Wisconsin Ground Water Association *Newsletter*

3rd Quarter 2013, Vol. 27, No. 3

PRESIDENT'S MESSAGE

We received the following note from President Jim Bannantine, who is currently working in Mozambique.

They do not have postcards here, this is the best I can do. The picture shows our drilling locations, approximately 500 meters from the Indian Ocean. The drill rig uses a donut hammer with a trip hammer drop system, something I have not worked with before. We are drilling 300 meter borings, geology is thick sequence of sand. There is great excitement if 3 meter sections of clay are encountered whereby we can collect Shelby tubes! So while the location is a bit exotic, the work is still pretty much the same.

One of the companies is bringing a sonic rig to the site to see if they can use this to collect quality geotechnical data. Lot's of people looking forward to seeing this in action.

Please reserve the dates of September 20-21 to join the annual WGWA Field Trip held jointly this year at UW-Whitewater during the first annual Wisconsin Earth and Water Student Conference.

Hope all is well with my WGWA colleagues,
Cheers,
Jim

IN THIS ISSUE…

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GROUND WATER RELATED CONFERENCES, MEETINGS, EVENTS, AND COURSES

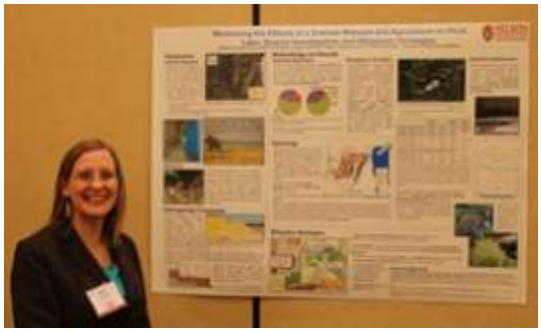
- August 17, 2013—**Kayak Estuary Ed-Venture:** 10:00 am—12:30 pm. Take a kayak trip with UW-Extension's Cathy Techtmann along Lake Superior's coast to explore Fish Creek and Whittlesey Creek Estuaries and beyond. More information here or call 608.250.9971.
- August 17, 2013—**Frog Jumping Jamboree:** 5:00—9:00 pm. Welty Environmental Center, Beckman Mill County Park, 8606 South County Road H, Beloit, Wisconsin. $10. Music by the Backroads Trio, refreshments available. 608.361.1377 or info@weltycenter.org.
- August 24, 2013—**Friends of Glacial Heritage Area Open House and Potluck:** 10:00 am—3:00 pm. Come out the the Korth Park Pavilion in Lake Mills, Wisconsin for an afternoon of paddling, prairie and bird walks, food, visiting and more. Watch for more details and flyer here or contact at friendsofgha@gmail.com.
- September 11, 2013—**Geothermal Heating & Cooling Innovations:** Design, Financing, and Regulation Workshop. Holiday Inn St. Paul East, 2201 Burns Avenue, St. Paul, Minnesota. Workshop Brochure.

FROM THE EDITOR

Our WGWA President, Jim Bannantine, is currently working in Mozambique (a large island off the southeast coast of the African continent). Coincidentally the USGS has just published a set of stunning new African ecosystem maps. You may wish to see the whole brochure of maps by going to www.aag.org/AfricaEcosystems. If you pay special attention to the surficial lithology layer in Figure 2, you will find that Mozambique has large areas of both karst and extrusive volcanics. Let's all wish Jim well and hope he is able to avoid sinkholes and volcanic activity during his stay.

WGWA NEWS & UPDATES

- On June 13, Ken Potter presented *Managing Groundwater in the Central Sands of Wisconsin* to WGWA, detailing the groundwater issues that have arisen due to high capacity wells throughout the area. The State Journal recently ran an article on the same issue, which can be read here.
- Ralph Smith, who was elected President Elect 2013, resigned his position in July due to the recent move of PECFA to the DNR. Jodie Peotter has been appointed President Elect 2013 and President 2014.
- WGWA is looking for a new Assistant Editor! Responsibilities largely revolve around formatting the newsletter quarterly from articles and photos directed to you from the editor and various journalists. Must have familiarity with Publisher software. If interested, contact Lee Trotta lctrotta53072@yahoo.com or Jodie Peotter jpeotter@consulttruenorth.com
- Correction Notice: In our last newsletter, we incorrectly identified our student poster winner. The student poster winner was Heather Summer Davis. We apologize for the error. Congrats, Heather!



Get Yourself Published!

We are looking for articles for future editions of the WGWA newsletter. Articles should be 1 to 8 pages in length and can include photographs and graphics. Articles should be generally technical in nature focusing on groundwater or environmental topics, but not commercial or political.

To submit an article for publication, contact:

Lee Trotta, Editor lctrotta53072@yahoo.com

GROUND WATER RELATED CONFERENCES, MEETINGS, EVENTS, AND COURSES (cont'd)

- September 10-12, 2013—**Great Lakes Restoration Conference.** Milwaukee, Wisconsin. Save the date.
- September 14, 2013—**NERN "Ledge Tour" at Northern Kettle Moraine Forest:** Join UW-Oshkosh Geology Professor, Dr. William Mode for a series of short hikes in the northern unit of the Kettle Moraine Forest – a unique environment (an Interlobate moraine) on the Niagara Cuesta that was formed by the glaciers. Registration details here.
- September 20-21, 2013—**Wisconsin Earth and Water Conference** and AIPG/WGWA joint field trip at UW-Whitewater. : Whitewater, Wisconsin. Register here.
- September 30, 2013—**Due date for symposium proposals:** Wisconsin Wetlands Association's 19th Annual Wetland Conference, February 18-20, 2014. Submit proposals via email to Katie Beilfuss, Outreach Programs Director, programs@wiwisconsinwetlands.org. 608.250.9971

WISCONSIN EARTH AND WATER STUDENT CONFERENCE

The first annual **Wisconsin Earth and Water Student Conference** will be held September 20-21, 2013, at University of Wisconsin-Whitewater campus. This meeting is being jointly sponsored by the Wisconsin Chapter of the American Institute of Professional Geologists (AIPG, http://www.aipgwisconsin.org/), and the Wisconsin Groundwater Association.

DR. GEORGE STONE WILL BE THE KEYNOTE SPEAKER AT THE CONFERENCE

Student abstract submission deadline: **Tuesday, August 20, 2013**
Notification of abstract acceptance will be sent by e-mail on or before: **Friday, August 30, 2013.** Both platform (oral) and poster presentations on research being conducted in the areas of earth and water are welcome. Topic areas include (but are not limited to) the following:

- Alternate Energy/Carbon Sequestration
- Aquatic Toxicology
- Environmental Economics and Sustainable Business Development
- Environmental Mapping & Information Management Systems
- Issues in Global Warming and Climate Change
- Mineral & Water Resource Assessment & Management
- Soils, Land Conservation and Habitat Restoration
- Water Quality

Abstracts should be submitted following the format as described here. Students may compete for Best Student Platform and Best Student Poster awards.

(Continued on page 5)

GROUND WATER RELATED CONFERENCES, MEETINGS, EVENTS, AND COURSES (cont'd)

- September 27, 2013—Using Practical Road Salt Reduction Strategies to Protect Groundwater Resources: Brookline, Massachusetts. Register here.
- October 6, 2013—Abstract submittal deadline for 2014 NGWA Groundwater Summit: To be held in Denver, Colorado May 4-7, 2014. Submit abstracts here.
- October 6—11, 2013—**5th World Conference on Ecological Restoration**—Reflections on the Past, Directions for the Future: Madison, Wisconsin. Conference will bring together more than 1,500 attendees from around the world to explore a range of topics related to the practice of ecological restoration. More information here.
- October 23-26 2013—**AIPG 50th Anniversary Conference—Geology Serving Society:** With a focus on Energy Independence, Mineral and Water Resources, and Geologic Education. Held in Denver, Colorado. Register here.
- December 3-6, 2013—2013 Groundwater Expo: Nashville, Tennessee. Register Here.

WISCONSIN EARTH AND WATER STUDENT CONFERENCE

(Continued from page 4)

CONFERENCE AGENDA

- Registration/sign up/poster put up: **Friday, September 20, 1:00 – 2:00 PM**
- Welcome speech 2:00 PM
- Student poster presentations and other potential breakout sessions: 2:00 – 5:00 PM. The posters will be up for the entire duration of the meeting, but the students will be at their posters 2:00 – 3:30 PM
- Welcome Banquet and Keynote speaker 5:30
- Field trip(s), and/or if possible, professional development workshops on **Saturday, September 21, 8:00 – 1:00**

SATURDAY FIELD TRIPS

A field trip covering the Paleozoic bedrock and glacial tills around Whitewater, with stops at various local quarries, a groundwater monitoring station that Jacobs has been monitoring for the last four years, and also stops at the Whitewater Creek. We are targeting this trip towards students from different disciplines who are interested in a variety of water-related issues, so that they can be exposed to a multidisciplinary perspective of how groundwater and surface water can interact in different spatial and temporal scales.

Meet the buses at the Arts Parking Lot on Saturday, September 21, at 7:45 AM. Buses leave at 8:00 AM

FIELD TRIP STOPS

Stop 1- Whitewater Creek

Field trip stop number one will focus on stream ecology and environmental toxicology. This stretch of Whitewater Creek is fourth order and located just upstream of the Whitewater Wastewater Treatment Plant (WWTP) discharge pipe. Here, we will discuss the importance of sediment type, certain water chemistry parameters and variability in flow in determining benthic macroinvertebrate and fish community composition. We will also discuss point and non-point sources of pollution to this stream, including the WWTP. The results of a study that examined the effects of WWTP effluent on survival, reproduction, and vitellogenin (egg precursor protein) concentrations in fathead minnows caged upstream and downstream of the WWTP will be presented.

(Continued on page 6)

INTERESTING ARTICLES AND OTHER TIDBITS ON THE WEB

- Where there are rain clouds, there are jobs for hydrologists. Right? Well the following article indicates there may be 6 billion new jobs out there.
- 15 more families added to the Town of Jackson water advisory. Article here.
- Mammoths may have died after impact from space.
- Dino-killing asteroid also triggered mind blowing submarine landslides. Article here.
- One man's trash, another man's treasure. Rare Elements to Fuel Cellphones Tossed Aside During Gold Rush.

WISCONSIN EARTH AND WATER STUDENT CONFERENCE

(Continued from page 5)

Stop 2 – Hausz Brothers Quarry (located on County M south of Fort Atkinson)

Field trip stop number two will focus on bedrock geology of the region exposed by the operations of the Hausz Brothers Quarry. Quarrying for over a century has exposed the Middle to Late Ordovician Galena, Decorah and Platteville Formations. We will observe and discuss the varying lithologies of each formation, with special attention focused on the vuggy dolostones and the vertical jointing of the Galena, both of which affect groundwater flow of the region. Fossils can be numerous in the Decorah and Platteville, and upward changes in their abundance and preservation are useful markers of ancient sea level variation. Depending upon the current workings of the quarry, the glacial striations on top of the bedrock may be seen, as well as Pleistocene sediments of the Green Bay Lobe till and Lake Scuppernong. The quarry setting will be described (Lee Trotta, PG.) and the paleontology and more recent deposits of Pleistocene Green Bay Lobe till and Lake Scuppernong sediments will be examined (Dr. Rex Hanger).

Stop 3

This field trip stop will investigate soil hydrology and wetland ecology. The site consists both a remnant wetland and a reconstructed wetland and prairie as part of Wetlands Reserve Program project to restore and reconstruct wetlands in the Allen Creek watershed, south of Fort Atkinson. In the remnant, we will discuss several years of water table monitoring through shallow piezometers in wet-mesic prairie and fen sites. In the reconstructed wetland area, we will discuss water table changes following removal of drain tiles prior to seeding to native species. In addition, the utility of a student project investigating topsoil properties that were used as a guide for area-specific seeding will be shared.

More information about the conference can be found at: http://blogs.uww.edu/bhattacj/

MORE STORMS EXPECTED FOR WARMER WISCONSIN

Reprint Courtesy of Center for Water Policy, School of Freshwater Sciences,
University of Wisconsin—Milwaukee
Authored by Michael Timm

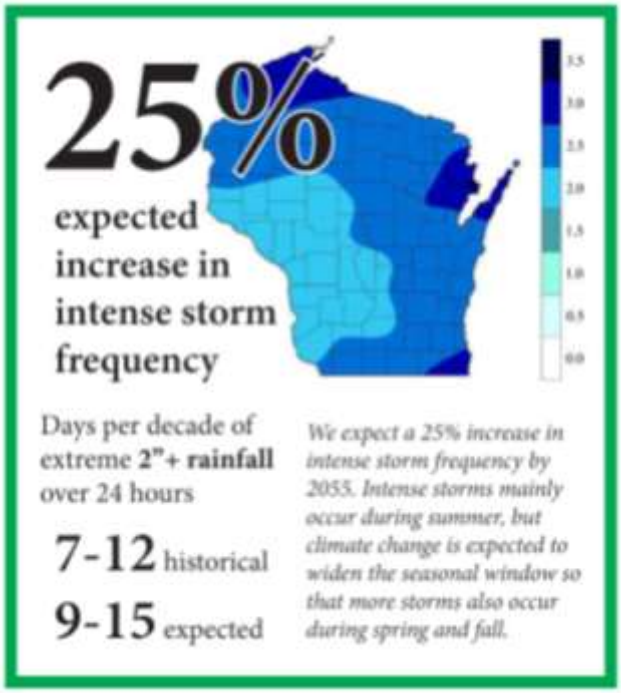
KEY MESSAGE

Our water and sewer infrastructure were designed under assumptions that no longer hold true. A wetter Wisconsin with more frequent, intense storms will tax that failing infrastructure increasing the risk of waterborne disease.

The extreme storms that wreaked catastrophic flooding and historic damage in 2008 and 2010—causing the state to request millions in federal disaster assistance because the deluge overwhelmed our infrastructure—are consistent with the future pattern of climate change predicted for Wisconsin. Weather is determined by the roll of the dice—climate change loads those dice.

Wisconsin's Loaded Precipitation Dice Scientists have focused their attention on what those loaded climate dice mean for Wisconsin's future precipitation. They raise three flags.

1. The odds of precipitation increase during fall, spring, and winter. This means our systems will generally be wetter, with more rain when historically we have expected snow.



2. Precipitation intensity is also expected to increase. This means more storms instead of gentler rains. Storms are generally harder for our conveyance systems to handle.
3. The odds dramatically increase for the most extreme storms to be heavier than historic trends. Models project that extremely heavy storms will be 10% to 40% stronger in southern Wisconsin. With current infrastructure, this increases the risk of flooding, sewage overflows, and rain-related disease.

Infrastructure Inadequate for Expected Flows

Engineers use statistics based on historic weather data to design pipe capacities. Most pipes are designed to accommodate a 10-year rain event, which has a 10% chance of occurring in any one year. The historic weather used to define the intensity of those 10-year rain events decades ago was relatively dry when compared to a longer historic record. This increases the likelihood that our existing infrastructure will be inadequate to convey stormwater runoff.

If climate change jacks up the intensity of storms as expected, our design standards will prove even less adequate to meeting actual design goals.

Current risk assessments are based on historic storms and do not account for projected increases in rainfall frequency and intensity. Successful adaptation requires increasing our capacity and revising our thinking. Failure to adapt is a choice that cedes control over our rain-related disease risk to chance.

List of supporting literature can be found here.

BEST MANAGEMENT PRACTICES TO PROTECT GROUNDWATER AT HINE'S EMERALD DRAGONFLY LARVAL SITES IN DOOR COUNTY, WISCONSIN

Final Report - February 1, 2013
Cooperative Agreement No. F12AC00153 Between the U.S. Fish and Wildlife Service and the Ridges Sanctuary

Submitted by:
The Ridges Sanctuary, PO Box 152, Baileys Harbor, WI 54202
Phone: 920.839.2802

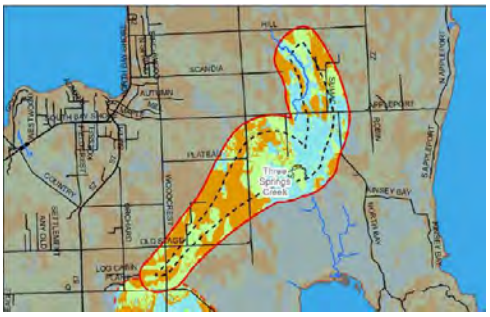
TABLE OF CONTENTS

APPENDICES

Introduction

The largest population of federally endangered Hine's emerald dragonfly (HED) exists in Door County due to the extensive coastal wetland habitat on the Peninsula. The HED have a relationship to groundwater sources, as they need calcium-rich, spring-fed wetland for larval development. Protecting existing habitat locations as well as the quality of groundwater supplying these sites is essential for the dragonfly's survival and recovery.

In 2008, the groundwater contribution areas (GCAs) of HED larval wetlands in Door County were delineated the Wisconsin Geological and Natural History Survey (Cobb and Bradbury 2008). The maps produced from this project are instrumental resources for the community. Now with the knowledge of locations of the GCAs and their importance to the protection of groundwater for the HED, best management practices (BMPs) need to be identified for landowners and local government to reconsider Door County activities and potential land use impacts. Providing this information through outreach has the potential to instill a sense of stewardship in the public and encourage landowners and local decision-makers to take an active role in protection of endangered resources.



Map of the Three Springs Creek GCA. *Cobb and Bradbury 2008*. View the HED GCAs on the Door County web map: http://map.co.door.wi.us/map/

The Ridges Sanctuary, Wisconsin's oldest member-based nature preserve and first land trust has some of the best and most extensive HED habitat. Similarly, many other rare species also call The Ridges home, giving rise to the Wisconsin Department of Natural Resources (WDNR) claim that The Ridges is the "most biologically diverse landscape in Wisconsin". Consistent with The Ridges' mission to promote awareness of biodiversity and the importance of protecting rare and threatened species, The Ridges started planning for a new educational interpretive center.


In cooperation with local businesses, The Ridges Sanctuary developed a simple fire ring and drip line to place under fish boils to prevent contamination of the soil and groundwater.

In 2012 during negotiations to purchase the adjacent Sandpiper Restaurant property for the new building site, an environmental investigation of the site revealed that a portion of the kerosene used to fuel fires for fish boils did not burn off and seeped into the ground. Fish boils have been an iconic Door County meal and activity for over 100 years. Kerosene is used to create a flashover for guest appeal. The tradition is a large tourist attraction. On this particular site, the environmental investigation determined that 25 years of fish boils had contaminated 800 tons of soil.

This newly discovered contamination issue compelled The Ridges to start a campaign to build more awareness on how best to protect Door County's groundwater. By mitigating contamination and restoring healthy soils and native vegetation at the new building site, managing storm water using retention and infiltration devices, and working with the community on groundwater protection throughout the watershed, The Ridges will become a model for groundwater protection in the Midwest. The HED BMP project was an opportunity that matched The Ridges' goals and addressed a need for outreach to protect the Hine's emerald critical habitat. This report lays the framework for further outreach to be conducted to satisfy HED BMP project deliverables and The Ridges Sanctuary outreach programs.

Thanks to the volunteers and professionals for their time and assistance in laying the framework for this project. Also, many thanks to the project technical committee for their guidance and collaboration. Committee member agencies include:

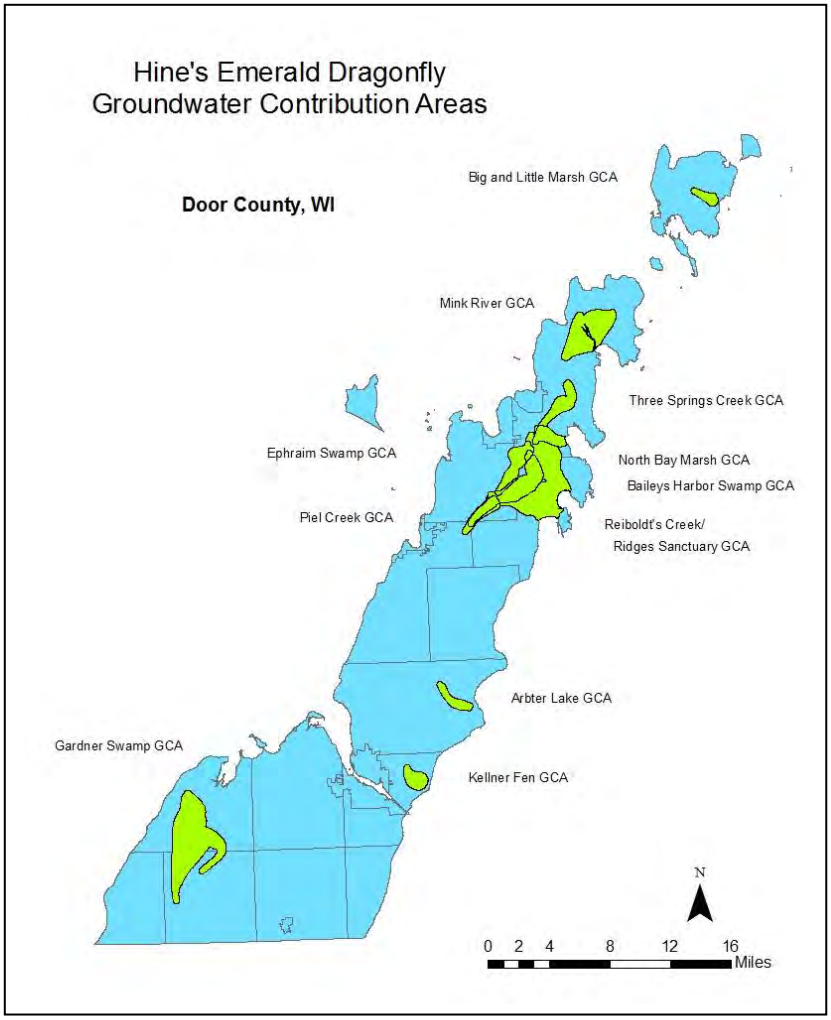
- U.S. Fish and Wildlife Service (USFWS)
- Door County Soil and Water Conservation Department (DCSWCD)
- Wisconsin Department of Natural Resources (WDNR)
- The Nature Conservancy (TNC)
- Door County Planning and Zoning Department (DC Planning)
- Wisconsin Geological and Natural History Survey, University of Wisconsin-Extension (UWEX)
- The Ridges Sanctuary (TRS)

This project serves as a proactive and preventative means to protecting the HED. Protecting the groundwater that supports HED wetlands sites is a Priority 1 task identified in the HED Recovery Plan (USFWS 2001). The project also addresses the following recovery tasks:

- Task No. 1.1.4 Long term watershed and habitat protection
- Task No. 5.1. Encourage private landowners to conserve HEDs
- Task No. 5.2 Inform local and county governments of HED goals; and
- Task No. 5.3 Develop outreach material on HED life history and conservation.

This project was funded by a 2012 Great Lakes Restoration Initiative grant.

Hine's Emerald Dragonfly Life History



The HED (*Somatochlora hineana*) became federally listed as endangered on January 26th, 1995, and is the only dragonfly to be protected under the Federal Endangered Species Act (USFWS 2007). The larvae of the HED require a calcium-rich wetland habitat underlain with dolomite bedrock and sustained water quality. Fragmentation of habitat, destruction of wetland sites, changes in hydrology, and degradation of water quality are causes for the species rarity and loss (USFWS 2001).

Historically the species was found in Ohio, Indiana, and Alabama but now believed to be extirpated from these states (USFWS 2001). Known populations are currently found in Wisconsin, Illinois, Michigan, and Missouri, and the province of Ontario, Canada.

HED in Door County, Wisconsin

The first HED identified in Door County was collected in 1987 in the Mink

River watershed by WDNR Biologist William Smith (Vogt and Cashatt 1990). Several of Door County's Lake Michigan tributaries and coastal wetlands provide the calcium-rich groundwater that enables the HED to flourish in these habitats. Although populations existing in Illinois and Missouri are the most genetically diverse, populations found in Door County, Wisconsin are the largest and have more protected larval habitat (Vogt and Cashatt 1990, 1992; WDNR 1993). Currently there are 11 federally designated critical habitat areas in Door County (USFWS 2007, 2010).

Life Cycle

The life cycle of the HED spans four to five years, with most of this time spent as aquatic larvae. A female lays about 500 eggs in rivulets, small streams connected to seeps, or in small ponds and swales (USFWS 2007). Eggs overwinter in the mud and hatch the following spring coinciding with increased water temperature.

Adult male HED. *Photo by Dan Jackson*

Adults

During a two to six week period as adults, HEDs feed, establishes territories, mate and the females oviposit (lay eggs) (Mierzwa et al. 1995b; Corbet 1962). In the northern range, which includes Wisconsin, adults emerge in late June (this varies depending on temperature and precipitation) and the flight season will last until late August (Mierzwa et al. 1995a, Vogt and Cashatt 1994). Adult male HEDs patrol territories and both sexes forage along narrow corridors, like streams, swales, and tree-bordered roads (Lukes 1993). Distinctive characteristics of adult HED include bright emerald green eyes and large body size, having a length of 60-65 mm (2.4- 2.6 inches) and wing span of 90-95 mm (3.5 -3.7 inches) (USFWS 2007). HED are easily distinguished from other adults in the genus *Somatochlora* by two cream-colored lateral stripes on thorax, distinctive clasping appendages at the end of the abdomen in males, and a distinctive vulvar lamina in females (Williamson 1931).

One, two, three and four year old HED larvae. *Photo by Dan Soluk*

Larvae

Larvae spend four to five years in an aquatic environment during which they molt through four instar stages (Soluk et al 1996, 1998a). They are sit-and-wait predators, feeding on smaller aquatic insect larvae at night (Soluk et al 2000, Johnson 1991). HED larvae take refuge from drought and to overwinter in burrows of the red devil crayfish (*Cambarus diogenes*) (Door County HED workshop 2000; Pintor and Soluk 2006).

Habitat Requirements

To thrive, HED need cool, shallow, slow moving, and mineral rich groundwater-fed wetland habitat (Door County HED workshop 2000). The plant communities associated with this kind of ecosystem may vary, but can include sedge meadows, fens, and wetland with calcareous springs (Door County HED workshop 2000). Occasionally, wetlands are subject to drought for a few weeks in summer but maintain a relatively steady water temperature due to groundwater influence (Door County HED workshop 2000). Adults utilize fields, meadows and forested edges near larval habitat. These corridors provide space for forage, protection, perching and roosting.

Door County provides a highly suitable habitat for HEDs because the seeps and springs associated with the dolomite/dolostone bedrock leaches calcium rich groundwater into wetlands that sustain larvae. However, the karst bedrock is highly fractured and much of it is covered with thin soil. These structural conditions provide ready access to pollutants that can quickly make their way through bedrock to surface springs, contaminating wetland habitat (see 2. Hydrology of Door County below).

Hydrology of the Door Peninsula

The Door Peninsula rests on layers of dolomite rock first formed as sediment within the warm, shallow Silurian sea between 428 and 444 million years ago. Rain and snow-melt water erode the fractured and soluble bedrock made up primarily of calcium magnesium carbonate, forming enlarged fissures and other karst features (Surface Water Inventory of Door County 2000). Characteristics of the bedrock are occasionally visible on the surface of the land as sinkholes, cave openings, swallets, closed depressions, fracture traces, crevices, springs, seeps, and exposed dolomite pavement (refer to Appendix A). These features can act as direct conduits to groundwater sources.

Springs at Three Springs Nature Preserve (HED critical habitat).

In many parts of Door County, glaciation over the last ice age removed much of the material above the bedrock surface. Today, soils are very shallow; 22% of the soil on the Peninsula is less than 18 inches deep, and 17% is between 18 to 46 inches deep (Surface Water Inventory of Door County 2000). Highly fractured bedrock and thin soils can be the equation for significant groundwater contamination.

Door County's natural history, exposure of the Niagara Escarpment, and proximity to Green Bay and Lake Michigan combine to form small but incredibly unique ecosystems including ridge-swale complexes, coastal wetlands, dunes, estuaries, and embayment lakes. Inhabiting these areas are 30 Wisconsin State threatened or endangered plants, and nine animals. In addition to the HED, species with Federal protection include the piping plover (*Charadrius melodus*), dwarf lake iris (*Iris lacustris*), and Pitcher's thistle (or dune thistle, *Cirsium pitcheri*).

Groundwater; A Shared Resource

Knowledge of the "Swiss cheese" bedrock and the wealth of biodiversity that exists in Door County should encourage the evaluation of existing land uses, maintenance, and management that may degrade the quality of our local resources and the upper Lake Michigan basin (Surface Water Inventory of Door County 2000). On the peninsula, the Silurian aquifer supplies groundwater as drinking water and to local ecosystems. A shared resource should be of concern to the public not only for health and human safety and preservation of natural resources, but also to support an important tourism based economy.

Guidelines or best management practices (BMPs) coupled with outreach are needed to protect groundwater sources discharging to wetlands with HED breeding sites and other sensitive habitats. Public awareness, education, and voluntary implementation of BMPs can avoid or minimize groundwater contamination and changes to the natural infiltration processes.

Field Work

The information used in developing the maps showing karst features in the GCAs, was obtained from the Door County Soil and Water Conservation Department (DCSWCD). DCSWCD houses extensive data on previously documented types and locations of karst features throughout Door County (refer to "Maps" below and Appendix A).

Engineered surface water hydrologic connections (e.g., culverts, channels, and ditches) can influence water quality by facilitating erosion and conveying pollution during storm events and spring melt. Other than data of culvert locations within The Ridges Sanctuary watershed and minimal non-digitized information of culverts along county highways maintained by the Door County Highway Department, a comprehensive record of culvert locations and conditions in Door County is lacking.

Unmapped hydrologic connections were field checked as a part of the HED BMP project. With the help of volunteers, The Ridges Sanctuary partnered with the WDNR and TNC in a road-stream crossing inventory. Although designed to assess culvert function and barriers to fish passage, the survey protocol was modified to identify undocumented culvert locations to establish a database within to HED GCAs. This was an opportunity for citizen scientists to utilize technological tools in the field and observe ecosystem connectivity to assess watershed health. Over 320 hours of volunteer and staff time was spent in the field identifying culvert locations documenting man-made surface water channels. Utilizing volunteer efforts aided in educating the public about watersheds and water quality.

The survey results indicated that culvert locations did not have much significance when plotted with the GCAs using Geographic Information Systems (GIS). Because the GCAs are generally more inland areas of the county, culvert function may be for drainage systems during spring melt. Culverts may convey some surface flow from one area to another before infiltration in the GCAs, but their overall significance to large scale impacts on groundwater in the GCAs is questionable. Also, the data on all culvert locations is incomplete and therefore conclusions on the scale of their impact in the GCAs cannot be determined.

Culvert impact may have some relevancy in affecting HED wetland habitat in facilitating flow through HED critical habitat areas. A map of the culvert locations in the Reiboldts Creek and Ridges Sanctuary HED GCA (including critical habitat) can be found in Appendix C.

Maps

Four sets of maps were developed for the HED BMP project and are included in this report. The maps show the HED GCAs developed by Cobb and Bradbury (2008) and include data representing potential, natural, man-made, and land use activity influences. Project maps consist of the following:

- HED GCAs with Karst Features and Closed Depression Capture Zones (Appendix A)
- HED GCAs among Watersheds and Subwatersheds (Appendix B)
- Culvert Locations in HED GCAs (Appendix C)
- Land Uses in HED GCAs (Appendix D)

Notes:

- *Groundwater contribution area data is from Cobb and Bradbury (2008). Read the report and view the GCA maps with groundwater recharge potential: www.ridgessanctuary.org/aboutus/preservation/HED/cobbandbradbury2008*
- *All maps were created by Marne Kaeske, using 2011 orthogonal photos, color, 1 foot pixel resolution; Pictometry International Corp.*
- *All maps are scaled in miles. 1 mile = 1.609 kilometers*

Framework Used to Develop BMPs and Design Outreach Approach

Guidance from HED BMP Technical Committee

To discuss potential threats and areas of interest meetings were conducted with the HED BMP technical committee to gather information, identify gaps within existing regulatory programs, discuss opportunities within community interest, and target audiences for outreach purposes.

Review of Existing Regulations and Programs

Some examples of state regulations that apply to land use, resources, and protections in the Door County HED GCAs are:

- Runoff Management under NR 151 identifies standards for non-agricultural activities generating runoff pollution.
- Wisconsin's Shoreland Protection Program, NR 115, regulates the zoning to reduce impacts along lakes streams, and wetlands.
- Door County is a sensitive area identified under NR 812, *Well Construction and Pump Instillation*. Most private wells in Door county have casing requirements of 170 feet deep to provide protection for the drinking water in the fractured dolomite.

Concern over the historical occurrence of water contamination in Door County has led to the development of governmental rules to protect water quality. Examples of such rules are noted below:

- Chapter 21of the Door County Sanitation Code sets minimum standards for criteria including design, instillation, inspection and management of Private Onsite Wastewater Treatment Systems (POWTS).
- The DCSWCD has established criteria for urban storm water runoff control design. *Construction Site Erosion Control and Post Construction Storm water Policy Procedure* is consistent with NR 151, but intended to protect runoff conditions affecting or magnified by karst features.
- The DCSWCD enforces Chapter 23, *Agriculture Performance Standards and Animal Waste Storage Ordinance*, to promote public health and safety.
- Setbacks to shorelines, wetlands, rock holes, and escarpment are sited in Chapter 5, the *Natural Features* protection requirements chapter of the Door County Zoning Ordinance.

Identifying Current Land Use

The top land uses within each HED GCAs directed selection of BMPs to include in this project. For further information on HED GCA landscapes and land use percentages refer to Appendix E. Maps of land use distribution in each HED GCA can be found in Appendix D.

Communicating Community Interest

Initial communications with town boards, planning commissions and special interest groups to communicate interest and to build relationships during project planning is reflected in the included BMPs. Likewise, some BMPs included within are also based on partnership opportunities with special interest groups for support and reach more people. Comprehensive plans developed by each town provided guidance for assessing community interest within the HED GCAs and likelihood of BMP incorporation. Smart Growth plan objectives consistent with the BMPs, previous community accomplishments satisfying HED BMPs, and identification of local stakeholders are discussed in *Land Use and Community Information for Door County HED GCAs* (Appendix E).

Eliminate Pesticide and Synthetic Fertilizer Usage on Residential Lawns, Public Spaces and Recreational Fields

Pesticides are commonly used to control weeds and bugs in crop fields, orchards, and golf courses. Pesticides are also available to private landowners to support lush green and manicured lawns. However, these uses are not regulated and unknown amounts and types of pesticides may be used in "weed and feed" mixes and applied by hired companies in "seasonal treatments."

Make your lawn *Safe to Play*.

With Door County's shallow soils, pesticides and synthetic fertilizers applied to lawns can quickly be carried into the groundwater and drinking water sources. In addition, these substances can be harmful to the health of children, pets and wildlife through exposure in the environment.

How to:

- Plant a mixture of grass seed to develop a diverse lawn. Include species that prefer cooler conditions for spring and fall, and some preferring dry hot conditions. Make seed selection to address impacts from foot traffic tolerance to sun and shade conditions.
- Mow high. Set your blade to 2.5" or 3"above the ground. Taller grass has healthier roots. This will result in thicker turf that is more resistant to drought.
- Let it lie. Grass clippings are local, organic, and free fertilizers.
- Consider alternatives to traditional "lawns" (e.g., artistic, organic or edible yards). Reduce your lawn burden and expand your garden.
- Many Door County landscapers offer organic and pesticide-free fertilizers. Inquire about alternative services.

For more information, check out *Safe Lawns in Door County*, a local special interest resource: www.doorpropertyowners.org/safe-lawns-in-door-county

Maintain Private Onsite Wastewater Treatment Systems (POWTS)

GCA locations for HED habitat generally include rural lands where POWTS are the norm for handling waste water. Door County requires POWTS inspections every three years. However, maintenance and awareness can prolong the life and function of POWTS.

Septic failure or flooded drain fields result in smelly and costly messes. Furthermore, they can spread disease and contaminate well and groundwater. Maintenance and upkeep will protect your water and wallet.

How to:

- Check or clean the effluent filter one to three times a year.
- If you are in the market for a new POWTS, consider keeping it small. Smaller systems will have potentially smaller problems and cost less to maintain.
- Reduce waste water volume: fix plumbing leaks and consider up-grading to water saving toilets or wash machines.
- Don't hook up garbage disposals to mound or in-ground systems; food particles can plug the filters and clog the drainfield.
- Protect the drain field from damage to pipes: keep it clear of driving paths, and large tree roots.
- Watch for early warning signs: water pooling at your ankles in the shower, you sense an occasional sewage smell, or soggy soil above drain field.
- Be aware and get your flushes worth!

Learn the ins and outs of your POWTS:
http://learningstore.uwex.edu/Assets/pdfs/B3583.pdf

Peil Sanitation, Baileys Harbor, WI

Protect Exposed Bedrock

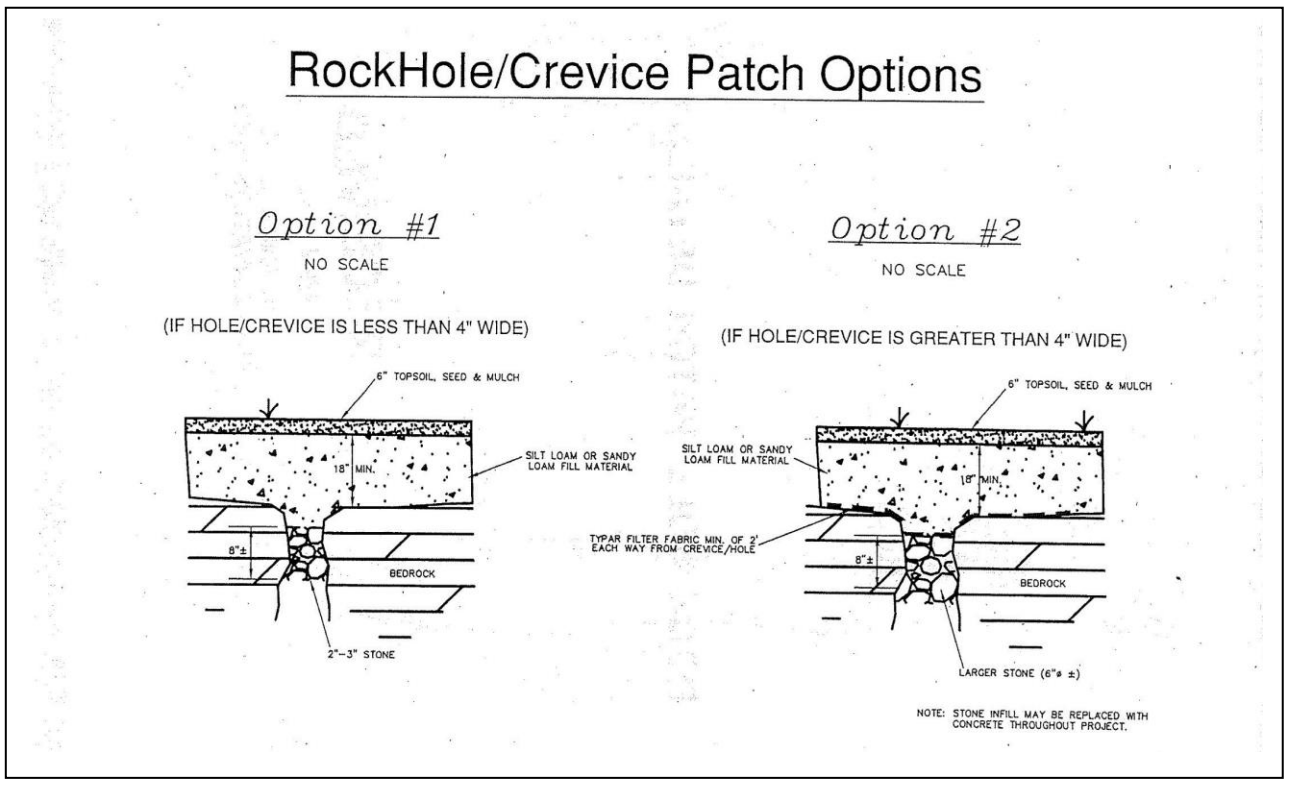
In parts of Door County the bedrock is highly fractured and covered with little soil. Karst features like cracks, fissures and sinkholes are direct conduits to groundwater. They provide access for pollutants to reach our well water and HED habitat.

Areas adjacent to exposed bedrock and closed depressions (low spots in the terrain, usually lying over cracked bedrock) should be treated as riparian (shoreline) areas around surface waters. Activities such as (but not limited to) tilling, spraying, grazing, manure spreading or development have the potential to negatively impact groundwater resources.

Sinkholes can be stabilized to minimize erosion and groundwater contamination. *Photo by DCSWCD*

How to:

- Clean out sinkholes historically used as dump sites.
- Setback activities like pasturing, development or landscaping 75 feet from karst features.
- Establish buffer areas over 75 feet wide surrounding karst features to filter any water entering bedrock by planting native vegetation.
- To avoid potential exposed karst feature enlargement, use DCSWCD's patching options (below or view online at: www.ridgessanctuary.org/aboutus/preservation/HED/SWCDrockholepatchoptions).
- Be a community model! Contact The Ridges Sanctuary if you are interested in assistance with cleaning out, patching, or creating a buffer around sinkholes on your property.



Properly Dispose of Pharmaceuticals and Hazardous Waste

Door County hosts a Household Hazardous Waste Collection Program. *Photo by Door County HHW recycling program*

In the past, the public was advised to flush unused prescription drugs down the toilet. Likewise, dumping old gas/oil mixes into a fallow field was a common practice. However waste that doesn't break down organically can persist in the environment. Cleaning solvents, petroleum products, mercury-containing equipment, hormones and antibiotics are all examples of pollutants that have been found to enter the ground and surface watersheds.

Door County citizens should be concerned about the environmental health of the larger Lake Michigan basin, impacts to the local fishery, and the contents of their drinking water. Extra precautions should be taken to make sure hazardous waste makes an appropriate exit.

How to:

- Don't flush pharmaceuticals down the toilet; take them to the Door County Sheriff's Office.
- Don't put household hazardous waste in the trash; take them to a "Door County Household Hazardous Waste Collection".
- Capture excess kerosene used in fish boils to prevent it from contaminating nearby soils and filtering into the groundwater.

Find when, where and how to drop your old and unused pharmaceuticals:
http://doorcountysheriff.homestead.com/files/Press_Release_Prescription_Drug_Drop_Off.pdf
Check the Door County "Events" page to find the next Household Hazardous Waste Drop-Off:
http://www.co.door.wi.gov/events.asp?locid=137

Follow Manure Application Standards

Nutrients cannot be incorporated into frozen soil; spring rains and snow melt can cause runoff into waterways.

Applying manure to agricultural fields is a cost effective and sustainable practice. It is a beneficial fertilizer with many agricultural and economic advantages.

However, there are environmental concerns with manure runoff entering local surface waters. Phosphorus nutrient loading leached from fertilizers adds to *Cladophora* (algae) blooms on Lake Michigan shorelines. Likewise, nitrogen can escape into the groundwater as nitrate which can cause health problems for humans if ingested at high levels. Given the potential to cause harm to our surface and groundwater, it is prudent for Door County citizens to adhere to manure land application standards.

How to:

- Manure and organic by-products should not be applied on frozen or snow covered grounds.
- Manure and organic by-products shall not be applied within 75 feet of surface water.
- Manure and organic by-products shall not be applied within 75 feet of exposed bedrock.
- Manure and organic by-products shall not be applied unless incorporated within 72 hours.

Learn more about the benefits and precautions of manure as a soil amendment:
http://learningstore.uwex.edu/Assets/pdfs/A3392.pdf

Develop and Implement a Storm Water Management Plan to Control Erosion on Construction Sites

During construction top soil is removed. Heavy rains can erode the bare soil and carry it away with any near-by pollutants. Developing and implementing storm water management plans that include the use of building pads can alleviate the threat of contaminating surrounding surface and groundwater.

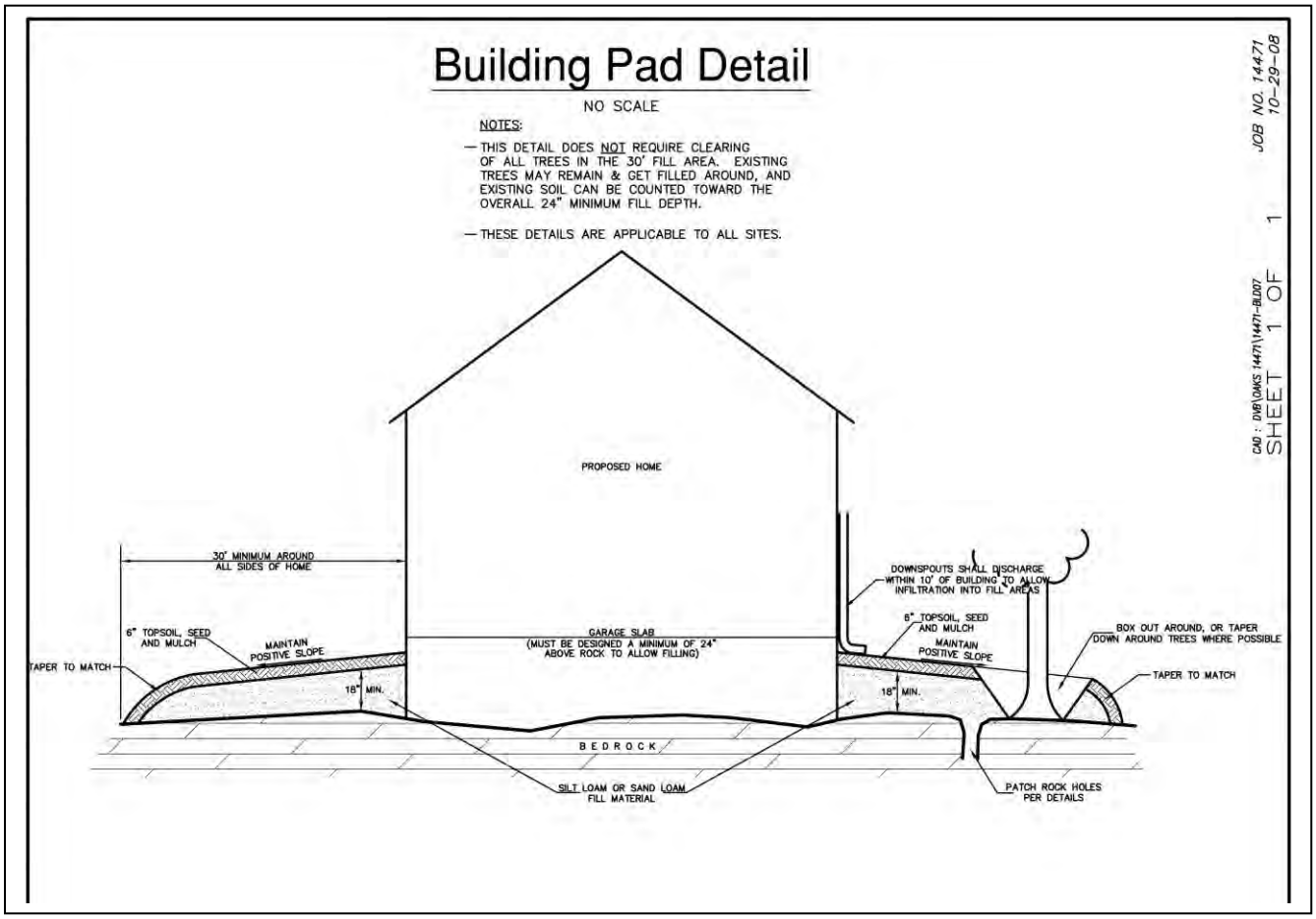
A storm water management plan is required by the WDNR if land disturbance is over one acre in size. Having a storm water management plan on *any size* project is a preventative measure that will help protect ground and surface waters.

Building pads that filter storm water blend into the landscape after construction, as green space or heavy mulch cover. *Photo by DCSWCD*

How to:

- Implement erosion and stabilization or sediment control practices consistent with WDNR storm water construction technical standards: http://dnr.wi.gov/topic/Stormwater/standards/const_standards.html

- Use DCSWCD's construction pad design for your project (below or view online at: www.ridgessanctuary.org/aboutus/preservation/HED/SWCDbuildingpaddetail).



Install Storm Water Infiltration Systems to Mitigate Impervious Surface Runoff

Impervious surfaces can facilitate the movement of a considerable amount of water during storm event and displace pollutants with it. This water can change natural infiltration regimes, degrade the quality of shoreline beaches, create mosquito breeding habitat, or erode top soils. Simple, low maintenance retention and infiltration devices can mitigate the negative impacts of storm water.

Storm water mitigation systems can also fit into existing landscaping and work in tandem with the artistic design of your yard or business.

Bioswales are planned for storm water mitigation at The Ridges Sanctuary's new interpretive center (dark green areas).

How to:

- Establish a low-maintenance rain garden with native vegetation to infiltrate storm water from downspouts or in low areas.
- Install French drains (or a sub-drain) to infiltrate storm water or convey storm water away (underground) from building foundations.
- Install vegetated swales to convey and enhance storm water infiltration around larger impervious areas like parking lots.

Learn design criteria, standards and specifications for storm water infiltration systems:

WDNR Storm Water Technical Standards
http://dnr.wi.gov/topic/Stormwater/standards/postconst_standards.html

UWEX Rain Garden Manual
http://clean-water.uwex.edu/pubs/pdf/rgmanual.pdf

Vegetated Infiltration Swale
http://dnr.wi.gov/topic/Stormwater/documents/Interim_Infiltration_Swale_1005.pdf


French drains convey rain water from rooftop gutters into the ground.

Promote Conservation Practices to Support Increasing Environmental Awareness and Demand for Green Tourism

Door County's strong tourist economy offers an opportunity to educate our visitors on protecting water resources and endangered species such as the HED. Our green space and scenic water frontage are some of the main reasons tourists visit the Peninsula. Demonstrating that local businesses are taking steps to conserve water and safeguard its quality will persuade patrons to do the same and encourage their return. In fact, many visitors plan their vacations around leaving little or no foot print and seek out *Travel Green* certified Door County businesses.

Encourage visitors to consider the impacts of daily actions.

How to:

- Urge guests to reuse towels and sheets to conserve laundry water.
- Obtain *Travel Green* certification for your business and highlight your water conservation and wastewater management efforts: http://www.travelwisconsin.com/wisconsin/Travel-Green
- Offer information on Door County groundwater and the HED in rooms and visitor information centers.

Learn what simple reading material is available for visitors:

Protect the Water You Drink
http://map.co.door.wi.us/swcd/DoorCoKarst%20(2).pdf

Groundwater and the Hine's Emerald Dragonfly in Door County
http://map.co.door.wi.us/swcd/HED-fly/GW_Hines%20brochure%20.pdf

Protecting Groundwater in Door County
www.ridgessanctuary.org/aboutus/preservation/HED/HEDBMPbrochure

Look for the *Travel Green Wisconsin* logo at participating Door County businesses. *WI Dept. of Tourism*

Protect Groundwater from the Impacts of Development with Conservation Easements

Washington Island landowners discuss conservation easements with Terrie Cooper (Door County Land Trust).

Reserving natural space from development is an important tool in land and resource protection. Door County's rural and green space plays a role in expressing our cultural heritage and supports numerous economic and ecological factors.

Conservation organizations and governmental bodies like The Ridges Sanctuary, Door County Land Trust (DCLT), Door County Parks, TNC, WDNR, and local governments are instrumental in reducing our local footprint now and forever. The DCLT can assist landowners in erecting easements on private property.

How to:

- Work with the DCLT to develop a conservation easement for your land. Landowners retain ownership while future development is permanently restricted. Information on the DCLT can be obtained from: http://www.doorcountylandtrust.org

- Consider donating your land for natural resource protection. Door County conservation organizations and local government bodies will accept donations of land that possess high quality value such as habitat supporting the HED.

Use Door County *Greenprint* to Guide Development in Protection of Areas Crucial for HED Recovery

Door County Greenprint is a virtual resource (found on the web) that combines scientific data with conservation goals which can assist local policy makers in strategic planning and guide local development businesses in protecting natural resources. It is a program utilizing a framework to identify locations of highest concern for environmental protection.

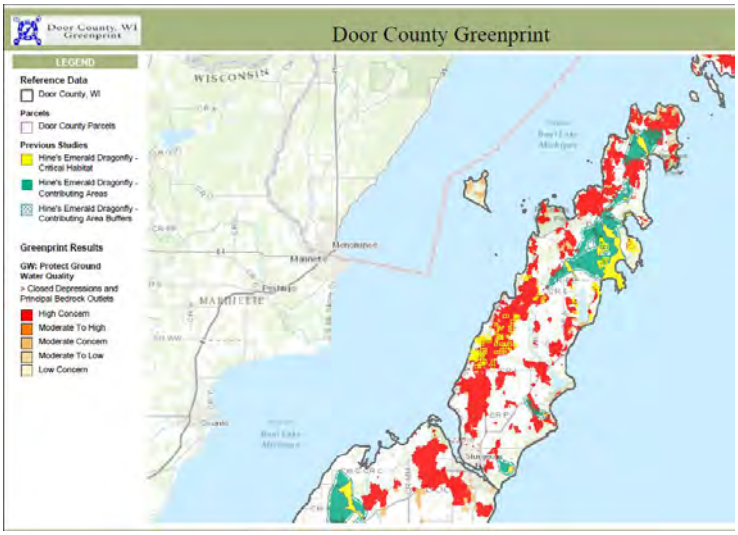
The software and modeling process was developed by the national non-profit conservation organization *The Trust for Public Land*. "Greenprinting" is used in over 50 locations across the United States but the *Door County Greenprint* project was the first in Wisconsin. The goals, weight and overlay data regarding resource sensitivity is designed by a technical committee of local natural resource managers, making it a program specific to land use in Door County.

Protection of the HED groundwater contribution areas (GCA) have been added to the *Door County Greenprint* as an overlay under "Previous Studies". Using *Door County Greenprint* can assist with planning development in a manner that protects the HED and the groundwater resources crucial to maintaining its wetland habitat.

How to:

- Learn how to use *Door County Greenprint* in the self-guided training tool.
- Use *Door County Greenprint* to identify steps in building process (e.g., permits needed if in areas of concern).

Plan development and land use while protecting sensitive Door County resources:
http://tplgis.org/DoorCounty_Greenprint/



Use *Door County Greenprint* to guide development while protecting groundwater.

A Groundwater Protection Zoning Overlay Model Ordinance

The locations supplying groundwater to HED larval wetlands were delineated by Cobb and Bradbury (2008). The maps produced from the project are instrumental in conveying the opportunity for residents and local governments to protect endangered resources.

A groundwater protection zoning overlay model ordinance is included in Appendix F. The model ordinance is a resource for local governments to use as a regulatory measure to help protect the HED and the groundwater essential for its survival.

Notes:

- *Enforcement is not included within the model ordinance and is left to the discretion of the town to designate.*
- *For those towns without county zoning, this ordinance may be adopted as a "Groundwater Protection Ordinance".*

Voluntary Implementation of BMPs

This report presents an initial set of BMPs that will be promoted through education and outreach to landowners, local governments, special interest groups and stakeholders. The BMPs presented here are resources for the Door County community to be stewards in protection of local endangered resources.

Although the BMPs are targeted for proactive and preventative protection of groundwater in the almost 23,000 acres of HED GCAs, they can be applied anywhere in Door County. Protection of the groundwater in the GCAs will help insure that the wetlands that the HED depend on are maintained as high quality wetlands. As a shared resource, protection of groundwater also protects drinking water sources and the overall water quality of the surrounding Lake Michigan basin.

Due to the voluntary nature and purpose of the project, BMP implementation will be based on land use and is ultimately dependent on landowner or business interest. As an example, GCAs including a large number of residential homes might consider adopting additional in-home water conservation practices and more awareness and diligence of septic system maintenance.

Parties interested in implementing BMPs are encouraged to contact The Ridges Sanctuary for further guidance and resources. The HED BMP project objectives fulfilled by The Ridges Sanctuary and will continue to be a focus of The Ridges *Landowner Stewardship* outreach program. The Ridges Sanctuary will continue to educate the importance of groundwater protection in Door County through a new educational interpretive center that is currently under development.

Guidance and Assistance from Resource Agencies, Organizations, and Volunteers

Many partnering organizations were instrumental in the development of this project. Various discussions, meetings, phone calls and e-mails were coordinated with individuals to obtain information and guidance in planning throughout the project period. The Ridges Sanctuary wishes to acknowledge the following individuals for their efforts and support on behalf of the HED and assistance in this project:

Ken Bradbury, UWEX
Laurel Braatz, WDNR
Paul Burton, Volunteer
Cathy Carnes, USFWS
Vinnie Chomeau, Volunteer
Nancy Ciezki, Volunteer
Terrie Cooper, Door County Land Trust
Greg Coulthurst, DCSWCD
Kim Cuddington, University of Waterloo
Matt Diebel, WDNR
Judy Drew, TRS
Kevin Fermanich, UW-Green Bay
Eric Fowle, East Central Wisconsin Regional Planning Commission
Brian Forest, DCSWCD
Jamie Forest, Door County Board (past)
Audrey Forslund, DC Planning
Mariah Goode, DC Planning
Theo Goode, Volunteer
Gus Glaser, WDNR
Shirley Griffin, Volunteer
Mike Grimm, TNC
Kari Hagenow, TNC
Tom Haight, Door County Land Information
Marilyn Hansotia, Volunteer
Coggin Heeringa, Crossroads at Big Creek
Joe Henry, WDNR
Hickey Brothers Fisheries
Peter Jacobs, Baileys Harbor Town Board
Pam Johnson, Volunteer
Sue and Skip Kaeske, Volunteers
Elizabeth Kimbrough, Volunteer
Mark Klotzbuecher, UW-Green Bay
Steve Leonard, TRS
Karl and Lucy Klug, Volunteers
Kris Lah, USFWS
Kevin Masarik, UWEX
Emy Monroe, University of South Dakota

Charlie Most, Liberty Grove Town Board (past)
Maureen Muldoon, UW-Oshkosh
Chris Olson, Door County Sanitarian
Barb Ottum, Volunteer
Eric Peil, Volunteer
Peil Sanitation
Nick Peltier, DCSWCD
Trey Perlman, Volunteer
Glenna Peters, Volunteer
Chris Plzak, Door County Forester
Josh Schedler, Bay Lake Regional Planning Commission
Paul Schumacher, Wisconsin Lakes
Bill Schuster, DCSWCD
Pete Schuster, LFP Design
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Bill Smith, WDNR
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Ron Stieglitz, UW-Green Bay (retired)
Mary and Roy Thilly, Volunteers
Gary VanVreede, USFWS
Dean Volenberg, UWEX
Dick Weidman, UWEX (retired)
Jane Whitney, Volunteer

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Websites Related to BMPs

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- Door County Land Trust
  http://www.doorcountylandtrust.org
- Door County Web Map
  http://map.co.door.wi.us/map/
- Groundwater Protection Model Ordinance Resources
  http://water.epa.gov/polwaste/nps/mol7.cfm#groundwater
- SafeLawns (National umbrella)
  http://www.safelawns.org
- Safe Lawns in Door County (Local special interest group)
  http://www.doorpropertyowners.org/safe-lawns-in-door-county
- The Ridges Sanctuary
  http://www.ridgessanctuary.org
- Storm Water Construction Technical Standards
  http://dnr.wi.gov/topic/Stormwater/standards/const_standards.html

- Storm Water Post-construction Technical Standards
  http://dnr.wi.gov/topic/Stormwater/standards/postconst_standards.html
- Travel Green Wisconsin
  http://www.travelwisconsin.com/wisconsin/Travel-Green

Outreach Materials

- Door County Soil and Water Conservation Dept., "Protect the Water You Drink: Tips for Door County Landowners" http://map.co.door.wi.us/swcd/DoorCoKarst%20(2).pdf
- Groundwater and the Hine's Emerald Dragonfly brochure
  http://map.co.door.wi.us/swcd/HED-fly/GW_Hines%20brochure%20.pdf
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- WDNR, Vegetated Swale Fact Sheet
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APPENDIX A
HED GCAs with Karst Features and Closed Depression Capture Zones

Karst features identified on maps

CLOSED DEPRESSION CAPTURE ZONE: An area of land surface which is internally drained with no surface outlet for runoff water.

SINKHOLE: A depression or opening on the land surface, formed by solution or the collapse of limestone or dolostone bedrock. Sinkholes may be partially or completely filled with unconsolidated material and vertical passages often extend to the groundwater sources.

CREVICE: A linear opening or fissure within bedrock created by water penetrating along a joint.

SWALLET: A sinkhole or rockhole that intercepts a stream, diverting all or a portion of potential contents into the groundwater.

SPRING: Groundwater that emerges at the land surface, usually diffuse and ephemeral in the Door County area.

EXPOSED BEDROCK: Areas lacking soils where Silurian dolostone is present at the land surface. Undefined karst features are included within Exposed Bedrock on the following maps.

FRACTURE TRACE: A natural linear feature consisting of topographic, vegetation, or soil tonal alignments expressed continuously for less than one mile, which might reflect fractures in the bedrock.

MULTIPLE KARST FEATURES: A term developed during the ground mapping process when karst features were at a high density and used here for the purpose of map clarity and readability.

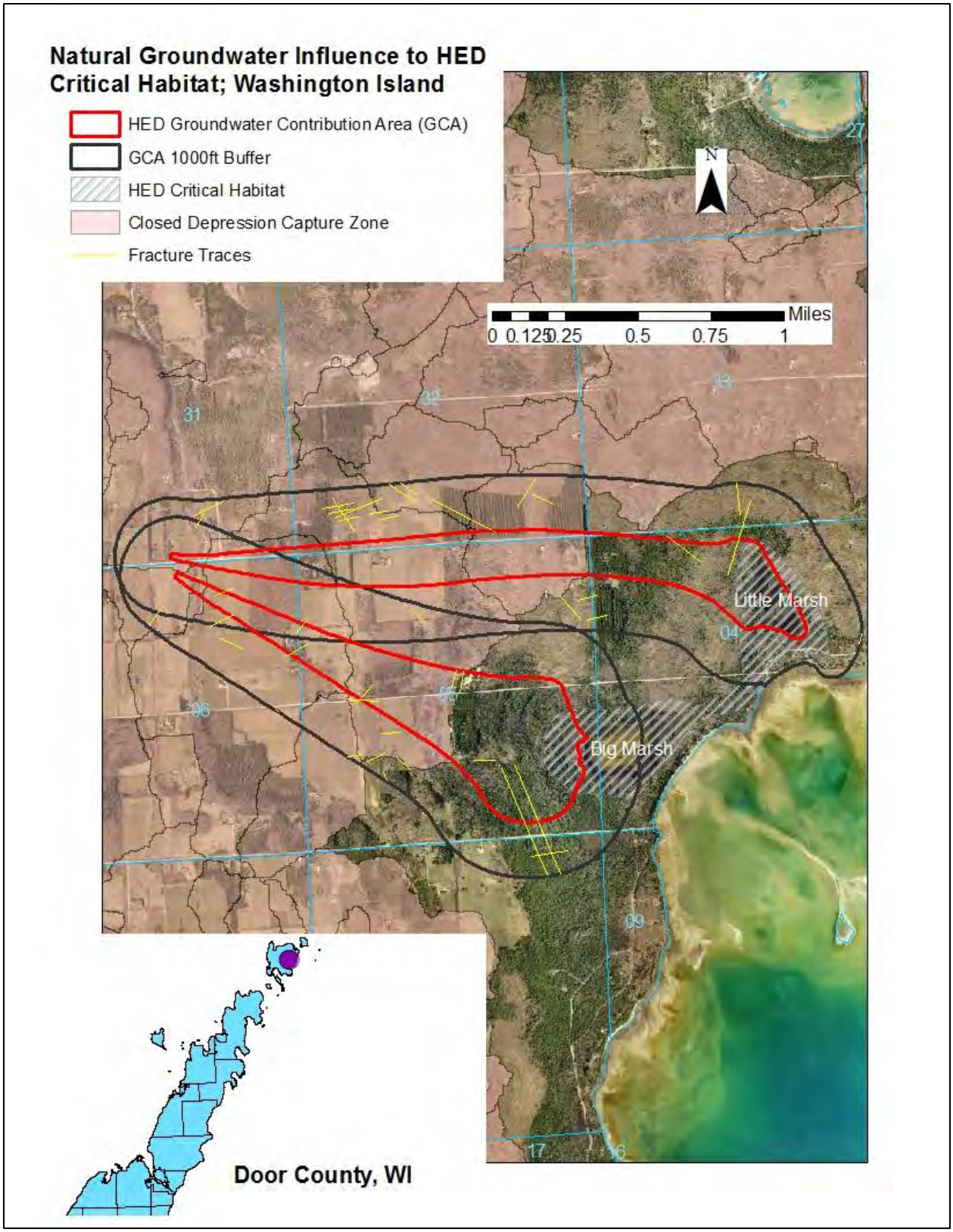

Figure A1. Contributing areas for larval sites on Washington Island

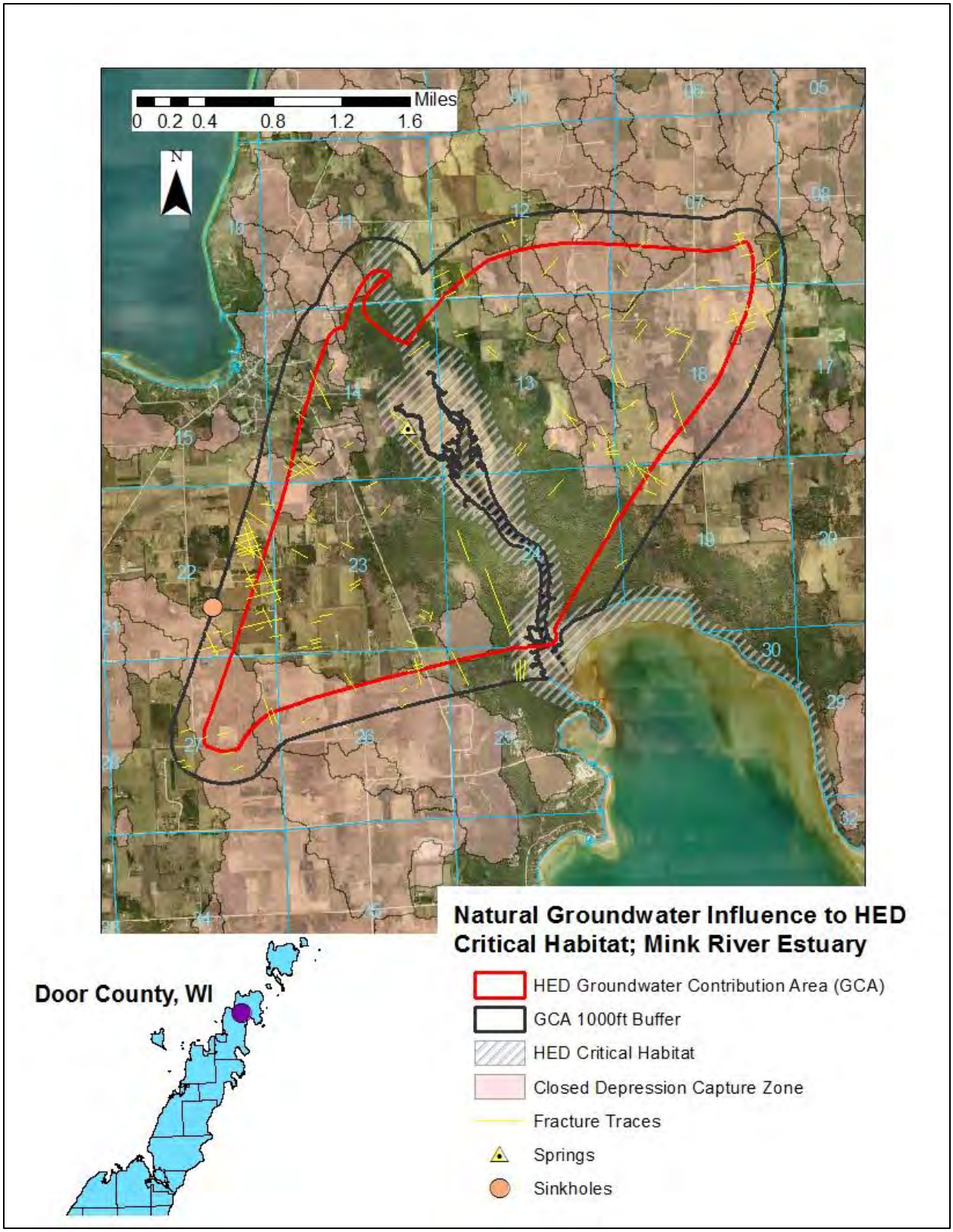

Figure A2. Contributing areas for larval sites along the Mink River

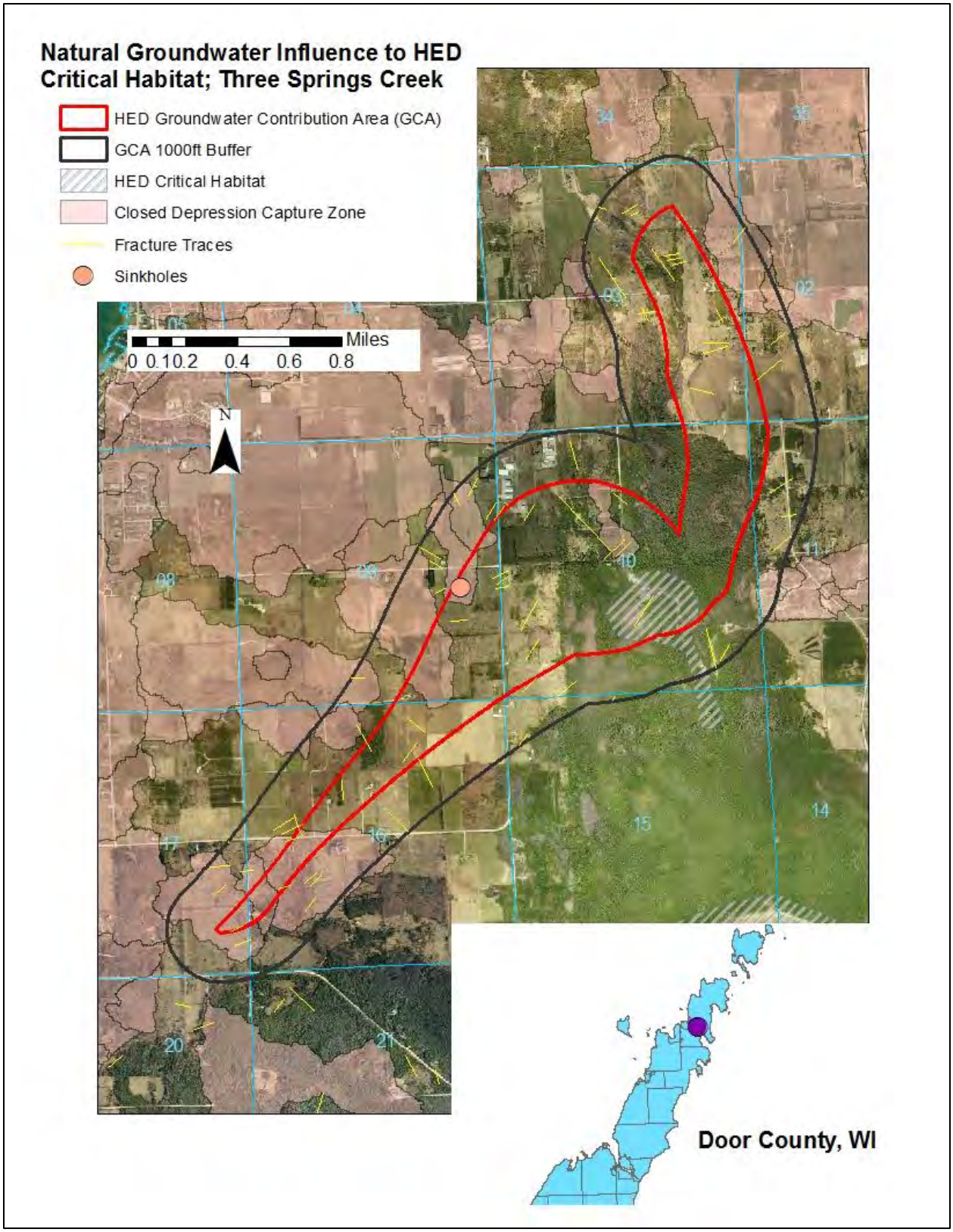

Figure A3. Contributing areas for larval sites along Three Springs Creek

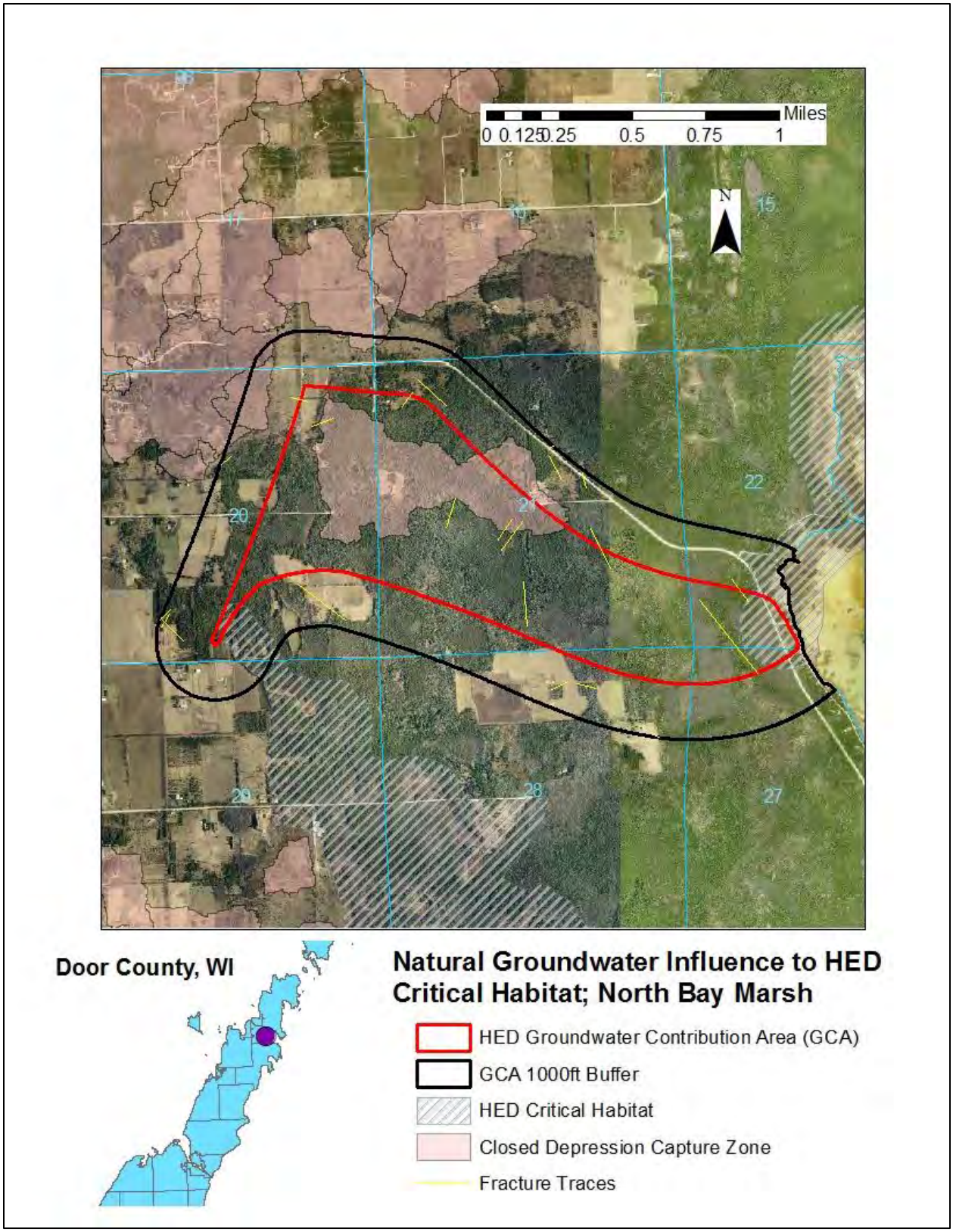

Figure A4. Contributing areas for larval sites near North Bay Marsh

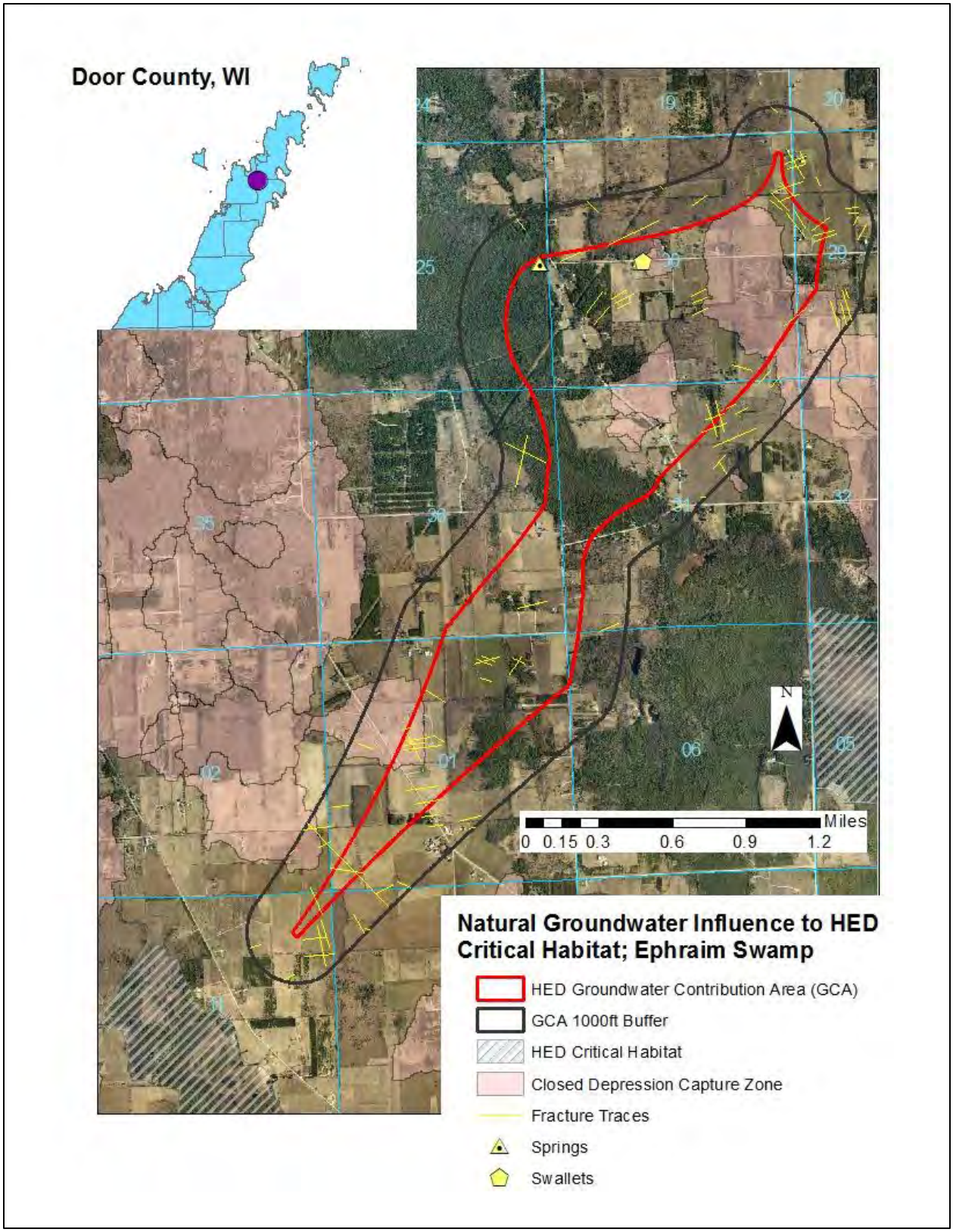

Figure A5. Contributing areas for larval sites near Ephraim Swamp

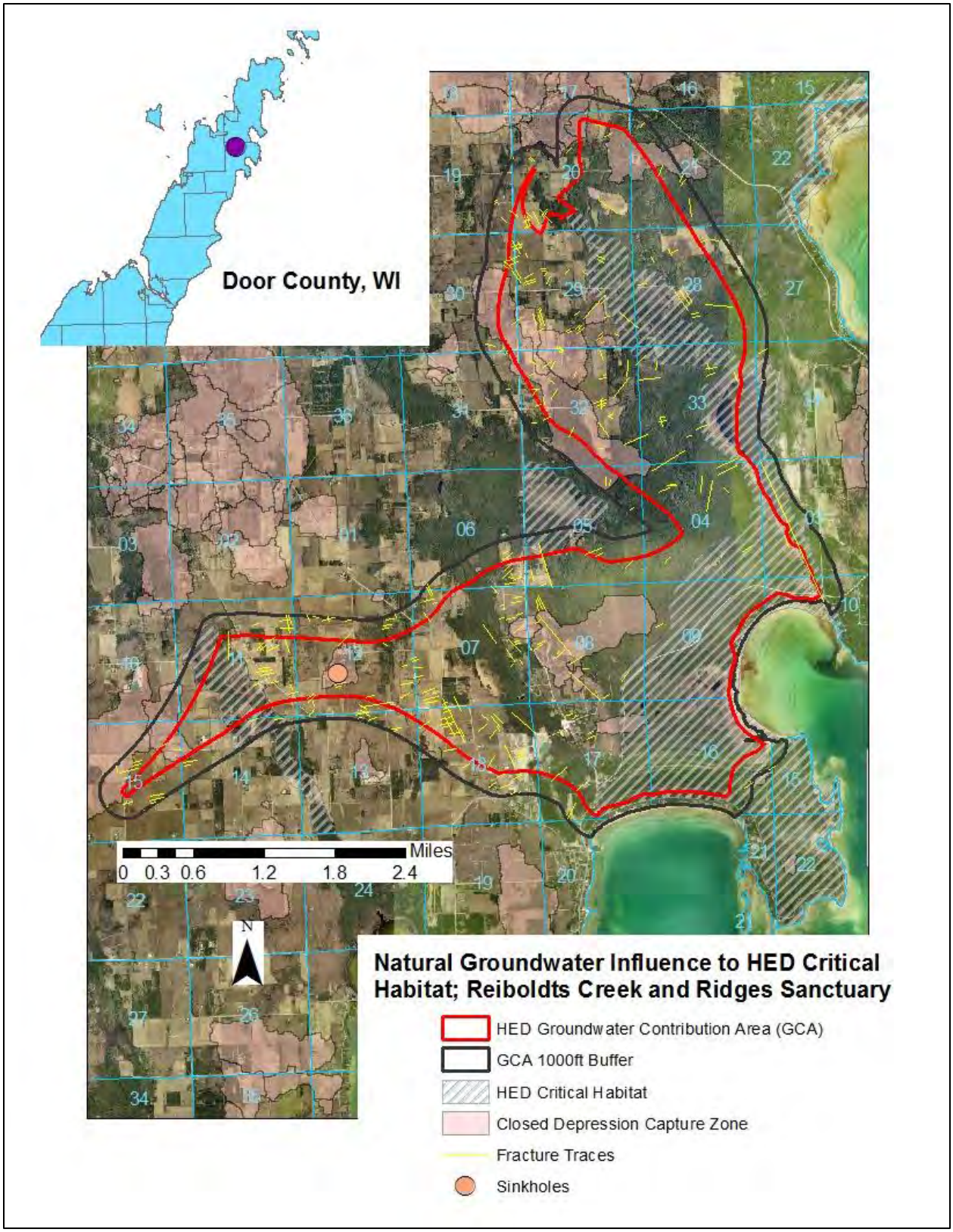

Figure A6. Contributing areas near Reiboldts Creek and The Ridges Sanctuary

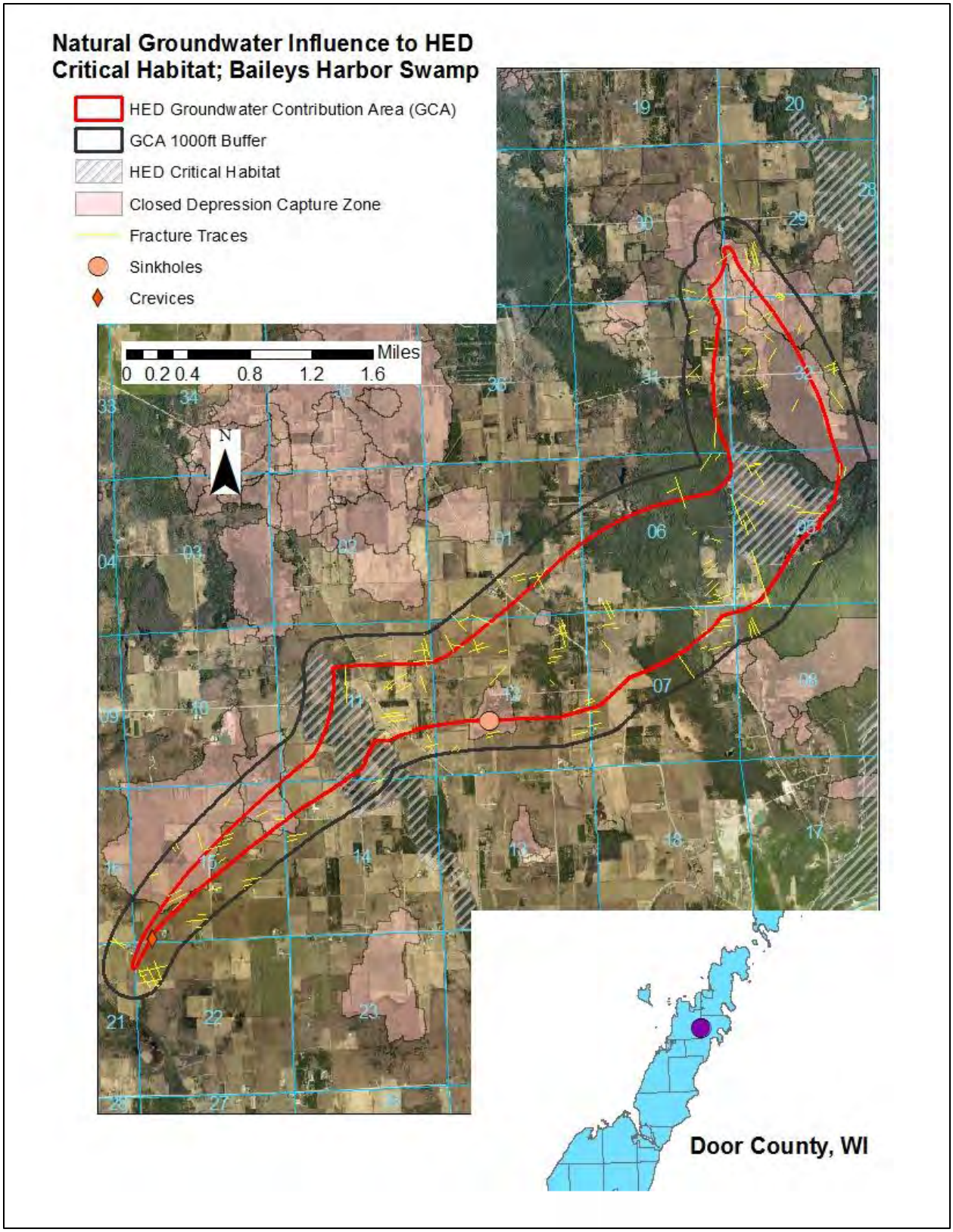

Figure A7. Contributing areas near Baileys Harbor Swamp

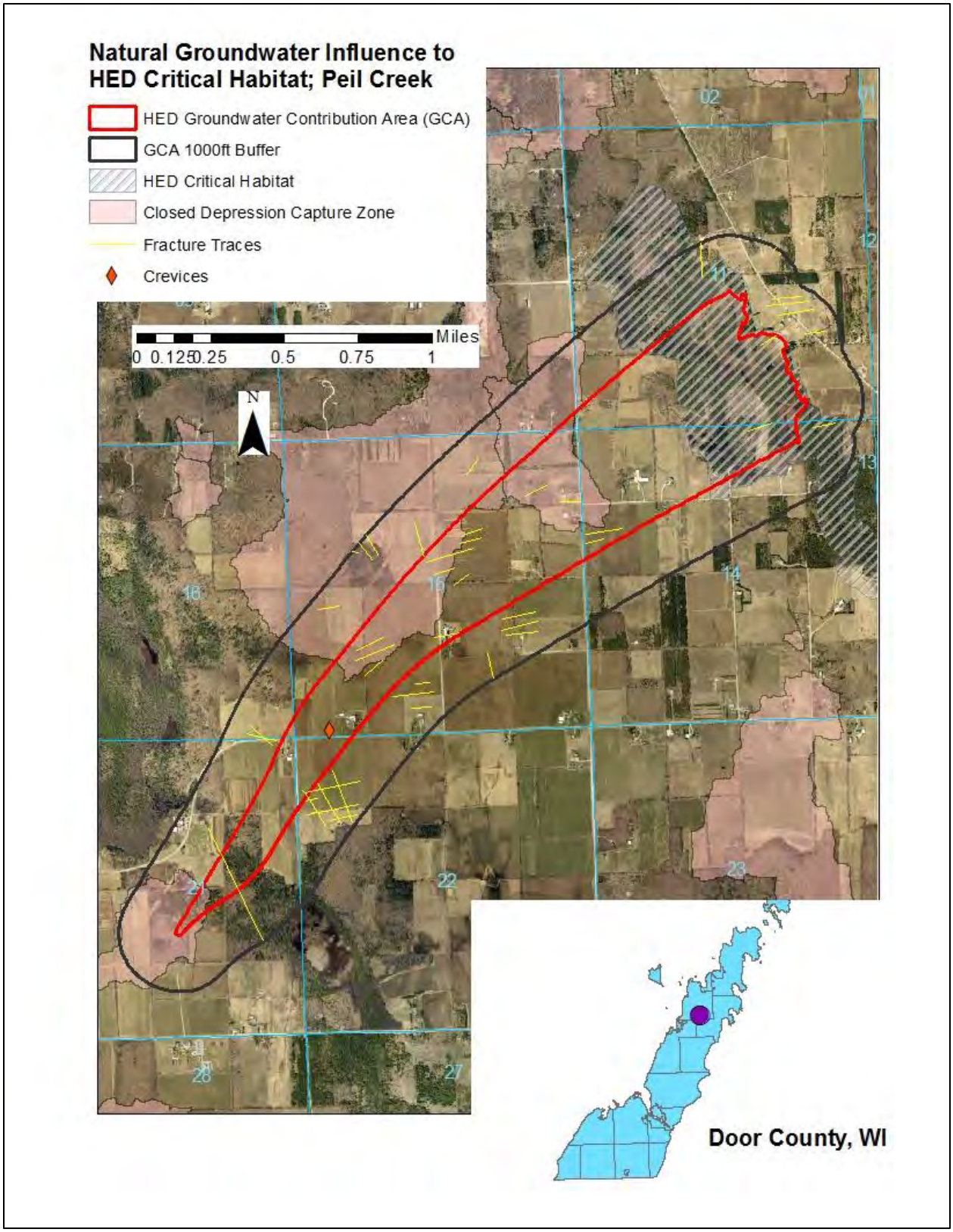

Figure A8. Contributing areas near Peil Creek

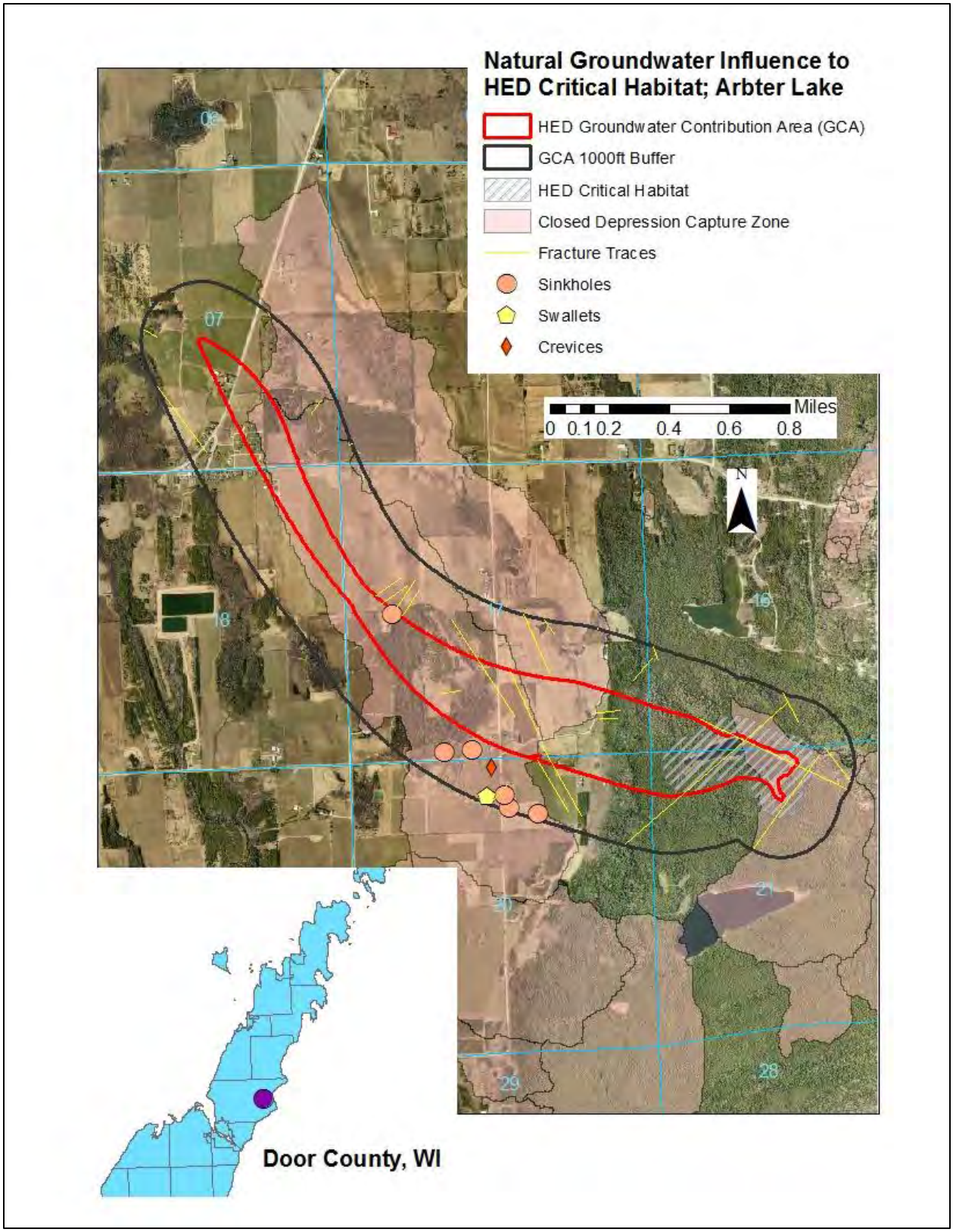

Figure A9. Contributing areas for larval sites at Arbter Lake

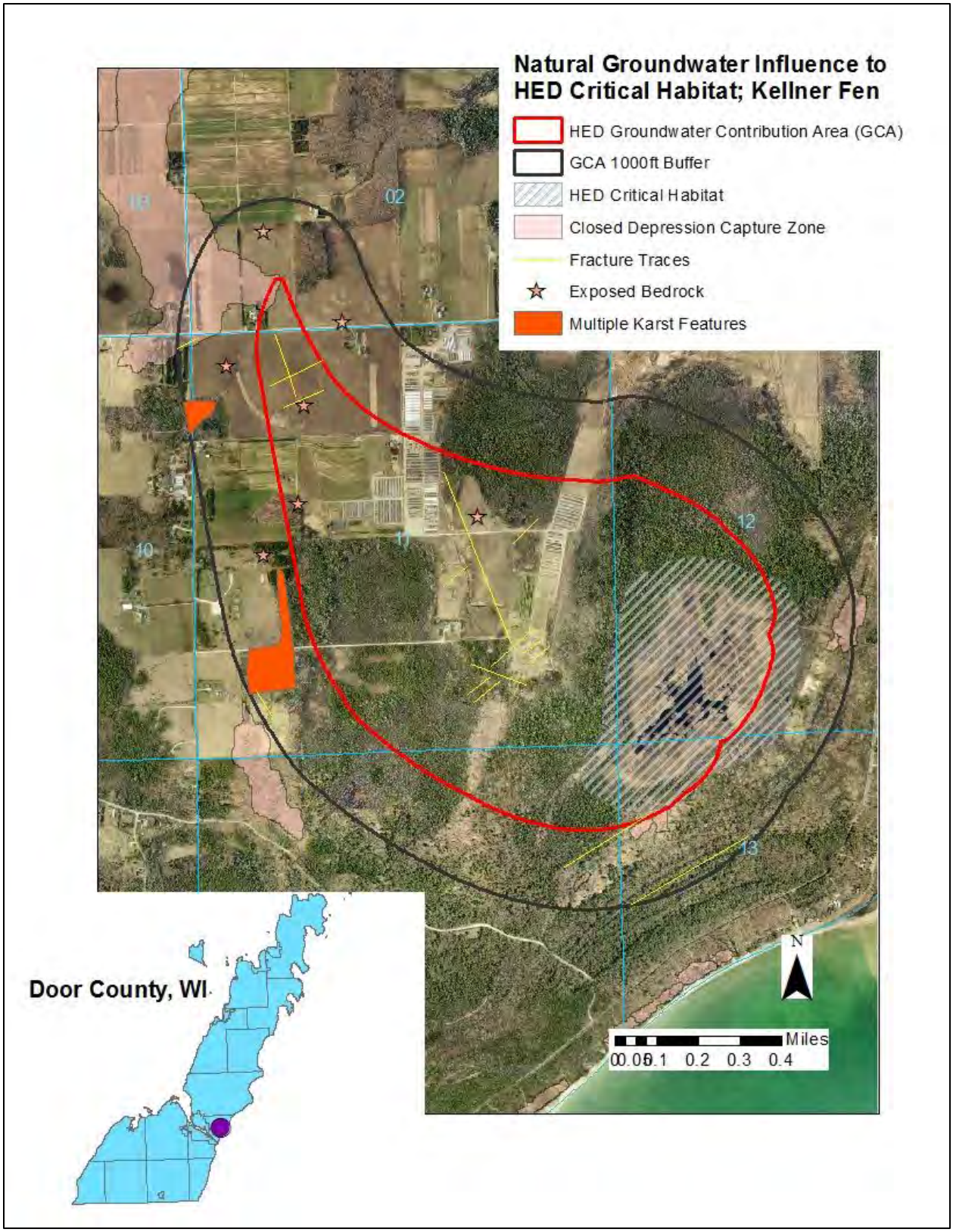

Figure A10. Contributing areas for larval sites near Kellner Fen

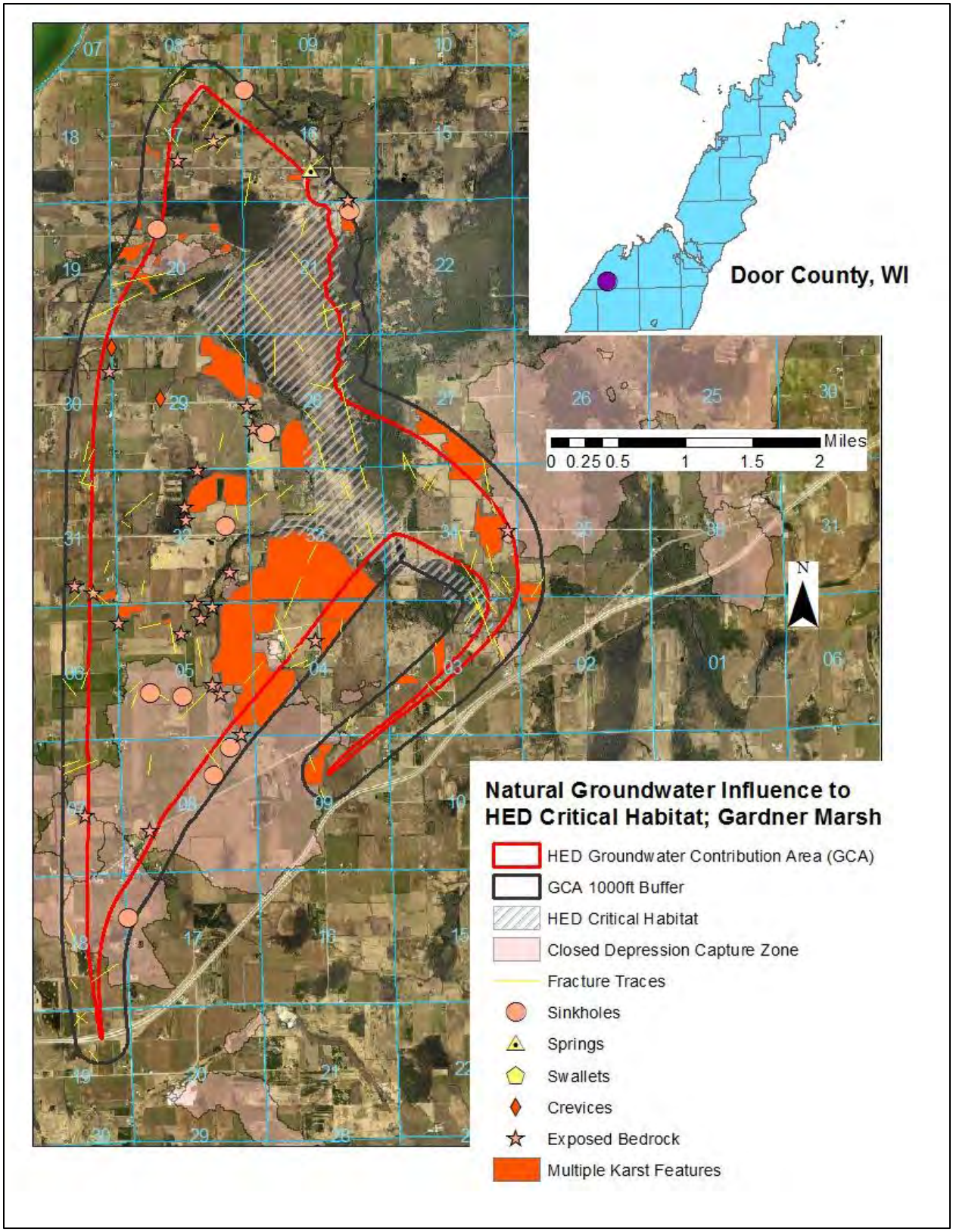

Figure A11. Contributing areas for larval sites near Gardner Swamp

APPENDIX B
HED GCAs among Watersheds and Subwatersheds

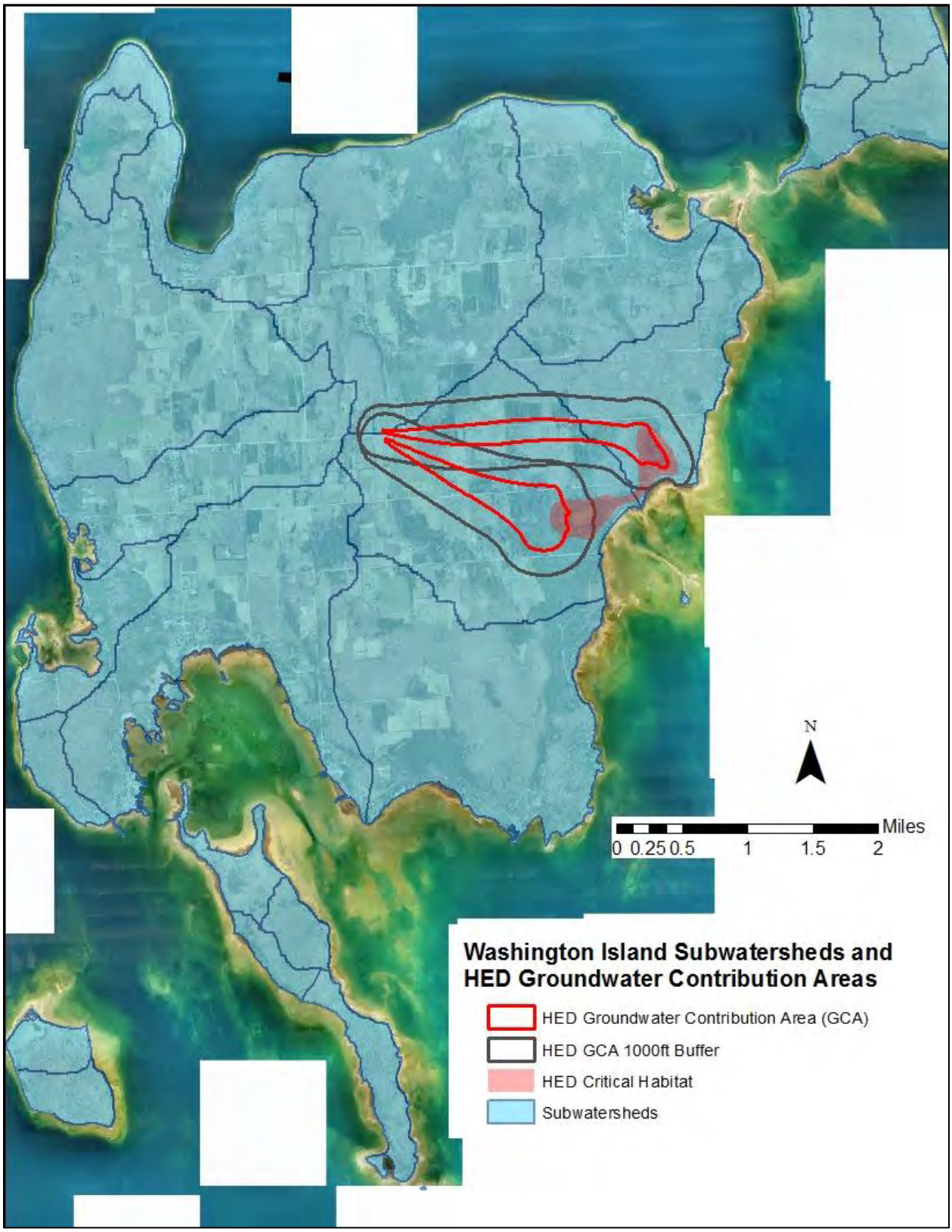

Figure B1. Contributing areas for larval sites on Washington Island

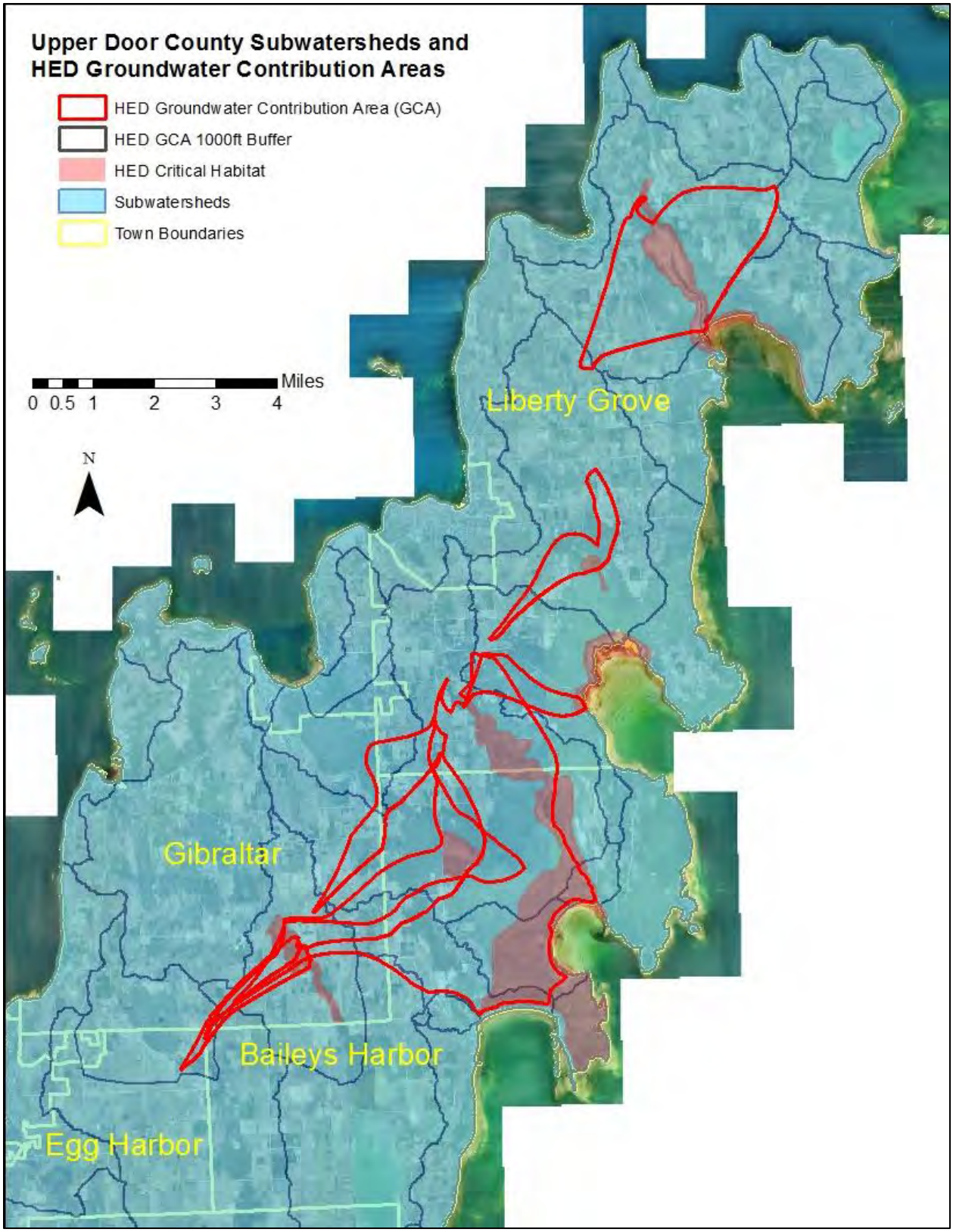

Figure B2. Contributing areas for larval sites in upper Door County

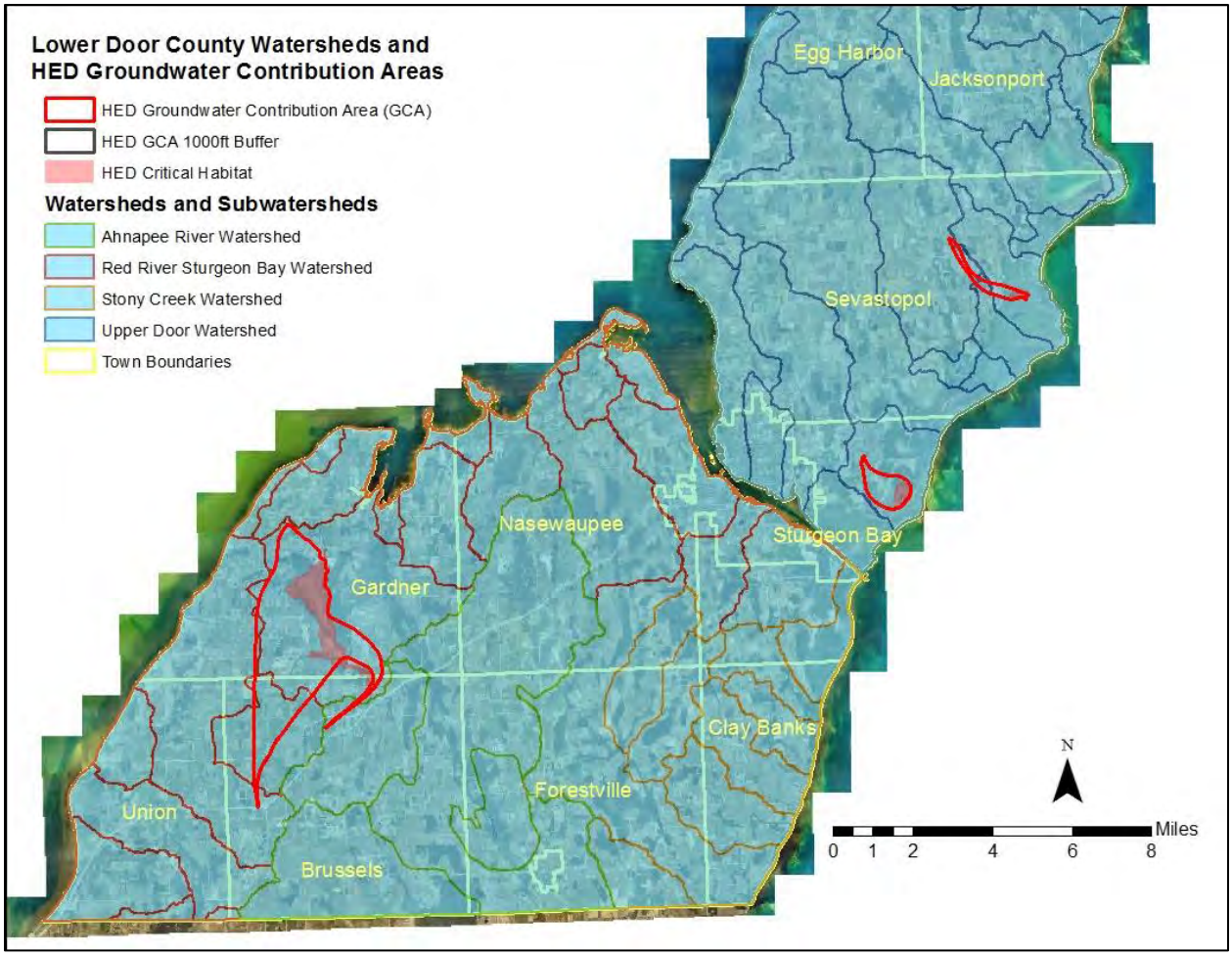

Figure B3. Contributing areas for larval sites in lower Door County

APPENDIX C
Culvert Locations in HED GCAs

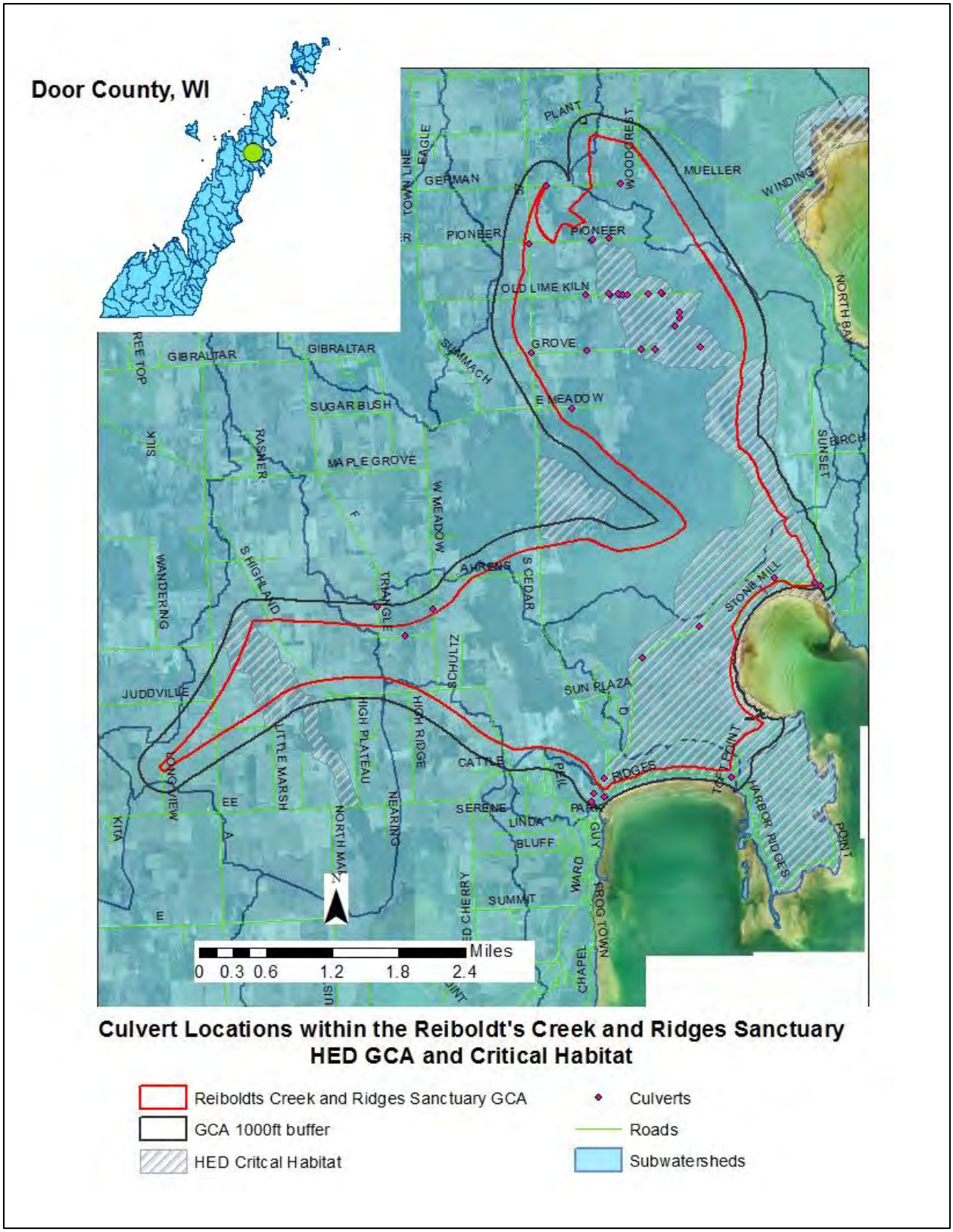

Figure C1. Contributing areas near Reiboldts Creek and The Ridges Sanctuary

APPENDIX D
Land Uses in HED GCAs

Notes:

- *Exact land use percentages per each GCA can be found in Tables 1-11 in Appendix E.*
- *Not all land uses within GCAs are represented. In most cases, those with values less of than .1% of the total land use and those bearing no visual impacts were removed.*
- *Color coding is not consistent throughout all land use maps. To provide the best layout and clarity for each map the color of less frequently occurring land use categories vary. The most common land uses throughout all GCAs follow the same color scheme.*
- *Land use is extended into the GCA 1000ft buffer.*
- *These maps are intended to identify stakeholders, special interest groups, and outreach opportunities within the HED GCAs.*

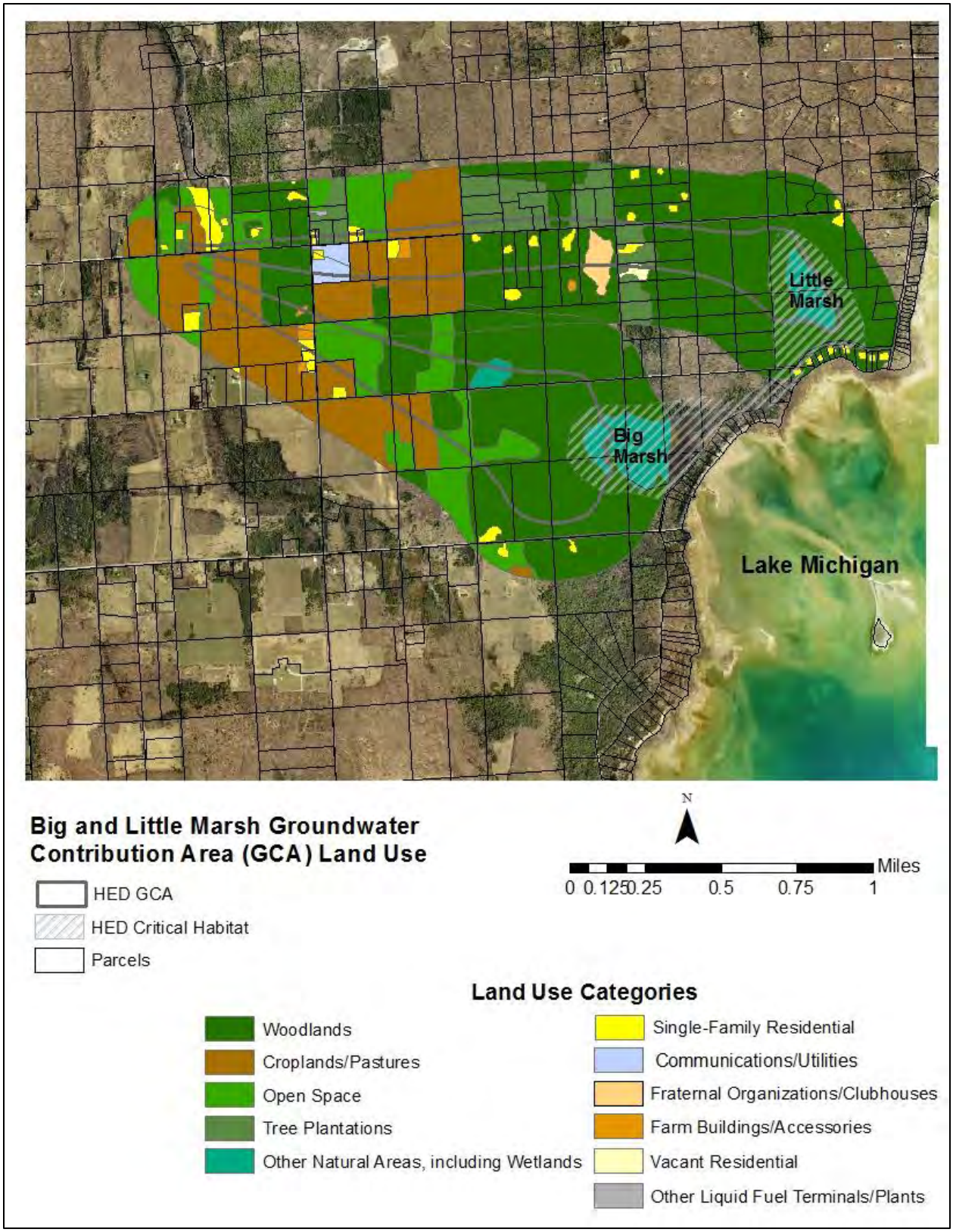

Figure D1. Contributing areas for larval sites on Washington Island

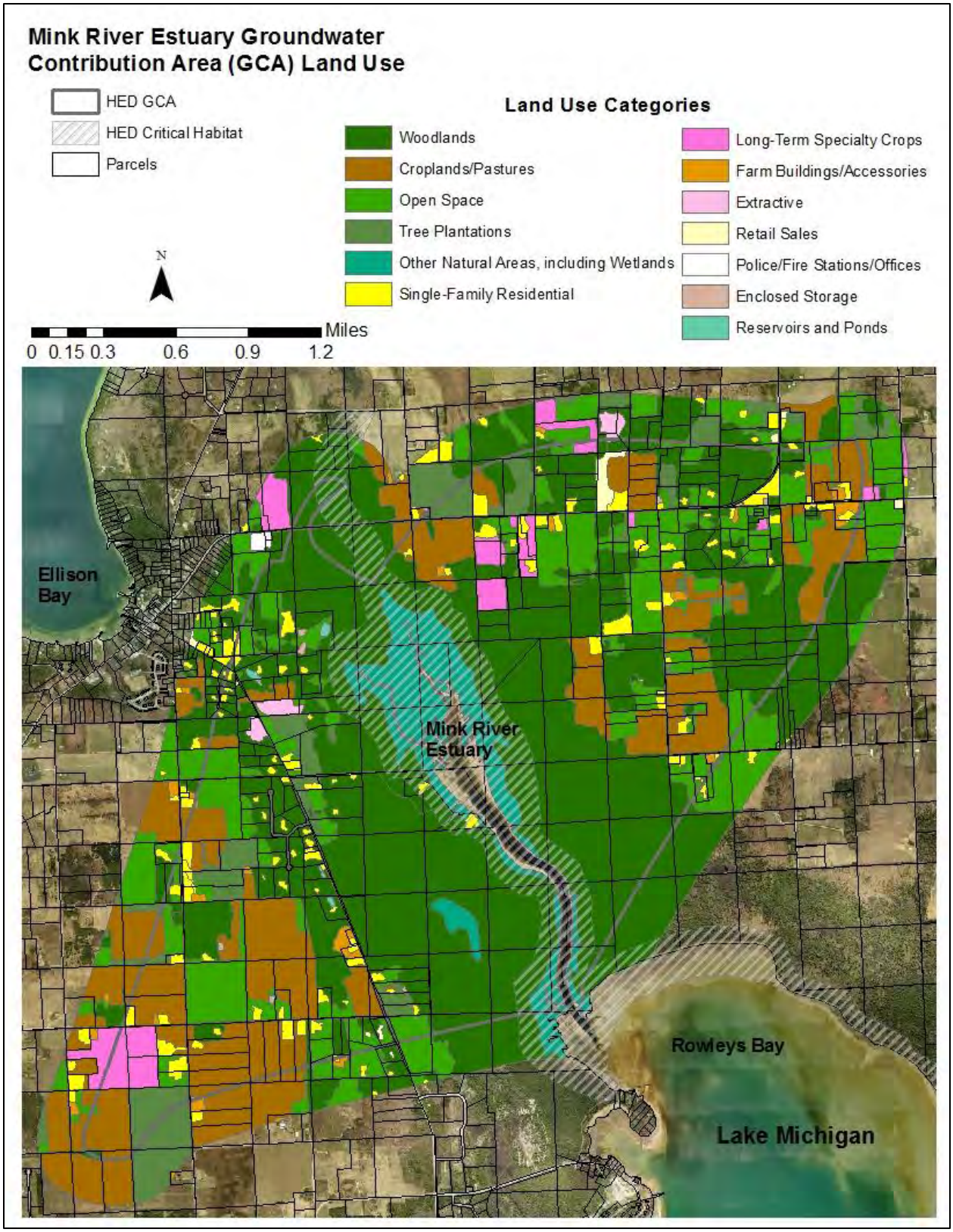

Figure D2. Contributing areas for larval sites along the Mink River

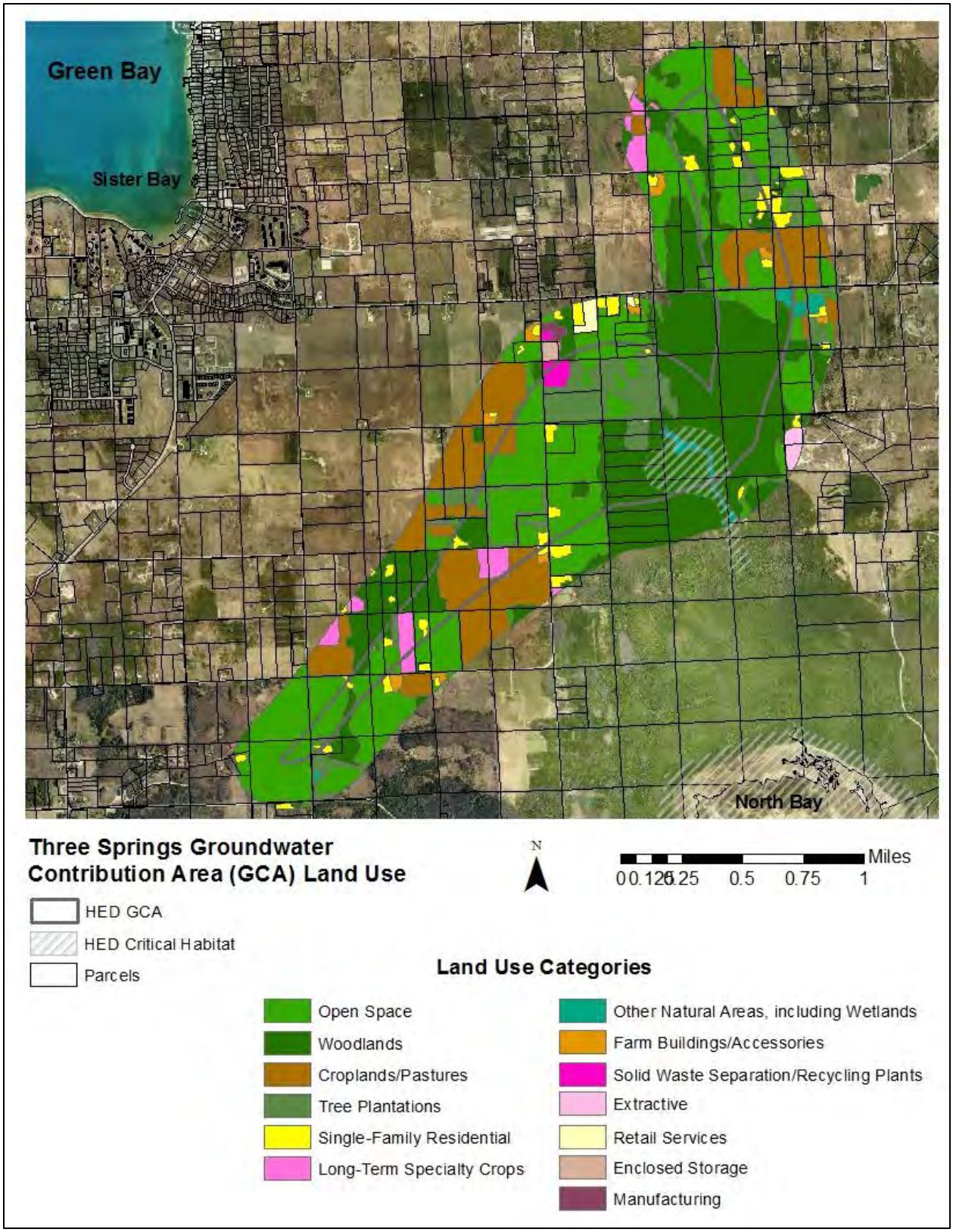

Figure D3. Contributing areas for larval sites along Three Springs Creek

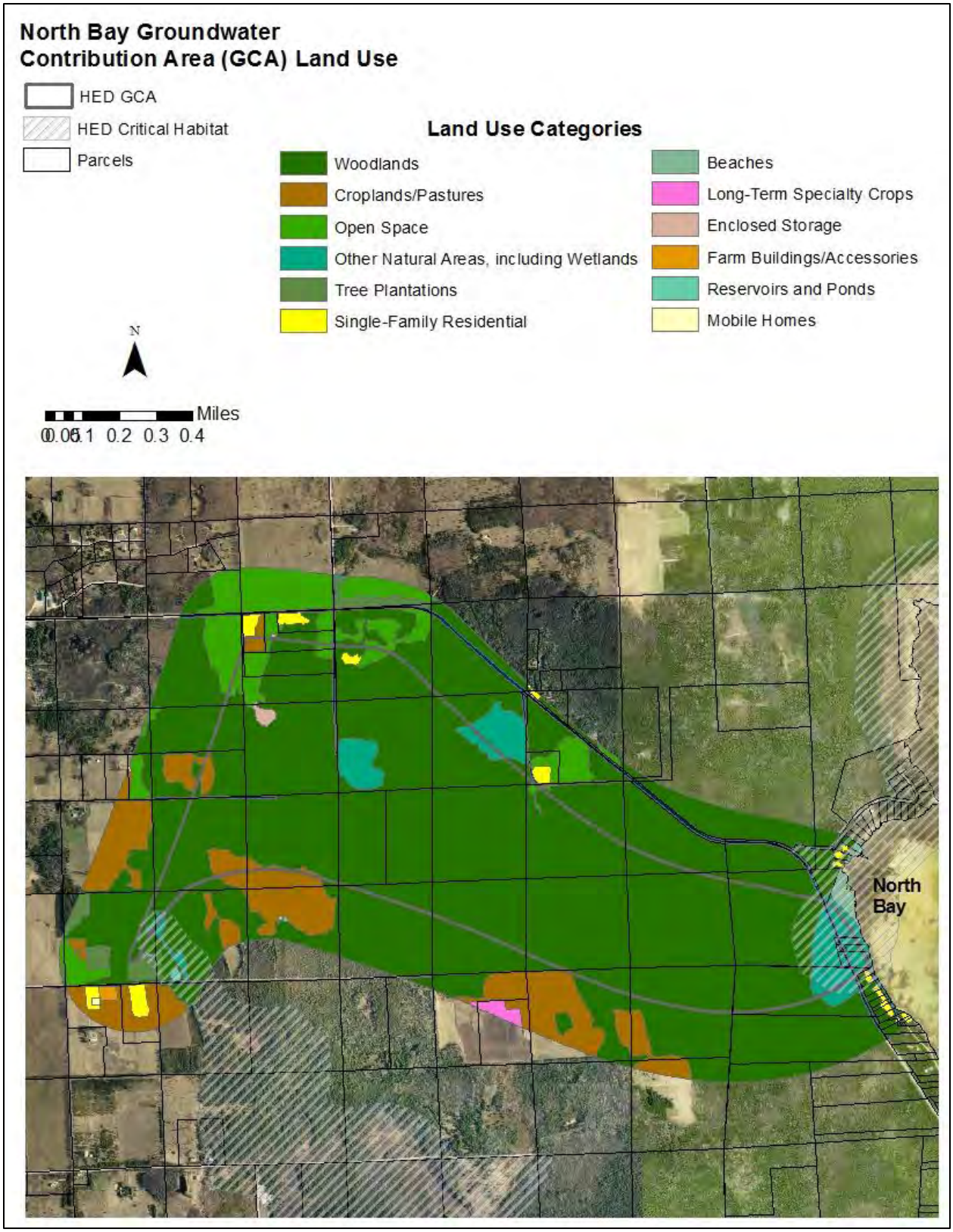

Figure D4. Contributing areas for larval sites near North Bay Marsh

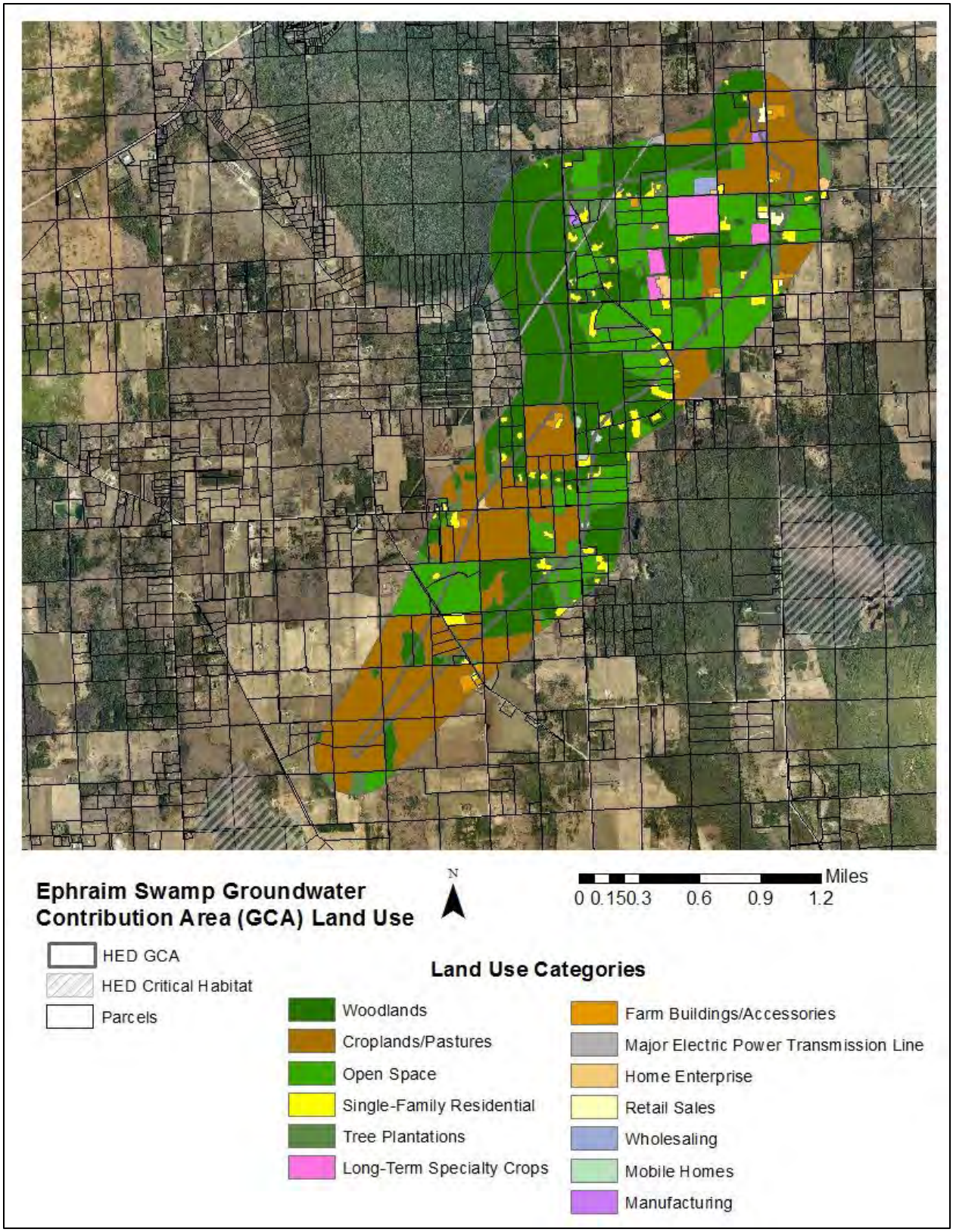

Figure D5. Contributing areas for larval sites near Ephraim Swamp

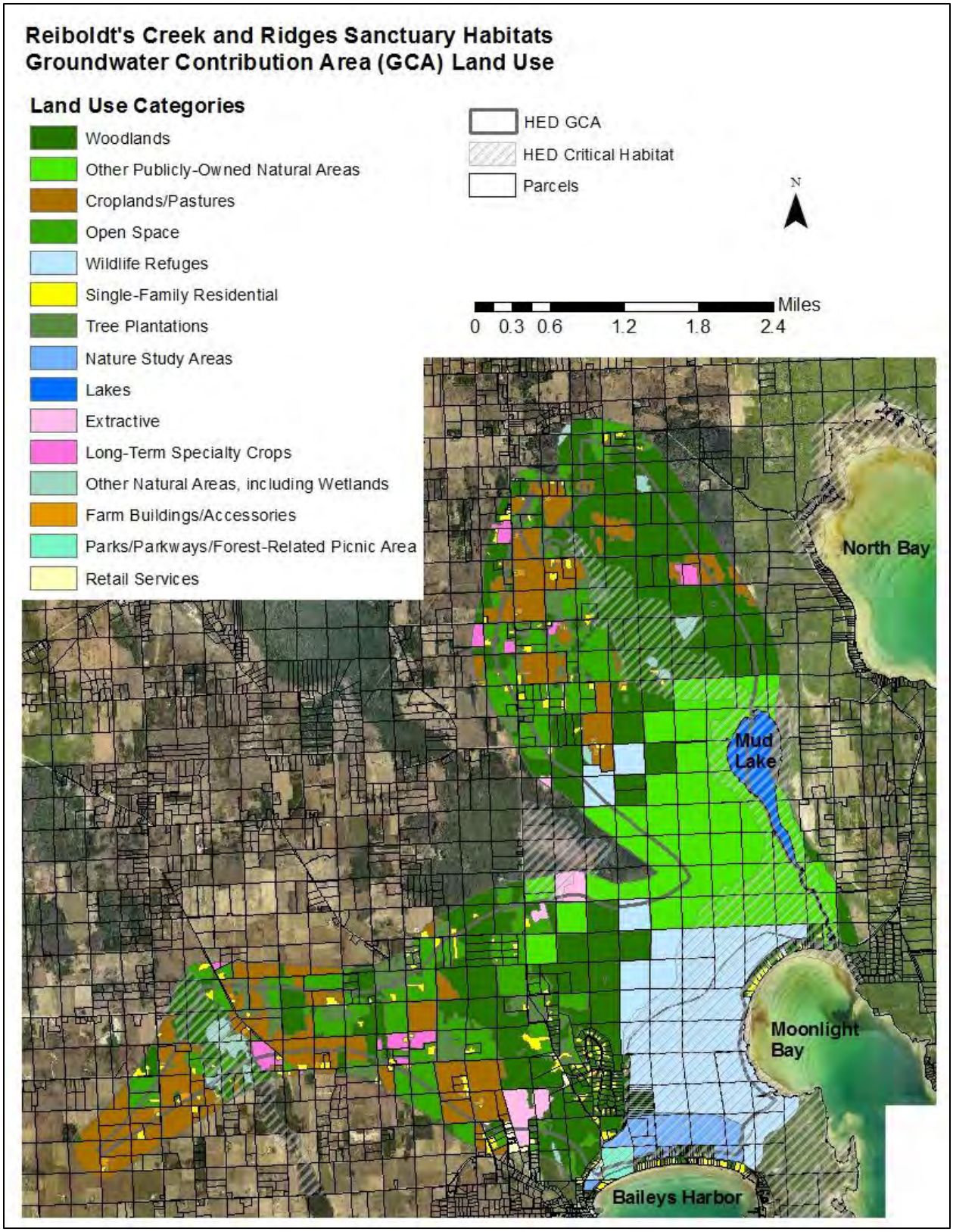

Figure D6. Contributing areas near Reiboldts Creek and The Ridges Sanctuary

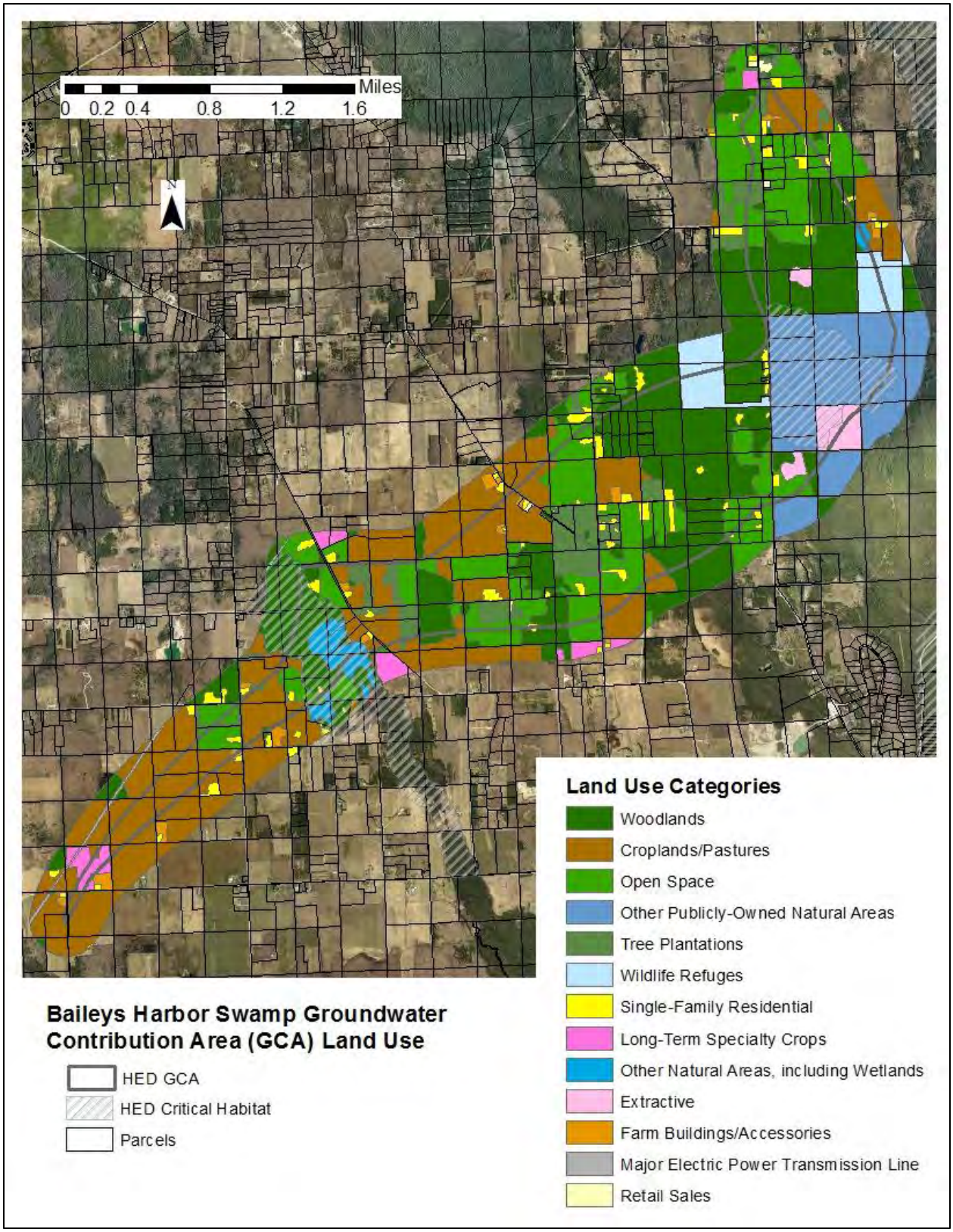

Figure D7. Contributing areas near Baileys Harbor Swamp

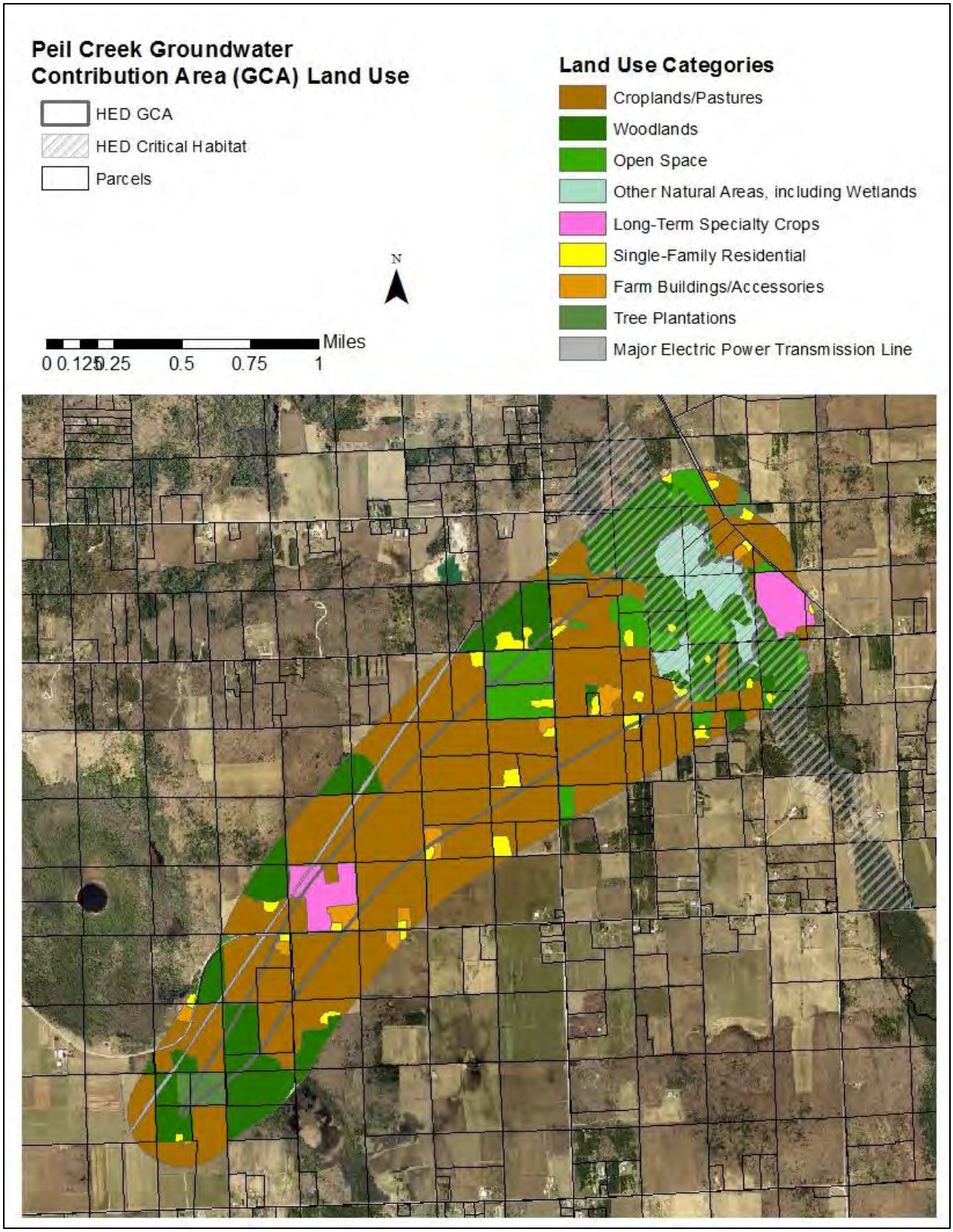

Figure D8. Contributing areas near Peil Creek

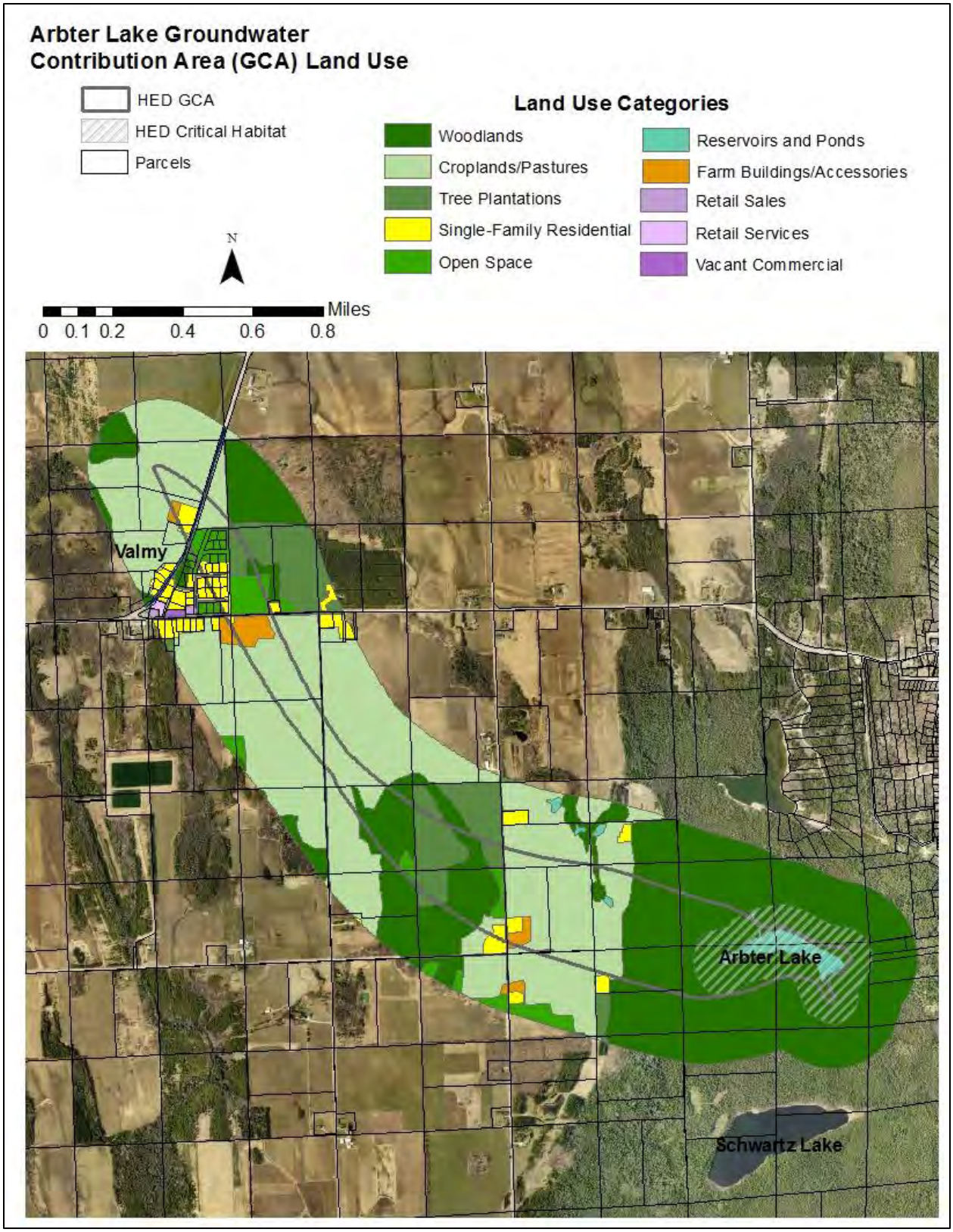

Figure D9. Contributing areas for larval sites at Arbter Lake

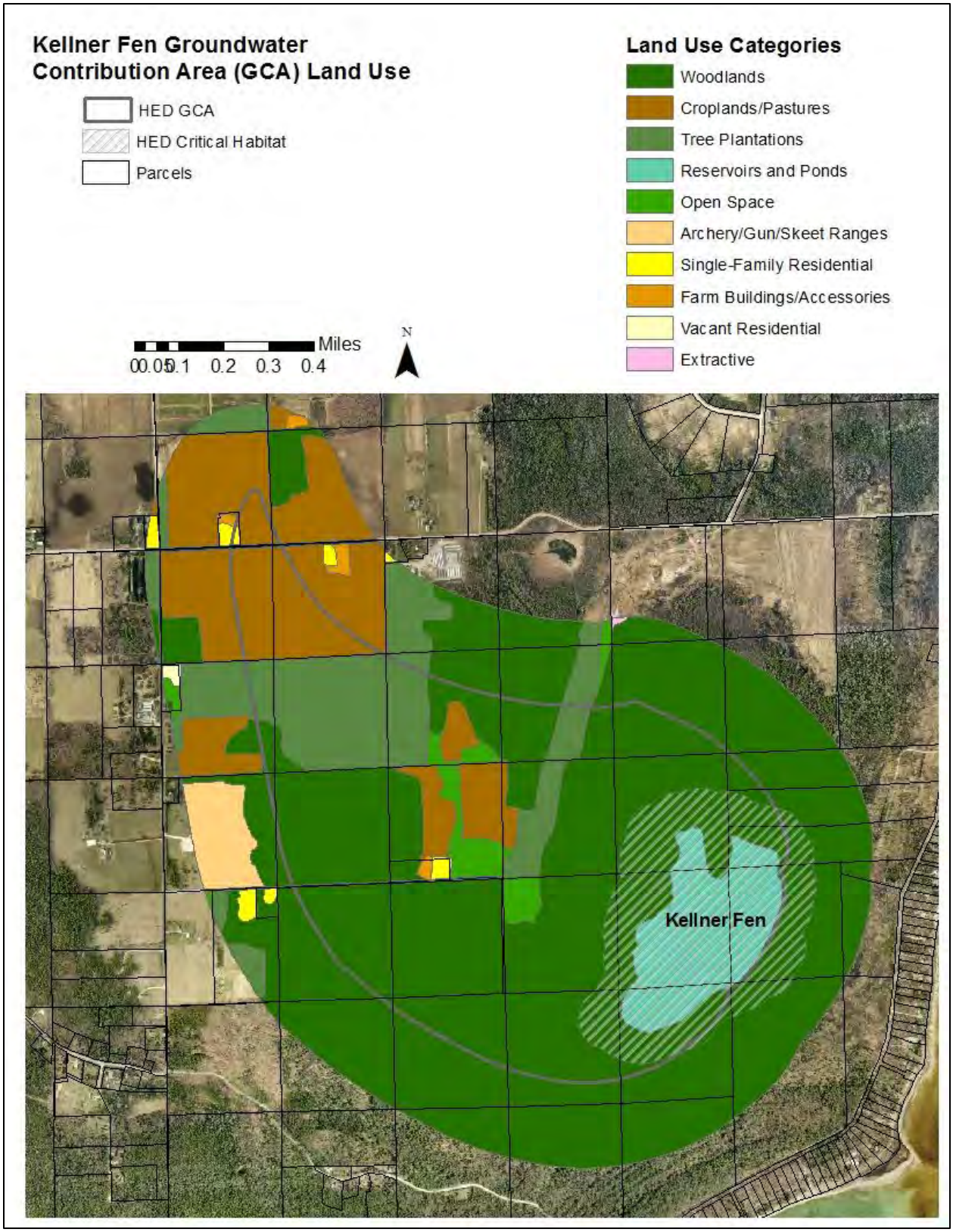

Figure D10. Contributing areas for larval sites near Kellner Fen

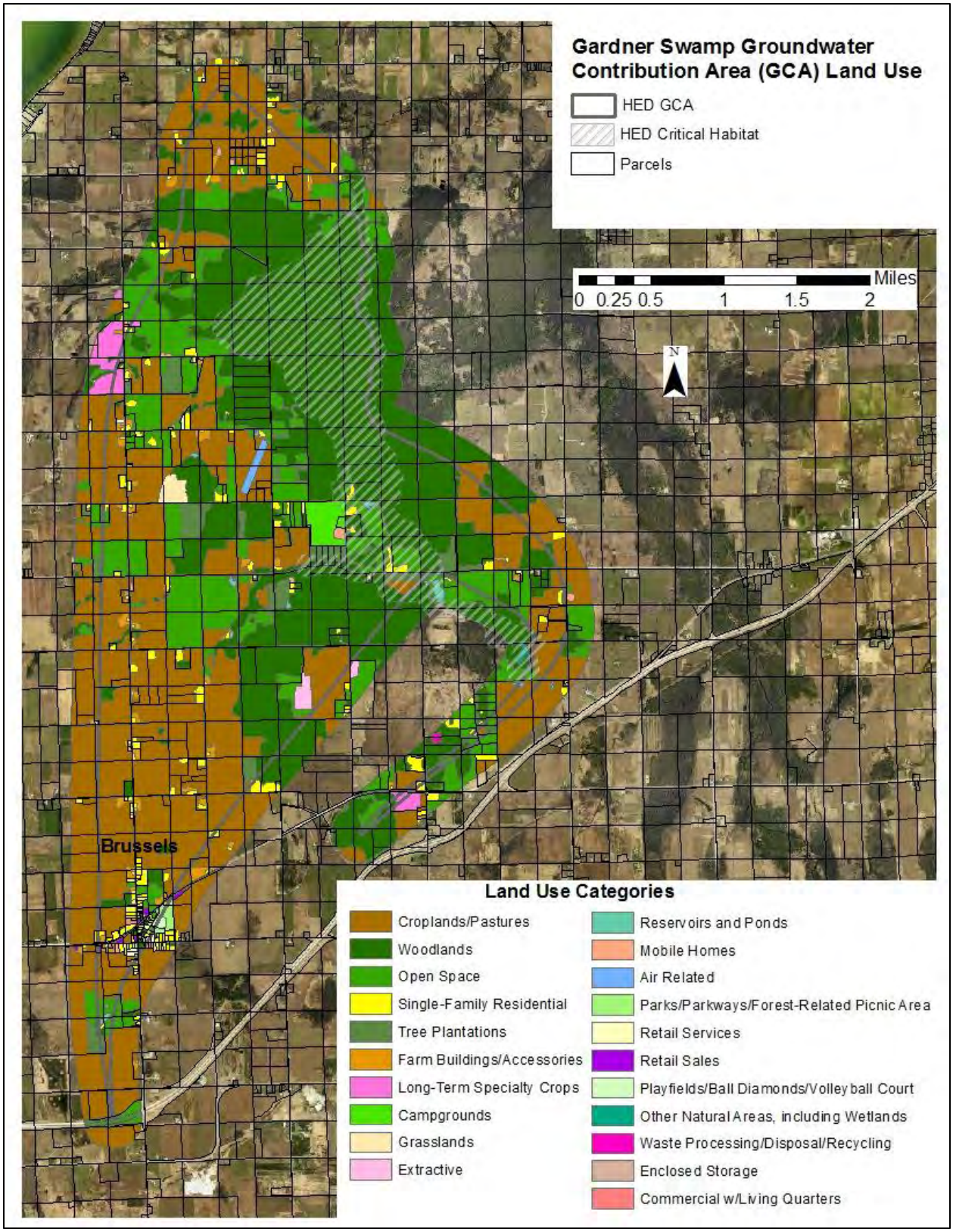

Figure D11. Contributing areas for larval sites near Gardner Swamp

APPENDIX E

Land Use and Community Information for Door County HED GCAs

Notes:

- *The tables showing land use percentages for each GCA listed below were generated using land use GIS data from the Door County Planning Department. Refer to Appendix D for maps showing land uses in each GCA.*
- *Specific town Smart Growth Plan goals and objectives are quoted directly from the plans. No language or formatting has been changed. Only goals and objectives consistent with HED BMPs are included, such as those applying to groundwater, development, natural resource protection, or working with other towns.*
- *Smart Growth Plans for each town can be found in the website link for the Door County Comprehensive Plan 2030:*

  http://map.co.door.wi.us/planning/comp_planning.htm

Quick Reference

Washington Island HED Habitat Groundwater Contribution Area

A) Big and Little Marsh Area Landscape

Big (Gunnerson Marsh) and Little Marsh (Wickman Marsh) HED GCAs are located on Washington Island, in the town of Washington. The 414 acre recharge area includes the WDNR designated Big and Little Marsh State Natural Area. These two GCAs and buffers have lands with the highest recharge potential of any HED GCA in Door County, and therefore it is especially important to conduct further outreach with the Washington Island community and encourage implementation of BMPs.

B) General Land Use

Table 1: Big and Little Marsh GCA Land Use Percentages

Land Use Type	% Land Use Totals
Woodlands	54.6608%
Croplands/Pastures	18.3097%
Open Space	11.3752%
Tree Plantations	5.6600%
Other Natural Areas, including Wetlands	3.9803%
Single-Family Residential	2.6086%
Local Streets and Roads	1.2759%
Communication/Utilities	0.6854%
Fraternal Organizations/Clubhouses	0.6440%
Farm Buildings/Accessories	0.3921%
County Highways	0.2107%
Vacant Residential	0.1589%
Other Liquid Fuel Terminals/Plants	0.0383%

C) Washington Island Plans

Note: The town of Washington does not have a Smart Growth Plan, nor work plan activities within the Washington Island Parks comprehensive plan or the Zoning and Planning committee plan.

D) Existing Special Interest Groups and Local Stakeholders

- The WDNR is a major stakeholder as State owned public lands surround Little Marsh and a large portion of Big Marsh.
- The Washington Island Parks committee is a very proactive group.
- The Door County Land Trust (DCLT) has particular interest in land protection through conservation easements within the Washington Island GCAs.
- The Washington Island Sportsmen's Club owns an 80 acre parcel of land within the Little Marsh recharge zone.

Mink River Estuary Groundwater Contribution Area

A) The Mink River Area Landscape

The Mink River Estuary HED GCA exists within the town of Liberty Grove and encompasses approximately 3,323 acres. It includes the WDNR designated Mink River Estuary State Natural Area. TNC protects 1,854 acres of the Estuary complex, including lands owned and managed by TNC and conservation easements. The first HED identified in Door County was found at the Mink River estuary in 1988 by WDNR Biologist Bill Smith.

B) General Land Use

Table 2: Mink River Estuary GCA Land Use Percentages

Total Land Use	% Land Use Totals
Woodlands	49.0903%
Croplands/Pastures	17.0694%
Open Space	15.9561%
Tree Plantations	4.7485%
Other Natural Areas, including Wetlands	4.4075%
Single-Family Residential	3.5055%
Long-Term Specialty Crops	2.4087%
Farm Buildings/Accessories	0.6776%
Local Streets and Roads	0.5841%
Extractive	0.3515%
Retail Sales	0.3032%
State Highways	0.2738%
County Highways	0.1570%
Police/Fire Stations/Offices	0.0855%
Enclosed Storage	0.0840%
Reservoirs and Ponds	0.0757%
Mobile Homes	0.0477%
Two Family	0.0375%
Cemeteries	0.0280%
Churches/Temples/Synagogues	0.0234%
Vacant Farms	0.0203%
Off-Street Parking	0.0175%
Wholesaling	0.0157%
Tennis Courts	0.0117%
Retail Services	0.0106%
Home Enterprise	0.0091%
Vacant Residential	0.0000%

C) Liberty Grove Smart Growth Plan Objectives Consistent with HED BMPs

Goal: Agricultural Resources

#3: Encourage the use of sound agricultural and soil conservation methods to minimize soil erosion and groundwater contamination.

Goal: Natural Resources

#1: Maintain and improve the quality of groundwater and surface waters within the confines of the Town.

#2: Preserve wetlands.

#6: Encourage provision of natural corridors for species exchange between major environmental land holdings.

Goal: Housing and Populations (Manage, through planning, high density development to preserve rural, open, and natural character of the Town of Liberty Grove)

#2: Minimize environmental impact of multi-unit housing.

Goal: Intergovernmental Cooperation

#1: Work with neighboring communities to discuss any unique features and other land uses which span municipal boundaries.

Goal: Land Use

#2: Encourage groundwater protection within the Town.

Liberty Grove Community Accomplishments Satisfying HED BMPs

In 2011, the town of Liberty Grove participated in a well water quality program through the UW-Extension office at the Center for Watershed Science and Education in Stevens Point, Wisconsin. The purpose of this program is to educate home owners on the quality of their drinking and groundwater by providing them information on the characteristics of the aquifer in which their well is placed and encouraging further testing. This program also aims to assess the condition of private wells (as they are not required to be tested unlike public wells) statewide. Well tests are separated into 3 packages, all of which Liberty Gove participated in. Package 1 includes tests for bacteria, nitrates, chlorides, pH, alkalinity, hardness and corrosivity. Package 2 tests for metals and package 3 screens for atrazine related pesticides. As a result, landowners who participated in well water testing have a better understanding of the bedrock geology in Door County and the karst groundwater system as a whole. This will aid in instilling a sense of stewardship for promoting groundwater protection for the HED.

Since 2007, the town of Liberty Grove requested that it take priority in the Door County Sanitarian testing of all private onsite wastewater treatment systems (POWTS) due to the interest of board members and citizens. Following a citizen survey designating water quality as the highest importance, holding tanks, conventional systems and mound systems were surveyed and most steel holding tanks were replaced with concrete systems. All POWTSs within Liberty Grove were checked within a five year period and found to be compliant with Wisconsin State code.

Note: A portion of Liberty Grove occurs in the Reiboldts Creek and Ridges Sanctuary GCA and the town has taken a measure of action to protect the HED in habitats occurring along Lime Kiln Road in this GCA. Along the graveled portion of the road the town has placed 15 MPH speed limit signs along with a sign depicting a dragonfly. This was done to slow vehicle speeds in order to avoid dragonfly/vehicles collisions as automobiles driving at speeds higher than 15 MPH may result in HED adult mortality.

D) Existing Special Interest Groups and Local Stakeholders

- TNC is a major stakeholder as main landowner and manager of the Mink River wetlands which support HED critical habitat.
- The Clearing is a folk school located in Ellison Bay, WI. Their mission is to provide diverse educational experiences and encourage adults to share their interest in nature, arts or humanities. Although The Clearing is not within a GCA, many of their goals overlap with HED BMP objectives and partnering on outreach efforts will reach more audiences.

- Existing private tree plantations occupy over 4% of the land use in this GCA.
- The Northern Door Kiwanis Club is a service based organization interested in giving back to the community.
- The Rowleys Bay campground is a large private campground in this GCA that hosts many visitors to Door County every camping season.

Three Springs Creek Groundwater Contribution Area

A) The Three Springs Creek Area Landscape

The Three Springs Creek GCA exists within the town of Liberty Grove and is approximately 745 acres in size. It includes the WDNR designated North Bay State Natural Area. The DCLT owns and manages the "Harold C. Wilson Three Springs Nature Preserve" in this GCA which supports HED breeding habitat. Three Springs Creek is an important coastal wetland corridor. In addition to providing critical habitat for the HED it is an important spawning area for Great Lakes migratory fish.

B) General Land Use

Table 3: Three Springs Creek GCA Land Use Percentages

Land Use Type	% Land Use Totals
Open Space	35.4258%
Woodlands	32.4279%
Croplands/Pastures	15.4350%
Tree Plantations	6.8636%
Single-Family Residential	3.1556%
Long-Term Specialty Crops	2.1972%
Other Natural Areas, including Wetlands	0.9706%
Farm Buildings/Accessories	0.7931%
Local Streets and Roads	0.7802%
Solid Waste Separation/Recycling Plants	0.4676%
Extractive	0.4084%
Retail Services	0.3199%
County Highways	0.2632%
Enclosed Storage	0.2604%
Manufacturing	0.1882%
Retail Sales	0.0431%

C) Liberty Grove Smart Growth Plan Objectives Consistent with HED BMPs

Refer to page 3 above

Liberty Grove Community Accomplishments Satisfying HED BMPs

Refer to page 4 above

D) Existing Special Interest Groups and Local Stakeholders

- The DCLT manages the 421 acre preserve within the Three Springs watershed.
- Private tree plantations occupy almost 7% of the land use in this GCA.

North Bay Marsh Groundwater Contribution Area

A) The North Bay Marsh Area Landscape

The North Bay Marsh GCA lies within the town of Liberty Grove. Consisting of 556 acres, this GCA includes part of the WDNR designated North Bay State Natural Area.

B) General Land Use

Table 4: North Bay Marsh GCA Land Use Percentages

Land Use Type	% Land Use Totals
Woodlands	75.89754%
Croplands/Pastures	9.25971%
Open Space	6.68533%
Other Natural Areas, including Wetlands	3.58674%
Tree Plantations	1.05019%
Single-Family Residential	0.99883%
County Highways	0.98702%
Local Streets and Roads	0.60106%
Beaches	0.35956%
Long-Term Specialty Crops	0.26179%
Enclosed Storage	0.13978%
Farm Buildings/Accessories	0.09667%
Reservoirs and Ponds	0.05562%
Mobile Homes	0.02013%
Campgrounds	0.00002%

C) Liberty Grove Smart Growth Objectives Consistent with HED BMP Project Objectives

Refer to page 3 above

Liberty Grove Community Accomplishments Satisfying HED BMPs

Refer to page 4 above

D) Existing Special Interest Groups and Local Stakeholders

- TNC owns and manages lands both north and south of the North Bay GCA and frequently communicates with the private landowners in the area.
- Door Sand Hill Farm own over 220 acres of land within the southern buffer of the North Bay GCA.
- The Aqualand campground is a large private campground in this GCA that hosts many visitors to Door County every camping season.

Ephraim Swamp Groundwater Contribution Area

A) The Ephraim Swamp Area Landscape

The Ephraim Swamp GCA consists of 1,045 acres and is located in the towns of Liberty Grove and Gibraltar, with the eastern portion extending into Baileys Harbor. This GCA includes a large number of residential homes.

B) General Land Use

Table 5: Ephraim Swamp GCA Land Use Percentages

Land Use Type	% Land Use Totals
Woodlands	36.6959%
Croplands/Pastures	28.6777%
Open Space	21.4714%
Single-Family Residential	3.3927%
Tree Plantations	3.0780%
Long-Term Specialty Crops	2.1606%
Farm Buildings/Accessories	0.9191%
Local Streets and Roads	0.8142%
Major Electric Power Transmission Line	0.5244%
Home Enterprise	0.3817%
Retail Sales	0.2753%
Wholesaling	0.2669%
State Highways	0.2637%
Mobile Homes	0.2097%
Manufacturing	0.2095%
Enclosed Storage	0.1887%
Animal Husbandry	0.1763%
County Highways	0.1498%
Storage	0.0657%
Commercial	0.0378%
Vacant Farms	0.0282%
Other Natural Areas, including Wetlands	0.0128%

C) Gibraltar Comprehensive Plan Objectives Consistent with HED BMPs

Goal 1: Agricultural & Natural Resources

Objective 1.2: Preserve and protect the quality of ground and surface waters within the Town.

Activity:

-Identify and protect through zoning overlays critical ground water recharge areas.

-Inventory the type and status of every sewage disposal system within the Town every five years, and require needed upgrades on failing systems within 12 months.

-Promote or require the construction of cluster wastewater treatment and other state of the art systems in areas where the Town determines they would be most appropriate for ensuring effective treatment practices.

-Require the certified delineation of rock holes, crevices and caves as a prerequisite to the issuance of a County of local building permit. In addition, ensure enforcement of County and state rules relating to the filling of crevices and rock holes within Town.

Objective 1.3: Protection and preservation of environmental corridors, (as defined on page 2-26 of narrative) green space, forests, environmentally sensitive areas, endangered species, parks and wildlife habitat in the Town.

Activity:

-Identify, inventory and map environmental corridors, open space, forests, environmentally sensitive areas, vistas, geological features, archeological sites and endangered species within the Town.

Goal 1: Utilities

Objective 1.1: Preserve and protect the quality of ground and surface waters within the Town of Gibraltar.

Activity:

-Implement measures to minimize storm water runoff into the Bay and other surface waters in the Town.

-Require all new construction developments adhere to minimum standards of storm water runoffs.

-Promote the construction of "cluster" wastewater treatment systems in areas unserviceable by sanitary sewers.

-Protect all wetlands within the Town.

Goal 1: Land Use

Objective 1.2: Maintain and/or improve the quality of our water and its sources (wetlands, springs, streams, and lakes) within and around the Town.

Activity:

-Promote the use of "cluster" wastewater treatment or other state of the art systems in areas where the Town determines they would be appropriate.

-All future development shall minimize storm water runoff and provide an approved storm water plan before a construction permit can be issued.

Goal 1: Intergovernmental Cooperation

Objective 1.1: Work with neighboring communities to discuss any unique natural features and other land uses which span municipal boundaries.

Activity:

-Work with neighboring communities to identify shared natural features such as wetland recharge areas and natural habitat areas.

Gibraltar Community Accomplishments Satisfying HED BMPs

In 1998, a special interest group from Gibraltar conducted a Fish Creek watershed study. They began a baseline inventory of surface waters which continues today. Five sites are tested for physical, biological and chemical parameters. This was one of the first volunteer monitoring programs in the State and the WDNR awarded members for their work. Coordinating and participating in this project has educated a number of community members about Door County's sensitive surface and groundwater supplies and will aid in promoting groundwater protection for the HED.

In 2012, the town of Gibraltar participated in a well water quality project with the UW-Extension office at the Center for Watershed Science similar to the town of Liberty Grove project (*see page 4*). Wells were tested for bacteria, nitrates, chlorides, pH, alkalinity, hardness and corrosivity (package 1). As a result, landowners who participated in well water testing have a better understanding of the bedrock in Door County and the karst groundwater system. Participation in this program will lay the foundation for promoting groundwater protecting for the HED.

D) Existing Special Interest Groups and Local Stakeholders

- Private tree plantations occupy over 3% of the land use in the Ephraim Swamp GCA.
- American Transmission Company (ATC) owns land within the Ephraim Swamp GCA. ATC is usually interested in collaborating on special interest projects with state and local stakeholders.

<u>Reiboldts Creek and Ridges Sanctuary HED Habitat Groundwater Contribution Area</u>

A) The Mud Lake Area Landscape

The Reiboldts Creek and Ridges Sanctuary GCA includes approximately 7,302 acres of land in the town of Baileys Harbor and extends north into Liberty Grove. The WDNR has protected all of the land around Mud Lake especially for migratory waterfowl. This GCA also includes the WDNR designated Ridges Sanctuary State Natural Area. Wisconsin's oldest member- based nature preserve and first land trust, The Ridges Sanctuary, owns and manages over 1,500 acres within the watershed.

B) General Land Use

Table 6: Reiboldts Creek and Ridges Sanctuary GCA Land Use Percentages

Land Use	% Land Use Totals
Woodlands	31.7697%
Other Publicly-Owned Natural Areas	15.6632%
Croplands/Pastures	13.1719%
Open Space	12.1573%
Wildlife Refuges	12.0103%
Single-Family Residential	2.7328%
Tree Plantations	2.6803%
Nature Study Areas	2.0000%
Lakes	1.4897%
Extractive	1.1629%
Long-Term Specialty Crops	1.1365%
Other Natural Areas, including Wetlands	1.0677%
Local Streets and Roads	0.4471%
Farm Buildings/Accessories	0.3939%
Parks/Parkways/Forest-Related Picnic Area	0.3864%
County Highways	0.3233%
Retail Services	0.2391%
State Highways	0.2344%
Campgrounds	0.2079%
Home Enterprise	0.1389%
Wholesaling	0.0899%
Enclosed Storage	0.0752%
Retail Sales	0.0735%
Beaches	0.0546%
Reservoirs and Ponds	0.0522%
Vacant Farms	0.0350%
Open Storage	0.0341%
Vacant Residential	0.0319%
Commercial	0.0313%
Multi-Family	0.0299%
Manufacturing	0.0225%
Mobile Homes	0.0192%
Storage	0.0141%
Major Electric Power Transmission Line	0.0097%
Residential	0.0087%
Transmission of Communic/Utilities	0.0045%
Other Water Access Sites/Areas	0.0004%

C) Baileys Harbor Smart Growth Plan Objectives Consistent with HED BMPs

Goal 1: Preserve Natural Resources

Objective 1.1 Ensure the safe usage of all harbor waters, lake waters (Lake Michigan and Kangaroo Lake), shorelines, marinas, commercial fishing docks, beaches, creeks and watersheds.

Policy 1.1d: Identify those areas within the town where susceptibility to groundwater contamination is highest and develop plans to ensure that land use within these areas occurs in a manner consistent with protecting groundwater.

Objective 1.2: Cooperate in the protection and preservation of Baileys Harbor's unique biological and other natural resources.

Policy 1.2a: Support continued open and cooperative relationships, especially the sharing of information between all resource conservation groups (e.g., The Ridges, The Nature Conservancy, The Door County Land Trust, Wisconsin Department of Natural Resources, University of Wisconsin, UW-Extension, etc.) and encourage stewardship of Baileys Harbor's unique biological resources.

Policy 1.2e: Continue to cooperate with adjacent communities when one or the other's actions impact shared natural resources.

Policy 1.2h: Coordinate with Door County and WDNR to encourage farmers, growers, park managers, golf course managers, and developers to implement best management practice to reduce nonpoint source water pollution.

Policy 1.2j: Partner with Door County Land Trust and similar groups to protect wildlife habitat areas. Encourage local landowners to pursue opportunities to protect their land through the use of conservation easements.

Policy 1.2k: utilize the Zoning and Subdivision ordinances to establish a network of green corridors through the community to link riparian buffers and existing habitat areas to create wildlife habitat and migration routes.

<u>Goal 5: Ensure development protects environmentally sensitive areas.</u>

Objective 5.1: Ensure that land use management ordinances in place in the town such as zoning recognize important natural areas.

Policy 5.1a: With environmental experts, examine zoning regulations to ensure protection of natural areas as development occurs.

Objective 5.2: Educate property owners about tools such as deed restrictions/conservation easements to protect private land.

Policy 5.2a: Encourage/sponsor educational programs regarding environmental issues facing the town and how landowners can work private to address those issues.

<u>Goal 11: The Town of Baileys Harbor shall provide or promote utilities to service the current community and anticipated growth within the community.</u>

Objective 1.1: Safely operate a system for wastewater treatment within the community that anticipates growth while preserving and upgrading existing waste collection and treatment facilities.

Policy 11.1e: Amend the Subdivision Ordinance to encourage or require the use of alternative wastewater treatment systems outside of the core area.

Objective 11.2: Provide that sewer and storm water drainage systems and periodic maintenance thereof be consistent with minimizing adverse impact to the community's groundwater and shore waters.

Policy 11.2d: Utilize where possible such tools as retention ponds and dry-wells to collect storm water discharge.

Objective 11.5: Provide adequate solid waste and recycling services through outside contractors to the community.

Policy 11.5b: Provide information (date and location) to residents regarding drop-off point for hazardous materials, recyclables, and compost material.

Goal 13: Promote cooperation between the town of Baileys Harbor and any other governmental agency that make decisions impacting the town.

Objective 13.2 The Town of Baileys Harbor shall work with neighboring communities and other pertinent agencies to discuss land use issues that span municipal boundaries.

Policy 13.2a: Encourage an annual review of zoning/planning issues with neighboring towns and create process to notify each other of potential land use conflicts.

Baileys Harbor Community Accomplishments Satisfying HED BMPs

The Baileys Harbor Community Association went through a "branding session" in early 2012 to discuss a marketing brand and cohesive theme for developing marketing materials for the town. Local business owners and citizens recognized The Ridges Sanctuary as a primary attraction for tourism in the area, which supports critical habitat for the HED.

Over 47% of land in Baileys Harbor is preserved. The community is thriving even though no taxes are generated from these public lands.

Note: Refer to the "Mink River Estuary Groundwater Contribution Area" (page 4) for information on protective measures taken for the HED along Lime Kiln Road in this GCA by the town of Liberty Grove.

D) Existing Special Interest Groups and Local Stakeholders

- The Ridges Sanctuary owns and manages the ridge-swale embayment complex which includes the most extensive HED critical habitat area within Door County. The town of Baileys Harbor and The Ridges Sanctuary collaborate on educating visitors and residents about natural history, endangered resources and groundwater protection.
- The WDNR manages the 155 acre Mud Lake State Natural Area.

- Premier Concrete Inc. (PCI) is a local quarry and excavating business. PCI has previously partnered with local groups on various natural resource education programs.
- The Villagers Snowmobile Club is an active group that works with local landowners to encourage land stewardship and foster relationships to connect snowmobile trails.
- The Northern Door Rotary Club meets weekly in Baileys Harbor. Dedicated to *Service Above Self*, they are interested in continuing education opportunities.

Baileys Harbor Swamp Groundwater Contribution Area

A) The Baileys Harbor Swamp Area Landscape

The majority of the 2,227 acres Baileys Harbor Swamp GCA exists within Baileys Harbor and Gibraltar, with parts of the GCA buffer area extending into Liberty Grove and Egg Harbor. Baileys Harbor Swamp is a densely forested boreal wetland. The WDNR owns and manages a large portion of the area including the area designated as HED critical habitat.

B) General Land Use

Table 7: Baileys Harbor Swamp GCA Land Use Percentages

Land Use	% Land Use Totals
Woodlands	27.8821%
Croplands/Pastures	25.8104%
Open Space	18.7798%
Other Publicly-Owned Natural Areas	9.9369%
Tree Plantations	4.4879%
Wildlife Refuges	2.9386%
Single-Family Residential	2.9187%
Long-Term Specialty Crops	1.6705%
Other Natural Areas, including Wetlands	1.4320%
Extractive	1.3997%
Farm Buildings/Accessories	0.9299%
Local Streets and Roads	0.5303%
State Highways	0.3289%
County Highways	0.3047%
Major Electric Power Transmission Line	0.2637%
Retail Sales	0.1576%
Vacant Residential	0.0792%
Home Enterprise	0.0313%
Mobile Homes	0.0254%
Enclosed Storage	0.0252%
Residential	0.0217%
Vacant Farms	0.0186%
Cemeteries	0.0149%
Churches/Temples/Synagogues	0.0120%

C) Baileys Harbor Smart Growth objectives consistent with HED BMP project objectives

Refer to page 11 above

Baileys Harbor Community Accomplishments Satisfying HED BMPs

Refer to page 13 above

D) Existing Special Interest Groups and Local Stakeholders

- The Ridges Sanctuary, Wisconsin's oldest member- based nature preserve and first land trust promotes watershed protection and works with local landowners and businesses through outreach in their "Landowner Stewardship Program".
- Premier Concrete Inc. (PCI).

Peil Creek Groundwater Contribution Area

A) The Peil Creek Area Landscape

Most of the Peil Creek GCA exists within Gibraltar, with a small portion extending in Egg Harbor and Baileys Harbor. TNC owns and manages the Meissner Preserve which is located in the headwaters of Peil Creek (discharges to Kangaroo Lake). The Meissner Preserve supports HED critical habitat as well as a northern pike spawning area. The 544 acre Peil Creek GCA is contiguous with that of the nearby Baileys Harbor Swamp and Mud Lake GCAs which together support several HED critical habitat areas.

B) General Land Use

Table 8: Peil Creek GCA Land Use Percentages

Land Use Type	% Land Use Totals
Croplands/Pastures	56.2257%
Woodlands	21.2907%
Open Space	6.2090%
Other Natural Areas, including Wetlands	4.1472%
Long-Term Specialty Crops	3.3905%
Single-Family Residential	2.6458%
Farm Buildings/Accessories	1.8574%
Tree Plantations	1.8281%
Major Electric Power Transmission Line	1.0939%
County Highways	0.7209%
Local Streets and Roads	0.5012%
Storage	0.0527%
Enclosed Storage	0.0368%

C) Gibraltar Comprehensive Plan Objectives Consistent with HED BMP Project Objectives

Refer to page 8 above

Gibraltar Community Accomplishments Satisfying HED BMPs

Refer to page 10 above

D) Existing Special Interest Groups and Local Stakeholders

- ATC
- TNC

Arbter Lake Groundwater Contribution Area

A) The Arbter Lake Area Landscape

The 283 acre Arbter Lake GCA is positioned in Sevastopol. The small town of Valmy lies in the Northwest portion of the GCA. TNC owns over 42 acres of the wetland around Arbter Lake which supports HED critical habitat.

B) General Land Use

Table 9: Arbter Lake GCA Land Use Percentages

Land Use Totals	% Land Use Totals
Woodlands	41.5696%
Croplands/Pastures	41.1701%
Tree Plantations	6.8836%
Single-Family Residential	3.3169%
Open Space	3.2143%
Reservoirs and Ponds	1.2670%
Farm Buildings/Accessories	1.1327%
Local Streets and Roads	0.6464%
State Highways	0.2717%
County Highways	0.2605%
Retail Sales	0.1011%
Retail Services	0.0969%
Vacant Commercial	0.0692%

C) Sevastopol Comprehensive Plan objectives consistent with HED BMPs

Chapter 4: Housing Element

Goal 1: Enhance the environmental assets and residential atmosphere of the Town so that it continues to be an attractive place to live.

Objectives:

-Honor care for any desired development in floodplains, wetlands and environmentally sensitive areas.

-Encourage “low impact” development, including conservation subdivisions, within the Town to reduce storm water runoff and flooding.

Chapter 7: Agricultural, Natural, and Cultural Resources Element

Goal 1: Protect wetlands in the Town of Sevastopol.

Objectives:

-To the extent practicable, areas immediately adjacent to and surrounding wetlands should be developed using techniques to minimize effects on wetlands (e.g. buffers, setbacks, etc.).

Goal 3: Preserve and enhance wildlife habitats.

Objectives:

-Partner with local and trusts to protect wildlife habitat areas. Encourage local landowners to pursue opportunities to protect their land by working with land trusts.

-Coordinate with WDNR to better identify and protect wildlife habitats, particularly those unique to the community.

Goal 4: Protect the quality of surface and groundwater.

Objectives:

-Coordinate with the DCSWD and WDNR to implement agricultural and residential best management practices to reduce nonpoint source water pollution.

-Encourage farmers to use available manure management technology.

-Encourage residents to replace lawns with native species and use rain gardens to encourage infiltration of storm water and recharge to groundwater.

-Discourage the over-application of phosphorus- and nitrogen- based fertilizers.

-Coordinate with Door County and BLRPC to educate homeowners on the need for property maintenance of private well and onsite wastewater treatment systems, require periodic testing of private well water, and plan for eventual well, pump or drain field replacements.

-Strongly encourage or require water conservation and use of water saving devices such as low-flow showerheads and toilets within homes.

-Require conservation subdivision principals for all residential developments occurring in sensitive ecological areas or prime agricultural lands.

Goal 6: Preserve and protect Sevastopol's groundwater to ensure a long-term, viable source of potable water for current and future residents of the Town.

Objectives:

-Identify those areas with in the Town where susceptibility to groundwater contamination is highest and develop plans to ensure that land use within these areas occurs in a manner consistent with protecting groundwater.

-Develop an information and education strategy aimed at providing Town residents with the tools to protect their potable water supply.

Chapter 9/10: Land Use Elements

Goal 2: Maintain and enhance environmental corridors in the Town of Sevastopol.

Objectives:

-Reduce fragmentation of wooded areas and open spaces which negatively affect wildlife and rural character by establishing a Critical Areas Overlay district.

D) Existing Special Interest Groups and Local Stakeholders

- TNC has identified the wetlands associated with Arbter Lake and the surrounding area to be of conservation interest. They have previously worked with adjacent landowners to preserve some of these tracts.

Kellner Fen Groundwater Contribution Area

A) The Kellner Fen Area Landscape

The Kellner Fen GCA occurs within the town of Sturgeon Bay. The 559 acre recharge area includes portions of the Cave Point to Clay Banks Conservation Opportunity Area and State Natural Area, as designated by the WDNR. The DCLT owns and manages a major part of Kellner Fen, which is designated as critical habitat for the HED. The fen is historically known for cranberry production, and for that purpose two ditches were excavated to drain the fen through a dune area into Lake Michigan. The north ditch currently has a perennial flow while the southern ditch has been filled by natural debris and no longer carries water away from the fen.

B) General Land Use

Table 10: Kellner Fen GCA Land Use Percentages

Land Use Type	% Land Use Totals
Woodlands	63.8493%
Croplands/Pastures	14.5834%
Tree Plantations	10.8383%
Reservoirs and Ponds	5.4145%
Open Space	1.9596%
Archery/Gun/Skeet Ranges	1.7518%
Single-Family Residential	0.6367%
Farm Buildings/Accessories	0.3420%
Local Streets and Roads	0.2785%
County Highways	0.2229%
Vacant Residential	0.0941%
Extractive	0.0286%
Retail Services	0.0004%

C) Sturgeon Bay Comprehensive Plan Objectives Consistent with HED BMPs

Goal 7: The Town Board of Supervisors will adopt a conservation subdivision ordinance when implemented by the county to encourage the preservation of natural areas, minimize the impact of urban sprawl and protect farmland in the town.

Goal 8: The Town Board of Supervisors will develop a web page which can be used to provide information on town services and education on the responsibilities and limitations of life in the Town of Sturgeon Bay.

Goal 10: The Town Planning Commission will work with the Door County Planning Department to provide clearly stated environmental standards for the Town of Sturgeon Bay to protect environmentally and culturally sensitive areas as well as air and water quality. The Town Board of Supervisions will refer all commercial development matters to the Door County Planning Department.

Goal 20: The Town Board of Supervisions will avoid the construction of roads in any area which would endanger or damage significant natural habitats, wetlands or environmental corridors.

Goal 24: The Town Board of Supervisions will post links on the town website to assist in educating farmers and other landowners about new developments and best practice methods of agricultural land use, water conservation, and waste disposal.

Goal 25: The Town Board of Supervisors will appoint a committee to communicate with the Door County Planning Department, the University of Wisconsin Extension Service, the Door County Environmental Council and the Wisconsin Natural Resources to develop programs and distribute information to educate and inform the public about environmental resources within the Town of Sturgeon Bay. The board will use the town web page and all means available to disseminate this information.

Goal 26: The Town Board of Supervisions will post land use regulations pertaining to the protection of sensitive environmental areas on the Town of Sturgeon Bay web page.

Goal 27: The Town of Supervisors will strongly request the maintenance of a no building zone from delineated wetlands in accordance with the adopted zoning ordinance and encourage the County Board to maintain or increase this setback.

Goal 28: The Town Board of Supervisions will encourage landowners to protect their land by working with the Door county Land Trust and/or other conservation groups to protect wetlands, shorelands, ridges and swales, and farmland.

Goal 31: The Town Board of Supervisions will work with Door County to provide well-head and groundwater protection.

Goal 33: The Town Board of Supervisors will work with property owners to encourage the preservation of significant sites.

Goal 44: The Town Board of Supervisors will coordinate with WDOA, WDOT, and WDNR in an effort to ensure facilities and services that are safe and that natural features and farmland that are protected.

D) Existing Special Interest Groups and Local Stakeholders

- DCLT is an important stakeholder as it owns and manages a significant amount of the HED critical habitat in this GCA.
- Evergreen Nursery Inc. owns over 350 acres within the GCA.
- The Door County Rod and Gun Club own almost 80 acres on the west side of the Kellner Fen GCA.
- Two Rotary Clubs meet weekly in Sturgeon Bay. Dedicated to *Service Above Self*, they are interested in continuing education opportunities.

Gardner Swamp Groundwater Contribution Area

A) The Gardner Swamp Area Landscape

This 5,841 acre GCA exists in the town of Gardner, with the southern edge extending into Brussels. It has the largest recharge area of any of the HED GCAs in Door County. This GCA includes a large number of residential homes. The WDNR manages the public lands around Kayes Creek and the Gardner wetland corridor which supports HED critical habitat.

B) General Land Use

Table 11: Gardner Swamp GCA Land Use Percentages

Land Use Type	% Land Use Totals
Croplands/Pastures	39.4104%
Woodlands	36.7264%
Open Space	13.8767%
Single-Family Residential	2.7456%
Tree Plantations	1.7610%
Farm Buildings/Accessories	1.0633%
Long-Term Specialty Crops	0.8601%
County Highways	0.6426%
Campgrounds	0.5664%
Local Streets and Roads	0.5529%
Grasslands	0.2346%
Extractive	0.2285%
Reservoirs and Ponds	0.2007%
Mobile Homes	0.1660%
Air Related	0.1652%
Parks/Parkways/Forest-Related Picnic Area	0.1472%
Retail Services	0.1051%
Retail Sales	0.0848%
State Highways	0.0753%
Playfields/Ball Diamonds/Volleyball Court	0.0465%
Other Natural Areas, including Wetlands	0.0448%
Cemeteries	0.0448%
Waste Processing/Disposal/Recycling	0.0283%
Enclosed Storage	0.0278%
Commercial w/Living Quarters	0.0264%
Manufacturing	0.0255%
Multi-Family	0.0251%
Wholesaling	0.0250%
Home Enterprise	0.0199%
Animal Husbandry	0.0170%
Churches/Temples/Synagogues	0.0135%
Religious and Related Facilities	0.0090%
Off-Street Parking	0.0082%
Administrative Buildings	0.0075%
Storage	0.0070%
Tennis Courts	0.0046%
Post Offices	0.0026%
Administrative Institutions/Governmental	0.0021%
Fraternal Organizations/Clubhouses	0.0019%

C) Gardner Smart Growth Objectives Consistent with HED BMPs

Erosion and Storm Water control Ordinances: Under 61.354 of the Wisconsin Statues, the Town may enact a construction site erosion control and storm water management zoning ordinance. Door County has an adopted Erosion Control ordinance in place. The purpose of such an ordinance is to protect water quality and to minimize the amount of sediment and other pollutants carried by runoff or discharged from construction sites to lakes, streams, and wetlands.

Sanitary Codes: The County has adopted on-site waste disposal regulations. Groundwater protection is of great importance to both the County and the Town of Gardner. Uncontrolled waste can have detrimental and wide ranging impacts on the health and property values.

Priority 1. Work with Door County to develop a detailed packet of information on what new residents should come to expect when building and living within the rural portions of the county. This information should be readily available to the public, and provided whenever a town permit for new construction is issued.

D) Existing Special Interest Groups and Local Stakeholders

- The WDNR.
- Quietwoods campground is a large private campground in Gardner which hosts many visitors to Door County every camping season.

APPENDIX F

Groundwater Protection Zoning Overlay Model Ordinance for Door County Towns

GROUNDWATER PROTECTION
ZONING OVERLAY DISTRICT

[Note: This draft ordinance has not undergone full legal review. Counsel for the town should review the draft for consistency with state law and with county and town ordinances.]

I. PURPOSE, INTENT AND AUTHORITY

The town of _____ ("town") adopts a groundwater protection zoning overlay district and accompanying regulations in order to protect, preserve and maintain groundwater quality and quantity in habitat areas important to the federally endangered Hine's emerald dragonfly (*Somatochlora hineana*).

To ensure proactive and preventative protection of groundwater supplies, this ordinance establishes a zoning overlay district for the Hine's emerald dragonfly habitat groundwater contribution area including 1000 foot buffer for the area. The purpose of the groundwater protection zoning overlay district is to protect groundwater quality and quantity by minimizing contamination potential and promoting infiltration. It is the intent to accomplish this through imposing regulations on land use.

II. DEFINITIONS

For the purposes of this ordinance, the following terms shall be defined as below:

a. BEST MANAGEMENT PRACTICE (BMP). A technique or preventative measure which is equal to or of a higher standard than the common industry practice (i.e., structural or non-structural measures, practices, techniques or devices employed to avoid or minimize soil, sediment or pollutants carried in runoff to waters of the state.)

b. CONTAMINATION. An impairment of water quality by chemical, biological, or other extraneous matter affecting the potential or intended beneficial use of water.

c. DEVELOPMENT. Carrying out any construction, reconstruction, alteration of surface or structure, land disturbance, or change of land use or intensity of use that is subject to the regulatory authority of the town.

d. GROUNDWATER CONTRIBUTION AREA. The total area in which surface water percolates into the below ground water table and yields as surface water again (i.e., wells or springs).

e. GROUNDWATER PROTECTION OVERLAY DISTRICT: The zoning district defined to overlay other zoning districts in the town of _____. This district may include specifically designated recharge areas that collect precipitation or surface water and carry it to groundwater sources.

f. IMPERVIOUS SURFACE. Surfaces which do not absorb precipitation including but not limited to buildings, structures, parking areas, driveways, roads, sidewalks, and any areas in concrete, asphalt, or packed stone.

g. KARST FEATURE. An area or surficial geologic feature subject to bedrock dissolution so that it is likely to provide a conduit to groundwater, and may include caves, enlarged fractures, mine features, exposed bedrock surfaces, sinkholes, springs, seeps or swallets.

h. LAND SPREADING. The disposal of manure waste in thin layers onto the land surface and/or the incorporation of such waste into the top several feet of the surface soil for agricultural and/or solid waste disposal.

i. MANURE. Livestock excreta and other materials such as bedding, water, soil, hair, feathers, waste water, contaminated runoff and other debris normally included in manure handling operations.

j. PRIVATE ONSITE WASTEWATER TREATMENT SYSTEM (POWTS). A sewage treatment and disposal system serving a single structure with a septic tank and soil absorption field located on the same parcel as the structure.

k. SINKHOLE. A depression or opening on the land surface, formed by solution or the collapse of limestone or dolomite bedrock. Sinkholes may be partially or completely filled with unconsolidated material (also known as “rockhole”).

l. STORM WATER MANAGEMENT PRACTICES. Measures, either structural or nonstructural, that are determined to be effective, practical means of preventing or reducing point source or nonpoint source pollution inputs to storm water runoff and water bodies.

m. SURFACE WATER. Any wetland, lake, perennial, or intermittent stream or direct conveyance to such waters.

III. EXTENT AND DESIGNATION OF RECHARGE AREAS AND PROTECTION ZONES

A zoning overlay district is hereby created within the boundaries set forth on the map attached hereto as _____. These boundaries include all of the surface areas that contribute groundwater to Hine’s emerald dragonfly larval habitat plus a 1000 foot buffer.

[Note: The boundaries of the 11 groundwater contribution areas of Hine’s emerald dragonfly habitat in Door County can be viewed at (under the Conservation layer): http://map.co.door.wi.us/map/]

IV. USES AND RESTRICTIONS

a. Prohibited Development –
   i. The expansion of an existing or creation of new non-metallic mines shall be prohibited within the zoning overlay district.
   ii. The creation of new golf courses shall be prohibited within the zoning overlay district.

b. Manure Spreading - The following setbacks are required for all sources of manure and organic by-products spread within the zoning overlay district and within the 1000 foot buffer:
    i. Manure and organic by-products shall not be applied on frozen or snow covered grounds.
    ii. Manure and organic by-products shall not be applied within 75 feet of surface water.
    iii. Manure and organic by-products shall not be applied within 75 feet of exposed bedrock.

c. Maximum Site Impervious Surface Coverage -
    i. Within the zoning overlay district, no more than 30% of a single lot or building site may be rendered impervious to groundwater infiltration.
    ii. Maximum impervious site coverage may exceed 30% provided that storm water mitigation devices are installed, such as rain gardens, vegetated retention swales, or bio filters. To the extent feasible, all runoff from impervious surfaces shall be recharged to the aquifer on-site and these devices shall provide for the retention, filtration and percolation.

d. Storm Water Runoff Plans - Any proposals for the construction of residential dwellings, commercial or industrial structures, recreational or institutional facilities, additions, or reconstructions within the groundwater protection zoning overlay district must adhere to the Door County Soil & Water Conservation Department Procedure Policy: Storm Water Runoff Control Design Criteria.
http://map.co.door.wi.us/swcd/Storm%20Water%20Policy.pdf

e. Minimum Lot Size and Land Divisions – Land divisions resulting in density greater than one unit per acre, or increased intensity of current use shall not be allowed in the zoning overlay district.

V. BEST MANAGEMENT PRACTICES

Under the provisions of this section all operations potentially resulting in sources of contamination, displacement, and erosion shall incorporate and utilize best management practices (BMPs). BMPs may include, but are not limited to, structural and nonstructural systems, conservation practices, and operation and maintenance procedures.

a. Exposed Bedrock - All development and land use activities shall be set back a minimum distance of 75 feet from any visible or detectable karst features. A buffer of native vegetation shall be installed around the entire perimeter of any exposed karst feature.

b. Deicing Road Salt - Deicing road salt applications in zoning overlay district is prohibited, where practical. Substitute products and alternative technologies shall be evaluated.

c. Lawn Care - Use of lawn care pesticides and synthetic fertilizers is prohibited on residential lawns, public places, and recreational fields, within the zoning overlay district. This excludes agricultural pest management and natural areas management (i.e., invasive species control, forestry project maintenance).

VI. PERFORMANCE STANDARDS

a. Violations -

[Note: Enforcement should be consistent with enforcement of other land use regulation and zoning violations in town.]

VII. SEVERABILITY

If any section, clause, provision or portion of this ordinance shall be held to be invalid or unconstitutional by any court of competent jurisdiction, such holding shall not affect or impair any other section, clause, provision, or portion of this ordinance.

VIII. DATE OF EFFECT

This ordinance, and amendments, shall take effect upon passage.

Approved by: _____

Date: _____

Additional Resources

Learn more about the Hine's Emerald Dragonfly:
http://www.fws.gov/midwest/endangered/insects/hed/hins_fct.html

See the Groundwater Contribution Areas important to protecting Hine's Habitat in Door County:
http://map.co.door.wi.us/map/

Use Greenprint to guide development in Door County while protecting groundwater:
http://tplgis.org/DoorCounty_Greenprint/

Contact the Door County Land Trust for options in conservation easements:
www.doorcountylandtrust.org/protect_your_land.htm

Explore alternatives to traditional lawns at Safe Lawns in Door County:
http://www.doorpropertyowners.org/safe-lawns-in-door-county

Learn more about conserving groundwater quality:
Read the complete Hine's Best Management Practices report
http://www.ridgessanctuary.org

For more information contact
The Ridges Sanctuary
920-839-2802
info@ridgessanctuary.org

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The Ridges Sanctuary watershed provides the most extensive Hine's emerald critical habitat in Door County.

THE RIDGES SANCTUARY

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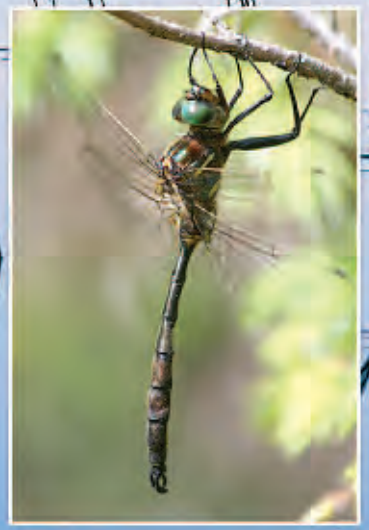
Hine's Emerald Dragonfly image on front cover by Paul Burton. All background water images from iStock.com

Protecting Groundwater in Door County



Benefits YOU and the Hine's Emerald Dragonfly

Clean Water is Important for YOU & the Hine's Emerald Dragonfly

In Door County, groundwater is a shared resource needing protection because fractured **karst** bedrock and thin soils can enable pollutants to quickly be carried into our **drinking water**, Hine's emerald dragonfly habitat or Lake Michigan. Every effort should be taken to protect water for the health of Door County families, businesses and wildlife.

The Hine's Emerald Dragonfly

The Hine's emerald is the only federally **endangered** dragonfly. The largest population exists in Door County because of the large quantity of coastal wetland habitat on the Peninsula.

Hine's larvae spend four to five years in wetlands that are spring fed by calcium-rich, dolomite bedrock. They need sustained groundwater quality and quantity in order to survive; *their presence is an **indicator** of good water quality.*

Hine's emerald dragonfly larva
Courtesy of Dan Soluk

To protect groundwater quality, adopt simple conservation measures...

In Your Own Backyard

- Eliminate pesticide and synthetic fertilizer usage on lawns; they can contaminate lakes, streams, and groundwater, and are unhealthy for children and pets
- Protect the natural features of your property with a conservation easement
- Don't flush pharmaceuticals or put hazardous waste in the trash; take them to a local "Clean Sweep" collection site
- Maintain private onsite wastewater systems annually; septic failure can be costly and can contaminate well water

Annual septic system maintenance is important for the health of your wastewater system

Storm water mitigation systems are important for filtering and replacing groundwater (Baileys Harbor Ridges Beach, graded and planted with Dune grass)

Through Your Government

- Require storm water management plans for all construction projects
- Enforce setbacks and buffers for activities near exposed bedrock
- Use Door County Greenprint to guide development and protect the Hine's emerald dragonfly and other natural resources of Door County (see back of brochure for websites)
- Adopt a groundwater protection ordinance

Exposed bedrock is a direct conduit to Door County groundwater

As a Business Owner

- Encourage guests to reuse towels and sheets to conserve laundry water
- Establish low maintenance vegetated buffers or rain gardens to filter and absorb storm water runoff from parking lots

Commercial fishing depends on clean water that discharges from streams to Lake Michigan

- Avoid applying manure to agricultural lands when soils are frozen
- Adopt environmentally responsible methods to sustain iconic Door County activities

Local fish boils now capture excess kerosene to prevent it from contaminating groundwater