laughing in the Wilderness: Adventures in the North Woods and Other Stories*. Stevens Point, WI: Back Forty Press.

2014. Guzman, Jose G., Rattan Lal, Shana Byrd, Steven I. Apfelbaum, and Ry L. Thompson. 2014. "Carbon Life Cycle Assessment for Prairie as a Crop in Reclaimed Mine Land." *Journal of Land Degradation & Development* (May 6). <http://doi/10.1002/ldr.2291>.

2014. Apfelbaum, Steven I. 2014. "Innovations in Water Management for Landfills." Paper and technical session presented March 24, 2014, at the SWANA Landfill Symposium, Monterey, CA, March 24-27, 2014.

2013. Apfelbaum, Steven. 2013. "New Aerial Imaging Tools Offer Cost Effective Assessments." *Claims Journal* 2, no. 1 (Winter): 30.

2013. Apfelbaum, Steven, and Jason Carlson. 2013. "Remote Sensing in Conservation Easement: An Easy Way to Manage a Property's Health While Improving Landowner Relations." *Right of Way* (March/April): 21-23.

2013. Elam, Jesse A., Steven I. Apfelbaum, Michael Sands, Brian J. Smith. 2013. "Stakeholder Engagement Creates Blueprint for a 21st Century Highway in the Chicago Area." In *TRB 92nd Annual Meeting Compendium of Papers*, paper no. 13-3998, presented at the 92nd annual meeting of the Transportation Research Board (TRB), Washington, D.C., January 13-17, 2013.

2012. Apfelbaum, Steven, Robert Rock, and Theodore Zoli. 2012. "A Simple Structure Supports a Complex Habitat in Wildlife Crossing Design." *Ecological Restoration* 30, no. 4 (December): 341-344.

2012. Apfelbaum, Steven I., John D. Eppich, and James A. Solstad. 2012. "Runoff Management, Wetland Hydrology, and Biodiversity Relations in Minnesota's Red River Basin Wetlands." *Journal of Environmental Science and Engineering B* 1, no. 1 (January).

2012. Apfelbaum, Steven I., Haney, Alan, and Blue, Jacob. September / October 2012. "Design with nature, or not." *Urban AG, UAC Magazine*, p. 60 - 64.

2011. Apfelbaum, Steven I., and Alan Haney. 2011. *Restoring Ecological Health to Your Land Workbook*. Washington, D.C.: Island Press.

2011. Apfelbaum, S., and W. Albright. 2011. "A Natural Harmony." *MSW Management* (June): 56-58.



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2011. Bowles, Marlin, Steven Apfelbaum, Alan Haney, Susan Lehnhardt, and Tom Post. 2011. "Canopy Cover and Groundlayer Vegetation Dynamics in a Fire Managed Eastern Sand Savanna." *Forest Ecology and Management* 262, no. 11 (December): 1972-1982.
2010. Apfelbaum, Steven I., and Alan Haney. 2010. *Restoring Ecological Health to Your Land*. Washington, D.C.: Island Press.
2010. Apfelbaum, S., and J. Ludwig. 2010. "Hydrology and Wetland Restoration for Human Subsistence and Regional Biodiversity: The Challenge to Restore the Living Landscape of Iraq's Mesopotamian Marshes." In *Restorative Redevelopment of Devastated Ecocultural Landscapes*. Boca Raton, FL: CRC Press: 132-154.
2009. Apfelbaum, Steven I. 2009. *Nature's Second Chance: Restoring the Ecology of Stone Prairie Farm*. Boston, MA: Beacon Press.
2009. Apfelbaum, Steven I., Dirk Brinkman, and Robert Seaton. 2009. "Soil's Role in Evolving Healthy Earth." *Silviculture Magazine* (April).
2008. Haney, Alan, Marlin Bowles, Steven Apfelbaum, Emily Lain, and Tom Post. 2008. "Gradient Analysis of an Eastern Sand Savanna's Woody Vegetation, and its Long-Term Responses to Restored Fire Processes." *Forest Ecology and Management* 256, no. 8 (October 1): 1560-1571.
2008. Haney, Alan, S. Apfelbaum, and J. M. Burris. 2008. "Thirty Years of Post-Fire Succession in a Southern Boreal Forest Bird Community." *American Midland Naturalist* 159, no. 2: 421-433.
2008. Apfelbaum, Steven I., and Neil Thomas. 2008. "Ecological Restoration Needs to Address Altered Ecosystems at Larger Spatial Scales." In *Handbook of Regenerative Landscape Design*, edited by Robert L. France, 357-378. Boca Raton, FL: CRC Press.
2007. Apfelbaum, Steven I., and John M. Kimble. 2007. "A Dirty Way to Fight Climate Change: A Promising Strategy: Store Carbon in the Soil." *Christian Science Monitor* (November 29).
2007. Kimble, John M., Charles W. Rice, Debbie Reed, Sian Mooney, Ronald F. Follet, Rattan Lai, and Steven I. Apfelbaum. 2007. *Soil Carbon Management: Economic, Environmental and Societal Benefits*. Boca Raton, FL: CRC Press.
2007. Tuttle, Craig T., Jill C. Enz, and Steven I. Apfelbaum. 2007. *Cost Savings in Ecologically Designed Conservation Developments*. Brodhead, WI: Applied Ecological Services, Inc.
2006. Constantine, Jim, and Steve Apfelbaum. 2006. "Turning Dirt Green: How Sustainable Site Design Creates Better Places, Captures Market Share, and Increases the Bottom Line." *Land Development* (Winter): 26-31.
2005. Apfelbaum, Steven I. 2005. "Stormwater Management: A Primer and Guidelines for Future Programming and Innovative Demonstration Projects." Chapter 19 in *Facilitating Watershed Management: Fostering Awareness and Stewardship*, edited by Robert L. France, 321-333. NY, NY: Rowman and Littlefield Publishers, Inc.
2003. Nielsen, S., C.Kirschbaum, and A. Haney. 2003. Restoration of Midwest Oak Barrens: Structural manipulation or process-only? *Conservation Ecology* 7(2): 10. [online] URL: <http://www.consecol.org/vol7/iss2/art10>
2001. Apfelbaum, Steven I. 2001. "A Brief History and Analysis of Floodwater Management Engineering: Experiments with Undefined Uncertainty." Appendix 1 in *Conservation Plan*, authored by The Conservation Fund, Applied Ecological Services, Inc., Resource Data, Inc., Heart Lake Conservation Associates, LLC, Velasco and Associates, and K. Singh and Associates. MMSD Contract No. W027DC001. Milwaukee, WI: Milwaukee Metropolitan Sewerage District (MMSD).
2001. Apfelbaum, Steven I. 2001. "The Importance of Ecological Restoration to the Success of Flood Damage Reduction." Appendix 2 in *Conservation Plan*, authored by The Conservation Fund, Applied Ecological Services, Inc., Resource Data, Inc., Heart Lake Conservation Associates, LLC, Velasco and Associates, and K. Singh and Associates. MMSD Contract No. W027DC001. Milwaukee, WI: Milwaukee Metropolitan Sewerage District (MMSD).
2001. Apfelbaum, Steven I., and David Johannesen. 2001. "Stewardship and Flood Damage Reduction." Appendix 4 in *Conservation Plan*, authored by The Conservation Fund, Applied Ecological Services, Inc., Resource Data, Inc., Heart Lake Conservation Associates, LLC, Velasco and Associates, and K. Singh and Associates. MMSD Contract No. W027DC001. Milwaukee, WI: Milwaukee Metropolitan Sewerage District (MMSD).
2001. Apfelbaum, Steven I. 2001. Review of Ecosystem Management: Lessons From Around the World: A Guide for Development and Conservation Practitioners, edited by J-Y Piroit, P. J. Meyenell, and D. Elder, 2000. *Ecosystem Health* 7, no. 1 (March), 59-60. <http://doi:10.1046/j.1526-0992.2001.007001059.x>.
1999. Apfelbaum, Steve, and Jack Broughton. 1999. "Using Ecological Systems for Alternative Stormwater Management." *Land and Water Magazine* (September/October 1999): 10-12.



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PUBLICATIONS

1998. Collada, A.E. and Alan Haney. 1998. Effect of oak wilt on the vegetation of oak barrens. *Transactions of the Wisconsin Academy of Sciences, Arts, and Letters* 86: 35-45.
1997. Apfelbaum, S. I., M. Sands, T. H. Price, J. D. Eppich, P. M. Hoffman, and D. Hoffman. 1997 [1996]. "On Conservation Developments and Their Cumulative Benefits." In *Assessing the Cumulative Impacts of Watershed Development on Aquatic Ecosystems and Water Quality: A National Symposium*, 181-187. Paper presented at the proceedings of the U.S. Environmental Protection Agency and Northeastern Illinois Planning Commission, March 19-21, 1996.
1997. Apfelbaum, Steven I., and Kim Alan Chapman. 1997. "Ecological Restoration: A Practical Approach." Chapter 16 in *Ecosystem Management Applications for Sustainable Forest and Wildlife Resources*, edited by Mark S. Boyce and Alan Haney, 301-321. New Haven, CT: Yale University Press.
1996. Bowles, M. L., J. L. McBride, S. Apfelbaum, A. Haney, and S. Packard. 1996. "Vegetation Composition, Structure, and Temporal Change in Middle Fork Savanna." Report to the Lake County Forest Preserve. Lisle, IL: The Morton Arboretum.
1996. Apfelbaum, S. I. and Alan Haney. 1996. An overview of ecological research and restoration programs in oak savanna systems in Midwestern U. S. (Abstr.) 5th Midwest Fish and Wildlife Conference, Omaha, NE. 8-11 December 1996.
1995. Apfelbaum, S. I., J. D. Eppich, T. H. Price, and M. Sands. 1995. "The Prairie Crossing Project: Attaining Water Quality and Stormwater Management Goals in a Conservation Development." In *Using Ecological Restoration to meet Clean Water Act Goals: A National Symposium*, 33-38. Paper presented at the proceedings of the U.S. Environmental Protection Agency, Chicago, IL, March 14-16, 1995.
1995. Applied Ecological Services (AES). 1995. Determination of Life Cycle Assessment Ecosystem Impact Indicators of Mining Activities for the Mesabi Iron Range, Minnesota. By Steven I. Apfelbaum, Reed Cockrell, John Larson, and Doug Eppich (AES), with Neil Thomas and Rick Odum (Resources Data). Brodhead, WI: Applied Ecological Services, Inc.
1995. Haney, Alan, and Steven I. Apfelbaum. 1995 [1993]. "Characterization of Midwestern Oak Savannas." In *Proceedings of the Midwest Oak Savanna Conferences*, February 20, 1993, Chicago, IL. Chicago, IL: U.S. Environmental Protection Agency.
1994. Roseboom, Donald, Richard L. Allgire, and Steven I. Apfelbaum. 1994. Preservation of Siloam Springs State Park by the Stabilization of Its Wooded Ravines. Champaign, IL: IL State Water Survey.
1994. Haney, A., and S. I. Apfelbaum. 1994. "Measuring Changes in Oak Savannas: A Review and Recommendations for a Monitoring Protocol." In *Proceedings of the North American Conference on Savannas and Barrens*, Illinois State University, Normal, Illinois, October 15-16, 1994, edited by James S. Fralish, Roger C. Anderson, John E. Ebinger, and Robert Szafoni, 253-257. Chicago, IL: U.S. Environmental Protection Agency, Great Lakes National Program Office.
1994. Crow, T. R., Alan Haney, and D. M. Waller. 1994. Report on the scientific roundtable on biological diversity convened by the Chequamegon and Nicolet National Forests. U.S.D.A. Forest Service, Gen. Tech. Report NC-166.
1993. Apfelbaum, Steven I. 1993. Analysis of Historic and Existing Ecological Conditions of Significant Oak Woodlands at High Park, Toronto, Canada. Toronto: Toronto Parks.
1993. Apfelbaum, Steven I. 1993. "The Role of Landscapes in Stormwater Management." In *National Conference on Urban Runoff Management: Enhancing Urban Watershed Management at the Local, County, and State Levels*, Document 625/R-95/003, 165-169. Seminar presented at the National Conference on Urban Runoff Management, U.S. Environmental Protection Agency, Chicago, IL, March 30-April 2, 1993.
1993. Haney, Alan, et al. 1993. Ecosystem Recovery Plan: Oak Savanna and Woodland of the Midwest. Region IX, EPA, special document.
1993. Haney, Alan. 1993. People in northern hardwood ecosystems, pp. 9-19, In: *Ecosystem management in a dynamic society*. Le Master, D.C., and G. R. Parker, eds. Proc. of Symposium, Purdue University, West Lafayette, IN. Nov. 21, 22, and 23, 1991.
1992. Haney, Alan, and Steven I. Apfelbaum. 1992. "Restoration and Management Techniques for Oak Savannas." Paper presented at the first national oak savanna conference of the U.S. Environmental Protection Agency, Chicago, IL.
1991. Burris, A. S., and S. I. Apfelbaum. 1991. "Five Years of Vegetation Change after Reclamation: Eagle Pitcher Zinc and Lead Mine & Mill, Shullsburg, Wisconsin." Paper presented at the annual conference for the National Association of State Land Reclamationists, Orlando, Florida, October 8-10.



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1991. Apfelbaum, S. I., and A. W. Haney. 1991 [1987]. "Management of Degraded Oak Savanna Remnants in the Upper Midwest: Preliminary Results from Three Years of Study." In Proceedings of the Oak Woods Management Workshop, edited by G. V. Burger, J. E. Ebinger, and G. S. Wilhelm, 81-90. Charleston, IL: Eastern Illinois University.
1990. Apfelbaum, Steven I., and Alan W. Haney. 1990 [1987]. "Management of Degraded Oak Savanna Remnants in the Upper Midwest: Preliminary Results from Three Years of Study." In Restoration '89: The New Management Challenge: Proceedings of the First Annual Meeting of the Society for Ecological Restoration, January 16-20, 1989, Oakland, California, edited by Glenn H. Hughes and Thomas M. Bonnicksen, 280-291. Madison, WI: Society for Ecological Restoration, The University of WI Arboretum.
1990. Hackeling, L., M. Leach, and S. Apfelbaum. 1990 [1989]. "Ecological Restoration and Environmental Mitigation: A Relationship Worth Scrutinizing." In Restoration '89: The New Management Challenge: Proceedings of the First Annual Meeting of the Society for Ecological Restoration, January 16-20, 1989, Oakland, California, edited by Glenn H. Hughes and Thomas M. Bonnicksen. Madison, WI: Society for Ecological Restoration, The University of WI Arboretum.
1990. Apfelbaum, Steven I., and Alan Haney. 1990. "Structure and Dynamics of Midwest Oak Savannas." In Management of Dynamic Ecosystems: North Central Section, edited by J. M. Seeney, 19-30. West Lafayette, IN: The Wildlife Society.
1990. Simmers, John W., Steven I. Apfelbaum, and Len F. Bryniarski. 1990. Assessment of Avian Botulism Control Pilot Project at the Dike 14 Confined Dredged Material Disposal Facility, Cleveland, Ohio. Miscellaneous Paper EL-90-23. Vicksburg, MS: U.S. Army Engineer Waterways Experiment Station.
1990. Apfelbaum, S., R. Baller, F. Faessler, F. Harty, W. Glass, and J. Nyhoff. 1990. "Costs and Rates of Controlling Woody Vegetation in Prairies." *Natural Areas Journal* 10, no. 3: 142-143.
1989. Apfelbaum, S. I., and A. W. Haney. 1989 [1987]. "Management of Degraded Oak Savanna Remnants in the Upper Midwest: Preliminary Results from Three Years of Study." In Proceedings of the Ninth Northern Illinois Prairie Workshop, Charleston, Illinois, edited by G. V. Burger, J. E. Ebinger, and G. S. Wilhelm, 17-46.
1989. Bowles, M. L., and S. I. Apfelbaum. 1989. "Effects of Land Use and Stochastic Events on the Heart-Leaved Plantain (*Plantago cordata* Lam.) in an Illinois Stream System." *Natural Areas Journal* 9, no. 2: 90-101.
1988. Motivans, K., and S. Apfelbaum. 1988. "Element Stewardship for Cattails (*Typha* spp.)." Abstract for The Nature Conservancy.
1987. Riggins, R. E., S. Apfelbaum, W. D. Goran, A. J. Krzysik, and T. J. Ward. 1987. Development of Environmental Guidelines for Multipurpose Range Complexes, vol. 1, Application Test and Environmental Management Plan Development. Report N-87/02. Champaign, IL: U.S. Army Construction Engineering Research Laboratory.
1987. Riggins, R. E., S. Apfelbaum, W. D. Goran, A. J. Krzysik, and T. J. Ward. 1987. Development of Environmental Guidelines for Multipurpose Range Complexes, vol. 2, Description of Field Tests, Sediment Yields, and Option Analysis. Report N-87/02. Champaign, IL: U.S. Army Construction Engineering Research Laboratory.
1987. Apfelbaum, S. I., and C. Sams. 1987. "Ecology and Management of Reed Canary Grass (*Phalaris arundinacea* L.)." *Natural Areas Journal* 7, no. 2: 69-74.
1987. Apfelbaum, Steven I. 1987. "Prairie Vegetation Planted on County Highways (Wisconsin)." *Ecological Restoration* 5, no. 1 (Summer).
1986. Apfelbaum, S. I., and J. P. Ludwig. 1986 [1982]. "Potential Applications of Guild Concepts in Nature Preserve Management and Mined Land Reclamation: The Functional Guild." In Proceedings: Conference on Applications of the Guild Concept to Environmental Management, University of Illinois, April 20-22, 1982, edited by William D. Severinghaus and Terry D. James, 65-76. Technical Manuscript N 86/07. Champaign, IL: U.S. Army Construction Engineering Research Laboratory.
1985. Apfelbaum, S. I., and A. Haney. 1985. "Changes in Bird Populations During Succession Following Fire in the Northern Great Lakes Wilderness." In Proceedings – National Wilderness Research Conference: Current Research, 10-16. General Technical Report INT GTR-212. Intermountain Research Station: U.S. Department of Agriculture, Forest Service.
1985. Apfelbaum, S. 1985. "Cattail (*Typha* spp.) management." *Natural Areas Journal* 5, no. 3: 9-17.
1985. Wilcox, D. A., S. I. Apfelbaum, and R. D. Hiebert. 1985. "Cattail Invasion of Sedge Meadows Following Hydrologic Disturbance in the Cowles Bog Wetland Complex, Indiana Dunes Natural Lakeshore." *Wetlands*, no. 4: 115-128.
1984. Ludwig, J. P., and S. I. Apfelbaum. 1984. "Quantitative Methods for Determining Wetland Values." Appendix H in Literature Review of Wetland Evaluation Methodologies, 77-80. Technical Report 905R84101. Chicago, IL: U.S. Environmental Protection Agency, Region 5.



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1984. Apfelbaum, S. I., and A. Haney. "Note of Foraging and Nesting Habits of Goshawks." *The Loon* 56: 132-133.
1984. Apfelbaum, S. I., A. Haney, and R. E. Dole. 1984. "Stimulation of Ascocarps of *Morchella esculenta* by Fire in Minnesota." *Michigan Botanist* 23: 99-102.
1983. Apfelbaum, S. I., K. Heiman, J. Prokes, D. Tiller, and J. P. Ludwig. 1983. Ecological Condition and Management Opportunities for the Cowles Bog National Natural Landmark and Great Marsh, Indiana Dune National Lakeshore, Porter, Ind. Technical report for the National Park Service.
1983. Apfelbaum, S. I., and A. S. Rouffa. 1983. "James Woolworth Prairie Preserve: A Case History of the Ecological Monitoring Programs." In *Proceedings of the Eight North American Prairie Conference*, Western Michigan University, Kalamazoo, Michigan, edited by R. Brewer, 27-30.
1983. Apfelbaum, S. I., and P. Seelback. 1983. "Nest Tree, Habitat Selection, and Productivity of Seven North American Raptor Species Based on the Cornell University Nest Record Card Program." *Raptor Research* 17, no. 4: 97-113.
1983. Apfelbaum, S. I., C. Ludwig, and J. P. Ludwig. 1983. "Ecological Problems Associated with Disruption of Dune Vegetation Dynamics by *Casuarina equisetifolia* L. at Sand Island, Midway Atoll." *Smithsonian Institution's Atoll Research Bulletin*, no. 261: 1-19.
1983. Apfelbaum, Steven I. 1983. "Factors in Invasion of Sedge Meadow by Cattails Documented (Indiana)." *Ecological Restoration* 1, no. 4 (Summer).
1981. *Transactions of the Illinois State Academy of Science* 74, nos. 3 & 4: 1-7.
1981. Apfelbaum, S. I., and A. Haney. 1981. "Bird Populations Before and After Wildfire in a Great Lakes Pine Forest." *The Condor* 83: 347-354.
1979. Apfelbaum, S. I., and A. Haney. 1979. Authored vegetation sections. In *Effects of Tracked Vehicle Activity on Terrestrial Mammals, Birds, and Vegetation at Ft. Knox, Kentucky*, by W. D. Severinghaus, R. E. Riggins, and W. D. Goran. Special report N-77. Champaign, IL: U.S. Army Corps of Engineers.
1978. Haney, A., S. I. Apfelbaum, and D. S. Seigler. 1978. "*Ambrosia bidentata* Michx.: An Eastern Range Extension." In *Transactions of the Illinois State Academy of Science* 71: 302.
1977. Apfelbaum, S. I., and A. Haney. 1977. "White Pelicans in Northern Cook County, Minnesota." *The Loon* 49, no. 3: 171.
1977. Apfelbaum, S. I., and A. Haney. 1977. "Nesting and Foraging Activity of the Brown Creeper in Northeastern Minnesota." *The Loon* 49, no. 2: 78-80.
- Unpublished. Haney, Alan, Steve Apfelbaum, and Lauren Ebbecke. n.d. "Oak Barrens of the Upper Midwest."
- Unpublished. William Richard Teague, PhD; Mimi Hillenbrand, MS; Ry Thompson, MS; Fugui Wang, PhD, *Impacts of holistic planned grazing with bison compared to continuous grazing with cattle on vegetation, water infiltration and soil carbon in South Dakota shortgrass prairie*, Elsevier Editorial System(tm) for *Journal of Environmental Management*.



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PRESENTATIONS AND SEMINARS

2019. **“Ecosystem Services Valuation of the Katy Prairie Conservancy Grasslands”**, Steven Apfelbaum, Applied Ecological Services, Inc., Mary Anne Piacentini and Elisa Donovan, Katy Prairie Conservancy, North American Prairie Conference, Houston, TX.
2017. American Grasslands Conference 2017 – United for Conservation – Fort Worth TX. Partners from various grasslands sectors meet to discuss the conservation of North America’s grasslands the opportunities and outlook for the future. **“Putting Grasslands to Work: The role of grasslands in flood risk mitigation and climate change adaptation”**: Steven Apfelbaum was invited to give a Plenary Talk on projects with documented lowest cost and highest multiple-value benefits where the restoration of native grasslands has occurred and where benefits to each of these challenges have been measured. Examples from grazing systems, urban developments, and watershed-scale improvements were presented.
2017. “Merging ecology and design to improve the ecological function of the designed world.” Penn State University – Center for Ecological Design and Restoration (CEDAR) Symposium in State College, Pennsylvania.
2017. “Ecology and Nature” A Key Note Presentation – Steve Apfelbaum was one of two leading experts invited to lecture. VanPlay Smart City Talks – Ecology + Nature. A lecture series to explore the ecological and environmental sustainability dimensions of parks and public spaces in urban environments. Vancouver Board of Parks and Recreation, Vancouver Canada.
2017. “New Trends in Sustainability” Panel Presentation. A perspective on innovative, science-based agricultural practices and how are business leaders actively changing the role of sustainability in the balance between profit and care for the planet. KEW Foundation Forum – “Root Code – Toward a Green Economy”. A one-day forum held in San Francisco, California.
2017. Green America – Center for Sustainability Solutions – Carbon Farming Innovation Network is a collaborative platform for leaders working toward a vision where agricultural systems are managed to restore soil Health, address climate change, improve food security and farmer incomes, and stabilize risks to supply chains. Steve Apfelbaum was invited to 50+ leaders in the official launch of a two-day meeting of the Carbon Farming Supply Chain Innovation Network held in Denver, Colorado.
2017. “Tipton Park – 15 Years Later – An Ecological Restoration”. IAPD/IPRA – “Soaring to New Heights Conference”. Steven Apfelbaum invited to participate in an education workshop session related to Parks and Natural Resources in Chicago, IL.
2014. “Landscape Forensics: Why Natural Systems-Based Design Solutions Sometimes Fail.” Seminar presented at Nov. 21 Education Session of the Annual Meeting & Expo, American Society of Landscape Architects, Denver, CO, November 21-24, 2014.
1995. Invited speaker in Urban Forestry Conference conducted on behalf of the Urban Forestry Association of the United States. Focused on the role of ecological restoration and maintenance of the oak woods and savanna systems, at Morton Arboretum, IL.
1995. Speaker for annual meeting with Beaver Creek Wetland Association (near Dayton, OH). Hired by the association to provide information on opportunities for restoration and potential threats of offsite impacts on the Beaver Creek system.
1995. Invited speaker at the annual meeting of the Garden Club, Evanston, IL. This presentation focused on opportunities for conducting ecological restoration in the ecosystems of northern IL and elsewhere.
1994. Co-presenter in educational programs for the Cannon River Watershed, Faribault, MN. Invited speaker before several groups to stimulate opportunities for watershed management in the Cannon River system in MN. Conducted under contract with The Nature Conservancy and MN Audubon Society.
1994. Speaker at ecosystem management conference at the University of WI, Stevens Point. This was a national conference that brought together key people from around the world to address ecosystem management options on public and private property.
1992. Keynote speaker at the Sierra Club conference on alternative strategies for stormwater management in developed urban landscapes, Chicago, IL.
1992. Speaker (topics: WisPark project, management of cattail and reed canary grasses) at The Nature Conservancy’s annual stewardship meeting, Madison, WI.
1992. Conference co-designer and speaker at “Managing Stream Landscapes, Enhancing Development While Protecting the Environment,” sponsored by Northeastern Illinois Planning Commission, Chicago, IL.
- 1991 - 1992. Invited speaker at National Environmental Conference on Reclamation and Restoration of Mines, Cincinnati, OH, 1991; and Sacramento, CA, 1992. Sponsored by *Pit and Quarry Magazine*, Washington, D.C.
1989. “Management of Degraded Oak Savanna Remnants in the Upper Midwest: Preliminary Results from Three Years of Study.” (S. Apfelbaum and A. Haney.) Society of Ecological Restoration, Claremont Resort, Oakland, CA; and 10th Northern IL Prairie Conference, Northeastern IL University.



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PRESENTATIONS AND SEMINARS

1989. "Ecological Restoration and Environmental Mitigation: A Relationship Worth Scrutinizing." (L. Hackeling, M. Leach, and S. Apfelbaum). Society of Ecological Restoration. Claremont Resort, Oakland, CA.
1988. "Thoughts About Woody Plant Management Goals in Natural Areas." Presented at Brush Control Workshop, Morton Arboretum, Lisle, IL.
1988. "The Use of Fire in Oak Woods Management." (S. Apfelbaum and A. Haney.) Oak woods management workshop, Bradley University, Peoria, IL.
1988. "*Plantago cordata* Lam. Population Responses to Stochastic Events and Watershed Land-Use Relationships with Watershed of Affecting Adjacent Stream Habitats, Tazewell County, IL." (Authors: M. Bowles and S. Apfelbaum.) 7th Natural Areas Conference, Peoria, IL.
1986. "Research Needs and Methods in Oak Savanna Remnants of Northern IL." Sponsored by the Max McGraw Wildlife Foundation, Dundee, IL.
1986. Keynote speaker (topic: "World of Prairie") at Green County, WI, Conservation League Annual Meeting.
1985. "Changes in Bird Populations During Succession Following Fire in the Northern Great Lakes Wilderness." National Wilderness Research Conference, Ft. Collins, Co.
1984. "Bird Population Changes After Wildfire and Logging in the Quetico-Superior Region." Environ. Sci. Div.: Oak Ridge National Laboratory, Oak Ridge, TN; and Leopold Memorial Reserve, Baraboo, WI.
1984. "Cattail Invasion of Sedge Meadows Following Hydrologic Disturbance in the Cowles Bog Wetland Complex, IN Dunes National Lakeshore." (Authors: D.A. Wilcox, S.I. Apfelbaum, and R.D. Hiebert.) Society of Wetlands Scientists annual meeting, San Francisco, CA.
1983. "Lichens Associated with Dead Tamarack (*Larix laricina*) at Cranberry Lake, WI." (Authors: K.A. Heiman and S.I. Apfelbaum.) Presented at A.I.B.S. Conference, Grand Forks, ND.
1982. "Case History of Ecological Monitoring and Management at the James Woolworth Prairie Preserve, Niles, IL." (Authors: S.I. Apfelbaum and A.S. Rouffa.) 5th Northern IL Prairie Conference, University of IL, Chicago, IL; and 8th North American Prairie Conference, Kalamazoo, MI.
1982. "Classical Wetland Assessment vs. a New Functional Approach to Monitoring, Regulation, and Assessment of Wetlands." 5th Northern IL Prairie Conference, University of IL, Chicago.
1982. "Potential Applications of Guild Concepts in Nature Preserve Management and Mined Land Reclamation: The Functional Guild Concept." (Authors: S.I. Apfelbaum and J.P. Ludwig.) U.S. Army Corps of Engineers, Applications of Ecological Guiding Conference and Workshop, Chicago, IL.
1981. "Computer Graphics in Ecological Monitoring and Nature Preserve Management." Computer Graphics Conference, Harvard University, Cambridge, MA.
1976. Invited testimony before the U.S. Congressional Subcommittee on Parks and Insular Affairs on Wildlife Diversity and Habitat Disturbances. Proceedings of the Boundary Waters Canoe Area Congress Hearings.