Massachusetts

Aerial Photo Survey of Potential Vernal Pools

Spring 2001

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Thanks are due to the following people for their help in the realization of this major undertaking. This survey has been an underlying goal of the Natural Heritage Program's vernal pool work for nearly 7 years, and the project's conception and ultimate execution has been aided by many people along the way.

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Preface

The Massachusetts Executive Office of Environmental Affairs seeks to engage citizens of the Commonwealth in the study, appreciation, and protection of vernal pool habitat. The Natural Heritage & Endangered Species Program of the MA Division of Fisheries & Wildlife is the state agency entrusted with the responsibility to oversee the official vernal pool certification program and to pursue research, education and outreach efforts that will enhance appreciation and protection for vernal pools in the state. This publication presents the first comprehensive aerial photo survey of potential vernal pools in Massachusetts. It is a statewide inventory of potential vernal pools that have been identified from aerial photographs. This survey represents a tremendous leap forward in the protection of this resource by providing, at a glance, the most complete picture available to date of the number and distribution of vernal pools across the Commonwealth.

Rather than on printed maps, the locations of photo-identified vernal pools are presented on a compact disc, developed by MassGIS, which is found at the back of this booklet. The compact disc contains a simplified version of the MassGIS Runtime Data Viewer with statewide USGS topographic maps and all of the potential vernal pools identified during this project. While the potential vernal pool data does not identify *all* vernal pool habitats in the state (many are not visible on aerial photographs), this will, nonetheless, provide a great tool for the conservation of many vernal pools.

The Massachusetts Aerial Photo Survey of Potential Vernal Pools does not replace the role of official state certification of vernal pools in the protection of these habitats. However, it does provide interested parties with valuable information on the occurrence of potential vernal pools that can then be verified in the field. School groups, land trusts and non-governmental organizations, local boards and commissions, landowners and environmental consultants should find the information presented useful in many ways.

Trespass

The Executive Office of Environmental Affairs (EOEA) urges Massachusetts' citizens to take interest in vernal pool appreciation, study and protection. However, EOEA strongly recommends that anyone interested in field verification of potential vernal pools or vernal pool certification obtain landowner permission prior to conducting any data gathering. No one pursuing official vernal pool certification should trespass on legally posted property under any circumstances. Please refer to the model letter for landowner permission (Appendix A) for help in drafting a letter seeking permission.

The Natural Heritage & Endangered Species Program of the Massachusetts Division of Fisheries & Wildlife maintains a file for every vernal pool that is certified. All information contained in these files, including the official field observation form and it's contents, are a part of the public record and may be requested through an official documents request.

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Spring, 2001

Dear Concerned Citizen,

Dear Concerned Citizens,

As Massachusetts' Secretary of Environmental Affairs, one of my top priorities is to help citizens reconnect to the natural world. A principal component of this goal is to create opportunities for children and adults to physically explore their environment. The Massachusetts Aerial Photo Survey of Potential Vernal Pools provides an important tool that will help the citizens of Massachusetts connect with these wonderful habitats that are found across our landscape.

Vernal pools are unique wetlands that support diverse and valuable wildlife communities, including many state-listed rare species, such as species of *mole salamanders* and the graceful, intricate *fairy shrimp*. Vernal pools come in a diversity of forms, but all are characterized by springtime ponding, a lack of reproducing fish populations, and the wildlife communities that are adapted to these conditions. Despite their variety in size and physical characteristics, they are all very important to the long-term preservation of biodiversity in our communities.

The Executive Office of Environmental Affairs (EOEA's) Vernal Pool Initiative seeks to engage citizens of the Commonwealth in the appreciation, study and protection of vernal pool habitat. This statewide inventory of potential vernal pools, through educational outreach and publications, will foster both interests in and understanding of vernal pool habitat.

Using a series of aerial photographs indicating potential vernal pools across the state as a guideline, citizens will join experts in the field to identify and certify vernal pool habitats. State laws protecting vernal pools from intrusive actions require physical assessment of the site for certification. Thus, field verification of potential vernal pools is essential to their protection.

I encourage school groups, children and parents, land trusts and non-governmental organizations, local boards and commissions, landowners and environmental consultants to join EOEA in this important initiative. If you choose to participate, please be certain to obtain permission to access any private or public property before searching for vernal pools.

I hope you take advantage of this opportunity and I look forward to your participation.

Very truly yours,

Bob Durand

Aerial Photo Survey of Potential Vernal Pools

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Please contact the NHESP with any questions.

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Aerial Photo Survey of Potential Vernal Pools

Aerial Photographic Interpretation of Vernal Pools

Introduction

Interest in vernal pool ecology and the biology of the plants and vertebrate and invertebrate animals that rely on vernal pools has been growing tremendously in Massachusetts, around New England, and beyond. The value of vernal pool habitat as a living classroom, for its diversity of wildlife and ecological processes, has resulted in the inclusion of vernal pool study at many grade levels in school systems throughout the Commonwealth. The importance of vernal pools to the conservation of amphibian and invertebrate wildlife, as well as biodiversity more generally, across the state has also been recognized in recent years. Vernal pools that have been officially "certified" by the Massachusetts Division of Fisheries and Wildlife (DFW) receive important protection under several state wetland protection regulations. Since the certification program relies on the public to collect documentation, it has led to a considerable increase in public awareness and participation in the protection of these important wildlife habitats, as well as the state's other wetland resources, by individuals, community groups, non-government organizations, and local and state government agencies.

Prior to this aerial survey, no comprehensive vernal pool inventory had ever been attempted in Massachusetts. However, the DFW's Natural Heritage & Endangered Species Program (NHESP) maintains a database of all certified vernal pools, the only statewide database concerning these habitats. This database has grown slowly since it was established in 1988. Data generated by voluntary efforts to identify and document vernal pools constitutes the vast majority of the information it contains. This has resulted in a patchy distribution of certified vernal pools, focused in areas that have had active individuals and groups working to identify them, rather than reflecting the true distribution of vernal pool habitat throughout the state (Figure 1). Reliance on this source of information results in no clear picture of the abundance, distribution or conservation status of vernal pool habitat across Massachusetts. Protection of vernal pools is therefore also inconsistent across the state and

focused in those areas that have undergone extensive, localized inventories. It is difficult to perform effective or pro-active conservation planning or management for the protection of vernal pool habitats and the biodiversity that they support without first knowing their distribution and the degree to which they are protected.

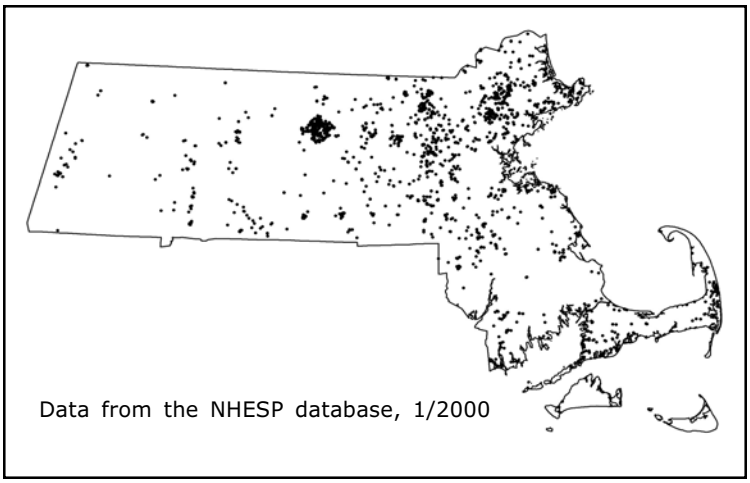

Figure 1: Distribution of Certified Vernal Pools in MA

Aerial photographic interpretation (photogrammetry) enables rapid and large-scale inventories of natural communities and landscape features. Vernal pools are generally visible on certain types of aerial photographs, permitting their inventory by photogrammetry. However, in Massachusetts, vernal pools are defined by the wildlife that use them rather than by the physical characteristics that make them visible on aerial photographs. Since wildlife can not actually be seen on aerial photographs, vernal pools identified on aerial photographs are known as "potential vernal pools" (PVPs) due to the possibility that they do not support vernal pool indicator wildlife. Several scientific studies in Massachusetts have proven that aerial photographic interpretation is highly effective for the identification of potential vernal pools which likely support populations of indicator wildlife (discussed below in *Interpretation of Potential Vernal Pools*). Aerial photo interpretation represents the best presently available tool for conducting a statewide inventory of potential vernal pool habitat. The NHESP has conducted this survey by interpreting potential vernal pools from 1:12,000 scale color infra-red aerial photographs. The potential vernal pools identified during this survey have been digitized in the Massachusetts Geographic Information System (MassGIS), and will be included in the MassGIS library of data. A compact disc has been developed and is included as a part of this publication which contains a stand-alone Runtime Data Viewer software package, selected MassGIS data layers, and the USGS topographic maps of the state. The data viewer allows anyone with an IBM-compatible computer (running Windows 95, 98, 00 or NT with a minimum of 32MB RAM) or Macintosh capable of running emulation software to view a map of the state with the USGS topographic maps, some data including town boundaries and major hydrological features, and the points representing all of the potential vernal pools. Zooming into a particular area of interest will allow individuals to print detailed maps of potential vernal pools for use in the field. The potential vernal pool data set

is also available on the MassGIS website (www.ma.state.us/mgis) which allows anyone with internet access to create maps and print them out from a standard internet browser.

Defining vernal pool habitat

In Massachusetts, vernal pools are defined rather broadly. They are distinguished primarily by indicator wildlife species and the absence of fish, rather than by physical characteristics such as hydroperiod, landscape position or vegetative community. Vernal pools are generally defined as basin depressions where water is confined and persists for at least 2 months during the spring and early summer of most years, and where reproducing populations of fish do not survive. Specifics regarding hydroperiod, vegetative characteristics, connections to other wetlands and waterbodies and other physical characteristics are the stuff of great debate. What is relied upon above all else is the documented presence of obligate or facultative indicator wildlife.

Vernal pool indicator species (Table 1) are generally able to use wetlands of tremendously varied physiographic conditions if the breeding habitat remains flooded for at least 2 months and is free of established, reproducing fish populations. Defining vernal pool habitat by indicator species rather than specific physical characteristics means that there is a wide diversity of habitat characteristics found in vernal pools. Blue-spotted salamanders (*Ambystoma laterale*) are as likely to be found breeding in a dense, shrub-dominated wetland as they are a classic kettlehole depression. Hydroperiods, landscape position and vegetation characteristics, among other physical characteristics, run the gamut. Vernal pool habitat therefore occurs in deep kettlehole depressions, among the small pockets of standing water in wooded swamps with pit and mound topography, in open marshes, shrub swamps, fens, interdunal swales, and other wetlands that are free of established, reproducing fish populations, and that contain standing water for at least 2 months in the spring and summer of most years. Vernal pools may be very shallow, holding only 5 or 6 inches of water at their maximum depths, or they may be quite deep. On average though, pools tend to hold

Obligate species
Mole salamanders
- Spotted
- Blue-spotted
- Jefferson
- Marbled

Wood frog
Fairy shrimp

Facultative species
Spring peeper
American toad
Green frog
Pickerel frog
Gray treefrog
Four-toed salamander
Spotted turtle
Caddisfly larvae
Dragonfly larvae
Fingernail clams
Amphibious snails

Table 1: Some vernal pool indicator species

2-3 feet of water during the spring time maximum flooding. They may be extremely small, fewer than 100 square feet in some cases, or reach several acres in size.

Among the debates over characteristics of the wetlands that may be called vernal pools, the very term is often argued. "Vernal pool" is an apt name for the spring-time pools of California where the term was coined. There, temporary pools are filled with annual spring (vernal) rains and reliably dry by early summer. Vernal pools in Massachusetts tend to begin filling in the fall, and among those that dry every year, many hold water well into the summer or even early fall. In Massachusetts the term is technically a misnomer, but has become inextricably linked to these seasonally-flooded wildlife habitats. Terms such as autumnal pools, seasonal forest ponds, and seasonally flooded depressions may describe these habitats more accurately, but have not begun to replace the widely-used "vernal pool."

Aerial photography primer

Aerial photo interpretation is used extensively for the inventory and mapping of landscape features, both natural and man-made. Photo interpreters can use tools such as a mirror stereoscope (Figure 2) to view the landscape in an effort to identify features of interest for a particular project. Photographs of the landscape can be taken with satellites from space or with cameras from airplanes resulting in a view looking straight down at the earth's surface. When photographs are taken from directly overhead, a unique perspective is gained that allows the photo interpreter to see landscape features that might be difficult or impossible to distinguish from other vantages. Aerial photographs can be taken such that two sequential photographs viewed under a mirror stereoscope produce a 3-dimensional view of the earth's surface. This phenomenon allows photo interpreters to read topographic features of the ground such as hills and depressions, and even allows the measurement of an object's height. Different landscape features can be emphasized in aerial photographs by selecting from a wide array of possible scales, emulsions (e.g. black and white versus color), and time of year that the images are taken, all of which are discussed below.

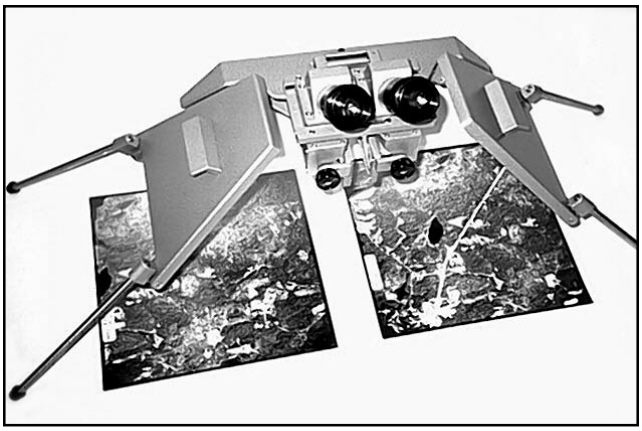

Figure 2: Mirror stereoscope

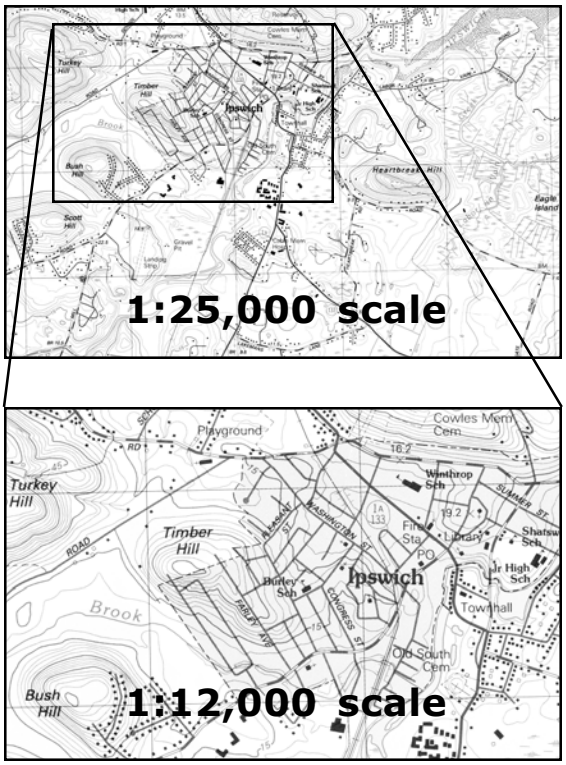

Figure 3: Map scale comparison

The scale of a photograph refers to the number of units (e.g. inches) on the ground surface that the same unit on the photograph represents. For instance, the photographs used to create this survey are at a scale of 1:12,000. On these photos, one inch represents 12,000 inches (or 1000 feet) on the ground. Smaller scale photography (e.g. 1:25,000) provides a view of much more of the earth's surface, while larger scale photography, such as 1:12,000, shows considerably more detail (Figure 3). However, covering large areas with larger scale photography requires many more individual pictures and much more time to interpret. In selecting the appropriate photographic scale for a particular project, photo interpreters balance the benefit of greater detail with the costs of increased effort associated both with obtaining and interpreting greater numbers of photographs. 1:12,000 scale photographs allow for fairly small vernal pools (<100' diameter) to be identified, yet cover the state with a reasonable number of individual images (approximately 10,000).

Aerial photographs are available in different film emulsions such as black and white, true color and color infra-red (CIR). Color infra-red film is very commonly-used in wetland and vegetation mapping. It is sensitive to wavelengths of light from the infra-red portion of the light spectrum. Different types of vegetation reflect various amounts of infra-red light and create unique "signatures" that allow photo interpreters to distinguish different vegetation types (conifer versus deciduous trees), associations, and even individual species. This type of film is also very useful to wetland mapping efforts since standing water appears dark blue to black and is quite distinctive.

The time of year at which photographs are taken is also an important tool in highlighting various features of the landscape that might be of interest. In areas of deciduous trees, prior to "leaf-out" in the spring, the ground surface can be clearly seen. Leaf-off photography is very useful in distinguishing the edges of water bodies that are obscured as leaves come out on canopy trees, and is critical to detecting small features on the landscape that can be completely obscured when the tree canopy is fully leafed-out. As the spring progresses, a period of early leaf emergence, called "first blush," can be photographed to

help distinguish between different hardwood tree species. Full leaf-out photographs are useful in identifying major vegetation associations, but are nearly useless for identifying small features underneath the tree canopy.

Interpretation of potential vernal pools

Use of color infra-red (CIR) leaf-off aerial photography for interpretation of wetlands is particularly effective. Open water bodies appear as black features and different vegetation types have distinctive signatures that allow skilled interpreters to distinguish between various plant species and communities. "Classic" vernal pools, isolated basin depressions with little or no vegetation, are readily interpreted from this type of photography. Without leaves obscuring the forest floor, the standing water of springtime vernal pools stands out within topographic depressions. For the classic pool, size becomes a primary consideration. Very small pools at the lower limit of resolution (< 60' diameter) are unreliably interpreted at the scale of 1:12,000. Surrounding forest cover also becomes important as size decreases. Coniferous forest cover obscures all but the pools that are large enough to create a gap in the canopy. Pools that have well-developed shrub or emergent vegetation are often easily identified by the standing water and vegetation "signatures" on spring-time CIR photography.

Several studies conducted in Massachusetts have demonstrated the effectiveness of aerial photo interpretation of vernal pool habitat. The first study to specifically address this tool for use in vernal pool identification was a Master's thesis by Janice Stone (1992) at the University of Massachusetts Amherst. She showed that 1:4800 scale black and white aerial photographs could be used effectively to identify vernal pools that were providing habitat to obligate vernal pool-breeding species (mole salamanders, wood frogs and fairy shrimp). While this proved that aerial photography could be used for identifying vernal pools, the scale of photography was not useful for large areas, such as a statewide inventory. The NHESP performed a small-scale test of the effectiveness of 1:12,000 scale color infra-red aerial photographs in 1996. The use of this scale and emulsion proved highly effective, with greater than 90% of the interpreted "potential vernal pools" verified in the field as providing habitat to vernal pool obligate species (unpubl. data, NHESP). Brooks, Stone and Lyons (1998) reported that interpretation of 1:12,000 scale CIR photography for seasonal forest ponds, wetlands that typically function as vernal pool habitat, was very effective in the large Quabbin Reservoir

watershed. They reported that the quality of photography and experience of the interpreter resulted in very limited errors of commission (identifying something, such as a tree shadow, as a seasonal forest pond that was not actually a waterbody), less than 5%. Furthermore, among a sample of interpreted seasonal forest ponds, greater than 85% that were field verified during the spring amphibian breeding season were found to function as vernal pool habitat. In 1999 the NHESP conducted its second trial using 1:12,000 scale CIR photographs across a randomly selected sample of aerial photographs in Barnstable, Plymouth, Essex, Middlesex and Worcester Counties. Errors of commission were extremely low (<3%), and greater than 80% of the potential vernal pools that were field-verified were providing breeding habitat to vernal pool indicator species (unpubl. data, NHESP). The year in which this second test was conducted experienced an extremely dry spring where many vernal pools dried up completely as early as the end of April. This affected the number of pools that could be confirmed to provide vernal pool habitat. It is expected that, in a more typical year, even better results would have been achieved.

While aerial photo interpretation is very effective in the identification of potential vernal pools, it is not a fool-proof method of inventorying all vernal pool habitats that exist in the survey area. Two types of error occur in any resource mapping using aerial photographs: errors of commission and errors of omission. When interpreting vernal pool habitat, errors of commission are those in which a feature on the photograph is identified as a vernal pool when, in fact, it is not. Shadows of large trees can be mistaken for a small ponded water body, for example. The quality of 1:12,000 scale CIR photography is excellent. However, as interpreters attempt to identify pools that are extremely small, the reliability of the interpretation becomes compromised (Brooks et al, 1998). Errors of commission also occur when a water body is identified as a vernal pool when it does not, in fact, meet the required physical or biological characteristics required to classify it as a vernal pool. For instance, a ponded waterbody might dry extremely quickly after a significant rain storm filled it. Photo interpreters will often be unable to distinguish these very ephemeral waterbodies from more permanent ones that will function as vernal pools. These types of errors occur infrequently, but must be acknowledged in any survey produced by aerial photo interpretation. Errors of omission are the other common error in aerial photo interpretation. These occur when an existing feature, such as a vernal pool, is overlooked. As discussed above, very small vernal pools can not be identified with great reliability in all circumstances.

This is particularly true in areas where tree shadows may obscure the forest floor and where topographic relief is slight and gives no additional clues to the interpreter. In areas with a lot of evergreen vegetation, it is difficult or impossible to see the forest floor. Photo interpretation of vernal pool habitat, or other features on the ground, is typically very difficult and particularly subject to errors of omission and commission in these areas. Furthermore, as leaf-out progresses through the spring, the forest floor is increasingly obscured in areas of deciduous tree cover when photography is taken later in the year (after early to mid May in Massachusetts), and interpretation can be compromised.

The Massachusetts Aerial Photo Survey of Potential Vernal Pools

The compact disc enclosed in this publication presents the loci of potential vernal pools in Massachusetts that were identified from 1:12,000 scale color infra-red aerial photographs. This statewide coverage includes the survey of Plymouth and Bristol Counties published in the spring of 2000. The Massachusetts Potential Vernal Pool Survey has been produced for several reasons. It provides an overview of the number and spatial distribution of vernal pool habitats in the state. This provides an important tool for conservation planning with respect to vernal pool habitat. By having an estimate of the number of vernal pools in the region, and a picture of their distribution, it will be possible to better direct acquisition and regulatory protection efforts for vernal pools. Vernal pool education and certification initiatives should also greatly benefit from the production of this survey. It will provide the loci of a tremendous number of potential vernal pools in the state to landowners, school and community groups, non-government organizations and non-profit organizations, as well as local, state and federal government agencies.

Aerial photos used in the Massachusetts Potential Vernal Pool Survey include images acquired in 1993, 1999, and 2000 (Figure 4). While generally of exceptional quality, the Massachusetts Aerial Photo Survey of Potential Vernal Pools contains a few problem areas resulting from photo quality or other related causes. Stereo pairs were not available for the outer arm of Cape Cod (from the eastern half of Brewster/Harwich north to Provincetown) and for all of Nantucket. Photo interpretation therefore was done without the aid of topographic relief or the magnification of a stereoscope. It is expected that more errors of omission and commission will be found in these areas of the state. The coastal dune systems from Barnstable to the outer tip of

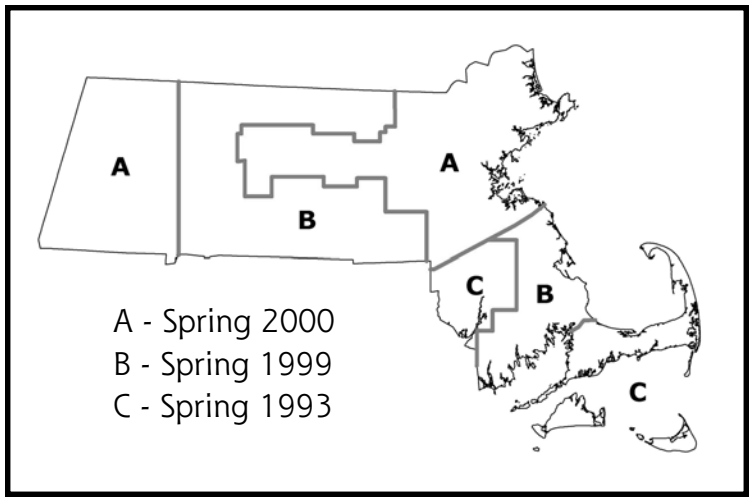

Figure 4: Aerial photo project areas and dates of photography

Provincetown contain tremendous numbers of interdunal swales. These quite often provide breeding habitat for Fowler's and spadefoot toads, facultative invertebrates, and other vernal pool indicator species. Accurate interpretation of vernal pools among these interdunal swales is difficult however, and it is expected that errors are more common among the potential vernal pools interpreted from the dune systems of Cape Cod, the Islands, and the north shore. Initial surveys of some potential vernal pools in Bristol County indicate that there may be more errors of commission than in other parts of the state. This may be due in part to comparative wetness of the photos used for interpretation in that county. It is expected that fewer than 80-85% of potential vernal pools in Plymouth and Bristol Counties will likely support breeding populations of vernal pool indicator wildlife. 1999 photos used for Plymouth County were flown very late in the spring (mid to late May), and suffered from early leaf out conditions which increases the probability of errors of omission. Over the western half of the county, much of the forest floor was obscured by tree canopy leaves, affecting the interpretation of smaller pools that do not have an open tree canopy. The floodplains of the Connecticut River and some of its tributaries were extremely wet in the photography used. This results in a probable under-accounting of the myriad potential vernal pools found among the sloughs, backwaters, and oxbows of large river floodplain systems. The spring 2000 photos for Berkshire County had some areas of snow which obscure all features. As a result, approximately 16,000 acres in southern Berkshire County (Figure 5) were not interpreted for potential vernal pools. Spring 2000 photos of central Worcester county west of Barre, through Petersham, were extremely dark and therefore lacked sufficient detail for high confidence in the interpretation of potential vernal pools in that portion of the state.

Photo interpretation itself has limitations and sources of error. Very small vernal pools are difficult to identify even with the highest quality photography. Pools as small as ~42' diameter (0.0042" on the photograph)

were occasionally identified. However, pools smaller than about 50-60' in diameter could not reliably be identified. Pools between 60' and 125' diameter were easily confused with tree shadow and some types of man-made features. Pools of 125' diameter (1/8" on the photographs) and larger could be reliably identified when photos were of fair to excellent quality, and where evergreen trees were not dominant. The upper size limit of potential vernal pools is quite difficult to establish, and is generally a subjective call. Some very large features were pulled out as potential vernal pools when connections to other water bodies did not appear to exist, and where vegetation signatures suggested that the hydroperiod was not permanent. Farm ponds and other obviously man-made waterbodies were generally avoided where it was possible to do so. Furthermore, any potential vernal pool with more than 50% of the shore line in managed vegetation (lawns, crops, etc.) was not included as a rule.

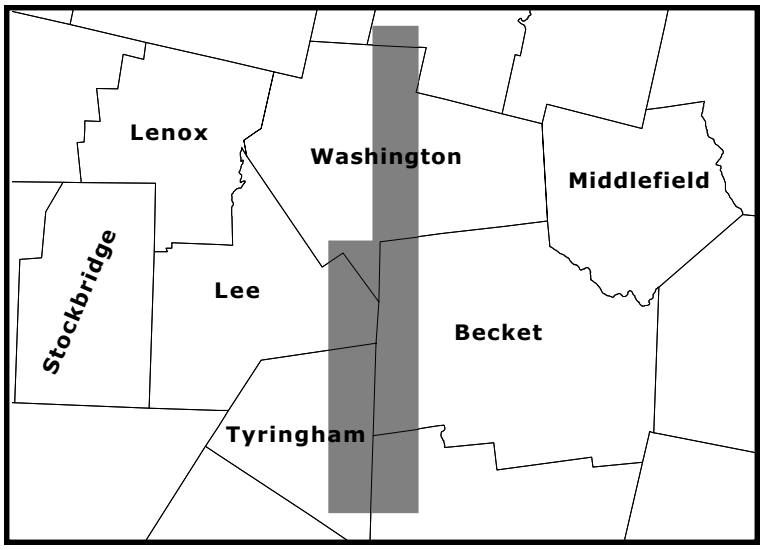

Figure 5: Area affected by snow in So. Berkshire Co.

It is important to understand that this potential vernal pool survey does **not** include all vernal pools in the state. Omission due to unfavorable conditions in the landscape topography, pool physiography and/or photograph quality (i.e. errors of omission, discussed above) result in vernal pools that are missed by photo interpretation. Furthermore, vernal pool habitat occurs in a wide variety of landscape settings, including within forested swamps, bogs, and other wetlands; within these settings vernal pools will typically not be photo interpreted, but nonetheless provide legitimate and valuable vernal pool habitat.

MassGIS has produced a special compact disc with the Potential Vernal Pool datalayer, select MassGIS data for the state of Massachusetts, and a stand-alone Runtime Data Viewer application. Instructions for installing the data viewer begin on page 22. The potential vernal pool data may be viewed over USGS topographic maps and select MassGIS data to help identify the exact loci of pools. Additional datalayers can be downloaded from the MassGIS website (www.state.ma.us/mgis), including black and white aerial photographs and boundaries of conservation and open space lands, for example, to create customized maps with the runtime data viewer.

PVP versus CVP

Potential vernal pools (PVP) identified in this survey are not to be confused with certified vernal pools (CVP). Evidence of amphibians or invertebrates using a vernal pool, in addition to proof that the pool does not support an established, reproducing fish population must be presented to the Natural Heritage & Endangered Species Program for certification to obtain official standing as a certified vernal pool under state wetlands protection laws. Potential vernal pools identified in this survey do not automatically receive protection under the Massachusetts Wetlands Protection Act Regulations (310 CMR 10.00), nor under any other state or federal wetlands protection laws that have specific language protecting certified vernal pools. However, the Wetlands Protection Act regulations allow the local conservation commission to protect the wildlife habitat value of any resource area when it is demonstrated to be important to wildlife. This demonstration can be through the presentation of clear scientific evidence (such as that required for official certification) at any time during the public hearing process.

It is important to note that there are considerable differences in the precision with which the locations of vernal pools are mapped in both the potential vernal pool and certified vernal pools data layers. The potential vernal pools identified by aerial photo interpretation are actually located with much greater precision than the points representing certified vernal pools in the MassGIS. Potential vernal pools are digitized at a scale of approximately 1:12,000 on rectified orthophotographs. At that scale, points representing potential vernal pools have a precision equal to less than +/- 15 feet or so from the center of an interpreted pool. Note that as the view of a map in the data viewer is zoomed in to larger and larger scales, the point representing a potential vernal pool will migrate away from the true center of the pool because the point was drawn at 1:12,000 scale. Certified vernal pools are currently digitized by generating a latitude and longitude number measured on a paper 1:25,000 scale USGS topographic map. Measurements made on these maps have a precision of approximately +/- 50 feet in any direction. Therefore, when comparing the PVP layer to the CVP layer there may well be some disagreement between the two points representing the same vernal pool. It may appear that the two layers do not match up when looking at points representing the same pool. The local conservation commission is sent copies of the maps that are submitted to the NHESP for certification. To be certain

about the location of a certified vernal pool relative to potential vernal pools that you might be working with, visit the conservation commission office and ask to view the file they received from the NHESP when the pool was certified. In addition, the layers are not exactly the same; some certified vernal pools can not be seen on the aerial photographs (for various reasons) and are therefore not included in the PVP data, and the vast majority of potential vernal pools have not been certified.

So please take care in interpreting the differences in the PVP and CVP datalayers, understanding that there will be inconsistencies between the two, both real and perceived.

Vernal pool protection in Massachusetts

Massachusetts has long been one of the most progressive states in the nation in protecting wetlands. It has been a leader in the protection of vernal pools through implementation of regulations and programs that have resulted in the identification and regulation of more than 2000 of these important wildlife habitats. Vernal pools are protected under the Massachusetts Wetlands Protection Act regulations (310 CMR 10.00), Surface Water Quality Standards (314 CMR 4.00), subsurface sewage disposal regulations (Title 5: 310 CMR 15.000) and the Forest Cutting Practices Act regulations (304 CMR 11.00). Many communities across the Commonwealth have also enacted additional protection through local bylaws (see Appendix A) that can significantly increase the protection of vernal pools beyond that which state regulations provide.

Wetlands Protection Act. Prior to 1986, the wildlife habitat function of wetlands was not protected by the Massachusetts Wetlands Protection Act (WPA, M.G.L. c.131 §40). Revisions to the Act in 1986 added wildlife habitat as a protected "statutory interest" to be considered when permitting work in and around wetlands. Vernal pools were recognized as important but often overlooked wildlife habitats. However, their protection was not made automatic because "it would be unfair to applicants to require them to conduct difficult, timely, expensive, and often inconclusive searches for possible vernal pools" (Wetlands Protection Act Regulations Preface, 1987). Thus, the vernal pool certification program was developed for use with the Wetlands Protection Act regulations to identify and map vernal pools that meet established physical and biological criteria. The program is administered by the Natural Heritage & Endangered Species Program (NHESP) of the Massachusetts Division of Fisheries and Wildlife. The

certification program was developed to inform applicants, conservation commissions and regulators of the occurrence of vernal pool habitat in advance of project proposals.

Through the Massachusetts Wetlands Protection Act regulations, local conservation commissions regulate building and development that is proposed within and adjacent to wetlands across the state. The Act protects wetland functions, referred to as the "interests of the Act." Its regulations (310 CMR 10.00) define wetland resource areas, the inland and coastal wetlands that fall under the jurisdiction of the Act, and establish presumptions of significance for each resource area. These presumptions establish the interests of the Act that are supported by each jurisdictional wetland type. Presumptions of significance are rebuttable upon a clear showing, through the presentation of scientific evidence, that a wetland resource area functions in a manner that is inconsistent with the presumptions in the regulations for that wetland type. All jurisdictional inland wetlands except Isolated Land Subject to Flooding (ILSF) and portions of Bordering Land Subject to Flooding (BLSF) are presumed significant to the protection of wildlife habitat. ILSF is defined as "isolated depression or closed basin [wetlands] without an inlet or an outlet" that, at least once a year, "confine standing water to a volume of at least 1/4 acre-feet and to an average depth of at least six inches." Since ILSF does not carry a presumption of significance to wildlife habitat, it cannot be protected for the wildlife habitat interest unless it is shown, by a preponderance of evidence, that it is significant to that interest. The official vernal pool certification program was originally developed to document cases where ILSF and BLSF were functioning as vernal pool habitat, and therefore significant to the protection of the wildlife habitat value protected by the Act. It is notable that in the years since 1987, the NHESP has found no instance where an ILSF does not function as vernal pool habitat.

In collaboration with biologists and regulators, the NHESP developed the official vernal pool certification program. Criteria were established for the documentation of the physical and biological characteristics of vernal pool habitat consistent with the definition in the regulations. The process typically involves volunteer effort in the documentation of the physical and biological characteristics of vernal pool habitat and submission to the NHESP for review. If the vernal pool meets the requirements of the official *Guidelines for the Certification of Vernal Pool Habitat*, the NHESP certifies the pool and notifies the local conservation commission and the Massachusetts Department of Environmental Protection's (DEP) Regional Office. Biennially, the NHESP creates and distributes maps with the locations of certified vernal pools for use by town conservation commissions, DEP staff, and project applicants to be able to identify certified vernal pools during the permitting process.

The NHESP certifies any depressional area where vernal pool indicator species are documented, provided that it holds water for at least 2 months during the spring and summer of most years and is free of established fish populations. However, certification of a vernal pool does not mean that the pool is automatically protected by the Wetlands Protection Act

regulations; certified vernal pools are not themselves jurisdictional wetlands. If a certified vernal pool does not occur within a wetland protected by the Act, there is no jurisdiction over that pool, and the pool is therefore not protected under the Wetlands Protection Act. However, when a certified vernal pool falls within a jurisdictional wetland (e.g., ILSF or Bordering Vegetated Wetland), the regulations protect the pool and *up to* 100 feet beyond its boundary, referred to as the "vernal pool habitat." The vernal pool and associated "habitat" must exist within the boundaries of a jurisdictional wetland; no upland areas are protected under the Wetlands Protection Act (there is an exception to this under the Rivers Protection Act, discussed below). The NHESP defines the boundary of vernal pools, wherever they occur, as the maximum observed or recorded extent of flooding in a confined basin depression, or evidence of the same (e.g. leaf staining, etc.).

The regulations protect the wildlife habitat value of a certified vernal pool through general performance standards for proposed projects (310 CMR 10.57(4)(a)3 and (b)3). There is no threshold, or minimum size project, that is presumed to have no impact on certified vernal pool habitat, and no alteration of vernal pool habitat is permissible that would "impair [the resource area's] capacity to provide important wildlife habitat functions." Therefore, any project that would alter a certified vernal pool must demonstrate that there would be no substantial reduction in the pool's capacity to provide food, shelter, migratory and breeding areas, and overwintering areas for amphibians, or food for other wildlife. No changes to the topography, soil structure, plant community composition and structure, or hydrologic regime are permissible if, after 2 growing seasons, the habitat functions listed above would be substantially reduced.

Rivers Protection Act. The Wetlands Protection Act was again amended in 1996 (originally proposed as a separate Act, the Rivers Protection Act was ultimately passed as an amendment to the WPA), establishing a new wetland resource area called the Riverfront Area that extends 200 feet from the banks of perennial streams. The regulations (revised 1997) for this new resource area include specific protection for vernal pools, both certified and not. Where a vernal pool within the Riverfront Area is certified prior to the filing of a Notice of Intent, there is a strict performance standard that prohibits any project that will have any adverse effect on the wildlife habitat value of the vernal pool. For vernal pools that are not certified, yet are identified with evidence from a competent source during project review, a project must have "no significant adverse impact" on its ability to provide vernal pool habitat.

Specific standards for uncertified vernal pools are a departure from the vernal pool protection under the remainder of the Wetlands Protection Act regulations.

The Riverfront Area encompasses all lands within 200 feet of perennial streams. The wildlife habitat value of the entire 200 foot-wide Riverfront Area may be protected under 310 CMR 10.58. Therefore, unlike the protection provided to the wetland resource areas by the remainder of the Act, the provisions for Riverfront Area allow protection of the important habitat functions of uplands adjacent to vernal pool habitat. A growing body of research indicates the tremendous importance of upland areas to wetland-dependent wildlife populations (Burke and Gibbons, 1995; Dodd and Cade, 1998; Semlitsch, 1998). Surrounding uplands provide critical non-breeding habitat for animals that are largely terrestrial after completing their larval stage. Both vernal pools and adjacent uplands that occur within the Riverfront Area are protectable. Protection of uncertified vernal pools and adjacent uplands were important developments in the protection of vernal pool habitat developed under the Riverfront provisions of the Wetlands Protection Act. All vernal pool habitat, certified or not, within the Riverfront Area is protected, as is the associated upland, non-breeding habitat occurring within the 200 foot Riverfront Area.

Surface Water Quality Standards. The current Massachusetts Surface Water Quality Standards (314 CMR 4.00) were adopted in 1990 by the DEP's Division of Water Pollution Control to protect public health and enhance the quality and value of the water resources of the Commonwealth. The Standards implement the Massachusetts Clean Water Act (M.G.L. c.21, §26-53), "which directs the Division to take all action necessary or appropriate to secure to the Commonwealth the benefits of the Federal [Clean Water] Act. The objective of the Federal Act is the restoration and maintenance of the chemical, physical and biological integrity of the Nation's waters" (314 CMR 4.01(4)). Before the US Army Corps of Engineers may issue a federal Clean Water Act permit for activities proposed in "waters of the United States" (federal wetlands) that occur within the Commonwealth, a project must obtain a 401 Water Quality Certification (314 CMR 9.09). 401 Water Quality Certifications are issued by the DEP for projects that meet the requirements of the Massachusetts Surface Water Quality Standards (314 CMR 4.00).

The Surface Water Quality Standards designate certified vernal pools as Class B Outstanding Resource Waters (ORWs, 4.06(2)(a)). They are protected by antidegradation provisions (314 CMR 4.04(3)) that prohibit any new or increased discharge of pollutants. "No discharge of dredge or fill

material shall be allowed to a [certified] vernal pool." (314 CMR 4.06(1)(d)(11)). These regulations relate directly to the federal Clean Water Act. Therefore, the vernal pool must occur within a wetland under federal jurisdiction, and the activity proposed must also trigger federal jurisdiction. Similar to the Wetlands Protection Act, the protection provided by the Surface Water Quality Standards end at the boundary of the jurisdictional wetland, in this case a water of the United States, as determined by federal wetland delineation standards.

Title 5. Title 5 of the Massachusetts Environmental Code (310 CMR 15.000) protects certified vernal pools by establishing minimum setbacks from their boundaries for subsurface sewage disposal (septic) system components. Septic tanks must be sited at least 50 feet, and soil absorption systems (leach fields) and their reserves a minimum of 100 feet from the boundary of a certified vernal pool. The leach field setback may be reduced to 50 feet where an applicant provides hydrogeologic data that demonstrates that the location of the leach field is hydraulically down-gradient of the vernal pool.

The effective implementation of these regulations requires local boards of health to check with their conservation commission for the locations of certified vernal pools before permitting septic system plans. Title 5 only protects vernal pools certified prior to application for septic system permits.

Forest Cutting Practices Act. The Forest Cutting Practices Act regulations protect vernal pools from certain forest harvesting impacts, and include protection for both certified and uncertified vernal pool habitat. Harvesting around certified vernal pools is restricted to cutting no more than 50% of the basal area of trees within 50 feet of the pool. The regulations require that no trees or tree tops be felled in vernal pool depressions and that skidder trails not traverse them. They also prohibit their use as staging areas. Vernal pools that have not been officially certified but are located by a service forester may also be protected. The regulations contain guidelines for activities around these pools that are similar to the requirements for forestry practices performed near certified vernal pools.

NHESP Potential Vernal Pool Metadata: Synopsis of the PVP data layer
-December 2000

OVERVIEW

This datalayer identifies the locations of potential, unverified, vernal pool habitat. Vernal pools are small, shallow ponds characterized by lack of fish and annual or semi-annual periods of dryness. Vernal pool habitat is extremely important to a variety of wildlife species including some amphibians that breed exclusively in vernal pools, and other organisms such as fairy shrimp which spend their entire life cycles confined to vernal pool habitat.

Potential vernal pools visible on aerial photographs were interpreted and digitized on the MassGIS. This datalayer does not include every vernal pool in Massachusetts. Many vernal pools have not been identified due to unfavorable conditions in the landscape topography, pool physiography and/or photograph quality. Furthermore, vernal pool habitat occurs in a wide variety of landscape settings, including forested swamps, bogs, and other wetlands. Vernal pools within these settings were not typically interpreted, but are nonetheless legitimate and valuable vernal pools. Also, field verification of all potential vernal pools in this study will identify errors such as the inclusion of features that are not actually vernal pools.

Potential vernal pools identified in this survey are not to be confused with Certified Vernal Pools. Data pursuant to the official "Guidelines for the Certification of Vernal Pool Habitat" must be collected in the field and presented to the Massachusetts Natural Heritage & Endangered Species Program to obtain official certification for a vernal pool. Potential vernal pools identified in this survey do not receive protection under the Massachusetts Wetlands Protection Act Regulations (310 CMR 10.00), or under any other state or federal wetlands protection laws.

PRODUCTION

Potential vernal pools were identified from 1:12,000 scale, color infra-red (CIR), leaf-off aerial photographs flown between late March and Early May. Statewide coverage included photos taken in 1993 (Bristol, Barnstable, Nantucket and Dukes Counties), 1999 (Plymouth, northern and southern Worcester, and eastern Franklin, Hampshire and Hampden Counties), and 2000 (Essex, Middlesex, Suffolk, Norfolk, central Worcester, western Franklin, Hampshire and Hampden, and Berkshire Counties). Using stereo pairs under a mirror stereoscope, the approximate centers of pools were located. These points were digitized in a heads-up manner onto the MassGIS black and white digital orthophotos at a scale of approximately 1:12,000.

ATTRIBUTES

The datalayer contains a field called Pvp_id that identifies each Potential Vernal Pool by a unique alphanumeric code. The digits correspond to the Town names in alphabetical order.

AVAILABILITY

This datalayer may be made available to EOEA agencies and EOEA cooperators for certain projects. The legend that MUST accompany this datalayer on all maps is:

"NHESP Potential Vernal Pools: NOT equivalent to Certified Vernal Pools"

Suggested Reading

Vernal Pool Identification and Certification

Colburn, E.A., ed. 1993. *Certified: A Citizen's Step-by-Step Guide to Protecting Vernal Pools.* 5th Edition. Massachusetts Audubon Society, Lincoln, MA.

Kenney, L.P. 1995. *Wicked Big Puddles: A Guide to the Study and Certification of Vernal Pools.* Vernal Pool Association, Reading, MA.

Kenney, L.P. and M.R. Burne. 2000. *A Field Guide to the Animals of Vernal Pools.* MA Division of Fisheries & Wildlife, Westborough, MA.

Amphibians/Reptiles

Behler, J.L. and F.W. King. 1979. *The Audubon Society Field Guide to North American Reptiles and Amphibians.* Alfred A. Knopf, New York.

Conant, R. and J.T. Collins. 1998. *A Field Guide to Reptiles & Amphibians, Eastern and Central North America.* 3rd Edition, Expanded. Houghton Mifflin, Boston, MA.

Hunter, M.L., A.J.K. Calhoun, and M.McCollough, ed. 1999. *Maine Amphibians and Reptiles.* University of Maine Press, Orono, ME.

Tyning, T.F. 1990. Stokes Nature Guides: *A Guide to Amphibians and Reptiles.* Little, Brown and Company.

Invertebrates

Lehmkuhl, D.M. 1979. *How to Know the Aquatic Insects.* The Pictured Key Nature Series, W.C. Brown Company, Iowa.

McCafferty, W.P. 1981. *Aquatic Entomology, The Fishermen's and Ecologists' Illustrated Guide to Insects and Their Relatives.* Jones and Bartlett Publishers, Boston, MA.

Pecharsky, B.L., P.R. Fraissinet, M.A. Penton, and D.J. Conklin, Jr. 1990. *Freshwater Macroinvertebrates of Northeastern North America.* Cornell University Press, Ithaca, NY.

Plants

Redington, C.B. 1994. *Plants in Wetlands.* Kendall/Hunt Publishing Co., Dubuque Iowa.

Newcomb, L. 1977. *Newcomb's Wildflower Guide.* Little, Brown and Co., Boston, MA.

Magee, D.W. 1981. *Freshwater Wetlands: A Guide to Common Indicator Plants of the Northeast.* University of Massachusetts Press, Amherst, MA.

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Brooks, R.T., J. Stone, and P. Lyons. 1998. An inventory of seasonal forest ponds on the Quabbin reservoir watershed, MA. Northeast Naturalist 5(3): 219-230.

Burke, V.J. and J.W.Gibbons. 1995. Terrestrial buffer zones and wetland conservation: A case study of freshwater turtles in a Carolina bay. Conservation Biology 9:1365-1369.

Dodd, C.K., Jr. and B.S. Cade. 1998. Movement patterns and the conservation of amphibians breeding in small, temporary wetlands. Conservation Biology 12(2): 331-339.

Semlitsch, R.D. 1998. Biological delineation of terrestrial buffer zones for pond-breeding salamanders. Conservation Biology 12(5): 1113-1119.

Stone, Janice. 1992. Vernal pools in Massachusetts: aerial photographic identification, biological and physiographic characteristics, and state certification. Master's Thesis. University of Massachusetts. 98 pp.

Appendix A

Model Letter for Landowner Permission

Following is a model letter for landowner permission. While the information presented in the Massachusetts Aerial Photo Survey of Potential Vernal Pools should be used to increase vernal pool awareness and protection through local efforts or through the official Vernal Pool Certification Program, **landowner permission should be obtained, in writing, prior to any field investigation.**

The Massachusetts Natural Heritage & Endangered Species Program is required to release all information contained in our files when an information request is made under the state's public documents request law. The official field form becomes part of the public record and must be released when requested. The name and address of the observer must be included in the documents that are released under this law, so it is strongly recommended that you obtain permission prior to collecting information for certification.

Name
Address
Phone number

Date

Landowner name
Street address
Town, State, ZIP

I am writing to ask for your permission to study a potential vernal pool. The local assessor's records indicate that you own the parcel containing the potential vernal pool I am interested in. I am **(a student / conservation commission member / other)**. I would like to visit the potential vernal pool on your property to **(explain your interest in the pool)**.

(If certifying)

Vernal pools are important nurseries for a wide variety of amphibians (frogs, toads and salamanders), and are also important to birds, mammals, reptiles, and a host of invertebrates. I will search for evidence of amphibians or invertebrates that may be breeding in the vernal pool. If the eggs or young of vernal pool species are found, I will take photographs and make notes of the animals that are found. This information, along with maps of the vernal pool, will be submitted to the state's Division of Fisheries and Wildlife for official certification.

The official certification of a vernal pool on your property could result in protection under the Massachusetts Wetlands Protection Act, as well as three other state wetland protection regulations. Although this might result in restriction on certain activities in or immediately around the pool, such as vegetation cutting or dumping, it would greatly help the protection of the wildlife that depends on these important nurseries.

(If not certifying)

(Explain specifically what you intend to do and how the information would be used)

I would greatly appreciate your permission to visit the potential vernal pool that is on your property. I would be happy to talk with you about these important wildlife habitats, and even bring you out to the pool to show you what I find. I also would like to share the information that I collect with you when I am done.

Thank you very much,
Sincerely,

(Sign)

Appendix B

Vernal Pool Protection - the Local Bylaw

The Massachusetts Wetlands Protection Act does not protect vernal pools that are outside of jurisdictional resource areas and does not address the upland habitat needs of terrestrial vernal pool dependent species like the spotted salamander. The exception to these shortfalls is for vernal pools found within the 200 foot "Riverfront Area" associated with perennial (permanent) streams. Vernal pools and their associated uplands, to the extent that they fall within the Riverfront Area are much more effectively protected. To address the shortcomings of the Wetlands Protection Act, many towns throughout the Commonwealth have implemented local bylaws, administered by the conservation commission, that protect any vernal pool (officially certified or not), and upland habitat surrounding them. Some even refine their definition to include extremely small vernal pools. When properly constructed and adequately justified, bylaws are powerful tools for protecting a town's vernal pool resources along with critical upland non-breeding habitat.

Following are excerpts from the Sudbury bylaw and regulations pertaining specifically to the definition and protection of vernal pools. This bylaw is one of the most progressive and comprehensive in the state because it broadens the definition of protectable vernal pools far beyond simply those that are certified by the NHESP, and establishes the upland area surrounding vernal pools (as well as all other wetland resource areas) as a resource area protected under the bylaw. While the specific language is not necessarily applicable for all towns across the Commonwealth, the Sudbury bylaw provides useful hints and ideas for crafting a bylaw that will more effectively protect vernal pools. The complete text can be found at http://home.att.net/~sudbury.concom/bylaw.htm.

Contact the Massachusetts Association of Conservation Commissioners (www.maccweb.org) for additional information and assistance in developing and passing a bylaw for the protection of your town's vernal pools and other critical wetland resources.

Town of Sudbury Wetlands Administration Bylaw (Revised June 1998)

Bylaw Section 1. Purpose

The purpose of this bylaw is to maintain the quality of surface water, the quality and level of the ground water table and water recharge areas for existing, or potential water supplies; to protect the public health and safety; to protect persons and property against the hazards of flood water inundation; to protect the community against the costs which may be incurred when unsuitable development occurs in wetland resource areas; and to provide for the reasonable protection and conservation of certain irreplaceable natural features, resources and amenities for the benefit and welfare of the present and future inhabitants of the Town of Sudbury.

Accordingly, this bylaw protects the wetlands, related water resources, and certain adjoining land areas in the Town by providing for prior review and control of activities deemed to have a significant or cumulative adverse effect upon wetland values, including but not limited to the following: protection of public and private water supply, protection of ground water, flood control, erosion and sedimentation control, storm damage prevention, avoidance of water and soil pollution, protection of fisheries, wildlife habitat, rare species habitat including rare plant species, agriculture, aquaculture, and recreation values, deemed important to the community (collectively, the "wetlands values protected by this bylaw"). This bylaw is intended to utilize the Home Rule authority of this municipality to protect additional resource areas, for additional values, with additional standards and procedures to augment those of the Wetlands Protection Act, G.L. Ch 131, §40 and Regulations thereunder, 310 CMR 10.00.

Bylaw Section 9. Definitions

The following definitions shall apply in the interpretation and implementation of this bylaw.

The term "adjacent upland resource area" shall include all lands within 100 feet of wetland resource areas as enumerated in section 2, except for perennial streams and rivers for which the adjacent upland resource area extends for 200 feet from the top of bank, and except for vernal pools, ponds under 10,000 square feet in area, and isolated land subject to flooding for which special adjacent upland resource area definitions are described below.

The term "vernal pool" shall include, in addition to that already defined under the Wetlands Protection Act, G.L. Ch. 131, §40 and Regulations thereunder, 310 CMR 10.00, any confined

basin or depression not occurring in existing lawns, gardens, landscaped areas, or driveways which, at least in most years, holds water for a minimum of two continuous months during the spring and/or summer, contains at least 200 cubic feet of water at some time during most years, is free of adult predatory fish populations, and provides essential breeding and rearing habitat functions for amphibian, reptile or other vernal pool community species, regardless of whether the site has been certified by the Massachusetts Division of Wildlife and Fisheries. The presumption of essential habitat value may be overcome by the presentation of credible evidence which in the judgment of the Commission demonstrates that the basin or depression does not provide the habitat functions as specified in the Bylaw regulations. The adjacent upland resource area for vernal pools shall extend 100 feet from the mean annual high-water line defining the depression, or one-half of the distance between the vernal pool and any existing house foundation, which ever is smaller. In either case the adjacent upland resource area for vernal pools shall not extend over existing lawns, gardens, landscaped or developed areas.

Sudbury Wetlands Administration Bylaw Regulations Revised November 2000

Regulations Section 2. Jurisdiction

2.1 Presumption of Vernal Pool Habitat

The Bylaw presumes vernal pool habitat exists if a wetland's physical characteristics conform with those defined for vernal pools in Section 9 (Definitions) of the bylaw: [see above]

This presumptive definition for vernal pools is based on systematic field observation in the Town of Sudbury by the Sudbury Conservation Commission showing that virtually all basins that possess the above characteristics actually host breeding vernal pool species. Undoubtedly this is a particular consequence of Sudbury's semi-rural character and enduring woodlands and wetlands.

The presumption of vernal pool habitat may be overcome, however, with the presentation of credible evidence which in the judgment of the Conservation Commission demonstrates that the wetland does not provide, or cannot provide, vernal pool habitat functions.

2.1.1 Demonstrating that a Ponding Area is not a Vernal Pool

For the purposes of overcoming the presumption of vernal pool habitat the Commission will consider:

2.1.1.1 Evidence that the ponding area does not hold water for at least two continuous months in most years. As a rule of thumb the term "most years" shall mean three out of five consecutive years.

2.1.1.2 Evidence that vernal pool species do not breed or have not bred in the ponding area. The Conservation Commission shall provide explicit guidelines for this evidence.

2.1.1.3 Evidence that the ponding area could not be a viable breeding site for vernal pool species due to incompatible physical, chemical, biological, or other persistent conditions at the site in most years. Such evidence could include, without limitation, several months of pH and dissolved oxygen measurements yielding values incompatible with amphibian or reptile breeding.

2.1.2 Timing of Evidence Collection

Many of the indicators of vernal pool habitat are seasonal. For example, certain salamander egg clusters are only found between late March and late May. Wood frog chorusing only occurs between late March and May, and then only at night. Consequently, failure to find evidence of breeding must be tied explicitly to those periods during which the evidence is most likely to be available.

Accordingly, in the case of challenges to the presumption of vernal pool habitat the Conservation Commission may require that the determination be postponed until the appropriate time period consistent with the evidence being presented. The Commission may also require its own site visits as necessary to confirm the evidence.

Regulations Section 7. Permits and Conditions

7.1 Performance Standards & Design Criteria for Adjacent Upland Resources

As stated in the Bylaw, Section 7 Permits and Conditions lands within 100 feet of wetlands resource areas (25 feet in the case of isolated land subject to flooding):

"...are presumed important to the protection of these resources because activities undertaken in close proximity to wetlands and other resources have a high likelihood of adverse impact upon the wetland or other resource, either immediately, as a consequence of construction, or over time, as a consequence of daily operation or existence of the activities. These adverse impacts from construction and use can include, without limitation, erosion, siltation, loss of groundwater recharge, poor water quality, and harm to wildlife habitat.

The Commission may therefore require that the applicant maintain a strip of continuous, undisturbed vegetative cover in part or all of the 100-foot area and set other conditions on this area, unless the applicant provides evidence deemed sufficient by the Commission that the area or part of it may be disturbed without harm to the values protected by the law."

7.2 Considerations in Setting Disturbance Restrictions.

A growing body of research evidence suggests that even "no disturbance" areas reaching 100 feet from wetlands may be insufficient to protect many important wetland resource characteristics and values. Problems of nutrient runoff, water pollution, siltation, erosion, vegetation change, and habitat destruction are greatly exacerbated by activities within 100 feet of wetlands. Thus, in general work and activity within 100 feet of wetlands should be avoided and discouraged and reasonable alternatives pursued.

Accordingly, the Conservation Commission shall begin with the presumption that lands within the adjacent upland resource of a resource are best left in an undisturbed and natural state. [Note: the Bylaw contains a number of exemptions for single family residences existing prior to July 27, 1994]

However the Commission shall designate areas of the adjacent upland resource to be suitable for temporary, limited, or permanent disturbance as appropriate when the applicant can demonstrate to the Commission's satisfaction that the proposed work or activity will not affect wetland values singularly or cumulatively and that reasonable alternatives to the proposed work or activity do not exist.

In considering designation of adjacent upland resource disturbance areas, the types of work and activities allowable, and conditions to apply, the Conservation Commission shall consider:

7.2.1 Values and Functions of the Resource Area

The quantity and quality of resource values and functions should be considered explicitly in placing conditions on adjacent upland resource work. Some isolated land subject to flooding, for example, may serve for temporary flood storage only. Minimal adjacent upland resource restrictions within several feet of the resource might be necessary only to prevent erosion.

Other isolated land subject to flooding might provide vernal pool habitat. It might also provide important flood storage capacity and intersect ground water. In this instance far stronger adjacent upland resource restrictions would be appropriate because a larger number of functions are involved and some functions, such as habitat, are more sensitive to adjacent upland resource activity and require greater protection. If rare or endangered species, such as blue spotted salamanders, were found at the site then still greater levels of restrictions would be appropriate.

7.2.3 Wildlife Habitat and Rare Species

The near-upland areas around wetland resources often play important roles in determining and maintaining the wildlife habitat values of associated wetlands. While it is common to think of the protective or "buffering" value of adjacent upland resources in terms of area undisturbed, habitat values may be equally affected by the configuration of the adjacent upland resource perimeter, the inclusion or exclusion of specific topographical and ecological features (such as an abutting sandy knoll or tree canopy), etc.

Therefore where significant wildlife habitat values and functions are present delineation of non-disturbance areas within the adjacent upland resource shall, as is reasonable, minimize the length of perimeter to area left undisturbed, exclude fingers, islands, or other projections or indentations of the non-disturbance zone, and in general avoid delineating oddly shaped non-disturbed areas. The Commission shall give special attention to inclusion inside the no disturbance area of those topographical and ecological features that it deems important for maintaining the wildlife habitat value of the resource.

The potential presence of rare or endangered species and their specific sensitivity to adjacent upland resource activity shall be considered in determining adjacent upland resource restrictions. Evidence of the presence of such species or evidence of likely habitat shall be considered by the Conservation Commission. Prior designation or rare or endangered species habitat by the Division of Fisheries and Wildlife Natural Heritage Program is not necessary.

The Commission may consult with the Division of Fisheries and Wildlife Natural Heritage Program or other authorities as it deems necessary for guidance and recommendations.

7.2.4 No Significant Adverse Impact on Wildlife Habitat

Wildlife habitat serves a variety of functions in support of wildlife. Food, water, breeding space, shelter, security, movement and migration space, and connections to other habitat areas are all equally important. All of these wildlife habitat functions are presumed to exist in all resource areas.

Therefore in accordance with the Bylaw's fundamental purposes (see Bylaw, Section 1 above) no project may have a significant adverse impact - either project-specific or cumulative - on wildlife habitat for more than two growing seasons.

For wildlife habitat purposes, a significant adverse project-specific impact is defined as an impact caused by work in a resource area that would under reasonable assumptions (a) result in a measurable decrease in the extant wildlife populations or biological composition, structure, or richness on the site or in the vicinity exclusive of the present or future state of adjacent and nearby

properties, or (b) impair, damage, destroy, or reduce in value for wildlife purposes certain specific habitat features.

Wildlife studies have shown that direct impacts from work - filling, grading, vegetation removal, construction of barriers to movement, etc. - in resource areas can severely harm wildlife populations. For example, low stone walls bisecting a resource area can prevent amphibians that live in upland areas from reaching breeding pools, marshes, and streams. Or, removal of large snags (dead trees) can virtually eliminate nesting by barred owls, pileated woodpeckers, mink, etc. Accordingly, the Commission shall prohibit the placement of fences or other barriers to wildlife movement within and between resource areas and the destruction of specific habitat features.

Examples of protected habitat features include (but are not limited to):

- Large cavity trees
- Turtle nesting areas
- Existing nest trees for birds that reuse nests
- Beaver dams, dens, and lodges
- Mink or otter dens
- Vernal pools
- Vertical sandy banks
- Migration corridors that provide connectivity between wildlife habitats
- Sphagnum hummocks and pools suitable to serve as nesting habitat for four-toed salamanders

But indirect impacts - the effects of human activities near wildlife habitat - can have equally harmful effects. Therefore the Commission shall take into account indirect effects on a project by project basis. So, for example, no work within resource areas shall be permitted within 100 feet of existing beaver, mink or otter dens, or within 200 feet of existing osprey or great blue heron nests.

As clearly stated in Section 1 of the Sudbury Wetlands Administration Bylaw the purpose of the Bylaw is to preserve for future generations of residents the natural resources and amenities - including wildlife - we presently enjoy in Sudbury. The Bylaw protects future values as well as current ones. Therefore, the Commission must be especially cognizant of the likely cumulative impact of work within resource areas.

For wildlife habitat purposes a significant cumulative adverse impact is defined as an impact that would under reasonable assumptions result in a measurable decrease in the extant wildlife populations or biological structure, composition, or richness on the site or in the vicinity taking into account the projected impacts of future projects that could be proposed in the vicinity with similar, comparable, or other significant impacts and disturbance.

This method for assessing cumulative impacts avoids the pitfall of placing an unreasonable burden of resource protection on subsequent applicants/projects in the vicinity while subsidizing those who are first to develop land. It allows the Commission to level the marginal impact of all proposed projects in the vicinity while ensuring appropriate protection - present and future - of the values and interests protected by the Bylaw.

Regulations Section 9 DEFINITIONS

9.10 Vernal Pool Species

Any species of reptile, amphibian, or invertebrate that breeds in a vernal pool. These species may be obligate or facultative.