Attachment A
Grant Agreement No. AD069014-007.02

1. Type of Project (check one):	☐ Coastal Land Acquisition x Coastal Wetland Protection and Habitat Restoration ☐ Nonpoint Source Pollution Control ☐ Coastal Resources and Community Planning ☐ Great Lakes Education ☐ Public Access and Historic Preservation
2. Project Title: Delineation of areas contributing groundwater to springs and wetlands supporting the Hine's Emerald Dragonfly, Door County, WI	
3. Organization applying: Wisconsin Geological and Natural History Survey, University of Wisconsin-Extension	**5. Primary County where project is located: Door County, WI**
4. Contact Person and Address: Kenneth R. Bradbury Wisconsin Geological and Natural History Survey 3817 Mineral Point Rd, Madison, WI 53705 **Phone:608-263-7921** **Fax: 608-262-8086** **Email: krbradbu@wisc.edu**	**6. Other Counties where project is located:** **7. Congressional District #: 8** **8. State Senate District #: 1** **9. State Assembly District #: 1**
10. Total Project Cost: $ 79,272	
11. WCMP Share: $ 31,650	**13. WCMP Percent: 39.9%**
12. Applicant Share: $ 47,622	**14. Applicant Percent: 60.1%**

15. Brief Summary of the Project (300 word maximum, use this page only). Include (1) Project Description and (2) Project Outcomes:

1. Project Description.

The Hine's emerald dragonfly is possibly the most endangered dragonfly in North America. One of its prime habitats is the coastal springs and wetlands of Door County, Wisconsin. Development and disturbance in upgradient recharge areas has the potential to alter groundwater flow to these springs and wetlands. Accordingly, understanding, maintaining, and protecting groundwater flow to these coastal areas is essential for protection of the Hine's emerald, and delineating the recharge areas is the first step in this process.

At least eleven wetland complexes in Door County contain or are suspected to contain essential larval habitat for the Hine's emerald dragonfly (Table 1). Recharge-area delineations will include a combination of water-balance and groundwater-flow modeling supported with field measurements of water levels and baseflows. We will estimate groundwater recharge *rates* using a GIS-linked soil-water budget model. Contributing-*area* delineations will use a series of relatively simple groundwater flow models calibrated to field measurements of surface water and groundwater levels and surface-water discharges. Measurements of spring chemistry, temperature, and isotopic indicators will assist in verifying model results and will provide baseline data currently lacking at the Hine's emerald sites.

2. Project Outcomes.

The objectives of this project are; 1) to prepare maps, in GIS format, showing land areas contributing groundwater to these wetland complexes and specific springs and seeps within them; 2) to characterize the flow and water quality of specific selected springs; and 3) develop an interpretive report describing the delineations, spring characterization, and groundwater contribution to these essential areas. Delineating the land areas contributing groundwater to these wetland features is a first step toward protecting the springs and wetlands and ultimately protecting the Hine's emerald dragonfly. The project also will provide an opportunity for partnerships between organizations (WGNHS, The Nature Conservancy, US Fish and Wildlife, University of Wisconsin, Wisconsin Department of Natural Resources (DNR), and the University of South Dakota) and disciplines (hydrogeology, biology, ecology) in addressing these endangered species issues.

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1. Problem: Concisely state the problem or issue that this proposal addresses. Include important background information.

The Hine's emerald dragonfly (HED) is both federal and state listed as endangered, and is considered a globally imperiled species. It is found in only four states, Illinois, Wisconsin, Michigan, and Missouri, and occurs in greatest abundance in Door County, Wisconsin. The species is restricted to wetland habitats that occur on thin soils with underlying dolomite bedrock and that are fed by springs and seeps. As the species spends four or more years of its life as an aquatic invertebrate (larvae), it is essential to protect the water quality and quantity of the wetland habitats they occupy. Groundwater maintains these springs, seeps, and wetlands, and thus maintaining the quality and quantity of groundwater discharged into the wetlands is essential for long-term habitat protection. In Door County, groundwater originates as recharge (infiltration of rain and snowmelt) at the land surface hydraulically upgradient of the wetlands. The specific land area from which recharged groundwater flows to a particular surface water feature is called the contributing area for that feature. Development and disturbance in these upgradient contributing areas has the potential to alter the quantity and quality of groundwater flow to the springs and wetlands. Mapping the land areas contributing groundwater to these wetland features is a first step toward protecting the springs and wetlands; such protection might involve public education, land-use controls, zoning, or eventual land acquisition by conservation organizations. Over the last 20 years significant hydrogeologic research has occurred in Door County, including the delineation of contributing areas for some municipal water-supply wells, but there has been no delineation of contributing areas for springs and wetlands and very little hydrogeologic characterization of specific springs. This project will delineate contributing areas for springs and wetland features serving as HED habitat. Groundwater protection of HED larval sites is identified as a Priority 1 task in the U.S. Fish and Wildlife Services' (Service) HED *(Somatachlora hineana* Williamson) Recovery Plan (U.S. Fish and Wildlife Service, 2001.)

Beyond protection of the HED itself there is also great need to protect Wisconsin's coastal wetlands. These wetlands are directly connected to the Great Lakes and play important roles in providing coastal habitat for numerous species and in buffering the Great Lakes from onshore water quality degradation. Most, if not all, of these coastal wetlands exist because of groundwater inflow.

2. Project Description: Address all of the issues listed below as they relate to your project.

a. Describe the project for which funding is requested.
b. Describe how this project is part of an integrated effort or approach.

a. Project description

Background

The Hine's emerald dragonfly is possibly the most endangered dragonfly in North America. One of its prime habitats is the springs and wetlands of Door County, Wisconsin, such as The Ridges Sanctuary (see http://www.ridgesanctuary.org/hines.htm). Groundwater maintains these springs and wetlands. Understanding, maintaining, and protecting groundwater flow to these areas is essential for protection of the Hine's dragonfly. Development and disturbance in upgradient recharge areas has the potential to alter groundwater flow to the coastal springs and wetlands. Mapping the land areas contributing groundwater to these wetland features is a first step toward protecting the springs and wetlands.

The Wisconsin Geological and Natural History Survey (WGNHS) has many years of experience working with groundwater issues in Door County, WI (see a summary of some of this work (Bradbury, 2003) in the April, 2003 issue of Geotimes: (http://www.geotimes.org/apr03/feature_wisconsin.html). In Door County, groundwater moves predominately through fractures in a shallow dolomite aquifer. Due to the county's history of glacial erosion, local soils are often thin or absent, and groundwater recharge often occurs rapidly on exposed bedrock or through minor karst features. Groundwater moves laterally outward from the center of the Door Peninsula to discharge points along the Green Bay and Lake Michigan coastlines. Groundwater flow rates can be rapid - up to tens or hundreds of feet per day, and most of the county is extremely vulnerable to groundwater contamination from surface activities. At the same time, pressure for development of rural lands in the county is large, as Door County is a popular tourist and retirement destination. Such development can threaten springs and HED habitat if located in or adjacent to areas contributing groundwater to the springs and wetlands.

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Objectives

This proposed project will delineate groundwater basins, or areas contributing groundwater, for essential HED habitats in Door County. At the end of this project the WGNHS will develop and deliver maps showing areas contributing groundwater to specific springs and wetland areas identified by the Nature Conservancy and the US Fish and Wildlife Service as being essential HED habitat. These maps will be in digital form appropriate for GIS overlay. We will also prepare a project report describing the maps, with statements about their use and limitations. Specific objectives of this project are 1) to prepare maps, in GIS format, showing land areas contributing groundwater to these wetland complexes and specific springs and seeps within them; 2) to characterize the flow and water quality of specific selected springs; 3) develop an interpretive report describing the delineations, spring characterization, and groundwater contribution to these essential areas; and 4) to communicate the results of the work to the public and to conservation organizations through an informational pamphlet and public meeting.

Study sites

Significant study and cataloging of HED habitats has been carried out by biologists from the U.S. Fish and Wildlife Service, The Nature Conservancy, Wisconsin DNR, Dr. Dan Soluk (Univ of South Dakota), and others. These biologists are serving on the advisory committee for this project, which also includes personnel from Door County Soil and Water Conservation Department and UW-Green Bay. This advisory group has selected 11 wetland complexes in Door County for evaluation under this project (Figure 1). Each of these sites contains confirmed or suspected HED larval breeding areas; adult HEDs have been confirmed present at all eleven sites (Table 1). Nine of these areas are classified as 1st priority sites and will be studied during this project; two additional sites (Gardner Marsh and Ephraim Swamp) are 2nd priority and will be studied if time and budget allow.

Each study site consists of a wetland complex containing one or more springs or seepage pools believed essential to HED habitat. These springs and pools are small features within the context of the larger wetland complex around them. It is unlikely that we will be able to delineate discrete areas contributing groundwater for each of these small features, because doing so would require extremely detailed and site-specific hydrogeologic data beyond the scope of this proposal. Instead, we intend to delineate contributing areas for the larger wetland complexes, with the assumption that such delineations will include the specific subareas contributing to particular HED springs.

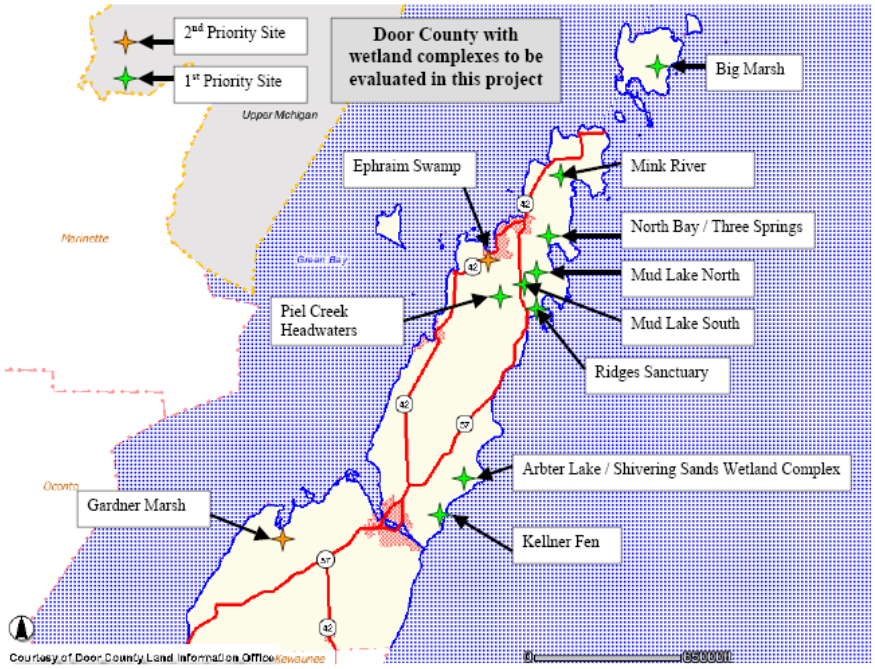

Figure 1 Locations of study areas

Table 1. Wetland Complexes to be evaluated and status of Hine's Emerald Dragonfly at each site.

SITES	Confirmed Breeding	Confirmed Adults Present	Suspected Breeding
Big Marsh – Washington Island	X	X	
Mink River	X	X	
Three Springs – North Bay	X	X	
Mud Lake North – North Reibolt's Creek	X	X	
Mud Lake South – Mystery Creek		X	X
Ridges Sanctuary Wetlands	X	X	
Piel Creek Headwaters		X	X
Arbter Lake – Shivering Sands Wetlands		X	X
Kellner Fen		X	X
Gardner Marsh		X	X
Ephraim Swamp		X	X

Methods

Delineations will be accomplished using a combination of water-balance and groundwater-flow modeling supported with field measurements of water levels, stream baseflows, water chemistry and temperature, and spring characterization. Groundwater and water-balance studies will be conducted by WGNHS personnel with the assistance of volunteers from The Nature Conservancy. Spring and habitat characterization will be carried out by the WGNHS with the assistance of Dr. Dan Soluk and students from the University of South Dakota-Vermillion. An advisory committee composed of personnel from the WGNHS, The Nature Conservancy, U.S. Fish and Wildlife Service, UW-Green Bay, DNR, and the Door County Soil and Water Conservation Service will meet monthly either in person or by teleconference to oversee the project; this committee has already been formed and met several times in 2005.

1. Water-balance modeling to develop estimate recharge rates

Understanding the dynamics of groundwater flow requires a reliable estimate of areally-distributed recharge rates. The WGNHS has recently developed a deterministic water-balance model (Bradbury and others, 2000) for estimating groundwater recharge rates over large spatial areas. This model combines a Thornthwaite soil-water mass balance calculation with surface-water routing based on digital land surface elevation data. The model is linked to GIS coverages and produces a gridded estimate of deep infiltration (assumed to be recharge) over the landscape on a seasonal (daily, weekly, monthly, or annual) basis. The model uses readily-available climate, soils, land cover, vegetation, and digital elevation model (DEM) data. As part of a USGS-funded recharge study, Kelson (2005) recently improved the software coding in the model to allow it to run very rapidly, and developed a GIS link for easier operation. Appropriate digital data sets for this model exist and will be contributed by Door County, The Nature Conservancy, and WGNHS. This model will be run for each area identified for groundwater-flow analysis, and will provide recharge input for the groundwater flow modeling described below.

2. Groundwater flow modeling to delineate contributing areas for springs and wetlands.

Delineation of contributing areas will be undertaken using a series of groundwater flow models constructed using the GFLOW groundwater modeling code. GFLOW (see http://www.haitjema.com/) is an analytic element modeling code that simulates steady groundwater flow in two dimensions using mathematical analytic elements (linesinks) to represent hydrologic features such as wells, streams, wetlands, and springs. Because it is analytically based, GFLOW is scale-independent and so it is well-suited to simulating very small features such as springs and small wetlands within a larger basin region. GFLOW is

particularly useful for simulating groundwater-surface water interactions - the focus of this study. Input data for GFLOW include aquifer thickness, recharge rates, hydraulic conductivity, porosity, and the locations, elevations, and hydraulic properties of surface-water features (lakes, streams, wetlands) to be simulated. Given these inputs, GFLOW solves the groundwater flow problem and outputs a continuous array of calculated hydraulic heads and/or groundwater fluxes. GFLOW uses analytical particle tracking to delineate groundwater boundaries and simulate advective flow to hydrologic features. It also calculates volumetric flow to every stream segment simulated and simultaneously solves the conjunctive surface-water problem for flow into or out of surface streams. The current version of GFLOW includes the automated parameter estimation routine PEST, which greatly assists model calibration. The Principle Investigator (Bradbury) uses GFLOW and PEST routinely in groundwater investigations.

The WGNHS will construct a single regional GFLOW model covering all the mainland study sites (a separate model will be needed for the Washington Island site) and then refine the model for each individual site. The model will be calibrated to measured hydraulic heads and surface water discharges (described below). The great advantage of GFLOW for this purpose is its scale independence - the entire county (called the far field in GFLOW terminology) can be simulated using a single model and the model can be focused on specific sites (called the near field) by adding hydrologic detail as needed.

Once each model is calibrated, GFLOW can be used to delineate contributing areas for each spring and/or wetland through analytical particle tracking.

3. Field assessment of springs and surface water

Groundwater models require calibration data in the form of groundwater levels (head) and groundwater discharges (flux). Prior to model construction we will collect all available and appropriate water-level and flow data for the study areas. Much water-level data is already available from prior studies and well construction reports on file at the WGNHS and from current studies by The Nature Conservancy and others. We will collect additional water-level data from existing wells as needed and from field observations in shallow hydrologic features (springs, dug wells, quarry pits, wetlands) in the study areas. We will also collect groundwater discharge data by flow measurement in streams and channels in the study areas. The WGNHS owns measurement equipment suitable for this purpose.

We will also characterize the water quality and isotopic signatures of springs and seeps known to provide essential HED habitat. Although not strictly required for the groundwater modeling, this geochemical data will be of immense value in understanding how the springs form within the groundwater flow system and in documenting the current spring conditions as a comparison for future change. During field visits to each spring or seep the project team will conduct *in situ* measurements of geochemical field parameters (temperature, electrical conductivity, pH). The team will collect water samples at obvious spring vents and return these to the laboratory for analysis of basic inorganic water chemistry (Ca, Mg, Na, K, Fe, Mn, Cl, NO_3, SO_4, HCO_3). We will also collect water samples for analysis of the isotopes oxygen-18 (^{18}O), deuterium (^{2}H), and tritium (^{3}H). Oxygen-18 and deuterium are useful for determining groundwater source area, and for distinguishing groundwater from surface water. Tritium is a radioactive isotope produced by nuclear weapons testing in the 1960s and offers a simple measure of relative groundwater age. Although we expect the groundwater produced by these springs to be hydrogeologically "young" (less than 1-2 years since recharge) it is possible that some springs might produce older water (30-50 years). Such water should contain elevated tritium levels. The WGNHS has experience and baseline data for using these isotopes as recharge indicators in Door County (see Bradbury and others, 2002).

After collection and compilation the water-level and flux data will be assembled in a spatial GIS database for easy viewing and transfer to the groundwater flow models.

Limitations

The mapping produced by this project will be based on porous-media groundwater flow simulations. This method is open to criticism in fractured-rock environments such as the dolomite aquifer in Door County, where fractures generally dominate groundwater flow. Bradbury and others (2002) addressed this issue by comparing results of a detailed three-dimensional model of part of Door County that specifically included stratigraphically-controlled fracture zones with a simple two-dimensional model of the same area. Their comparison showed that the overall capture areas predicted by the models were about the same but that the 3-D model gave much more realistic predictions of flow velocities. For the objective of delineating contributing areas for the wetland complexes we believe the porous-media approach will be adequate;

implementation of fracture-flow simulations would require a level of effort and sophistication far beyond the scope of the proposed project.

b. Describe how this project is part of an integrated effort or approach.

This is a cross-discipline project involving hydrogeology, geology, ecology, and endangered species, and is an integral part of the U.S. Fish and Wildlife Services HED recovery plan. The project will foster working partnerships between institutions (WGNHS, U.S. Fish and Wildlife Service, The Nature Conservancy, Door County, UW-Green Bay, USD-Vermillion, Wisconsin DNR) and to our knowledge is the first such project in Wisconsin in which groundwater has been linked directly to endangered species protection. The project also meshes well with a series of ongoing springs assessments in Wisconsin that have grown out of the 2004 Wisconsin Groundwater Protection law (Wisconsin Act 310). The Act includes special protection for springs and has fostered a series of spring inventory and survey projects currently being undertaken by University of Wisconsin researchers, Beloit College, the Wisconsin Wildlife Federation, and others, with funding from the WDNR through the 2005-2006 Groundwater Joint Solicitation Program.

References

Bradbury, K.R., Dripps, W., Hankley, C., Anderson, M.P., and Potter, K.W. 2000. Refinement of two methods for estimation of groundwater recharge rates. Final Project Report to the Wisconsin Department of Natural resources. 84 p.

Bradbury, K.R., T.W. Rayne, and M.A Muldoon, 2002. Field Verification of Capture Zones for Municipal Wells at Sturgeon Bay, Wisconsin: Final Report to the Wisconsin Department of Natural Resources-Wisconsin Geological and Natural History Survey, Open-file Report WOFR 2001-01, 20 p. plus 10 color pages.

Bradbury, K.R. 2003. A circuitous path: Protecting groundwater in Wisconsin. *Geotimes*. P 18-21.

Kelson, V.A. 2005. Implementation of a daily soil water balance model for estimating spatial and temporal distributions of aquifer recharge. (abstract). Geological Society of America, Annual meeting, Salt Lake City.

U.S. Fish and Wildlife Service. 2001. Hine's Emerald Dragonfly *(Somatochlora hineana)* Recovery Plan. Fort Snelling, MN 120 pp.

3. Impact on Coastal Resources: Address all of the issues listed below as they relate to your project.

a. Describe the extent to which the problem, need or priority will be addressed by the project.
b. Describe how this project addresses a high priority need as identified in state-recognized plans (such as remedial action plans, basin plans, Lakewide Management Plans, State Hazard Mitigation Plan, and county Land and Water Conservation Plans) *or priorities of regional organizations such as the Council of Great Lakes Governors.*
c. Describe the extent to which the project permanently addresses the problem or need.
d. Describe the extent to which the project leverages other technical or financial resources.
e. Describe the measurable results (give estimated benefits for all that apply). Use the suggested indicators listed below, or others as appropriate to your type of project.

Type of Project	Suggested Indicators
Coastal Land Acquisition	• Acres protected • Linear feet of coastline acquired • Type of habitat or ecosystem acquired
Wetland Protection and Habitat Restoration	• Acres of habitat restored or protected • Endangered species protected • Type of habitat or ecosystem protected or restored
Nonpoint Source Pollution Control	• Reduction in pounds of P delivery • Reduction in tons of soil erosion/sedimentation • Miles of vegetative buffer
Great Lakes Education	• Number of people trained • Projected audience
Coastal Resources and Community Planning	• Number of municipalities included in a plan

	• Population affected by the plan • Land area covered by the plan • Type of coastal resource protected • Ordinances developed
Public Access and Historic Preservation	• Linear feet of coastline made accessible • Population affected

a. Describe the extent to which the problem, need or priority will be addressed by the project.

The main problem addressed by this project is protection of high-priority HED habitat in Door County. The project will address this need by delineating the onshore areas contributing groundwater to the HED sites. This information can then be used by land managers and conservation groups to justify protecting these onshore areas through land purchase, zoning, public education, or other means. This project will also lead to a better characterization and collection of baseline data about the specific springs and seeps providing HED habitat. The information can also be used in the future to document habitat change and to better understand the ecology of the HED.

b. Describe how this project addresses a high priority need.

Groundwater protection of HED larval sites is identified as a Priority 1 task in the U.S. Fish and Wildlife Services' HED (*Somatachlora hineana* Williamson) Recovery Plan. Maintaining appropriate groundwater flows, as rivulets or as sheet flow appears essential to aquatic systems supported by groundwater with groundwater quantity and quality important habitat elements.

Conducting hydrological studies is a need identified in several of the recovery tasks included in the HED Recovery Plan. Sites identified in the Recovery Plan needing hydrological study are The Ridges Sanctuary and Mud Lake "North" (Lime Kiln Road) (Priority 1 Task); Mud Lake South, Arbter Lake, North Bay, Three Springs Creek, and new larval sites (Priority 3 Task). Hydrologic studies will serve to identify threats to the water quality, identify recharge and contribution areas, and help in the protection of those areas as well as seeps, and springs that are important to HED habitat. Determining water movements in the wetland habitat for this species would aid in the interpretation of the hydrology requirements of the dragonfly. Threats to recharge and contribution areas include development, agricultural activities and road construction. This work is particularly urgent in Door County because of the rapid pace of current and anticipated development there.

Water quality monitoring is a Priority 2 Task in the HED Recovery Plan. The Plan recommends monitoring at least twice a year in August (low flow) and in the spring (high flow) to assess the impacts of road salt, siltation and contamination from surface runoff; monitoring is also important to determine baseline water chemistry and assess shifts in water quality over time.

This project will also promote a priority identified by the Council of Great Lakes Governors which is to "enhance fish and wildlife by restoring and protecting habitats and coastal wetlands." This project will promote protection of the HED, and the coastal wetland habitat essential for its, and many other species survival. Coastal wetland habitat protection also supports the goals of the Lake Michigan Integrated Fisheries Management Plan (WDNR, 2004), a primarily goal of which is a "diverse, balanced, healthy ecosystem."

c. Describe the extent to which the project permanently addresses the problem or need.

Permanently addressing the protection of HED habitat requires both identification of the land area contributing groundwater to the habitat and protection of that land area by zoning or land acquisition. This project will identify the important contributing areas for HED habitat in Door County.

d. Describe the extent to which the project leverages other technical or financial resources.

The project leverages other resources by building on the ongoing studies of the hydrogeology of Door County undertaken by the WGNHS and by studies and surveys of the Hine's emerald dragonfly undertaken by U.S. Fish and Wildlife Service, and

The Nature Conservancy, USD-Vermillion, and the Wisconsin DNR. The project is receiving significant in-kind support from the WGNHS, The Nature Conservancy, and the Door County Soil and Water Conservation Department.

e. Describe the measurable results (give estimated benefits for all that apply).

This project falls under the category of wetland protection and habitat restoration. Based on the potential upgradient areas on our primary sites the project will aid the protection of 9 coastal wetland areas, comprising over 3600 acres in Door County. The project will aid in the protection of the endangered Hine's emerald dragonfly in Wisconsin, one of only four states where the species is known to occur. Development of maps of groundwater contribution areas for HED sites will provide the regulatory agencies (U.S. Fish and Wildlife Service and Wisconsin DNR) and conservation organizations (TNC, The Ridges Sanctuary, Door County Land Trust) a tool for use in habitat protection, and for outreach and education to the public and to landowners in the contribution areas. Thus information from this project is anticipated to result in protective actions that will reduce threats (e.g., rural development, agricultural pollution, etc.) to the HED and aid in the recovery of the species.

4. Methodology and Timetable

a. Provide a task description, including major milestones.
b. Provide a list of work products.
c. Describe how the project will encourage public participation and how the final product will be distributed (as appropriate).
d. For Public Access projects, please describe how the project incorporates planning for lake level changes.

a. Provide a task description, including major milestones.
Major milestones are indicated with an asterisk (*).

<u>July - August 2006</u>
Field visits to all prospective sites
*Description and location of important springs and seeps
Initial round of flow measurements and water sample collection
Identification and acquisition of appropriate GIS coverages, maps and other data

<u>September - October 2006</u>
Preparation of database/GIS for data storage
Assembly of data sets for soil water-balance model for each site
*Implementation of soil water-balance modeling
Evaluation of recharge estimates for all sites
Assembly of detailed elevation information for each site
Field measurement of water-levels in existing shallow wells, quarrys, and other excavations
Second round of flow measurements and water sample collection

<u>November - December 2006</u>
Review/compilation of aquifer information (hydraulic conductivity, thickness, porosity) for each site
Collection/compilation of existing water-level data for model calibration
*Assembly of GFLOW models covering each site

<u>January-February 2007</u>
*Calibration of GFLOW models
Assessment of model sensitivity
Evaluation of water quality data

<u>March-April 2007</u>
*Delineation of groundwater basins using GFLOW

Presentation/review of delineations by advisory group
Refinement of models as necessary

May-June, 2007
*Preparation of draft final report, to include section on what can be done to protect groundwater contribution areas, and an educational pamphlet for the public, summarizing the findings about the groundwater contribution areas and what they can do to help protect those areas.
Review by advisory group
Preparation of graphics
Documentation of computer and GIS coverages
*Revision/completion of final report
*Presentation of findings at an informational public meeting in Door County, with the assistance/participation of the advisory committee.

b. Provide a list of work products

Work products will include the following:

1. Maps, in GIS format (shape files), showing the land areas contributing groundwater for each of the targeted HED wetland complexes in Door County. Documentation (metadata) for each file will be included.

2. A calibrated GFLOW groundwater flow model for each study site.

3. A database of spring and surface-water flows and chemistry for each site.

4. An interpretive report summarizing the work accomplished and interpreting the groundwater system at each targeted HED study site.

5. An educational pamphlet geared to the public summarizing the location of the contribution areas, why it is important to protect them, and what people can do to protect them.

6. An information meeting held in Door County to educate conservation agencies and other interested parties (noted below in c) about the locations of the groundwater contribution areas, and to provide advice and guidance on what those parties could do to help protect these areas.

c. Describe how the project will encourage public participation and how the final product will be distributed (as appropriate).

The products noted above will be distributed to all parties involved in the project (U.S. Fish and Wildlife Service, UW-Green Bay, USD-Vermillion, Wisconsin DNR, TNC, and Door County Soil and Water Conservation) as well as other parties that would be anticipated to use them to guide their land protection programs, or for use in outreach and education e.g., The Ridges Sanctuary, Door County Land Trust, Bay Lake Regional Planning Commission and the Natural Resources Conservation Service. Copies of the reports will also be provided to the Townships that have HED wetland sites to educate them about sensitive areas within their towns. The Door County Planning and Zoning Department would receive a copy to help guide their land management and development actions. A copy will be provided to the Wisconsin DNR's landowner contact specialist, who could use the information when working on land protection projects for the HED with landowners in the identified groundwater contribution areas. An information meeting would be held in Door County to educate conservation agencies and other interested parties (noted above and including landowners within the contribution areas) about the locations of the groundwater contribution areas, and to provide advice and guidance on what those parties could do to help protect those areas. A pamphlet geared to the public summarizing the location of the contribution areas, why it is important to protect them, and what people can do to protect them will be developed and provided at the informational meeting. Such measures should encourage public and agency participation in protection of these sensitive areas.

d. For Public Access projects, please describe how the project incorporates planning for lake level changes

This is not a public access project.

5. Project Budget

a. Provide a breakdown of the proposed project budget using the following table. WCMP Grant projects totaling $60,000 or less require a 50% match. Projects larger than $60,000 require a 60% match.

Activity	Match	WCMP Request	Total
A. SALARIES			
1. WGNHS Staff (Ken Bradbury, Pete Schoephoester, Mindy James, Susan Hunt)	$16,566		$16,566
2. Graduate Assistant – 40%		$13,552	$13,552
3. Student help – 40 hrs @ $10/hr		$ 400	$ 400
B. FRINGE BENEFITS			
1. WGNHS Staff @ 34%	$ 5,632		$ 5,632
2. Graduate Assistant @ $26%		$ 3,524	$ 3,524
3. Student Help @ 2%		$ 8	$ 8
C. TUITION REMISSION @ 25% of Graduate Assistant salary		$ 3,388	$ 3,388
D. SUPPLIES & EXPENSES			
1. Stream gaging supplies		$ 200	$ 200
2. Sample analyses		$ 2,800	$ 2,800
3. Pass-through to Univ. of N. Dakota		$ 2,000	$ 2,000
E. TRAVEL			
1. Meals – 40 person days @ $30/day		$ 1,200	$1,200
2. Lodging – 5 nights @ $90/night		$ 450	$ 450
F. IN-KIND CONTRIBUTIONS (from third parties)			
1. University of South Dakota			
Dan Soluk – 40 hours @ $150/hour	$ 6,000		$ 6,000
2, The Nature Conservancy			
a. Mike Grimm – 72 hrs @ $35/hr	$ 2,520		$ 2,520
b. Volunteer assistance – 155 hrs @ $10.50/hr	$ 1,627		$ 1,627
c. Mileage for TNC staff/volunteers – 2,160 @ $.42/mi	$ 907		$ 907
3. UW – Green Bay – Ron Stieglitz, 33 hrs @ $150/hr	$ 4,950		$ 4,950
4. Door County Soil & Water			
a. GIS coverages	$ 310		$ 310
b. Conference calls/meetings – 24 hrs @ $45/hr	$ 1,080		$ 1,080
c. Field work – 24 hrs @ $45/hr	$ 1,080		$ 1,080
d. Mileage / phone charges	$ 290		$ 290
5. U.S. Fish & Wildlife Service – Cathy Carnes.	-0-		-0-
TOTAL DIRECT CHARGES (TDC)	**$40,962**	**$27,522**	**$68,484**
G. INDIRECT COSTS			
1. WCMP funds – 15% of TDC		$ 4,128	$ 4,128
2. Matching funds – 30% of Modified TDC (only applied to the UWEX-WGNHS expenses)	$ 6,660		$ 6,660
TOTAL PROJECT COSTS	**$47,622**	**$31,650**	**$79,272**

6. Budget Description

a. Describe, in detail, the commitment of nonfederal matching funds.
b. Describe the composition and source of the matching funds.

a. *Describe, in detail, the commitment of nonfederal matching funds.*

Wisconsin Geological and Natural History Survey, UW-Extension – salary, fringe benefits, and indirect costs. This includes staff time for Kenneth Bradbury (hydrogeologist), Pete Schoephoester (GIS specialist), Mindy James (editor), and Susan Hunt (graphic artist). Bradbury will supervise the project. The WGNHS will also provide computer software for project use.

Third Party Contributions:

1. University of South Dakota – Consulting time from professor Dan Soluk, recognized expert on the Hines emerald dragonfly. Dr. Soluk and his students are involved in long-term HED research in Door County. Dr. Soluk will serve on the advisory committee and help direct field work.

2. The Nature Conservancy – staff and volunteer time and mileage. Mike Grimm will help coordinate field work and give local logistical support; he will also serve on the advisory committee. Volunteers from the Conservancy will assist with field work and provide vehicle support.

3. University of Wisconsin – Green Bay – consulting time from Prof. Ron Stieglitz; Dr. Stieglitz is a geologist very familiar with Door County; he will serve on the advisory committee and assist in the field.

4. Door County Soil and Water – value of GIS converages, conference calls, meetings, field work, and mileage; Mr. Bill Schuster from the Door County Soil and Water Conservation Department will serve on the advisory committee and assist with local logistics. The county will also make available detailed GIS coverages of the study sites. The county will also make meeting facilities available as needed.

5. Cathy Carnes of the U.S. Fish and Wildlife Service will serve on the advisory committee but her time is not being used as matching funds as she is a federal employee.

b.

7. Bonus objectives. Address all of the issues listed below as they relate to your project.
a. Build partnership alliances with other organizations or agencies
b. Develop exceptional marketing, outreach or education strategies
c. Encourage coast-wide projects

a. Build partnership alliances with other organizations or agencies

This project will help build partnerships between several organizations, as follows. Member of these organizations will interact throughout the project by participating directly in the work and by serving on an advisory committee that will meet frequently to guide and advise the research. These organizations will also use the information produced by the project to educate the public and to help analyze the impacts of projects on the HED and its wetland habitat.

The Wisconsin DNR, Bureau of Endangered Resources is implementing recovery actions for HED and staff member William A. Smith is on the Recovery Team. Smith and other BER staff have worked extensively in HED sites in Door Co. and have an excellent working knowledge of wetland ecology and specific HED breeding locations.

The Wisconsin Geological and Natural History Survey (WGNHS) is a unit of the University of Wisconsin-Extension. Investigators from the WGNHS have a long history of groundwater investigations in Door County, with emphasis on the hydrogeology of fractured dolomite. The WGNHS has recently completed new mapping of the glacial geology of Door County and maintains geologic and water-well records of the county. The WGNHS staff is able to carry out sophisticated field studies and maintains field equipment appropriate for this purpose.

The Nature Conservancy is an international, nonprofit conservation organization that has been working since 1962 to protect the exceptional diversity of plants and animals that inhabit the coastal wetland landscapes of the Door Peninsula. The Hine's emerald dragonfly is an ecoregional conservation target for the Conservancy and can be found utilizing Conservancy preserves for breeding and throughout its life cycle. The Conservancy supports research aimed at answering important scientific questions about the HED that will direct where and how we work to best protect this rare species.

The US Fish and Wildlife Service, Green Bay Ecological Services Field Office (GBFO) is working on the recovery of the

HED; Cathy Carnes, the Endangered Species Coordinator for GBFO is a member of the HED Recovery Team. As noted in the proposal, the HED Recovery Plan identifies groundwater protection as a Priority 1 task and water quality monitoring as a Priority 2 task. Information from this research is essential to the protection of the dragonfly and will be used by the Service to help educate the public about groundwater contribution areas and when assessing the impacts of proposed projects on the HED and its wetland habitat.

Door County Soil and Water Conservation Department: The Door County SWCD assists Door County citizens with conservation and environmental issues related to land and water use. The Department has a long history of work with groundwater in the county.

The University of Wisconsin-Green Bay : Dr. Ron Stieglitz is a geologist on the faculty at UWGB who has long experience studying the geology and hydrogeology of the Door Peninsula.

The University of South Dakota-Vermillion: Dr. Dan Soluk, a respected HED expert, conducts research on and surveys of the Hine's emerald dragonfly, including annual research in Door County. His expertise will be invaluable to this project.

Other Agencies/Organizations: It is anticipated that many agencies/organizations located in or serving Door County will benefit from having this information including townships with HED sites, the Door County Land Trust, The Ridges Sanctuary, Bay Lake Regional Planning Commission and the Natural Resources Conservation Service. Knowing where the groundwater contribution areas are in relationship to the HED sites can help these agencies/organizations with land management decisions (e.g., land acquisitions, conservation easements, management actions, etc.) and in education and outreach which will help contribute to the recovery of the HED. The information developed will also aid the Wisconsin DNR effort to catalog springs throughout Wisconsin.

b. Develop exceptional marketing, outreach or education strategies.

UW-Extension is primarily an education/outreach organization, and results of this project with be shared with the public and with interested organizations through a variety of means including workshops, scientific talks, scientific publications, and popular publications as appropriate. UW-Extension with assistance from the advisory group will produce an educational pamphlet geared to the public summarizing the location of the contribution areas, why it is important to protect them, and what people can do to protect them. At least one information meeting will be held in Door County to share research results with potentially effected, and interested parties. In addition the educational pamphlets will be provided to agencies and organizations in Door County for inclusion in their education and outreach literature displays.

c. Encourage coast-wide projects

The identification of groundwater contribution areas is anticipated to provide a tool that will help encourage and guide joint projects by conservation organizations and agencies (e.g., TNC, the Ridges Sanctuary, Wisconsin DNR, and the Door County Land Trust) to protect some of the larger coastal wetland complexes in Door County where the HED occurs. The HED also occurs in coastal areas of the Upper and Lower peninsula of Michigan; this project will provide a template for similar work in these other areas.