Maine Municipal Guide to Mapping and Conserving Vernal Pool Resources

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For more information please see: www.umaine.edu/vernalpools

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Preface

In 2007, Maine passed legislation regulating development activities within 250 feet of a subset of vernal pools known as Significant Vernal Pools (SVPs). In response to the regulation, the University of Maine and Maine Audubon initiated a vernal pool mapping program with several Maine towns interested in proactively identifying pools for planning purposes. Since then, we have worked closely with constituents from 12 Maine communities to develop and test our mapping and assessment methods with the goal of developing this manual to assist additional towns interested in vernal pool mapping and natural resource planning.

The intent of this manual is to guide municipalities in mapping and assessing pool resources in order to pre-identify exemplary pools (either SVPs or by using other definitions of exemplary), provide information to citizens, and create a vernal pool data layer for use in municipal-wide planning. It is written for municipal officials, natural resource planners, naturalists, or any Maine citizen interested in learning about vernal pools. While the focus of this publication is to provide guidance to municipalities in Maine, the methodology is appropriate at a variety of scales and is applicable to any region interested in local, collaborative conservation planning. For example, this process and the associated resource materials may be of use to land trusts, conservation organizations, non-governmental organizations, and both public and private land managers. We tried to write this manual for non-scientists but have included research citations for those readers who wish to explore the scientific literature in greater depth.

The Manual is divided into three sections:

(I) vernal pool ecology,

(II) a step-by-step guide to pool mapping and assessment using citizen scientists,

(III) vernal pool regulation in Maine with strategies for conserving pool habitats at a local scale.

Recommendations made in this document are based on feedback from our state and town partners. Utmost care was taken to design data collection protocols that are manageable for citizen scientists and will yield quality results. Following the steps outlined in Section II of this manual will meet criteria for data submission to the Maine Department of Inland Fisheries and Wildlife for regulatory determination. A variety of resource materials designed specifically for this program are available at ***www.umaine.edu/vernalpools***. Materials referred to in the text that are available on the website are designated with this icon:

Linking this document to a website will enable us to add new resources and update materials as needed.

Most importantly, the manual is designed to inspire you to learn more about vernal pools. Part of the joy of living in New England is celebrating the simple treasures that this recently-glaciated landscape affords us including salt marshes, peatlands, kettle ponds, and, of course, vernal pools. As long as our forests are rich with amphibian and bird choruses, we know they are healthy. Please join us in an effort to find, describe, and conserve the best wood frog choruses in the forest.

Acknowledgments

To keep pace with changes in vernal pool regulations, we have updated the 2003 *Maine Citizen's Guide to Locating and Documenting Vernal Pools* so it is more of a "how-to" guide for towns interested in proactively mapping their vernal pool resources and in pre-identifying Significant Vernal Pools. Motivated by requests for guidance on mapping and assessment of pools from towns in Maine and throughout the Northeast and Atlantic Canada, this Manual will provide guidance on conserving vernal pools in developing landscapes through local efforts.

This project has benefited greatly from feedback from towns participating in the vernal pool mapping project (2007-2011) including Brunswick, Cumberland, Freeport, Orono, Readfield, Scarborough, Topsham, Wayne, Windham, and Yarmouth. Special thanks to Vanessa Levesque, the natural resources planner for Brunswick, who provided invaluable feedback on improving the data collection process and field data sheets. We would also like to recognize the help and feedback provided by Penny Asherman, Paul Austen, Cathy Bevier, Jerry Bley, Amanda Devine, Vanessa Farr, Robert Jordan, Theresa Kerchner, Donna Larson, Leslie Latt, Rod Melanson, Evan Richert, Ben Smith, David Sawyer, Bill Shane, Tim Sniffen, and Andy Wilbur.

Fred Dibello (Stantec, Inc.) photo interpreted potential vernal pools for all the participating towns and continues to work with us to provide towns with feedback and to improve the accuracy of remote sensing of vernal pools. His expertise and patient support were critical to the success of this project. We also wish to acknowledge Phillip deMaynadier, Jason Czapiga, and Don Katnik from the Maine Department of Inland Fisheries and Wildlife (MDIFW) with whom we have worked to develop data collection forms compatible with the MDIFW database, and Jim Cassida from the Maine Department of Environmental Protection (MDEP) for providing summer interns.

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Louis Morin (UMaine School of Forest Resources), Sally Stockwell (Maine Audubon), and Gregory Penta, Ruth Ladd, and Jay Clement (US Army Corps of Engineers). Thank you to Diane Morgan for providing copy editing throughout the production of this *Guide*. And lastly, a very special thank you to Rena Carey in the Department of Wildlife Ecology at UMaine for designing and launching the Maine Vernal Pool webpage, for providing technical support, and for publication layout.

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Section 1
About Vernal Pools

"Quack, quack, quack ... could it be? " As we bushwhack our way through the awakening forest over patches of slushy snow and soggy moss, we move ever closer to what we think must be a flock of ducks hidden in a secret pond. Instead, we find a vernal pool alive with male wood frogs chorusing to attract mates after a long, solitary winter under the snow. Celebrated in poems and art, vernal or springtime pools continue to remind us that magic can be real and that some of the best things in life are ephemeral.

An ecologist would describe a vernal pool as a wetland that is temporary, typically filling with snow melt and spring run-off (vernal = spring), and often drying by summer's end. These pools are the preferred breeding habitat for a few of our amphibians and invertebrates such as wood frogs, spotted and blue-spotted salamanders, and fairy shrimp. The seasonal nature of the pool maintains a fishless environment conducive to the successful breeding of animals whose eggs and young would otherwise be eaten by fish.

For many animals coming out of hibernation (bears, turtles, aquatic frogs), and for birds returning to Maine to breed (e.g., herons, ducks, raptors), vernal pools provide a spring feast of egg masses and adult amphibians. In short, springtime pools provide easy, fast food for woodland animals after a long winter with limited food.

In this section, you will learn about the uniqueness of vernal pools, how you can find them in our forested landscape, and about the species of wildlife they support.

Part 1: Vernal Pool Ecology

Vernal pools offer special benefits to wildlife that both breed and feed there. Learn about the characteristics of vernal pools and the fascinating life cycles of the animals that use them.

Topics Covered

- Definition and characteristics of vernal pools
- Important connections between the breeding pool and adjacent forest
- Five good reasons to conserve vernal pools

Key concepts

- Defined by the indicator species that breed in them, vernal pools occur in many different types of wetlands
- As unique seasonal wetlands, vernal pools provide specialized breeding habitat for certain amphibian and invertebrate species
- Breeding pools **and** the adjacent forest are essential in supporting wildlife throughout the year
- Vernal pools are critical to many more species of wildlife than just the amphibians and invertebrates that breed in them
- Vernal pools are especially vulnerable to loss

What are vernal pools?

In the Northeast, vernal pools are also known as seasonal woodland pools, ephemeral forest pools or seasonal wetlands. For the purpose of this manual, vernal pools are defined as naturally occurring, seasonal bodies of water free of predatory fish populations. They provide breeding habitat for one or more of Maine's vernal pool indicator species: spotted and blue-spotted salamanders, wood frogs and fairy shrimp.

Defined by the animals that breed in them, vernal pools in Maine occur in a number of wetland settings. For example, vernal pools may be described by wetland ecologists as marshes, shrub swamps, or forested wetlands. They occur on floodplains, as depressions in upland forests, or in association with other wetlands (see Figure 1).

The length of time that a pool holds water varies from pool to pool and from year to year, depending on rainfall and snowmelt. Pools may be ephemeral (drying each year but holding water 3-5 months) or semi-permanent (partially drying every year but only drying completely during years of drought). Semi-permanent breeding pools tend to be shallow enough to exclude adult fish populations by becoming anoxic (without oxygen) by summer's end and/or by completely freezing to the bottom in winter.

Figure 1: *Vernal pools in different landscape settings. A) Flood plain vernal pool. B) Upland depression pool. C) Pool associated with glacial kettle hole containing sphagnum wetland surrounded by scrub-shrub.*

Vernal pool habitat

Vernal pool habitat consists of the breeding pool **and** the adjacent forest. Protection of the pool alone is not enough to conserve the species dependent upon them. Maine's vernal pool amphibians need both aquatic and terrestrial habitat to complete their life cycle.

During the 11.5 months in which they are not breeding in vernal pools, they live in the adjacent forests. Typically referred to as critical terrestrial habitat (Semlitsch 1998), these forests provide vernal pool amphibians with areas of deep uncompacted leaf litter, decaying logs which provide food and cover, and shade for keeping the forest floor cool and moist so the animals don't dry out (Patrick et al. 2006, deMaynadier and Houlahan 2008).

Dependence on adjacent forested habitat has prompted Semlitsch (1998) to refer to this "buffer" around pools as a "life zone." Juvenile salamanders and wood frogs may spend their first summer and winter within 100 feet of a pool making this zone an important nursery area. Adult amphibians (particularly males) may move into this area in late fall to hibernate closer to the breeding pool (Regosin et al. 2005). Wood frog adults in southern and central Maine often summer in adjacent forested wetlands before moving to well-drained forested uplands to hibernate (Baldwin et al. 2006; Blomquist 2007), while spotted salamanders summer and hibernate in adjacent well drained uplands (Homan et al. 2007). Animals typically travel over 700 feet to reach summer or winter habitat (see Figure 2). Dispersal distances (distances traveled by animals, usually juveniles to find new places to breed) may be even further, measured in miles rather than hundreds of feet (Smith and Green 2005; Gamble et al. 2007).

Figure 2: *Travel distances of adult wood frogs and spotted salamanders (adopted from Calhoun and deMaynader, 2008).*

Resources Available at: www.maine.edu/vernalpools

For additional information, please see Part 3: Vernal Pool Animals, or refer to the annotated *Vernal Pool Ecology* slides on the Maine Vernal Pool Website.

Five reasons to document and conserve pool habitat

1. Special breeding habitat

Vernal pools are fishless pools that provide the best breeding sites for vernal pool amphibian indicator species and for fairy shrimp. For example, egg masses of wood frogs and blue-spotted and spotted salamanders are easily consumed by fish. Even though vernal pool animals may breed in other wetlands, successful production of juveniles is less likely in wetlands with fish or permanent populations of other predators such as bull frogs and green frogs.

Pool-breeding salamanders and wood frogs often return to breed in the pools from which they hatched (Sinsch 1990) and show little tendency to move away from pools that have been drained or filled (Petranka et al. 1994) (see Figure 3). At a minimum, protection of the breeding pool is a critical first step in conserving these species.

Human-created pools and other wetlands that have the proper hydrology--holding water long enough for young to develop but drying by season's end--may also provide breeding sites for some of the indicator species. We encourage landowners to be aware of this and conserve these sites when feasible because they are not covered by Maine's vernal pool regulation.

2. Habitat for other wildlife

Figure 3: *Many wood frogs and salamanders return to the same breeding pool each spring to mate and lay their eggs. If their pool has been drained or filled for development, the adults may deposit egg masses on dry leaves or pavement where the pool used to be located.*

Small wetlands and vernal pools support other animals that might otherwise be limited or absent from our forests (Gibbs 2000). Conserving vernal pools and the connections between them and among other wetlands contributes to maintaining healthy populations of Maine wildlife. For example, many small mammals, birds, amphibians, and reptiles use these wetlands for resting and feeding and as stepping stones to larger, permanent wetlands and waterbodies. Large mammals (e.g., bear, deer, and moose) use these small wetlands as a food source throughout the growing season (Mitchell et al. 2008).

In southern Maine, Blanding's turtles (state-endangered), spotted turtles (state-threatened), and ribbon snakes (state-special concern) use vernal pools extensively for feeding and resting. The ringed boghaunter (state-endangered) and ebony boghaunter (state-special concern) dragonflies and four-toed salamanders (state-special concern) may also breed in acidic, sphagnum-filled vernal pools. Wood turtles (state-special concern) use vernal pools in riparian areas extensively for feeding. In southern Maine, featherfoil (*Hottonia inflata*), a rare aquatic plant, is exclusively found in vernal pools.

The average travel distance for amphibians and small mammals is less than 1000 feet (Gibbs 1993; Semlitsch and Bodie 1998) so the destruction of small wetlands, including vernal pools, will increase distances between waterbodies and make it more difficult for animals to reach suitable breeding and feeding sites. Disruption of connections among wetlands and waterbodies may reduce or eliminate local animal populations.

In short, the critical habitat value of vernal pools extends well beyond Maine's official vernal pool indicator species.

3. Food for wildlife

During the spring, mink, raccoon, bear, great blue herons, dabbling ducks, and turkeys, among others, feed on amphibian egg masses and adults in the breeding pools. This seasonal migration of readily available nutrient-rich food attracts the attention of winter-weary wildlife anxious for a protein meal to energize them before their own breeding season begins. Pools have most likely been fast-food oases for New England wildlife since the glaciers receded over 10,000 years ago.

There is also ample evidence that amphibians leaving the pools (adults and juveniles) are an important source of food throughout the summer to wildlife in forests adjacent to pools (see Figure 4). Researchers who have outfitted amphibians with radio-transmitters have had their transmitters end up in snakes, hawks, and even turkeys (Wilbur 1980; Baldwin et al. 2006, Mitchell et al. 2008, Ryan unpubl. data). Vernal pool breeding amphibians are considered a delicacy by feathered and furred creatures forest-wide. In fact, the total weight of all forest amphibians may exceed the weight of all breeding birds and small mammals combined on a per area basis (Windmiller 1996). In the same study, Windmiller (1996) estimated the biomass of pool-breeding amphibians in 50 acres of forest adjacent to a breeding pool to be in excess of 150 pounds.

Figure 4: *Amphibians provide food for a variety of wetland and upland animals.*

4. Vulnerable to loss

Worldwide declines in amphibian populations have recently focused attention on amphibian conservation. As sentinels of environmental health (much like the canary in the coal mine), their decline is alarming ecologists and citizens alike.

Specifically, pool-breeding species are locally threatened and have been eliminated from some developed and agricultural landscapes in the Midwest (Lannoo 2005). Add to this trend that the breeding habitat of pool-breeding amphibians (e.g., wooded and small wetlands) are the most threatened wetland types in the eastern United States, and you can appreciate how vernal pool habitats need our immediate stewardship. Most pools occur on private lands and regulations to protect them in the Northeast are insufficient or non-existent (Mahaney and Klemens 2008, NEPARC 2010). For these reasons, vernal pool

conservation will always be most effective at the local level, and conservation will ultimately improve habitat for amphibians and for the many forest species that we cherish as our signature New England wildlife. Many vernal pool species in the northeastern United States are state-listed. For example, the blue-spotted salamander is listed as a species of special concern in Maine, Vermont and Massachusetts and as endangered in Connecticut (Hunter et al. 1999).

5. Educational resource

Vernal pools are small ecosystems that a community can literally wrap their arms around by holding hands! They change dramatically with the seasons, providing a dynamic learning laboratory for school children, college students, or other interested citizens (Calhoun and Reilly 2008; Calhoun and Morgan 2009). Often, there are local pools on public land, or even better, on your property. Small, accessible and rich with life, pools are easier to become intimate with than either a lake or river.

Part 2: Locating Vernal Pools

To conserve vernal pools, you first have to find them, but their temporary nature doesn't always make that easy. Searching for pools can be a fun and interesting process. Take advantage of some strategies and resources that make the job of finding vernal pools on an individual or town-wide basis easier.

Topics covered

- Where vernal pools occur on our landscape
- How to find pools in the spring time
- Clues for identifying pools at other times of the year

Key concepts

- Vernal pools occur in a number of landscape settings
- Not surprisingly, spring is the easiest time to find vernal pools
- Spring is the only time to accurately document vernal pools
- Potential vernal pools can sometimes be found when they re-fill with water in fall, and before snow covers them in winter

Where do vernal pools occur?

Vernal pools occur in deciduous, evergreen, and mixed canopy forests, at low elevations as well as on the tops and sides of mountains. You can find a vernal pool anywhere there is a depression in the landscape that holds water long enough to support successful reproduction of fairy shrimp, wood frogs, blue-spotted, or spotted salamanders.

For example, vernal pools may occur as discrete depressions (often kettle holes in southern New England) surrounded by upland forest, in deep swales (low-lying linear depressions) in association with floodplains, or as part of a larger wetland complex such as forested or shrub wetlands (wooded swamps). Pools may have ephemeral or temporary inlets and outlets but are not permanently connected to larger bodies of water.

In Maine, pools occur in all soil types and surficial deposits including till, outwash, or silt sediments from glacial lakes or seawater. These differences may be of little significance to the indicator species; for them, the important considerations are a seasonal breeding pool, the reduced predation rates characteristic of a fishless environment, and forested habitat adjacent to the pool where they can feed, summer, and hibernate.

Locating pools in spring

Follow the choruses! Spring is the easiest time of year to locate vernal pools. Salamanders do not vocalize, but wood frogs do (see Figure 5). In Maine, they call March through May depending on location and may begin when ice still lingers on the pool. Their calls have limited carrying power and can seldom be heard far from the pool so if you hear a chorus, the pool is close. The sound is remarkably like the quacking of ducks. Large choruses can create the impression of a continuous rattling sound. Calling occurs during the day in undisturbed locations, but activity increases at dusk.

The high-pitched, peeping calls of spring peepers are also heard from March through May, and sometimes carry up to a half mile away. Although peepers do not breed exclusively in vernal pools, their calls may also lead you to vernal pools. Calling activity for both species will be particularly low on cold or windy nights. *A CD of Maine's singing amphibians is included in Hunter et al. 1999.*

OR

Follow the migration! Expect amphibians to emerge from hibernation after the first

Figure 5: *Male wood frogs call to attract females by inflating vocal sacs on either side of their head.*

warm spring rains or substantial snowmelt. "Big Night," or the spring evening(s) when lots of amphibians move to pools, usually occurs on a warm rainy or misty evening(s) (40-50 degrees F). Migration from adjacent uplands to breeding pools takes place from mid-March to early April in southern Maine and from mid- to late April or early May in central and northern Maine.

Open water may not be necessary for courtship; spotted salamanders have been seen swimming under a thin film of ice and wood frogs may call from pools rimmed with snow and ice (see Figure 6). Look for activity *before* you decide spring is officially here! The trek of amphibians to the pools begins soon after dark so one way to find pools is to walk the roads and see what direction large numbers of animals are traveling. You may want to follow up with a "listening" trip once the frogs have made it to the pools.

Figure 6: *Amphibians often move to breeding pools while the ice is still melting.*

Locating pools in summer and fall

Dry pools may be located in late summer, fall and winter (in the absence of snow cover) but are more difficult to identify than flooded pools and many times are missed completely (see Figure 7A). In Maine, documentation, which primarily relies on evidence of amphibian breeding and the presence of certain invertebrates, is not possible except in the springtime (or fall in states where marbled salamanders occur).

Figure 7: *Variation in seasonal detectability of vernal pools. A) Dry pools in the summer may go unnoticed. B) Ice covered pools are often easy to detect when*

After drying in the late summer, many pools begin to refill in fall or early winter from groundwater discharge and rainfall. When trees are without leaves, pools may be evident from a distance. The silvery sheen of frozen water may indicate a vernal pool (see Figure 7B). Look for them in late fall or early winter before significant snowfall. If you find what you think might be a vernal pool in the summer, fall, or winter, make note of the location on a map and then visit it again in spring.

For additional information please see annotated slides: *Identifying Vernal Pools in Summer, Fall, and Winter* on the Maine Vernal Pool website.

The following features and evidence of temporary flooding may help you to notice dry pools in the summer:

- A shallow depression in the landscape that looks like it might fill with water in the spring time (sometimes these depressions contain "pit-and-mound" microtopography where pits may fill with water while mounds serve as islands within the vernal pool;
- Leaves darkened by water stains or a film of sediment (you may need to brush away this season's leaves to reveal the stained layer);
- Siltation marks or water stains on surrounding trees or vegetation;
- Fingernail clams or caddisfly cases just below the leaf litter;
- Sphagnum mosses or wetland plants growing in a dry depression;
- Presence of mucky or peaty soil.

Part 3: Vernal Pool Animals

You may not know that:

- Wood frogs are "explosive breeders;"
- Spotted salamanders can live up to 20 years;
- Blue-spotted salamander hybrids are nearly all females;
- Fairy shrimp hatch, breed, and die in the same year.

That information, and more like it, is certainly interesting, but also important. If you or the volunteers you train are going out in the field to document these species, you should know what you are looking for, about their life cycle, and when and where you can find them.

In addition, it can't hurt to have some interesting stories about the animals that depend on vernal pools to help get more people interested in their protection.

Topics covered

- How indicator species have adapted to the unique environment of vernal pools
- Description and behavior of vernal pool indicator species and their young
- Other species typically found in and around vernal pools

Key concepts

- The dynamic nature of vernal pools makes them a challenge to breed in, but some animals are well suited to the challenge
- Vernal pool animals are not all the same--different species have different habitat needs
- A number of Maine's endangered, threatened, and special concern species use vernal pools

Strategies for life in a dynamic environment

The salamanders, frogs and invertebrates that breed and develop in vernal pools live in a very dynamic environment. Since pools are small in size, water temperature and oxygen levels vary greatly. From the beginning of the season to summer's end, temperatures increase and oxygen levels decrease. Many pool animals have developed survival strategies, or adaptations, to cope with these extreme changes in oxygen, temperature, and water levels. For example, larval amphibians (the aquatic phase of salamanders and wood frogs) develop rapidly (in three to five months) and metamorphose into miniature adults, called metamorphs, before the pool dries out sometime in summer.

Other survival strategies include:

- Departure from the pool when metamorphosis is completed (adult insects fly away and frogs and salamanders transform from aquatic larvae into juveniles that move into adjacent forests);
- Dormancy or a "wait-it-out" strategy until the pool floods again. Fairy shrimp eggs and other invertebrates can rest in the sediments for years until conditions are right for hatching, while fingernail clams and snails aestivate (summer equivalent of hibernation) in the mud;
- Feather-like gills develop in larval salamanders and some invertebrate larvae such as mayflies to increase the surface area available for collecting oxygen in low-oxygen environments (Colburn et al. 2008).

In the following pages, we share natural history facts about Maine's four vernal pool indicator species (spotted and blue-spotted salamanders, wood frogs, and fairy shrimp) as well as other animals commonly seen in vernal pools. To help with identification in the field, identification cards are available on the Maine Vernal Pool website for you to print and laminate (see Figure 8). Also on the website you will find additional information on the ecology of each indicator species.

Figure 8: *Laminated vernal pool identification cards.*

Resources Available at: www.maine.edu/vernalpools

Amphibians

Wood Frog

Description: Wood frogs (*Lithobates sylvaticus*) have a dark patch or "robber's mask" (typically brown) that extends back from each eye. A dark line of the same color usually runs from the front of the eye to the snout. Although body color varies depending on sex, time of year, or even habitat, it ranges from light tan or salmon to dark brown. In general, males tend to be darker than females. Two ridges start behind the eyes and run down either side of the back.

Size: Wood frogs range in size from 1.5 to 2.75 inches. Females are larger than males.

Distribution and status: Found throughout New England, the Great Lake States, Atlantic Canada, and as far north as Alaska, wood frogs are common in Maine where habitat is suitable. They are not currently a state-listed species in New England, although they have been locally extirpated due to habitat loss in parts of the Midwest.

Breeding pool: Breeding pools are usually in or near wooded areas. Preferred breeding habitat in Maine occurs in temporary pools that dry before summer's end. In other parts of New England and in mountainous regions of Maine, where vernal pools are less common, wood frogs may use active and abandoned beaver flowages (Karraker and Gibbs 2009, Groff unpubl. data) or fishless lakes (Shearin, unpubl. data).

Although the majority of adults return to breed in pools from which they were hatched, some may end up in "new" pools encountered along the way. For example, as with all the pool-breeding amphibians, wood frogs may be found breeding in roadside ditches, farm ponds, skidder ruts, and gravel pits. Often, these more open, artificial breeding sites do not successfully produce juvenile wood frogs.

Wood frogs are forest specialists and do not compete well with Maine amphibians associated with more sunny, permanent open pools as their eggs and larvae are very susceptible to being consumed by bull frogs and green frogs as well as many insects associated with permanent waters.

Egg mass description and attachment sites: Wood frog eggs are deposited in ping-pong ball size globular masses containing 800-1,000 eggs per mass. They are dark on top (to absorb heat) and light below (to reduce predation) and lack an outer gelatinous envelope (as is seen in salamander masses). Wood frog masses expand to soft ball size within a couple of days as water is absorbed by the jelly surrounding each egg. At their largest, individual egg masses measure 2.5-4 inches in diameter after water absorption.

Eggs are often deposited near the surface giving the appearance of floating marbles or tapioca. Wood frogs tend to attach their egg masses to twigs and stems of vegetation left over from the previous growing season (such as sedges, grasses, or cattails) or to shrubs where they are common in winterberry or alder thickets. However, despite their tendency to lay large communal "rafts" containing up to hundreds of masses, it is not difficult to differentiate between individual masses if surveyed soon after egg-laying. Within these rafts, egg masses may be 2-3 layers deep and are sometimes deposited on the pool bottom below or adjacent to a raft requiring counting to largely be done by feel and not by sight (Morgan 2010).

Tadpoles: Frog and toad larvae are commonly known as tadpoles or polliwogs. When first hatched, tadpoles hang from their eggs or nearby vegetation by an adhesive appendage on their head. Tadpoles use their tails to propel themselves through the water. The hind legs grow first, then front legs. Newly hatched tadpoles measure 0.4-1.2 inches in length. As they grow, their color lightens from velvety black to a mottled olive-brown with coppery sides. In Maine, development into froglets occurs from late July to mid-August. Transforming juveniles are faithful miniatures of adults.

Terrestrial habitat and hibernation: After adults leave the breeding pools in spring, they may feed along slow streams or in other vernal pools while traveling to their summer habitat, which may vary depending on geographic region (Rittenhouse and Semlitsch 2007). For example, in southern and central Maine, forested wetlands are preferred summer habitat (Baldwin et al. 2006; Blomquist 2008) while in higher elevations of western Maine, mossy, cool seeps in evergreen forests or mossy areas not far from small streams are prime habitat (Ellis, unpubl. data). Summer habitat may be over a mile from the breeding pool. Adults summer and hibernate in cool, moist woods and consume a wide variety of invertebrates including slugs, spiders, and worms. Wood frogs hibernate in a shallow depression under the leaf litter in upland forests or in small mammal burrows (Groff, unpubl. Data)(see Figure 9). Within five minutes of freezing, wood frogs accumulate high levels of glucose (a natural anti-freeze) in the liver and leg muscles which prevents their organs and muscles from being damaged by freezing (Storey and Storey 1986).

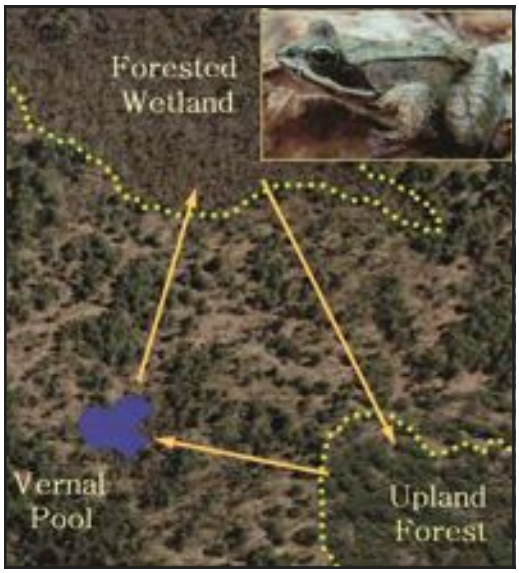


Figure 9: *Wood frog habitat requirements.*

Voice: A hoarse, clucking sound reminiscent of a quacking duck.

Adult behavior: Adult wood frogs begin their annual migration to breeding pools when melting snow and spring rains saturate the leaf litter and thaw them from hibernation. Remarkably adapted to the cold, it is not unusual to find the earliest migrants walking over the melting snow and swimming in icy pools. Wood frogs

will often move to breeding sites even in cold, dry springs when rains are absent (Vasconcelos and Calhoun 2006).

Wood frog calling, mating, and egg-laying occur mainly in the early night hours and gradually diminish toward dawn. Calling and breeding activity also occurs during the day in undisturbed locations. Wood frogs are described as explosive breeders because the entire sequence of appearance, mating, egg laying and return to the terrestrial habitat occurs quickly (often in as little as two weeks). Duration of calling time to attract mates is limited by fat reserves accumulated over the winter. This may be as short as a week in some pools but, in rare instances, may extend up to 30 days.

Tadpole and froglet behavior: Tadpoles transform into miniature adults 6 to 15 weeks after hatching. Newly hatched tadpoles hang motionless next to their rapidly deteriorating egg mass. Within a few days they are capable of rapid escape movement. When disturbed, they disappear into the leaf litter or underwater vegetation.

Tadpoles are suspension feeders; they eat primarily plankton, bacteria and algae. Food is ingested as the tadpoles swim or root around on leaf litter to dislodge debris. They may also feed on spotted and blue-spotted salamander embryos (Baldwin and Calhoun 2002) or on the algae growing on the egg mass surface. As they grow older, additional plant and animal matter is consumed.

In July and August, large numbers of tiny, less than 0.5 inch long, newly emerged froglets may congregate under shore litter and vegetation before dispersing into surrounding terrain. The majority of froglets spend their time near the breeding pool for the first winter (Regosin 2005). Froglets are much more susceptible to drying out and predation than adults so they may limit overland travel during their first fall and winter (Patrick et al. 2006). It is not uncommon for a small pool to produce over 10,000 froglets. The majority fall prey to other animals and hence provide an important food source to the surrounding forest wildlife.

Spotted Salamander

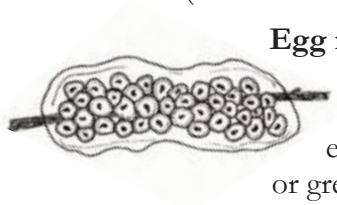
Description: Spotted salamanders (*Ambystoma maculatum*) are brown to blue-black with two irregular rows of bright yellow spots on the back, sides, and along the tail. Their undersides are lighter, typically slate gray. Spotted salamanders appear broad-headed compared to red-back salamanders and newts.

Size: Adults are 6 to 8 inches long measured from head to tail.

Distribution and status: Spotted salamanders occur throughout New England, the Great Lake States, southeastern United States (excluding Florida), and Atlantic Canada.

Breeding pool: Spotted salamanders breed in vernal pools. They also may successfully breed in beaver flowages, slow moving streams, or along lake shores

where vegetative cover provides ample protection from predators. Although some breed in artificial pools (roadside ditches, borrow pits, skidder ruts), reproductive success (measured in terms of numbers of juveniles that leave the pool and return to breed), may be lower or absent. Salamanders need a pool to be flooded between 12-16 weeks. For this reason, ditches, small created pools, and skidder ruts may be "ecological traps" because they typically dry before eggs hatch or juveniles mature (DiMauro and Hunter 2002).



Egg mass description and attachment sites: Spotted salamander eggs are surrounded by a jelly-like envelope (feels like firm Jello). Eggs are dark brown or gray above and lighter below. The color of the jelly envelope may be cloudy (owing to an inherited maternal protein), clear, or green from an algae (*Oophilia amblystomatis*) that may live in the embryos. These are natural variations in color and may all occur in the same pool.

Egg masses may be globular (approaching spherical), but more often are elongated or kidney-shaped. The number of eggs per mass in Maine may range from 30 to 200, depending upon geographic location. Immediately after deposition, the mass is 2.5-3 inches in diameter, but it quickly absorbs water and can expand to over 5 inches. Each female may lay from 1 to 3 masses (usually one large and two smaller satellite masses).

Egg masses are often attached to sticks or twigs that have fallen into the pool or to shrubs or plant stems several inches below the water surface. They are typically found within 3 to 4 feet of the shoreline, but may occur in the middle of pools as well. Spotted salamanders may deposit their eggs in northern side of the pool that has southern exposure and therefore warms sooner than the rest of the pool. However, egg deposition sites vary from pool to pool depending on availability of egg attachment sites (Shearin, pers. comm.). Eggs hatch a few at a time as the outer embryos develop first, probably because they receive more warmth from the sun. One to two months to hatching is typical in the Northeast when temperatures are 50°F (10°c) or above.

Egg masses are readily consumed by larval insects, leeches, turtles, ducks, and tadpoles of green frogs and bullfrogs. Predators such as adult eastern newts may be found on the surface of salamander egg masses working to break through the outer coating of jelly to gain access to embryos (Hamilton 1932, Wood and Goodwin 1954).

Larvae: In general, larvae are a dull green or yellow, the chin and throat are without markings, and the head is broad, blunt, and wider than the body. At hatching, spotted salamander larvae are 0.5 inches long. Salamander larvae have bushy external gills (they look like feathers coming out of the head); the tail fin continues onto the back and four tiny legs are present. The prominent ruff of gills readily distinguishes salamander larvae from frog larvae. They are very fragile and

can be easily killed by dip-netting for up to a month after-hatching, so it is best not to handle larvae until they are at the end of development (late summer).

The larval period is 70-100 days. Larvae transform into miniature adults at approximately 3 inches. Transforming young are found in August and September and rarely in October in colder waters. Recently hatched larvae of many salamander species differ markedly from older ones. When they leave the pool, the young salamanders may be completely dark, but yellow or orange spots appear soon after they leave the pool.

Terrestrial habitat and hibernation: Spotted salamanders are found in all forest types although they may travel across other habitats including open fields. They are sometimes referred to as "mole" salamanders because they live underground in shrew and other small mammal burrows year round (Madison and Farrand 1998; Regosin et al. 2004). They also seek refuge under leaf-litter and coarse woody material (e.g., logs, fallen branches, rotting stumps). Adults feed on forest-floor invertebrates including earthworms, snails, spiders, and insects (Colburn et al. 2008).

Adult Behavior: Warm, wet springs may bring out large numbers of salamanders moving to breeding pools. This mass migration phenomenon is known by amphibian enthusiasts as Big Night. (If you are driving around on warm, wet spring nights, you should be aware of amphibians in the road and perhaps limit driving on these nights. Mortality from traffic is quite high among spring breeders.) After spotted salamanders arrive at the breeding pool, males and females participate in an elegant courtship ritual known as congressing (best viewed with a flashlight covered in red cellophane to limit disturbance to the animals and maximize your viewing opportunity). In a congress, males deposit gelatinous sperm-filled packets, called spermatophores, up to 0.5 inches long, on the bottom of the pool. A female will take up spermatophores into her vent (cloacae) where fertilization occurs internally as she deposits egg masses.

In any given pool, the breeding population may take up to six weeks to finish depositing eggs (they are not explosive breeders like wood frogs). However, if the spring is unseasonably cold or dry, a significant portion of the breeding population may not breed that year (adults can live up to 20 years and hence have many opportunities to breed). Because animals may not breed every year, it is difficult to assess the productivity of a pool with just one year of egg mass counts.

After breeding is over, the adults make their way to small mammal burrows or root channels where they spend the summer, often hunting from the burrow entrance (B. Windmiller, pers. comm.). They eat forest floor invertebrates and may move small distances from the burrow entrances to hunt during rain storms. In winter, adults may hibernate in these same burrows.

Larvae and juvenile behavior: By day, larval salamanders are typically hidden in and under debris near the pool bottom. At night they move into the water column where they suspend themselves near the surface to feed. Young salamander larvae dine on planktonic invertebrates (microscopic to barely visible animals floating in the water) and increase prey size as they grow. Although they feed to some degree during the day, the intensity of feeding behavior is elevated with a decrease in light

intensity (onset of dusk) because the concentration of plankton in the top six inches of water is higher after dark.

When larvae first emerge in the evening, they are very dark but as they move towards the surface to feed, they become pale, almost translucent. The change is due to expansion and contraction of melanophores (skin pigment). It is easiest to witness this phenomenon on dark nights following clear sunny days. Recently transformed young linger on the edge of the drying pool, hidden under logs, fallen bark or stones. Eventually they move on to find an underground retreat. On rainy nights in late summer, large numbers of newly transformed juvenile salamanders may journey from pools to terrestrial habitat. Though they can be found crossing roads in wooded areas during this migration, they often escape notice because of their small size of 2 to 2.5 inches and dark color. There is some evidence that the majority of young stay within the first hundred feet of the pool for their first winter making this zone an important nursery area (Regosin et al. 2005).

Blue-Spotted Salamander Complex

In Maine and much of New England, blue-spotted salamanders (*Ambystoma laterale-jeffersonianum*) descend from a female that shared a common ancestor with *A. barbourii* (a species currently found in Ohio, Kentucky, and Tennessee) over 3 million years ago (Bogart et al. 2009). These populations are almost entirely female and capable of using sperm from other closely-related salamanders to initiate egg development. This use of sperm is considered stealing (the reproductive mode has been termed "kleptogenesis") as the male salamanders genetic material is *typically* not incorporated into the resulting offspring (Bogart et al. 2007). These unisexual blue-spotted salamanders in Maine and elsewhere are also polyploid, meaning that they have more than one pair of chromosomes, some of which are from another species. In Maine, that species is the Jefferson salamander. Due to their complicated genetic makeup, the animals are referred to as the "blue-spotted salamander complex." For a complete discussion of the genetic complexities associated with these hybrids, refer to Bogart et al. (2009).

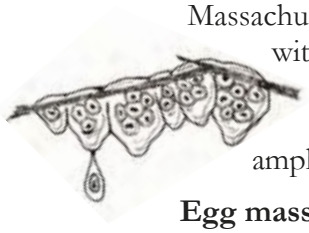
Variability in the physical characteristics of the adults, the size, shape, and consistency of egg masses, as well as habitat preferences, may stem from these differences in ancestral genetic make-up.

Description: Genetically-pure blue-spotted salamanders have a dark black base color with irregular blue or bluish-white spots on the sides of the body and tail. The head is narrow and tapers to a rounded snout. Blue-spotted complex salamanders tend to be brownish (rather than black) and attain a larger size than pure blue-spotted salamanders; they also tend to have a considerably wider head.

Size: Breeding adults of genetically-pure salamanders range from 3.9-5 inches. Blue-spotted complex salamanders are usually larger and may grow to 6.7 inches. (See the annotated slides *Identification of Vernal Pool Breeding Animals* on the web page that show many examples of blue-spotted complex salamander adults.)

Distribution and status: The blue-spotted salamander complex probably occurs throughout Maine, however they are less commonly reported than the spotted salamander. To date, no genetically-pure populations of blue-spotted salamanders have been reported in Maine. The blue-spotted complex is found throughout New England (with the exception of Rhode Island), the Great Lake States, and Atlantic Canada and is listed as a Species of Special concern in Maine, Vermont, Connecticut, and Massachusetts (Hunter et al. 1999). A population of genetically-pure blue-spotted salamanders in the eastern portion of Connecticut is listed as endangered (Klemens 2000). Homan et al. (2007) suggest the blue-spotted complex may be more vulnerable to declines than spotted salamanders. Although the study was not conclusive, it does highlight the need for protection of existing populations and the need for more study on the ecological needs of these animals. Our work in Maine certainly suggests that salamanders in the blue-spotted complex are less common than spotted salamanders state-wide.

Breeding pool: In Maine, blue-spotted salamanders breed in vernal pools, beaver flowages, and along slow-moving streams bordered with grass and sedge marshes (particularly Downeast) (Hunter et al. 1999). Researchers in New Hampshire, Massachusetts and Vermont more commonly associate blue-spotted salamanders with streamside pools or red maple forested wetlands. In Maine it has been observed that blue-spotted salamander eggs are readily eaten by wood frog tadpoles (Baldwin and Calhoun 2006), invertebrates and other amphibians so they may seek pools less populated by other pool-breeders.



Egg mass description and attachment sites: Egg mass appearance varies greatly among blue spotted salamanders depending on genetic make-up of individuals laying the eggs. Genetically-pure blue-spotted salamanders attach eggs singly or in very small clusters to submerged vegetation or branches; the jelly encasing the embryo is extremely loose and drippy (Klemens 1993). Genetically-pure Jefferson salamanders lay ±30 eggs in sausage-shaped masses attached to submerged twigs or branches; their egg masses are somewhat similar to that of spotted salamanders (Bishop 1941).

The size, shape, and consistency of egg masses laid by blue-spotted complex salamanders in Maine depends on the amount of genetic contributions from the parent species (Jefferson and blue-spotted). Animals with a lot of genetic material from Jefferson salamanders tend to lay eggs in small clumps of 5-30 eggs in linear (somewhat sausage-shaped) masses along stems and twigs. Most of the polyploid animals (3 or more sets of chromosomes) are females and have lower egg and larval survival (Homan et al. 2007). A high percentage of their eggs are infertile and

appear as all white eggs (like strings of pearls along a twig) rather than dark embryos. Animals with more influence from blue-spotted ancestors may lay single, clear eggs on the pool bottom or small clusters of eggs attached to twigs. Often these eggs are not visible unless you gently lift attachment sites out of the water. These eggs are largely viable and the surrounding jelly is extremely loose and drippy, like the masses of genetically-pure individuals.

Larvae: Blue-spotted salamander larvae are nearly black, have a prominent ruff of external gills, and a broad-finned tail with noticeable paired black spots on top and along the sides. They have a big-headed appearance in comparison to the more slender spotted salamander larvae, although distinguishing between the two species is very difficult. The free-swimming, limbless phase of blue-spotted salamander larvae is brief, ending when forelegs develop and become functional. The hind legs soon appear and larvae become bottom dwellers. The diet of small larval salamanders consists of various invertebrates. Large larvae may include other salamanders in their diet. The length of the larval period may be 66-80 days. Metamorphosis is signaled by absorption of their gills and frequent excursions to the surface to gulp air. Newly transformed larvae are 2-2.5 inches in length. They retain noticeable blackened gill stubs for several days, but acquire adult colors and spot patterns within 24 hours of leaving the water.

Terrestrial habitat and hibernation: Blue-spotted salamander habitat needs are probably similar to their spotted salamander relatives, with some slight differences. Blue-spotted complex salamanders may be more tolerant of disturbed forests and have been found to feed in forested wetlands during the summer (B. Windmiller, pers. comm). In some parts of New England, they favor sandy soils, but this has not been documented in Maine. A recent Connecticut study on genetically-pure blue-spotted salamanders shows that they may not travel as far from breeding wetlands as spotted salamanders. Both adults and juveniles were found summering in upland deciduous forests close to breeding pools (Ryan unubl. data).

Blue-spotted salamanders may spend a lot of time on the soil surface (as opposed to deep burrows), in shallow mammal tunnels, or under cover objects (e.g., rocks, logs, duff layer) during the late spring, summer, and autumn (Klemens 1993, Gibbs et al. 2007).

Adult Behavior: When handled, blue-spotted salamanders are very active; they tend to fight considerably and often coat their captor's hands with sticky, noxious secretions from glands in their skin. When blue-spotted salamanders are approached by a predator (or a human) they may raise their tail and wave the tip where toxins are concentrated. This is believed to direct the attack of a predator to the tail; it is not uncommon to find individuals with entire sections missing from their tail. Over time, tails are regenerated.

Crustaceans

Fairy Shrimp

Fairy shrimp (*Eubranchipus* spp.) are the only invertebrate indicator species for vernal pools in Maine. Often called "charismatic crustaceans" owing to their pretty salmon color and habit of swimming upside down with their dainty fairy-like appendages sweeping the water for food, these animals appear magically in spring and disappear just as quickly, often before amphibian embryos hatch. These are the freshwater analog of brine shrimp, sometimes marketed as sea monkeys. Fairy shrimp found in the northern region are most commonly *Eubranchipus bundyi* and *Eubranchipus vernalis*. *E. vernalis* is the dominant species replacing *E. bundyi* in southern New England. Fairy shrimp from the family Branchinectidae occur in eastern Atlantic Canada (*Branchinecta paludosa*) and may also occur in northern Maine (see Colburn et al. 2008).

Description: The different species of fairy shrimp vary somewhat in size (0.5 - 1.0 inches), color, and shape. All swim upside down, waving 10 pairs of leaf-shaped limbs, with which they feed. Most have a long tail, sometimes with "neon" spots near the tip. They are generally white or brownish, with orange or reddish marks. Fairy shrimp are strikingly large among the swimming invertebrates. From a distance, they may look like small fish; some people confuse them with mosquito larvae.

Distribution and status: Fairy shrimp probably occur in vernal pools throughout the State, however they are not widely reported. Of the hundreds of pools surveyed to date in Maine, less than 5% were reported to contain fairy shrimp.

Eggs: Fairy shrimp eggs are very small (pinhead size), brownish in coloration, and deposited in clusters. Their size and color makes them indiscernible on dry leaf litter where they overwinter before hatching in the spring.

Breeding pools: Fairy shrimp occur only in waters that are free of fish populations–primarily pools that hold water for 2-3 months. The habitat requirements for fairy shrimp are not well documented. *Eubranchipus* spp. are known to be intolerant of pollution, siltation, salinity, high alkalinities, and temperatures in excess of 72°F (20°c). Both *E. intricatus* and *E. bundyi* appear to be restricted to clear waters (Pennak 1978). They may develop in as little as 6 weeks. As they are delicious to all pool creatures, fairy shrimp are more successful in pools that hold water for a short time and therefore limit predatory amphibian and invertebrate populations.

Behavior: Fairy shrimp are often seen feeding in sunny portions of the pool. They swim upside down, fairly close to the pool surface. In shaded pools with dark substrate, fairy shrimp can easily go unnoticed. The female carries eggs until she dies and then the eggs rest in the leaf litter until the following spring. Within six weeks of hatching the shrimp develop to become breeding adults. Eggs may be transported from one pool to another on the fur and feathers of animals frequenting pools.

Other creatures that visit vernal pools

Animals that use vernal pools for resting or feeding, but do not depend on them for breeding sites, are called facultative species. These include green frogs, bullfrogs, spring peepers, American toads, and many species of snakes, turtles, small mammals, birds and aquatic invertebrates (insects, spiders, mollusks, crustaceans). Often these animals visit pools to feed or rest during travels to other wetlands.

Amphibians

Four-toed Salamander

Four-toed salamanders (*Hemidactylium scutatum*) may breed in sphagnum moss overhanging wetlands, including vernal pools (see Chalmers and Loftin 2006). The eggs hatch under the moss and larvae drop into the pool to develop. Four-toed salamanders are rarely reported in vernal pools as their nesting habit is so well hidden.

Dusky Salamander

Typically associated with mossy seeps and rocky streambeds, dusky salamanders (*Desmognathus fuscus*) may be seen in late summer congregating in the cool substrate of drying pools. Note their chubby back legs and ability to spring out of your hands!

Eastern Newt

Newts (*Notophthalmus viridescens*) may breed in some vernal pools, particularly those with longer hydroperiods and less canopy cover. The aquatic adults may prey heavily on salamander and frog egg masses and larvae.

Green Frog

During exceptionally wet years green frogs (*Lithobates clamitans*) may breed in vernal pools, but their larvae take 2-3 years to develop so they rarely survive in pools that dry completely. If you are surveying a pool after a very wet summer, be aware that the pool should **not** be discounted as a vernal pool because of the presence of green frog tadpoles. Green frog tadpoles feed heavily on salamander egg masses and have consumed more than 100 egg masses in one week (Vasconcelos and Calhoun 2004). Adults and juvenile green frogs are often seen feeding in vernal pools during the summer.

Bullfrog

Bullfrog (*Lithobates catesbeiana*) tadpoles need 2 -3 years to develop so they rarely breed in ephemeral pools. However, adult bullfrogs frequently visit pools in the spring, summer and fall to feed on egg masses and larvae (Gahl et al. 2008). They may also stop at pools to feed and rest on their way to more permanent waters where they hibernate and breed. Like with green frogs, presence of bullfrog tadpoles may indicate that the previous season was very wet and the pool retained water long enough for these more aquatic species to survive.

American Toad

Toads (*Bufo americanus*) may breed in more open vernal pools with less tree cover, particularly in southern New England. This is less common in northern Maine and coniferous forests in central Maine where heavily shaded pools are often too cold.

Spring Peeper

Similar to the toad, spring peepers (*Pseudacris crucifer*) may breed in more open, warmer vernal pools but are more commonly found in permanent, open marshes in Maine. Note their small size and cross-like marking on their backs.

Gray Tree Frog

Gray tree frogs (*Hyla versicolor*) may breed in more open, warmer vernal pools as well, particularly in southern New England and southern Maine, where they take advantage of lower predation pressures from fully aquatic species. This species develops rapidly--as fast as three weeks from egg to metamorphosis.

Reptiles

Painted Turtle

Vernal pools adjacent to lakes and rivers are often used by painted turtles (*Chrysemys picta*) for feeding and resting.

Snapping Turtle

Snapping turtles (*Chelydra serpentina*) are commonly found in vernal pools feeding on egg masses and larvae and may aestivate in pools during the summer.

Endangered, threatened, and special concern species

If you observe any of the following animals listed as state-endangered, threatened, or of special concern, you should take photographs and report your sightings to the Maine Department of Inland Fisheries and Wildlife's Endangered Species Program www.maine.gov/ifw/wildlife/ species/endangered_species/species.html.

Ribbon Snake (Special Concern)

Eastern ribbon (*Thamnophis s. sauritus*) snakes are highly aquatic and where present, are typically found in a variety of shallow water habitats. They tend to favor open (sunny), grassy or shrubby areas bordering streams, wooded swamps, and vernal pools (Klemens 1993). Amphibians form the majority of these snakes' diets and when not basking, they may be observed actively roaming the edges of vernal pools in search of frogs (Gibbs et al. 2007).

Spotted Turtle (Threatened) and Blanding's Turtle (Endangered)

In York County, vernal pools serve as habitat centers in which adult spotted (*Clemmys guttata*) and Blanding's turtles (*Emydoidea blandingii*) congregate, feed and breed. Pools may be of special importance to gravid (egg-carrying) females, providing refuge and important feeding opportunities (see Joyal et al. 2001; Beaudry et al. 2009).

Wood Turtle (Special Concern)

Vernal pools, especially old oxbows, within floodplains are used extensively by wood turtles (*Clemmys insculpta*) for feeding during the summer (Hunter 1999).

Section II
Municipal Vernal Pool Mapping Project

In the recent study, *Forests on the edge: housing development on America's private forests,* three out of the fifteen U.S. watersheds projected to experience the greatest conversion from private forestland to housing developments occur in Maine (Stein et al. 2005).

With increasing development pressures on private property, citizens must proactively conserve natural areas and the wildlife they support. This is particularly important in Maine where we take pride in our natural world and depend on our outstanding coastline, forests, and wetlands to attract tourists and support natural resource-based jobs.

The first step in conserving our natural wealth is to identify and map natural resources at a scale relevant for planning beyond the individual project (that is, at a town, watershed, or regional basis). This information may then be viewed and analyzed in conjunction with other priorities. A layer-cake approach provides the foundation for local land-use planning, promotes proactive decision making, and has the potential to conserve natural systems upon which we depend, and steer development to areas most appropriate for growth.

For a number of Maine towns, the 2007 Significant Vernal Pool legislation (see Section III, Part 1) spurred interest in mapping vernal pools and pre-identifying Significant Vernal Pools town-wide. In addition to avoiding the potential for prolonged permit review and increased costs to landowners, a map depicting the locations of vernal pools and SVPs serves as an additional natural resource data layer, in concert with others, that may be used to inform decisions regarding the most appropriate locations for development.

State regulation of a subset of vernal pools, Significant Vernal Pools, however, is only one step towards conservation of this resource. Of the pools surveyed between 2007 and 2011, less than 25% have met the criteria to be regulated as Significant Vernal Pools. On a pool-by-pool basis, State regulation is not sufficient to maintain pools in an ecologically meaningful way in any given town. Therefore, local knowledge and stewardship will be necessary to conserve landscapes that will maintain the diverse group of animals associated with Maine vernal pools and forests.

Seven steps to mapping vernal pools

While commercial property owners and individuals involved in developing subdivisions hire environmental consultants to map vernal pools on a site-by-site basis, this approach may not be financially feasible for a town. In this Section, we describe the development of a vernal pool map layer for towns, using trained volunteers, to collect data on potential vernal pools. The services of volunteer community members have obvious financial advantages; engaging local citizenry also increases awareness of natural resources, instills a sense of place and community pride, and encourages local control over quality of life through participation in planning for the future (see Calhoun and Reilly 2008).

Section II features seven steps to guide you through the process of mapping and assessing vernal pools using trained citizen scientists:

1. Plan and build project support;
2. Identify potential vernal pools;
3. Prepare for the field season;
4. Recruit and train volunteers;
5. Conduct field assessments;
6. Organize data and plan for additional field visits;
7. Submit data to the Maine Department of Inland Fisheries and Wildlife;
8. Establish and maintain a vernal pool database.

Time commitment for this project is greatest in the winter months leading up to the field season, during the spring breeding season (April-May) when field assessments are conducted, and shortly thereafter when data are reviewed and plans are made for follow-up surveys (see Table 1).

Each municipality may wish to modify this process to best meet specific goals, but we encourage Maine participants who are planning to submit data to the Maine Department of Inland Fisheries and Wildlife (MDIFW) to follow this protocol as closely as possible.

While the focus of this publication is to provide guidance to municipalities in Maine, the methodology is appropriate for any region interested in local, collaborative conservation planning and is applicable at a variety of scales. This process and accompanying resource materials may be of use to conservation organizations, land trusts, other non-government organizations, and both public and private land managers.

Table 1: *Timing of major pool mapping project tasks in northern New England.*

FIRST YEAR	
Any Time	Determine goals and acquire funding
January/February	Obtain aerial photography and hire photo interpreter to identify potential vernal pools Publicize project Recruit citizen scientists Create mailing list for landowners with pools on their properties Create maps of each potential vernal pool Mail landowner information packets and permission request forms
February/March	Use postcards and/or phone calls to contact unresponsive landowners Host public information session for landowners, town officials, and citizen scientists Prepare field packets for volunteers
April	Host indoor and outdoor training for volunteers Assign citizen scientists to pools and distribute packets
April/May	Conduct field assessments
Summer	Review data, verify photo documentation, and plan for follow up visits Host post field season gathering with citizen scientists Conduct follow up visits to pools that meet biological criteria for significance
Fall	Mail preliminary survey results to landowners
SUBSEQUENT YEARS	
January/February	Attempt to obtain additional landowner permission Confirm citizen scientist commitment/recruit additional citizen scientists
February/March	Host public information session for landowners, town officials, and citizen scientists Prepare field packets for citizen scientists
April	Provide refresher training for volunteers Assign volunteers to pools and distribute packets
April/May	Conduct field assessments
Summer	Review data, verify photo documentation, and plan for follow up visits Conduct follow up visits to pools that meet biological criteria for significance
Fall/Winter	Submit data to MDIFW Update map layers to reflect locations of vernal pools and Significant Vernal Pools Host public presentation of project results

Step 1: Plan and Build Project Support

Whether you represent a Maine municipality interested in proactively mapping vernal pool resources in response to the Significant Vernal Pool legislation, or are an advocate for natural resource mapping and conservation in another northeastern state, the first step in this process is to establish project partners, goals, and funding.

Topics covered

- Key questions to ask when initiating a mapping project
- Costs involved in a mapping project
- Building partnerships with project coordinators and town officials
- Leadership roles essential for success
- Resources to help build support in the greater community

Key concepts

- Success of a mapping project depends on understanding the time commitment and acceptance of the process by project coordinators and staff in local government
- Focusing on how the project will benefit the town and its citizens is key to gaining local support
- Educating your community about vernal pools is as important as collecting field data and creating a map
- Maintaining lines of communication among project initiators, municipal officials, citizen scientists, and landowners is essential for project success

Questions to consider in the planning process

Who?

- Who is going to initiate the project (town planner, manager, conservation commission)?
- Who are your partners (NGOs, land trusts, conservation commission, other towns)?
- Who will coordinate the project?
- Are there neighboring towns that are already engaged that could provide guidance?
- Are there neighboring towns that might also be interested in mapping their pools?

Why?

- How will this project benefit the town, developers, and private landowners? (This may influence how you present an initiative to your community.)

Where?

- What scale of mapping makes sense? Municipal? Regional?

Cost?

- How much will the project cost?
- How will it be funded? Internally, externally, or a combination of both?
- What resources do you have in-house (GIS, aerial photography, volunteers, interns)?
- Are there neighboring towns that might partner with you and benefit from shared resources from a regional approach?

Time?

- How many years will field surveys be conducted?
- Have project coordinators allowed enough time in their schedules to make this project a success?
- How much time will it take State agencies to review data?

Outcomes?

- What are the desired end products and outcomes?
- Who will use the products?

Major costs associated with a municipal vernal pool mapping project

- Administration*
- Aerial photography
- Photo interpretation (remote identification of potential vernal pools on aerial photographs)
- GIS infrastructure or outsourcing (for map making and determining parcel ownership)
- Citizen volunteer trainings
- Printing and mailing costs
- Data collection and data entry
- Miscellaneous supplies

*If feasible, you might consider hiring an environmental consultant to coordinate volunteers and or an intern to assist with this process and with data entry at the end of each field season.

Building town support

The success of a mapping project largely depends upon the understanding and acceptance of the process by leaders in your local government and employees in the municipal office. Take the time to explain and promote the project to key players in your town (manager, planning department, code enforcement officer, tax assessor, administrative staff, town council, conservation commission, local land trust, voluntary boards, etc.) and work together to shape the process so it results in outcomes most useful to your town.

Encourage a visit to a pool brimming with life in the spring time. Even skeptics often find themselves intrigued to learn more about the mysteries of vernal pools and the role they play in supporting Maine's signature wildlife.

Establishing project leadership

Projects are mostly likely to be successful when leadership is provided by hired municipal staff (planning department, town manager, GIS specialist), consultants, as a team effort by a conservation commission or local land trust, or as a combined initiative between town officials and a voluntary commission or land trust. Although the coordinator position does not require biological expertise, familiarity with field work, geographic information systems, natural resource protection, and community organizing is beneficial. Given the two-to-three year time frame recommended for a town-wide mapping program, it is best if the coordinator(s) remain consistent throughout the project period.

Building community support

The primary objective of this project is to map and assess vernal pools to produce a database for use in natural resource planning and for locating SVPs regulated by the State. An equally important aspect is the opportunity to educate your community about local natural resources.

Using media

Public education and involvement are likely to lead to increased interest in and stewardship of the resource, and ultimately to acceptance of the project. Towns with extensive publicity efforts well in advance of the field season have seen higher rates of landowner participation. Town newsletters, local newspapers, radio announcements, town websites, and local television coverage are all good avenues for introducing community members to the mapping project.

Resources Available at: www.maine.edu/vernalpools

Sample newsletter articles and two short informational documents--*Vernal pools in Maine: What do landowners and towns need to know?* and *Conserving Maine's Significant Wildlife Habitat: Vernal pools* may be beneficial to provide to landowners, town officials, and the general public.

Public information session

Hold an informational session for the public. In this forum, discuss the process involved in the mapping initiative, why the town decided to engage in such a project, and how the data will be used in your town. This also provides an opportunity for citizens to ask questions and for landowners to seek clarification before deciding whether they would like to participate. Videotape the session and broadcast it on local access cable television and/or invite a reporter to provide media coverage for community members unable to attend the information session.

Resources Available at: www.maine.edu/vernalpools

What is involved in a municipal vernal pool mapping initiative? A presentation detailing the mapping and assessment process is available on the Maine Vernal Pool Website. You can provide background information about the project for community members by linking your town website to the Maine Vernal Pool website.

Step 2: Identify Potential Vernal Pools

Maps and aerial photography, when used with local knowledge and field assessments, will help you to systematically identify potential vernal pools.

Topics covered

- Strategies for systematically locating potential vernal pools
- Readily available map resources that may help in identifying potential vernal pools
- Specifics about aerial photo requirements - type, scale, and time of year
- How a photo interpreter identifies potential pools on aerial photographs

Key concepts

- For quality results, use the best available aerial photos and hire a professional photo interpreter
- Costs associated with obtaining aerial photos and photo interpretation may be reduced if multiple adjacent towns collaborate
- Photo interpretation has its limitations; conducting field assessments is an essential part of the process

Systematic approaches to locating pools

A systematic search by a skilled photo interpreter using aerial photographs to identify potential vernal pools is **highly** recommended if you are interested in a mapping initiative at the municipal level. If this is not feasible, or if you are only interested in monitoring specific pools, you may choose to locate vernal pools in a small portion of your town, on specific properties such as those conserved by a land trust, or on select private parcels. Locating pools may be accomplished using any one, or a combination of the methods listed below, but since remote identification using aerial photographs is the best option available it is described last and in greatest detail.

Map work

Many types of maps are available on-line or from state, regional, and town offices, outdoor sporting stores, and libraries. Depending on the type of map and the level of landscape detail or scale, maps may or may not be useful in locating individual pools. Please be aware that the maps listed below are a good starting point and may provide additional information about a site, but have limited use in locating small pools or pools associated with evergreen or mixed forests.

U.S. Geological Survey Topographical Maps

Look for contours designating depressions, wetland symbols and small ponds. Especially look for concentrations of these features. Topographic maps may also be used to identify remnants of old riverbeds, wetland areas associated with rivers and streams, and low-lying kettle holes that may collect spring runoff, snowmelt or seepage. In general, topographic maps show the lay of the land and may indicate areas most likely to have pools.

U.S. Department of Agriculture Natural Resources Conservation Service (NRCS) soil surveys

To date, soil type has not proven to be a good predictor of vernal pool location. Soils described as peat, muck, very poorly drained, and poorly drained will help to identify wetland complexes that may contain vernal pool(s). Note, however, that vernal pools also occur in upland soils where an impermeable layer retards drainage. Soil maps are available for most counties through the NRCS DataMart website at: www.soildatamart.nrcs.usda.gov/.

U.S. Fish & Wildlife Service National Wetland Inventory (NWI) maps

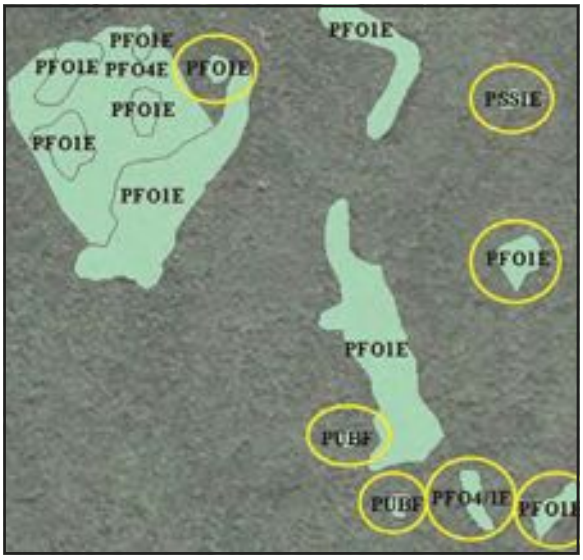


Figure 10: *NWI map of region with abundance of small discrete wetlands. Yellow circles indicate potential vernal pools (PUB, PSS, PFO, POW).*

The U.S. Fish and Wildlife Service produced National Wetland Inventory (NWI) maps that may direct you to areas likely to contain pools. In general, look for wetlands that are not permanently connected to streams or lakes including PUB, POW, PSS, and PFO wetland classes (codes are explained in the NWI map legend) (see Figure 10). Be aware that NWI maps are only a guide as they do not include all wetlands and may misrepresent wetland types or classes. They are particularly helpful for picking out large areas of forested wetland (labeled PFO) or shrub wetland (labeled PSS) within which vernal pools may occur. NWI maps may be viewed on the National Wetland Inventory Wetland Mapper web page (www.fws.gov/wetlands/Data/Mapper.html).

Transects

Walking pre-identified transects in the spring before leaf out and when frogs are calling (see Figure 11) may be appropriate on a parcel-by-parcel approach. Using this technique, a group of volunteers can cover a lot of ground in a short period of time. Visibility between survey lines will vary with the density of vegetation. That said, parallel transects spaced 50 feet apart are a good starting point.

Note: Remember to respect private property and landowner wishes; request written permission from property owners BEFORE visiting potential vernal pools.

Figure 11: *Field map showing a 50-foot transect grid used in a systematic approach for locating vernal pools in a small area. Volunteers walk each north-south line and record pool locations with a GPS.*

Networking

Many landowners know of "spring pools" or "places with frogs or salamanders." Foresters, loggers, surveyors, and naturalists may have invaluable local knowledge of breeding "hot spots."

Aerial photography

Interpretation of aerial photography is the best available method for remotely identifying potential vernal pools at the municipal scale. If you are considering a mapping project at this level, your best option is to hire the services of an experienced photo interpreter.

What type of aerial photography is necessary and where do I get it?

Potential vernal pools may be identified using aerial photography and remote sensing techniques (Calhoun et al. 2003, Lathrop et al. 2005, and Burne and Lathrop 2008). At a town-wide scale, this has proven to be the most effective technique for pre-identifying potential vernal pools.

The type of photography used and time of year are very important. Because pools are generally small, often less than 0.1 acre, they can be challenging to identify remotely. To enhance detection, aerial photographs should be taken in the spring, prior to leaf-out and before bud swell (see Table 2). Leaf-off imagery typically shows the ground surface and surface water under deciduous tree cover.

Though true color or black-and-white formats can be used for identifying potential vernal pools, color infrared photography is much preferred because it accentuates standing water and wet soils. Having stereo photography (i.e., overlapping images) is also critical. This allows viewing in 3-D which enables the interpreter to distinguish between topographic depressions (potential pools) and tree or building shadows (false pools). Identification of potential vernal pools can be done using 9 x 9 inch printed images under a stereoscope, or by viewing specially processed digital photos on a stereo computer monitor in a 3-D heads-up display.

The National Wetland Inventory (NWI) maps which often serve as the town's wetland data layer are created from aerial photographs typically taken at a scale of 1:24,000 (1 inch on the photo=2,000 feet on the ground) (see Figure 12A). Accurate identification of vernal pools requires larger scale photography (fewer photos of smaller area enables detection of small features such as vernal pools) (see Figure 12B). Generally, a film-based photographic scale of between 1:4,800 (1 inch=400 feet) and 1:12,000 (1 inch=1,000 feet) is suitable for identifying potential vernal pools, with the larger scale of 1:4,800 providing greater detail and detectability. The smallest effective scale for remotely identifying vernal pools is 1:12,000, however for best results, the largest scale feasible should be used in this process (see Table 2).

Note that with larger scale imagery, accuracy increases but so does the expense as more photos are required to cover the same area. For digital photography, the effective scale is typically measured in pixel resolution rather than fixed exposure

scales. Using digital imagery, a ground resolution (or pixel size) of 0.25 to 0.5 feet is ideal for vernal pool identification.

Before obtaining estimates for stereo aerial photographs, determine whether suitable imagery is already available for your town. Imagery that has already been acquired for purposes other than vernal pool mapping may be available for free or at a reduced cost. Potential sources include state or federal agencies, consulting firms, and companies that regularly contract for flights. If appropriate existing imagery is not available, compare prices for new imagery from firms that provide aerial photography services.

Note: Cost for acquiring new photography (and for photo interpretation) may be reduced if you collaborate with adjacent or nearby towns because a large portion of the cost is for mobilizing the aircraft.

Figure 12: *The same vernal pool shown at two different scales. In photograph A more of the landscape is captured in the image, but at a smaller scale (harder to identify vernal pools). In photograph B much less landscape is captured in the image, but it is at a larger scale (easier to identify vernal pools).*

Table 2: *Guidelines for determining appropriate imagery for a vernal pool mapping project.*

Photographic Criteria	Advantages	Disadvantages
Early spring flight	Increased detectability of potential vernal pools: - Highest annual water levels - Visibility best prior to bud swell and spring leaf out	Long shadows in the spring time may obscure potential pool features May be challenging to pin-point a cloud-free day for flights
Late fall flight	Additional option to accelerate process (flights flown in late fall enable field assessments the following spring)	Decreased detectability: - not all pools refill in fall - some deciduous trees retain leaves into winter Flights must be scheduled to follow heavy rain event
Color Infra-red (CIR) photography	Best for remote identification of vernal pools due to: - dramatic contrast between standing water and vegetation of surrounding landscape - soil moisture is detectable in addition to standing water	CIR photographic film no longer being made (as of 2010), but it is being replaced by digital CIR imagery May be more expensive than true color imagery
True Color (panchromatic) photography	May be less expensive and more readily available than CIR	More difficult to detect vernal pools than on CIR imagery
Black-and-White (B&W) photography	Less expensive and more readily available than CIR and True Color	More difficult to detect vernal pools than on CIR and True Color
Photographic Scale 1 inch = 400 feet (1:4,800)	Ideal for remotely identifying vernal pools (similar to 0.25' pixel resolution of digital photos)	More images are necessary which results in increased cost
Photographic Scale 1 inch = 1000 feet (1:12,000)	Smallest scale that is effective for remotely identifying vernal pools (similar to 1 foot pixel resolution on digital photos)	More difficult to detect small pools, and mapping errors may be higher
Note: Detection of pools located in a coniferous forest or under a mixed deciduous/coniferous canopy can be difficult with any imagery format because foliage and shadows obscure the ground surface.		

Photo interpretation of potential vernal pools

We highly recommend that photo interpretation be conducted by a trained professional with experience with both vernal pools and the geographic region that is the focus.

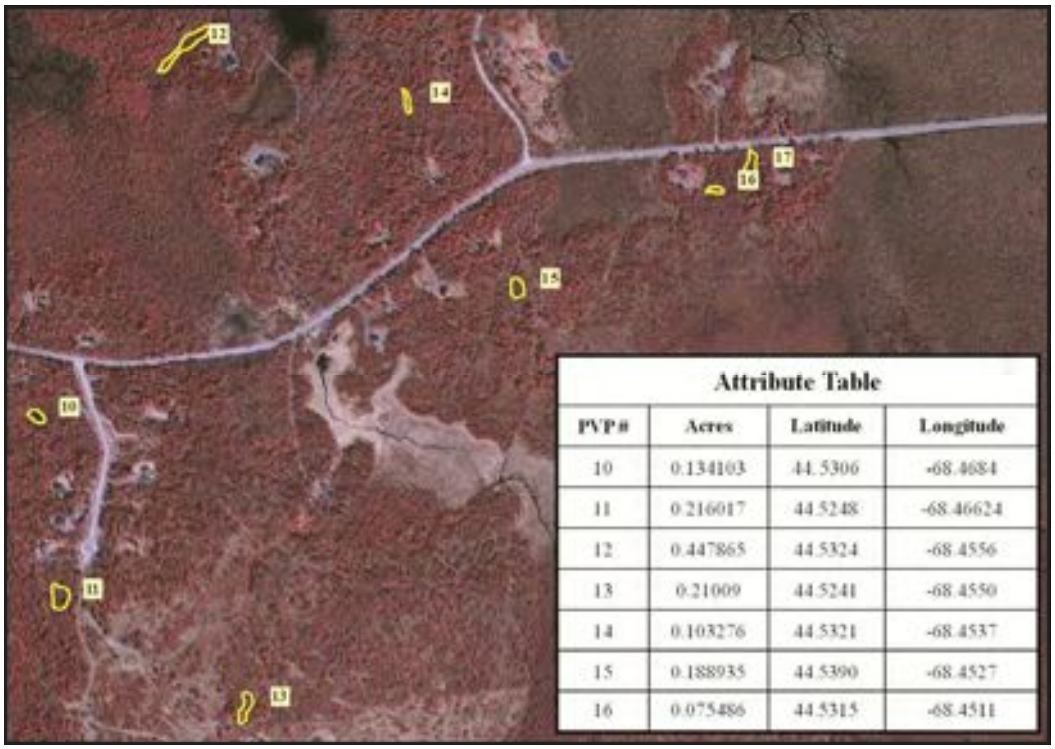
Traditionally, photo interpretation has been done using paired 9 x 9 inch stereo contact prints viewed under a mirror stereoscope, where the perimeters of pools are traced onto clear acetate overlays and then transferred by eye to a digital format for

use in a Geographic Information System (GIS) (see Figure 13A). Recent advances in technology allow on-screen viewing of digital stereo imagery in 3-D (see Figure 13B). This method allows more detailed, close-up views of potential pool features and their boundaries can be digitized on-screen directly into GIS format greatly reducing errors and speeding up the interpretation and mapping process. In some regions of Maine, existing digital imagery is available for purchase eliminating the cost of printed images and the time required to transfer data from acetate to a GIS layer.

Figure 13: *Photo interpretation. A) Using paired 9 x 9 inch stereo contact prints viewed under a mirror stereoscope. B) Using digitized aerial photographs viewed on-screen in 3-D.*

The end product of photo interpretation is a digital data layer of potential vernal pools (PVPs) that can be printed as a map (see Figure 14). Pool boundaries are digitized as individual shapes or polygons and should be accompanied by attributes or information including an identification number (PVP #), pool size, coordinates for input into a GPS unit, and pool-specific comments from the photo interpreter (e.g., "pool may be a tree shadow" or "pool looks like it might be artificial").

Even when conducted by a professional, photo interpretation of potential pools has its limitations (Burne and Lathrop 2008). Field checking is an *essential* element of the mapping project. Errors of omission (pools not detected on photographs) are typically as high as 30% (Calhoun et al. 2003). For example, extremely small pools, pools under a mixed or evergreen canopy, and those that are part of larger wetland complexes may be missed. Errors of commission (i.e., features that are misidentified as potential pools) may also be high. For example, wet swales, tree shadows, small streams and beaver flowages, road ditches, or farm ponds may be incorrectly identified as potential vernal pools.



Attribute Table

PVP #	Acres	Latitude	Longitude
10	0.134103	44.5306	-68.4684
11	0.216017	44.5248	-68.46624
12	0.447865	44.5324	-68.4556
13	0.21009	44.5241	-68.4550
14	0.103276	44.5321	-68.4537
15	0.188935	44.5390	-68.4527
16	0.075486	44.5315	-68.4511

Figure 14: *Sample map of potential vernal pools and associated attribute table.*

Step 3: Prepare for Field Season

Investing time in project preparation will help in the long run, however a good relationship with private landowners is essential to the success of a municipal vernal pool mapping project. It is well worth the effort to ensure that landowners and community members understand project goals and benefits prior to asking permission to survey pools on private property.

Topics covered

- Determining who owns the land that each potential vernal pool occurs on
- Securing landowner permission for field assessments
- Benefits of field assessments to landowners
- Preparing maps for volunteers

Key concepts

- Be clear that you are using the best method available for remotely identifying potential vernal pools but not all pools will be detected
- Before developing property, landowners are responsible for determining if they have Significant Vernal Pools
- All vernal pools are subject to regulation, mapped or unmapped
- Communication with the community--early and often--is essential

Determine property ownership for each potential vernal pool

Use your map of potential vernal pools in conjunction with your town's tax map to identify land ownership. For a person experienced with GIS technology, this process will likely consist of joining the town's property ownership database to a digital tax map (spatial data layer), identifying properties that contain potential vernal pools, and creating a list of landowners with pools on their property.

The resulting table should include the pool identification number, geographic coordinates for use by volunteers in the field, a parcel number, and the landowner's name and mailing address (see Table 3). This information can then be used to create mailing labels for requesting landowner permission to access pools. Towns without digital tax maps and/or GIS capabilities may be able to contract for these services from the organization hired to identify potential vernal pools, or from a local consultant.

Table 3: *Sample column headings in table resulting from spatial join between a property ownership database and potential vernal pool layer.*

PVP #	LATITUDE	LONGITUDE	MAPLOT	LANDOWNER	ADDRESS	TOWN	ZIP
145	44.5306	-68.4684	024-00-035	Jones, Omar	Pine St	-	-
132	44.5248	-68.4662	012-00-02	Kelly, Kirk	Stage Rd	-	-
17	44.5324	-68.4556	011-00-012	Gates, Ruth	Main St	-	-

Figure 15: *Determining property ownership in towns without a digitized tax map. In Wayne, Maine, aerial photographs overlain by scanned tax maps showing parcel boundaries, a digitized road layer, and locations of PVPs were used to identify land ownership. Volunteers used road intersections as geo-referencing points. To check their work, they compared their findings in GIS to the large paper copies of tax maps at the town office.*

It is more time consuming to engage in this process without tax maps in digital format, but it is possible, especially if you have a team of dedicated volunteers to share the workload. A hard copy of your tax map or zoning map may be scanned and geo-referenced (seek help from consultant providing photo interpretation services); then the resulting geo-referenced map overlain with PVPs may be printed, map lots identified for each pool, and landowner contact information retrieved from the tax assessor office (see Figure 15).

Secure landowner permission

Once parcels with potential vernal pools have been identified, you must obtain landowner permission from before sending volunteers out to assess the pools.

In order to secure landowner interest and participation, we suggest preparing Landowner Permission Packets that contain background information about vernal pools and provide a clear explanation of the town's rationale for participating in the project. Materials to include in a Landowner Permission Packet:

- Informational letter;
- Informational fact sheets;
- Map(s) showing the location of potential pools;
- Map disclaimer;
- Landowner consent form.

Prepared packets should be mailed in late winter, allowing ample time to follow up with a reminder (either a post card or a phone call) to non-responsive landowners. A verbal explanation from a town official may relieve landowner concerns.

Note: Factsheets and templates for materials listed below are available on the Maine Vernal Pool website for your use and modification.

Letter to Landowner

It may be stressful for citizens to receive a formal letter in the mail from the town or other official entity. It is important to allay these fears by highlighting:

- The objectives of your town's mapping project;
- How the Significant Vernal Pool legislation may affect landowners;
- The benefits to landowners (increased knowledge of resources on property and saving time and money involved in a field assessment required prior to development);
- That participation in the mapping program is *voluntary;*
- How pools will be assessed by citizen scientists;
- The timing of field visits each year (landowners often like to be invited to accompany and learn from pool assessors);
- Topics of potential concern, such as landowner liability;
- The anticipated duration of the project.

Note: Many landowners are under the false impression that if they deny permission for assessment, then their pools will not be regulated. Mapped or unmapped, *all SVPs* are subject to regulation.

Fact Sheets

Conserving Maine Significant Wildlife Habitat: Vernal Pools

Published by Maine Audubon, the Maine Department of Environmental Protection (MDEP), and the Maine Department of Inland Fisheries and Wildlife (MDIFW), this fact sheet provides ecological background pertaining to vernal pools and the animals that depend upon them, and makes a case for why these natural resources should be maintained on our landscape.

Vernal Pools in Maine: What do landowners and towns need to know?

This document briefly describes the Maine Significant Vernal Pool legislation, criteria used to determine whether a vernal pool will be mapped as Significant Wildlife Habitat, and the seasonal constraints for when a pool may be surveyed. It also includes testimonials from towns who have mapped their vernal pools using this community-based approach.

Map of potential vernal pool(s)

A printed copy of a map showing the location of potential vernal pools on the landowner's parcel (see next section *Prepare Maps* for more details).

Map disclaimer

This is an opportunity to ensure that landowners understand that you are using the best available technique for remote identification of vernal pools, but it is not possible to identify *all* pools that occur on the landscape.

Map Disclaimer

Interpretation of aerial photographs is used as a first step in the process of mapping the locations of vernal pools. At a town-wide scale, this has proven to be the most effective technique for identifying vernal pools. However, many pools (up to 30%) are not detectable through photo interpretation owing to factors such as dense canopy cover and shadows. In contrast, not all wetlands identified on the map are vernal pools, and an even smaller subset of the pools identified will meet the criteria to be considered Significant Vernal Pools.

Emphasize that the result of the survey will *not* be a complete map of all vernal pools. Landowners should be made aware that there may be unmapped vernal pools on their property and that they are responsible for having all pools evaluated prior to development. The disclaimer may be printed separately, displayed on the map sent to landowners, or incorporated into the landowner letter.

Landowner consent form

Request signed permission forms from landowners before surveys are conducted on private property. Include on this form a place for landowners to write their address, email, and phone number.

Signed consent forms ***are required*** *by the MDIFW if you choose to submit data for determination of regulatory status.*

Prepare maps

If your town does not have access to GIS software, you may acquire help from community members skilled in GIS, college students, local land trusts, or the organization completing your photo interpretation. If you provide tax maps in digital format, they should be able to create maps in either printed or electronic format. Once a GIS specialist creates a template, it will likely take roughly 10 minutes for them to create each individual map.

Prepare a map for each potential vernal pool. Critical information to include:

- The aerial photo mosaic as a base layer;
- Boundaries of potential vernal pools with corresponding identification numbers;
- Roads;
- Parcel boundaries with lot numbers (see Figure 16).

Note: A small inset showing the approximate location of the pool(s) within the town boundaries is also helpful.

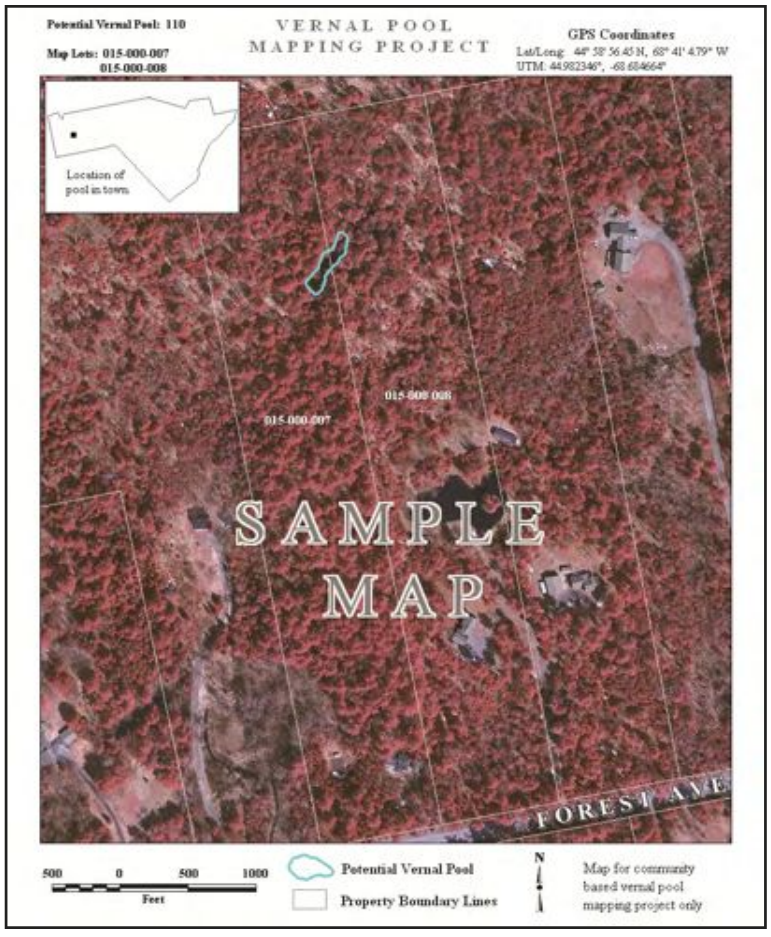


Figure 16: *Sample map to alert landowners of the location of potential vernal pools on their property and for volunteers to use for navigating purposes.*

Maps for landowners

Provide landowners with a map of potential vernal pools identified on their property (see Figure 16). In addition, we recommend posting a municipal-wide map on the town website and/or printed copy at the library or town office. Encourage citizens to view potential vernal pool locations on their property(s) and add pools missed by remote identification on aerial photographs. Be sure to include a disclaimer explaining the process by which potential vernal pools were identified.

Maps for citizen scientists

It is important that maps be made at a scale appropriate for on-the-ground navigation, *and that they depict all options for entering the property from public access points*. In addition, consider creating two to four (depending upon town size and distribution of potential vernal pools) overview maps that show PVPs, tax map property boundaries, and roads (see Figure 17) for ease of organizing and communicating with volunteers.

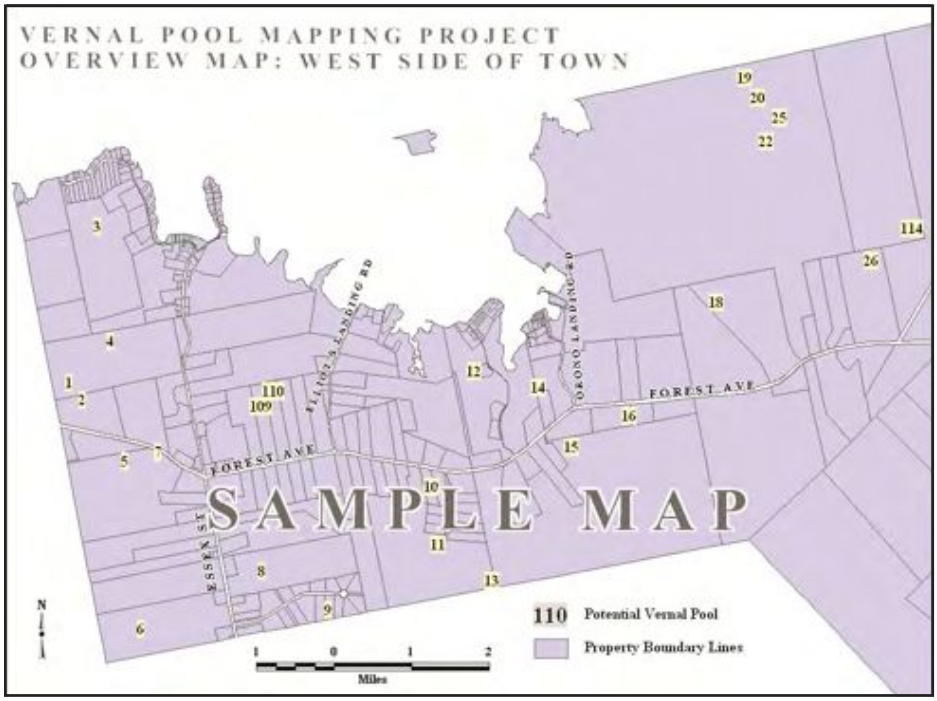


Figure 17: *Sample overview map to aid volunteers in locating potential vernal pools.*

Provide the coordinates for each pool so volunteers with access to GPS units can navigate to pools. Volunteers using recreational GPS units may be most comfortable entering coordinates in lat/long. It may also be helpful to volunteers if you list PVP coordinates on field maps, or provide a separate spreadsheet with landowner contact information, special instructions for volunteers and coordinates for each pool (see Table 4).

Table 4: *Example of column headings to include in spreadsheet for volunteers conducting field assessments.*

PVP#	LATITUDE	LONGITUDE	MAPLOT	LANDOWNER	ADDRESS	PHONE	EMAIL	INSTRUCTIONS FOR VOLUNTEERS
145	44.5306	-68.4684	024-00-035	Jones, Omar	Pine St	223-3104	ojone@gmail.com	park on road and walk up driveway
132	44.5248	-68.4662	012-00-02	Kelly, Kirk	Stage Rd	223-4585	kirkky@gmail.com	landowner would like to participate in survey
17	44.5324	-68.456	011-11-012	Gates, Ruth	Main St	223-8973	rgates7@gmail.com	Call first so we can put the dog inside

Prioritize pools to be assessed

It is best to survey all potential pools for which you are able to obtain permission. However, if you have limited time and resources, you might consider prioritizing pools to be assessed based on those most likely to provide valuable breeding habitat. Suggested guidelines for prioritization are listed below.

Higher priority pools

- Occur on large parcels of relatively undeveloped land
- Consist of multiple pools with 1,000 feet or less between each pool, especially if all pools in the cluster are on the same property
- Occur in low wetland density areas as they may be important if breeding sites are limited
- Occur in proximity to rivers, streams, lakes, or other protected natural resources
- Occur in areas zoned as rural

Lower priority pools

- Occur in highly developed landscapes (in close proximity to busy roads, in association with large parking lots, adjacent to commercial development, within a golf course, or within an expansive agricultural landscape)
- Occur on lands already conserved

Remind community of upcoming survey

Publicize upcoming field assessments in a follow-up article in your local newspaper, town newsletter, or website. Reiterate that in the coming months, trained citizen scientists will be conducting vernal pool assessments on parcels with permitted access. Offer to conduct surveys for landowners who suspect they may have a pool on their property but did not receive an invitation to participate in the survey.

If adjacent or nearby towns are similarly engaged in a town-wide mapping project, consider a joint press release, or the option of sharing resources for an infomercial on a local television station. Collaboration with other towns may serve to strengthen public perception of the project. Examples of publicity materials may be found on the Maine Vernal Pool Website.

Step 4: Recruit and Train Volunteers

The use of citizen scientists as volunteer data collectors in national, state, and local initiatives has grown in recent years (e.g., call surveys for birds and amphibians, mammal tracking, monitoring water quality, and documenting butterfly migration; Calhoun and Reilly 2008). Massachusetts was the first northeastern state to make use of trained volunteers to monitor and certify vernal pool resources.

In a study conducted in Maine and Connecticut, the efficacy of using citizen scientists was tested by comparing identification and egg mass counts done by professionals to those done by trained volunteers. This study confirmed that there were no significant differences in the number of egg masses counted by well-trained volunteer participants and biologists (Oscarson and Calhoun 2007).

A thorough training for volunteers is critical to assessing vernal pools accurately and safely--both for the wildlife and volunteers themselves. But don't lose sight of the other benefits of a good training. Your volunteers not only gather data, but they will also see new parts of town and spread the word about the importance of vernal pools to their friends and neighbors.

An important goal of any mapping project should be building a community of people who are knowledgeable and dedicated to the mission of maintaining vernal pool habitat in their towns. This will pay dividends well after the mapping project is complete.

Topics covered

- What to include in a public information session
- How to recruit volunteers
- What to include in volunteer training sessions
- Vernal pool etiquette

Key concepts

- Recruiting volunteers with natural history, education, or science backgrounds will likely improve the reliability of your survey results
- A combined indoor and outdoor training engages volunteers and yields best results
- For an accurate field assessment, volunteers must get in the pool

Recruit volunteers

Figure 18: *Open invitation to the general public.*

A well-organized team of trained volunteers can field check a town's PVPs during spring breeding in two consecutive years. We recommend recruiting 20 to 25 people for the duration of the project.

Citizen scientists may be recruited from the general public (see Figure 18); however, individuals with an interest in conservation or natural history, prior environmental monitoring experience, and/or map reading skills are preferable. Environmental consultants, high school teachers, biologists, naturalists, members of environmental non-profits, and local land trust or conservation commission members often make good volunteers.

The more engaged and committed your volunteers are, the more reliable your data will be. Targeted recruitment tends to generate better results than does an open invitation through a newspaper or radio advertisement. You might consider requesting the help of conservation commission members or local land trusts for volunteer recruitment.

If there is a home-school network or environmental club in your area, propose to the coordinator that a group of students and instructors incorporate the project into their spring studies. Because these styles of education often have flexibility regarding curriculum, daily schedule, and transport of students, such groups have in the past successfully completed a large number of field assessments.

Citizen scientists are more likely to commit to the project if their responsibilities are clearly defined and if they feel a sense of group purpose. Tokens of appreciation provide recognition for their efforts and identify them as part of a team (see Figure 19). Similarly, trainings and end-of-season gatherings with refreshments build community spirit.

Figure 19: *Tokens of appreciation: vernal pool volunteer t-shirt, field identification cards, project-inscribed frisbee (doubles as backdrop to improve photo documentation).*

Citizen scientist responsibilities

To participate, volunteers must attend all training sessions, be responsible for visiting a minimum of three to five potential vernal pools two times each spring (once in mid-to-late April and once in early-to-mid May), and must submit completed data forms with accompanying digital photographs to the project coordinator. Attending the public information session and trainings will require participation on set dates. However, the rest of the time commitment may be completed at the convenience of the volunteer. Some volunteers may opt to conduct one field assessment a day over the course of a week, while others might prefer to visit all of their pools in a single day. The amount of time required at each site will vary with pool size and complexity, number of egg masses, and with road access. Volunteers should expect to spend between 15 minutes and 1.5 hours at most pools.

To participate, a volunteer must be available to:

- Attend public information session and trainings;
- Review training resources on the website;
- Visit and assess 3 to 5 potential vernal pools each year for two years;
- Complete thorough pool assessments;
- Not mind getting wet and dirty;
- Work with another volunteer or bring a buddy;
- Complete data forms and archive digital photos for each pool visited.

Public information session (2 hours)

The public information session (mid-February to early March) provides an opportunity to inform potential citizen scientists and your town about the mapping project, vernal pool ecology, and the Significant Vernal Pool legislation. A mixed public audience (e.g., landowners who do not support the project may attend for more information) sensitizes citizen scientists to issues that are of concern to some private landowners. In turn, landowners will see that the project is well-organized and citizen scientists will be well-trained for the field work.

An LCD projector and screen are necessary for this session. Consider providing light snacks for participants and circulating a sign-in sheet. A large-scale printed map of your town with an aerial photograph background showing the potential vernal pools, roads, and landowner property lines, with an aerial photograph as a base layer is useful to display at this meeting (see Figure 20) . If the map also shows properties ***without*** landowner permission, community members attending the information session may be willing to explain project benefits to friends or neighbors with potential pools who did not respond to the invitation to participate in the survey.

Encourage town officials to attend this meeting. Code Enforcement Officers, Planning Staff, Tax Assessors, and members of the Planning Board are all likely to encounter vernal pools in their work; it is to their benefit to understand the mapping project and to have a basic understanding of the science behind the legislation so that they can address landowner concerns.

Figure 20: *Project maps to share with the community.*

Please familiarize town officials, citizenry, and citizen scientists with the resources available on the Maine Vernal Pool Website and encourage trainees to review annotated slide presentations: *Vernal Pool Indicator Species, Vernal Pool Trivial Pursuit,* and *How to Fill out the Municipal Vernal Pool Data Form* prior to attending the second training.

Outline for informational session

1) Presentation: *Vernal pool ecology*
2) Presentation: *What is involved in a municipal vernal pool mapping initiative?*
3) Open the floor for questions and discussion

Note: Annotated presentations mentioned above are available on the web site.

Citizen scientist training (3+ hours)

The timing of this training should overlap with the first appearance of wood frog egg masses (see Figure 21). This session provides hands-on training for conducting egg mass counts and for filling out vernal pool assessment data forms. At a minimum you should plan three hours to adequately train volunteers. We typically allow 1 hour for an indoor session, 15 minutes for questions, 15 minutes for travel to the training pool, 1+ hours in the field, and 30 minutes to assign pools and distribute field packets. Some towns opt to host a longer session to build a sense of community among volunteers and to allow time to complete data forms on a subset of assigned PVPs for practice. Consider holding the three-plus hour training in the morning, having lunch together, then visiting a few pools as a group in the afternoon.

In preparation for the training you will need a space equipped with an LCD projector and screen for the indoor portion and an easily accessible natural vernal pool that contains egg masses for the outdoor portion of the training. Pools with a

soft mucky substrate do not make good training pools because they are difficult to walk in and stirred-up sediment may hinder egg mass development. Look for a solid-bottomed pool that is relatively shallow and that contains a raft of wood frog egg masses (essential for learning how to count masses) and salamander spermataphores. The ideal pool for a field training will also contain egg masses from early arriving salamanders, and, if you are really lucky, fairy shrimp and blue-spotted salamander egg masses (see Figure 21). We recommend that you scout the pool just prior to the training to determine the locations of egg masses, spermataphores, and other features that should be highlighted and discussed with volunteers. In preparation for the training, project coordinators should access the Maine Vernal Pool website to review data forms, annotated training presentations, and resources available for volunteers. In addition, the short video entitled *Vernal Pool Outdoor Training* provides an outline of the key components to include in an outdoor session.

We have found that a brief show-and-tell session at the beginning of the indoor training using real egg masses, spermataphores, and pool amphibians excites volunteers and provides hands-on experience on the subtleties of identification covered in the training. Spermataphores may be difficult to identify the first time in a pool so it is useful to help volunteers develop a search image. Fairy shrimp do not travel well so if you know of a pool on public property that contains fairy shrimp, set up an optional group outing, or encourage your volunteers to visit the pool on their own. If you collect egg masses (and animals, if you encounter them), keep them cool and well watered and return to the pool from which they were collected soon after the training.

Prepare citizen scientists for field work by providing an advance list of materials that they will need at the field training (see Step 5: Conduct Field Assessments). Remember, not everyone will have access to hip or chest waders, so arranging for extra waders to loan is always helpful.

Figure 21: *What to look for when scouting an outdoor training site.*

Indoor portion of the training session

1. Hands-on identification (provide examples of egg masses for volunteers to view up close while discussing characteristics for each species).
2. View *Egg Mass Identification Video* that details the differences among masses present in Maine vernal pools.
3. Show annotated slide presentation: *How to Fill out the Municipal Vernal Pool Data Form.*
4. Review resources available to volunteers on the *Maine Vernal Pool* website.
5. Request that volunteers review annotated slides: *Vernal Pool Indicator Species* and *Vernal Pool Trivial Pursuit -- Test Yourself* before conducting field assessments.
6. Distribute Field Packets and related materials to volunteers. A large printed map of the town that clearly depicts potential vernal pools, the parcels with permission from landowners, and roads, with an aerial photograph as a base layer may be helpful at this training as well.
7. Assign pools to volunteers.

Outdoor portion of the training session

1. Discuss vernal pool field etiquette.
2. Demonstrate methods for finding egg masses:
   - Use polarized sun glasses for seeing egg masses below the water surface;
   - Scan vegetation that likely serves as attachment sites for egg masses (often shrubs for wood frogs, emergent dead sedges, grasses for spotted salamanders, and even downed woody debris in pools for all species);
   - Gently lift submerged vegetation when searching for blue-spotted masses.
3. Point out identifying characteristics of any animals, egg masses, or spermataphores.
4. Demonstrate techniques for counting wood frog egg masses that are deposited in large rafts. Conditions permitting (be aware of impact your group is having on site), everyone should experience what it is like to count a raft by feeling the large globular masses that are often laid in multiple layers just below the water surface.
5. After an initial orientation, divide your volunteers into small groups to practice filling out a data form. Reconvene to go over the data sheet as a large group leaving plenty of time for questions and answers.

Vernal Pool Field Etiquette

- Please do not bring four-legged friends to your pools.
- Be sure your hands are free of bug repellent and sun screen.
- Walk slowly around the pool. Check the substrate. Mucky or solid? If mucky, you may want to limit time in water to minimize disturbance.
- Leave egg masses attached to vegetation or sticks. Photographs should be taken in place.
- Tadpoles, larvae, adults frogs and salamanders, and fairy shrimp can be temporarily removed from pool and photographed in a frisbee or bucket.

Assign pools to participants

Consider whether you will give volunteers the option of choosing the pools that they will visit, or if you will make arbitrary pool assignments in advance of distributing field packets. Logistically, it is more difficult to allow volunteers to choose the pools they will visit, but there are some advantages to this technique. Volunteers may be willing to assess more pools if they are located close to their home, they may be more comfortable visiting ones that they are already familiar with, or they may see this survey as an opportunity to meet and get to know neighbors. However, if you do allow volunteers to choose their own pool assignments, *please do not permit landowners to make assessments on their own properties.*

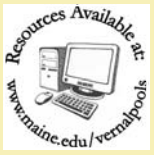
A printed map on the wall, or projecting the town map of PVPs on a screen, will allow volunteers to see where permission has been granted and locate the pools that they will be assessing. This also provides a good format if you opt to allow volunteers to choose their pool assignments. At the same time, you may wish to highlight locations of PVPs on properties without landowner permission in case volunteers are interested in taking the time to explain the project benefits to disinterested landowners.

We encourage you to request that citizen scientists work in pairs with one person in the pool while the other completes the data form. Consider team assignments based upon who has access to waders/or is willing to bring a change of clothes and get wet. On occasion, volunteers may encounter a pool where it is not physically possible or is unsafe to do a complete survey, but as a rule of thumb, one person in each team *must* be willing to conduct surveys by wading into the pools to make a complete survey. Merely walking the perimeter is rarely an acceptable method for determining that a potential vernal pool is not a vernal pool.

Field Packets

Organize field materials for each potential vernal pool in a 9x12 manila envelope that can be distributed to volunteers based on assigned PVP numbers. *While it may be tempting to organize data by volunteer or by property ownership, you may not have the same volunteers both seasons and some potential vernal pools may not require visits during the second year of the survey.* Use of a manila envelope for each potential vernal pool in your town will minimize confusion, make data entry from year to year much easier, and ensure consistency among the towns involved in the project. An envelope will also provide protection for the maps so they can be used for subsequent field visits.

On the outside of the envelope include the potential vernal pool number, the lot number, and landowner's name. In each envelope you should provide data forms and maps (see below) to volunteers at the beginning of the field season. Have them ready at the second training session, at an additional planning meeting, or for pick up from a location convenient for your volunteers.



Note: Templates and samples of all materials listed below are available for download from the Maine Vernal Pool website.

Materials to include in each field packet envelope (organized by PVP number):

- Municipal Data Form;
- Map(s) for navigating to potential vernal pool.*

Additional Materials to provide to each volunteer or pair of volunteers

- Town overview map(s) that show potential vernal pools with their identification numbers, tax map layer showing property boundaries, roads, and any other identifying features (see Figure 17)
- Extra Municipal Data Forms (for any additional unmapped pools)
- Field gear checklist for conducting field assessments
- Vernal Pool Field Etiquette list
- Spreadsheet that provides PVP #, pool coordinates, landowner contact information, the physical address of the property, and any special instructions specific to individual pools**
- Project Information Sheet to be posted on dashboard
- Volunteer Responsibility Agreement
- Contact information for project coordinators, external resource people, etc.
- Blank CD for submitting photo documentation
- Laminated Field Identification Cards (either provide or suggest that volunteers print from website and laminate themselves)

*Volunteers will be able to locate most pools with the aerial photo maps provided to them, however pools in the middle of large forested areas without easy-to-identify landmarks, may require navigation with use of a GPS. If you do not have access to a GPS, consider borrowing a few units, or designate a volunteer who owns a GPS as the Project's GPS technician.

**Some property owners may prefer to be notified just prior to each field visits while others may appreciate the opportunity to accompany the volunteer during the survey.

Step 5: Conduct Field Assessments

As the snow melts and wood frogs are heard calling, it's time to send volunteers out to find their pools and count egg masses. Learn how to make these assessments as thorough and accurate as possible.

Topics covered

- Appropriate timing for field surveys
- Field equipment
- Counting egg masses
- The data collection process and how to complete the survey forms
- What's involved in a multi-year field assessment process

Key concepts

- Peak breeding activity can differ from pool to pool within your town
- Two visits are needed during the breeding season--an early one for wood frogs and later one for spotted and blue-spotted salamanders
- Two years of surveys are necessary to account for natural variation in egg numbers from year to year
- There are two different data forms--one for all potential vernal pools surveyed by volunteers (the municipal form), and another for the subset of vernal pools that meet biological criteria for significance (the state data form) which are completed by individuals with additional training or professional expertise

When do we survey pools?

Peak wood frog activity will differ from pool to pool depending on geographic location, weather, tree cover/exposure to sunlight, and pool depth. Once wood frogs begin calling, monitor a few known pools in your town to see when egg masses first appear and then send volunteers out roughly one week later (may take longer if the temperature is very cold or it is exceptionally dry and windy) to ensure that assessments occur soon after ***all*** masses have been laid (see Figure 22). Breeding will occur earliest in pools with southern exposure or little tree cover; use pools in cool sites to gauge timing so that you do not send volunteers out too early.

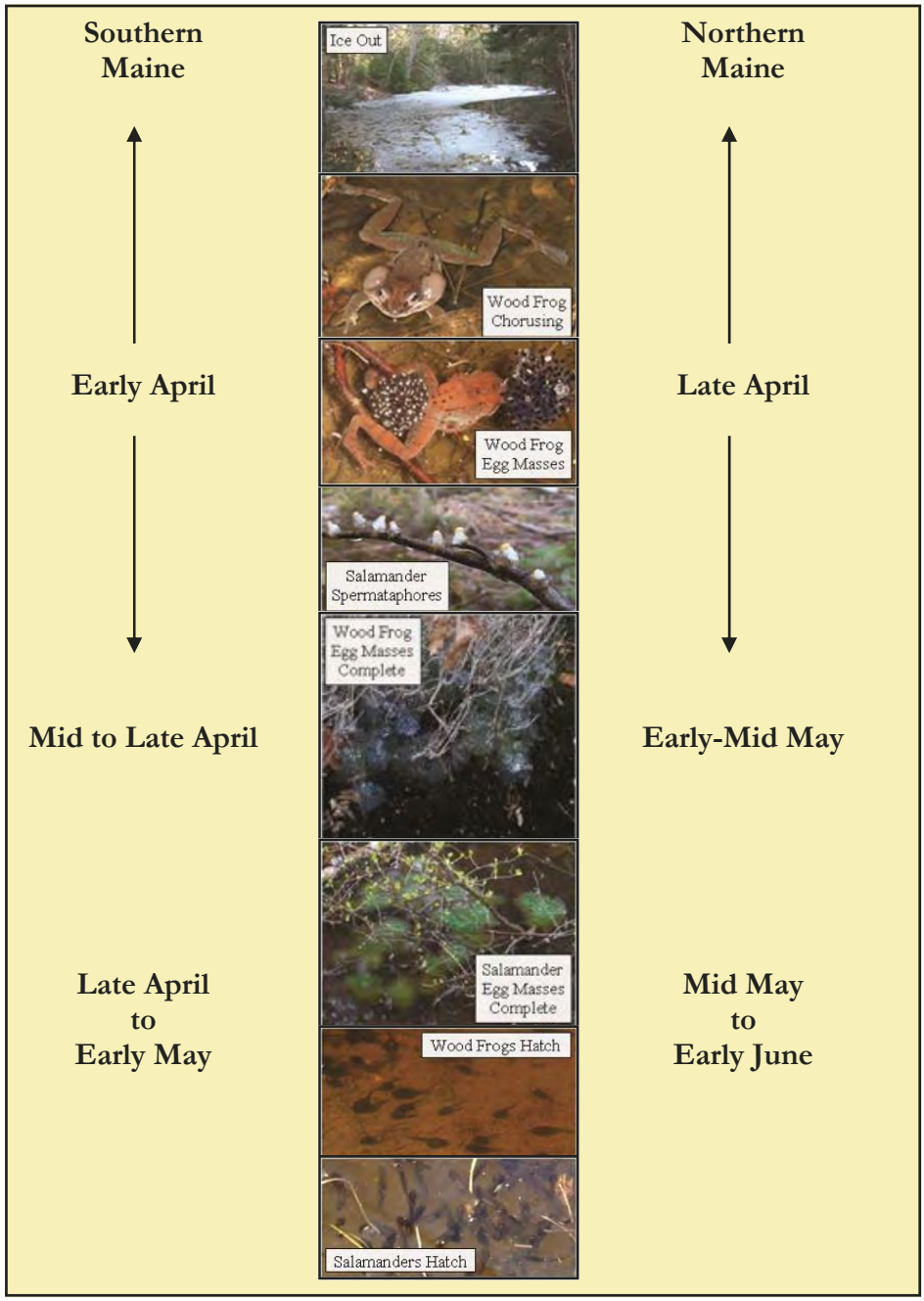


Figure 22: *Approximate timing of pool breeding events (adapted from Philip deMaynadier, MDIFW).*

How many times do we survey?

Volunteers must visit each potential vernal pool twice each spring. The first count is conducted just after the peak of wood frog breeding. Instruct volunteers to count all wood frog egg masses, scan carefully for fairy shrimp, look for spermataphores, count any spotted salamander egg masses present, and carefully search for blue-spotted egg masses. During their second visit, roughly two to three weeks later, volunteers will do a final count of blue-spotted and spotted salamander egg masses. By the second visit wood frogs will have hatched and tadpoles will be in the sunny shallows of the pool. Any given salamander population may take up to six weeks to lay eggs, so the visits are staggered to capture the range of laying times.

At each visit, volunteers should count ***all*** egg masses for all species present, even if the same masses were counted during a previous visit. The highest egg mass count will be used to determine if a pool is biologically significant (therefore meeting one of the criteria of a state-regulated Significant Vernal Pool). If egg masses are difficult to count because they are close to hatching or are beginning to break-up, this should be noted on the data form.

Why do we survey pools for two years?

The State does not require more than one year of assessment for determination of Significance, however, we know that there is great variation in egg mass numbers from year to year. Multiple years of field data will provide a more representative record of where significant breeding regularly occurs.

Is it okay to walk in the pool?

It is hard to accurately assess a pool without getting wet feet. Citizen scientists should expect to enter pools as part of the survey process (in teams of two, only one volunteer needs to be prepared to get wet). However, if a pool holds water for a relatively long time (through July) and has a soft mucky substrate, extra care should be made to avoid stirring up sediments or crushing obscured egg masses. In these mucky pools, volunteers should also be aware that getting stuck or losing a boot is a good possibility if not careful.

Sometimes it is not feasible to walk in all portions of the pool. In the past, creative volunteers have used an inner tube to float around a pool, or have searched for egg masses through binoculars. If for some reason volunteers were not able to enter a pool for a complete assessment, this should be noted on the data form. Another attempt should be made the following year to obtain a complete count. In all pools, movement should be slow and cautious to ensure that all masses are counted and potential damage is minimized.

What should volunteers bring in the field?

- Data forms
- Maps of assigned PVPs
- Landowner contact information
- Project Information Sheet to be posted on car dashboard
- Clipboard
- Hip boots/waders/shoes and pants that can get wet
- Pen and pencil
- Digital camera
- Frisbee or plastic plate or clipboard for photo backdrop
- Gazetteer (helpful to find pool location within town)
- Cell phone (for emergencies and to call for technical assistance)
- Walking stick or ski pole for balance
- Polarized sunglasses
- Binoculars (optional)
- GPS unit (optional)
- A buddy!

Searching for fairy shrimp

Although very easy to miss, when fairy shrimp occur in a pool they are typically abundant. Once detected, many others will be seen in the vicinity. Volunteers searching for fairy shrimp should stand quietly in the sunny shallows and look for movement within the water column. Often camouflaged against leaves on the pool bottom, the light colored egg sac attached to females may be easier to spot than the animals themselves. Polarized sunglasses are a useful tool for spotting these animals below the water surface. Use of an aquarium net sometimes reveals fairy shrimp in dark bottomed pools or when conditions are shaded. Don't confuse fairy shrimp with other aquatic animals such as wriggling mosquito pupae which may also be found in pools. Volunteers should familiarize themselves with the fairy shrimp and pupating mosquito images on the Maine Vernal Pool website. Be aware that to date, less than 5% of the pools surveyed in Maine have hosted fairy shrimp; this may be because assessors did not know what to look for.

Resources Available at: www.maine.edu/vernalpools

Counting egg masses

Counting egg masses during the appropriate time for your town is critical, especially for the first visit. Wood frog embryos develop rapidly and the egg masses merge together and break down quickly, making it difficult to count individual masses. The infertile hybrid blue-spotted egg masses seem to deteriorate rapidly as well, making counting difficult unless done soon after egg laying.

Wood frog egg masses deposited in large clusters, often called rafts, at the water surface may be detectable without setting foot in a pool. But because not all masses are laid in rafts (some may occur singly, or in small clusters at the surface, within the water column, and even on the pool bottom) (Morgan 2010), it is important that volunteers thoroughly and systematically search each pool. It is the volunteer's responsibility to count ***all*** egg masses and not just to determine whether the pool meets the biological criteria for significance based upon threshold egg mass numbers. Often laid multiple layers deep, wood frog eggs require care in counting. Volunteers may find it more effective to count by feeling each globular mass rather than by visual assessment.

Spotted salamander egg masses are not always clustered in one region and are frequently laid individually throughout the pool. Polarized sunglasses greatly improve detectability of these masses, which are often found attached to vegetation below the water surface and may be in deeper parts of the pool than the rafts of wood frog egg masses.

Blue-spotted salamander egg masses are deposited in small clusters, strings along submerged sticks, or individually. Often their eggs go unnoticed. Although time consuming, the best way to locate blue-spotted masses is by wading slowly through the pool and lifting submerged sticks just above the water surface. Many times not otherwise visible, the loose jelly of blue-spotted masses will hang (or drip) from sticks that are lifted out of the water. Sometimes the white infertile eggs make them show up more clearly (see *Egg Mass Identification* video on Maine Vernal Pool website). It can sometimes be difficult to determine what constitutes a "mass." Because blue-spotted egg masses are hard to count and often occur in the hundreds, it is not necessary or expected that volunteers provide an exact count of blue-spotted masses. Exact numbers should be recorded if less than 20 masses are found in a pool. The following intervals may be used for productive pools: > 20, >50, > 100, > 250, > 500. If observers find fewer than 10 masses, they should be encouraged search more carefully and re-visit the pool a few days to a week later.

Field Assessment Process

Year One

1. Volunteers complete Municipal Data Form for PVPs with landowner permission. In the field they will:

    - Search for and count amphibian egg masses
    - Document presence/absence of fairy shrimp
    - Photograph egg masses and fairy shrimp present
    - Photograph the pool and surrounding habitat

2. Project coordinators review data forms and photographs to determine follow-up visits.

3. Qualified individual(s) complete State Data Form for pools that met biological criteria for a Maine Significant Vernal Pool (summer/early fall visits).

Biological Criteria

≥ 40
wood frog egg masses

≥ 20
spotted salamander egg masses

≥ 10
blue-spotted salamander egg masses

presence of fairy shrimp

Year Two

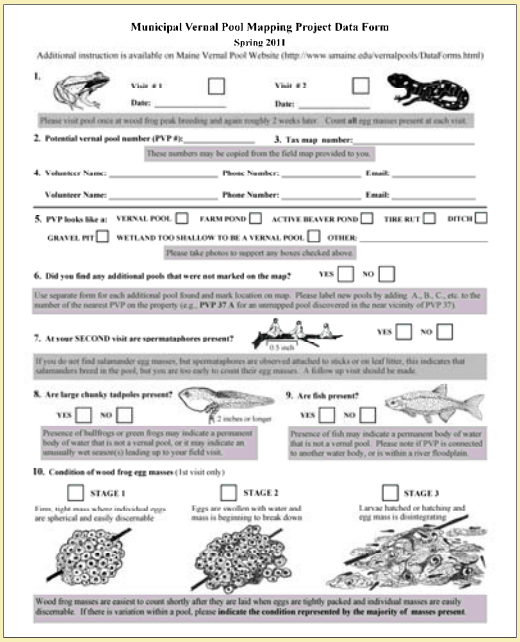
1. Volunteers revisit pools that did NOT meet biological criteria during Year One surveys for second year of data collection with Municipal Data Form (to account for natural annual variation and/or missing data from Year One).
2. Volunteers visit any PVPs not visited in Year One.
3. Project coordinators review data forms and photographs to determine follow-up visits.
4. Qualified individual(s) complete State Data Form for pools that met biological criteria for a Maine Significant Vernal Pool (summer/early fall visits) based on Year Two data.

Year Three (if needed)

1. Visit pools missing data.
2. Prepare and submit materials to MDIFW.
3. Report findings to community.
4. Establish and maintain vernal pool database.

Which data sheet should we use?

In Maine, determination of vernal pool regulatory status is based on the MDIFW Significant Vernal Pool Data Sheet. The form requires egg mass counts and information on hydrology and vegetation. This in-depth form may be completed by qualified state agency personnel, environmental consultants, wildlife biologists, trained DEP interns, wetland ecologists, or citizen volunteers wanting to go through additional training.


Municipal Vernal Pool Mapping Project Data Form
Spring 2011

With feedback from town partners and MDIFW, we designed a simplified Municipal Data Form that focuses on recording egg mass numbers and presence of fairy shrimp.

Pools that do not meet the biological criteria (egg mass numbers or presence of fairy shrimp) in year one are visited a second year with the Municipal Data Form, and pools that did meet the biological criteria in year one are revisited in year two by professionals or specially trained volunteers or interns to complete the State Vernal Pool Data Form. Additional data required for the State form include information on hydrology, pool size, substrate, vegetation, and surrounding habitat, all of which may be collected during the summer/early fall.

This strategy of using two levels of data collection was intended to simplify volunteer efforts and eliminate filling out the state forms for pools that are not biologically Significant.

Resources Available at: www.maine.edu/vernalpools

Note: Both the Municipal and State forms are subject to revisions; please make sure that the form you are using is current by checking for updates on the website.

Photographic documentation

Photo documentation provides credibility and is required by MDIFW for indicator species and pool habitat verification. For each PVP, request that volunteers submit:

- ***One*** photo of fairy shrimp if present;
- ***One*** photograph of each egg mass type found in the pool;
- ***Multiple*** pool overview and surrounding habitat photos showing what the pool looks like (include photos of the most common plants present, what the land surrounding the pool looks like, and any human impacts the pool such as ditches, trails, roads, trash, etc.

Emphasize to volunteers that duplicate photographs and photos beyond what is requested are a burden for protect coordinators or state personnel to sort through and store.

For more information on photo documentation, please direct volunteers to the annotated slides *How to fill out the Municipal Vernal Pool Data Form* on the Maine Vernal Pool website.

Note: Photos should be taken of all PVPs even if they are not vernal pools.

Obtaining data from citizen scientists

At the end of each field season, project coordinators should collect field packets with completed data forms for each of the two visits, maps, and photo-documentation for each pool. Information gathered during the first year of assessments will be used to inform the next steps in the field assessment process. It is important to collect forms as soon as possible so that if issues arise, volunteers may be contacted soon after completing their field surveys.

Field season wrap-up for volunteers

Consider hosting an appreciation party/ice cream social for your volunteers at the end of the field season as an opportunity to share preliminary results and allow volunteers to swap stories, provide feedback, and get excited about helping in the future. This is a good time to collect remaining field packets and ask for volunteer assistance with non-field related project tasks.

Step 6: Organize Data and Plan for Additional Field Visits

The work isn't over when temperatures have warmed, the egg masses have hatched, and volunteers have turned in their field data. In many ways, for the project coordinators, the work has just begun. Learn how to organize Year One data, communicate preliminary findings, and plan for the following year of field surveys.

Topics covered

- Assistance with data review and preparation for follow-up visits
- How to handle pools found in field that were not on PVP map
- Data entry and depiction of field data on maps
- Sharing preliminary field data with landowners and town officials

Key concepts

- Check photos and data soon after they are collected--it's easier to ask questions of volunteers when field surveys are fresh in their minds
- Follow-up checklists were designed to help organize data forms, determine next steps, and let volunteers know what needs to be done during follow-up surveys
- It is important to maintain contact with landowners to ensure they have access to information about pools on their properties

Verifying photo documentation

Check photos submitted by volunteers soon after the field season. If anything is missing or confusing, it is easier to check in with the volunteers when the field work is still fresh in their minds. Make sure all photos are organized in separate folders by pool number as described on the back of the data form. You should have a computer folder for each pool with photo documentation (please do not create separate folders for each year). Confirm that photographs for each pool are correctly labeled and that volunteers have not made identification errors. If any volunteers did not follow the labeling format provided, please re-label so files are consistent with the example on the back of the data form. Photo verification should be done by a town official, conservation commission member, volunteer, or intern who is familiar with the project.

If there is any doubt about the subject of a photograph, send photos via email to UMaine biologists (mainevernalpools@gmail.com) to confirm identification.

Note: If photos are of poor quality or the subject matter is not identifiable, the data are not valid and the pool should be revisited the following year.

Plan for follow-up visits to vernal pools

The *Checklist for planning follow-up visits to vernal pools* was designed to help you organize data forms after an initial field season and to determine appropriate next steps for each potential vernal pool. The checklist (available on the Maine Vernal Pool website) will identify whether the pool meets the biological criteria for Significance and therefore requires completion of the State Data Form, whether data are missing, surveys are incomplete, photos are inadequate, or a GPS location is missing. The checklist was designed to guide you through the data sorting process, but it also may serve to instruct volunteers on what each pool needs in the second year of surveys. If you print a copy of the checklist to include in each PVP packet, the space at the bottom may be used to write pool specific instructions. After verifying photo documentation and sorting through data forms, you will likely end up with three categories:

1. PVPs missing data;
2. PVPs that do NOT meet biological criteria for Significance;
3. PVPs that meet biological criteria for Significance (see Table 5).

What if new pools were found?

New pools found in the field should be labeled with the number of the closest mapped PVP on the property (27A, 27B, 27C etc.). Request that volunteers sketch the approximate location of new pools on their field map so that they may be re-located in the field. A GPS should be used to delineate the pool boundaries so that new pool polygons may be added to the municipal vernal pool data layer.

Table 5: *Pools will likely fall into 3 categories after a first year of field assessments, each requiring different follow-up activities.*

Data Form Categories	Explanation	Follow-Up Action
PVPs missing data	For example: · didn't contain indicator species but may be a vernal pool · volunteer could not find pool · only one visit completed · survey too late or incomplete · inadequate or missing photographs · new pool in need of GPS coordinates	Revisit with Municipal Data Form
PVPs that do NOT meet biological criteria for Significance	Pools that contain egg masses but in numbers less than biological criteria to meet Significance	Revisit with Municipal Data Form
PVPs that meet biological criteria for Significance	≥ 40 wood frog egg masses ≥ 20 spotted salamander egg masses ≥ 10 blue-spotted egg masses presence of fairy shrimp	Complete State Vernal Pool Data Form

Enter data into a spreadsheet

For ease of access to preliminary findings, enter data into spreadsheet format at the completion of each field season. A simple Microsoft Excel template is available for this purpose on the Maine Vernal Pool website, however, if you have the personnel and software available to do so, it may be wise to develop a relational database using Microsoft Access to house and manage long-term vernal pool data.

Representing preliminary vernal pool data on maps

Updating your vernal pool data layer to reflect the outcome of your field surveys may be helpful in planning for follow-up visits and/or for communicating with landowners interested in preliminary results. Because this is a multi-year project, the way in which pools are classified and depicted on your map will change as you receive additional information from each field survey (see Figure 23) and then ultimately you will end up with a data layer that depicts the regulatory status for vernal pools in your town.

Note: Please do not use the colors red, green, or yellow to represent preliminary data. These colors should be reserved to represent pools for which regulatory status has been determined by the State (see Section III, Part 1).

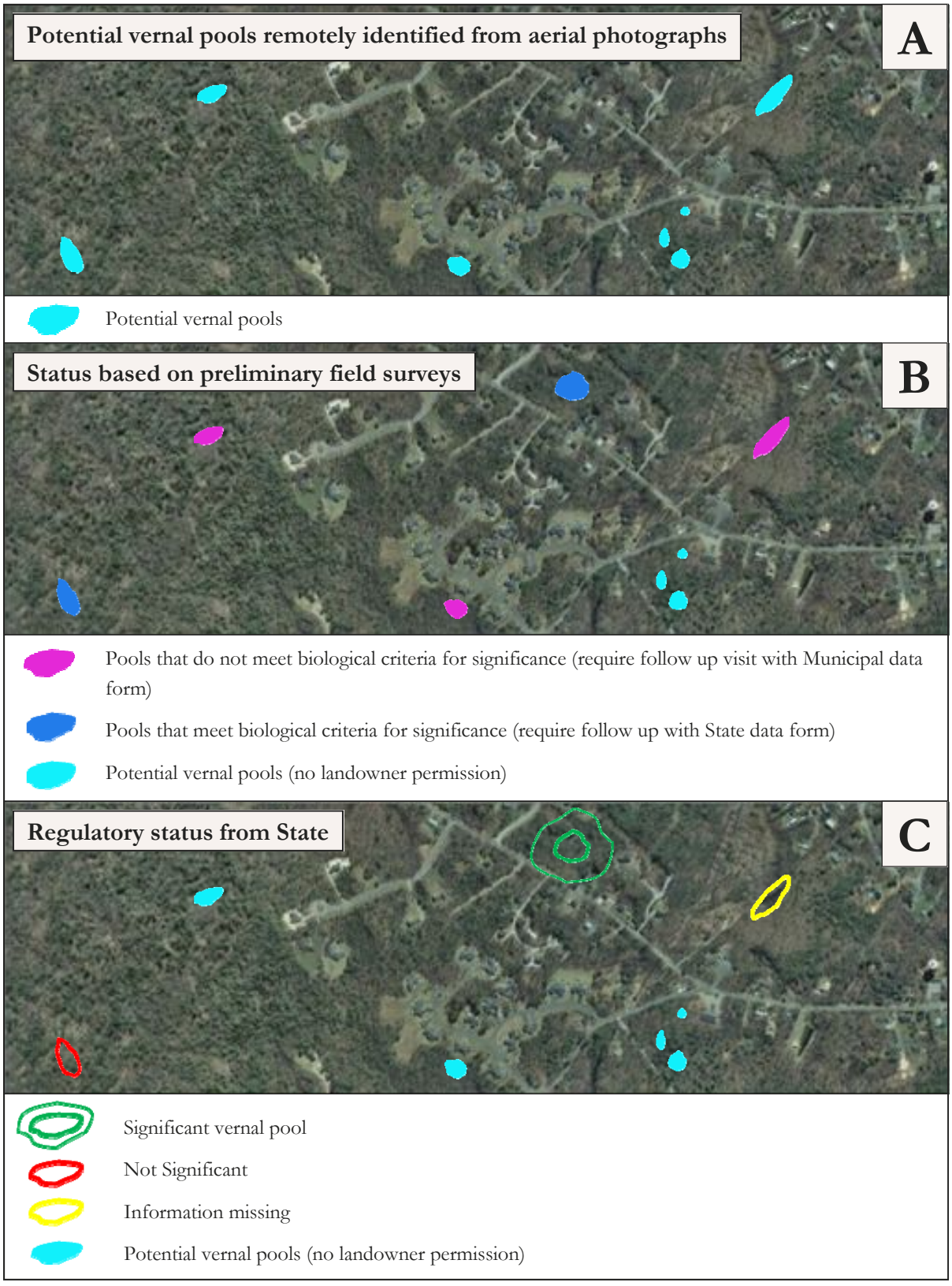


Figure 23: *Sample municipal vernal pool map symbology. A) Remotely identified potential vernal pools, B) Color-coding for purpose of planning follow up visits in second year of survey, C) Planning map at project completion that shows regulatory status as well as PVPs for which landowner permission was not granted. The images above were created for illustrative purposes and do not reflect actual pool locations.*

What to include in a preliminary report to landowners?

If you report preliminary findings to landowners, make it clear that the mapping process requires multiple visits over the course of two years and that data reported after the first field season may not be used to *predict* regulatory status. Some towns may wish to host a meeting to share results with town officials. If advertised, this presentation also could serve to inform landowners of preliminary findings. Additional options for maintaining contact with landowners might include:

- A letter to each landowner;
- A copy of data sheets for pools on each property with an accompanying form letter to explain findings;
- A post card stating that preliminary data were collected and may be viewed on the town website or obtained from the project coordinator;
- An article in the town newsletter and on the website encouraging landowners to view a preliminary map posted on the town website and contact the town if they would like to discuss preliminary results for their property.

No matter the format, it is important to maintain contact with landowners and ensure that they have access to information about their property.

Step 7: Submit Data to MDIFW

Data collected by volunteers may be submitted to the MDIFW for review and determination of state regulatory status if it is well organized and follows the directions provided in this document. Pools that meet the Natural Resource Protection Act's (NRPA) definition of a state-regulated Significant Vernal Pool will be included in a state-wide database.

Overview

- Explanation of Maine's process for determining Significant Vernal Pools
- Necessary materials to submit to MDIFW
- Map symbology used for depicting regulatory status

Key concepts

- Only qualified state personnel have the authority to make a regulatory determination of Significant Vernal Pools
- Careful organization throughout the project will make preparing materials to submit to MDIFW easier
- MDIFW only accepts volunteer data that is accompanied by signed permission forms from the landowner

Preparing data to submit to MDIFW

Biologists at the MDIFW will enter town data into their database and make a recommendation of pool regulatory status to the MDEP. The town and private landowners will receive a letter explaining the regulatory status from the MDEP. At your request MDIFW will provide the entered SVP data back to towns in the form of a GIS layer. Significant Vernal Pools will be colored green, Non-Significant Vernal Pools will be red, and pools missing critical information will be colored yellow (see Figure 23C).

If you are interested in pursuing regulatory status, you will need to submit the following to MDIFW:

1. Hard copies of the Significant Vernal Pool data forms (Please add PVP numbers to the top of each SVP form for cross-referencing purposes);
2. Hard copies of all Municipal Data forms (MDIFW would like biological data and locations of non-regulatory pools);
3. Hard copies of maps used by volunteers (aerial photo with parcel lines and PVP locations);
4. Photo documentation (digital format) for all pools visited. If volunteers provided more than one photo of the same subject matter (e.g., spotted salamander egg mass), please select the best image and delete the others. If image labeling does not follow the appropriate format, you will need to re-label images before submitting to MDIFW. If possible, hard copies of photos for pools that meet biological criteria are preferred;
5. Shapefile of all photo interpreted potential vernal pools. The attribute table should include the PVP number that corresponds to data forms and pool coordinates. For additional pools found that were not on photo interpreted map, perimeter coordinates should be obtained and pools either added to the GIS layer or provided as a separate layer. New pools should be labeled with the number of the closest mapped PVP on the property (27A, 27B, 27C etc.);

   Note: With this information, please include the coordinate system used to project your data (MDIFW uses Universal Transverse Mercator (UTM) Projection, North American Datum (NAD) 1983 Zone 19N).
6. Signed permission forms from landowners.

Please remember that no one other than qualified state personnel have the authority to make a regulatory determination of pool significance. You may refer to pools that contain fairy shrimp or meet the egg mass threshold criteria as being *biologically significant*, but please avoid referring to pools as being "Significant" until a regulatory determination has been made. Regulatory status may be used to inform upcoming development projects that are subject to Maine's NRPA regulation (for more information on regulation of vernal pools see Section III).

Step 8: Establish and Maintain a Database

The results of municipal mapping initiative will be of greatest use to town officials, planning boards, developers, and individual landowners if they are stored in a way that promotes easy access. Data storage using a Geographic Information System (GIS) is an excellent way to link and easily view both spatial and non-spatial information pertaining to this project.

Overview

- Using GIS to store vernal pool data
- Updating and maintaining a database

Key concepts

- Importing photos and data into GIS is time consuming but enables multiple people to have the information at their fingertips
- Think of the "final" database of assessments as a living document--it should be updated as additional field assessments are made and information becomes available

Using a GIS to store your vernal pool data

Field data collected for potential vernal pools (data forms, photographs, and spatial information about pool locations) are easily stored in a GIS database. Photos and scanned data forms may be linked to spatial data and easily retrieved for planning purposes (see Figure 24). This option is time consuming at the onset, but will enable multiple people to have the information at their fingertips without having to shuffle through hard copies of maps, photos, and data forms.

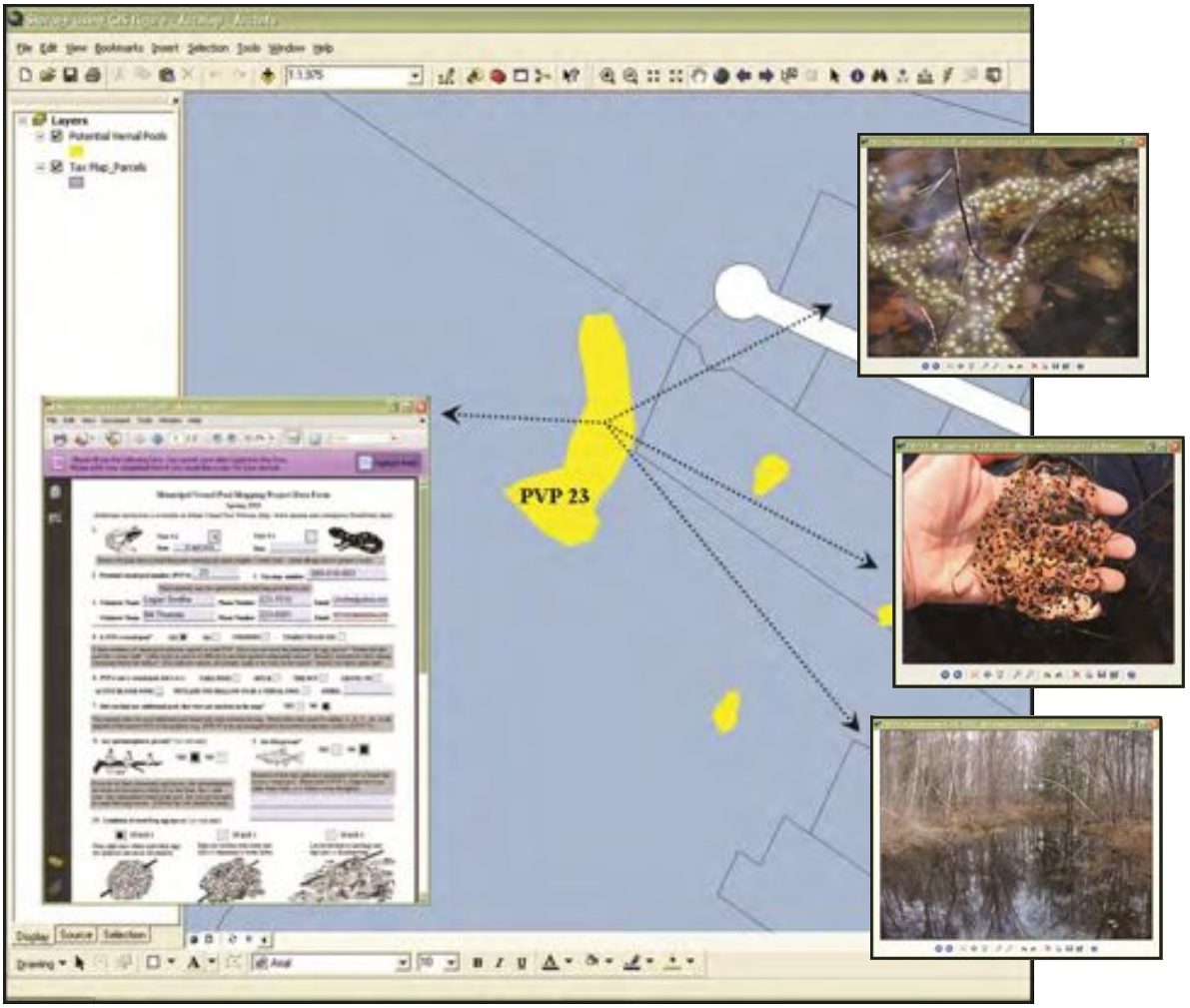


Figure 24: *Sample vernal pool database where data forms and associated photo documentation are linked for easy access.*

Why should we update and maintain a database?

A digital data layer showing the locations of Significant Vernal Pools, non-Significant Vernal Pools, and pools that have been surveyed but are missing information will be a useful end product. We encourage you to include PVPs that were not assessed as they will be helpful in identifying areas in need of assessment prior to development.

This final product should not be viewed as a complete assessment. As additional pools are identified and surveyed, this layer should be updated. Development projects may reveal additional pools and individuals may hire a consultant or request the services of the State for assessments. It is your responsibility to update your vernal pool layer. The MDEP currently maintains a spatial data layer that shows the location and regulatory status of vernal pools that have been mapped in Maine. It is frequently updated and may be found at: www.maine.gov/dep/gis/datamaps/.

Section III
Vernal Pool Regulation and Local Conservation Strategies

The seasonal nature of vernal pools limits the time of year when they may be evaluated to determine if they are a Significant Vernal Pool (SVP) and therefore subject to regulation under the Natural Resources Protection Act. It is this seasonality that makes it challenging for landowners to develop near pools prior to a field assessment conducted in the spring breeding season.

In most Maine towns, vernal pools are not pre-identified or mapped and permitting happens on a case-by-case, reactive basis. Some Maine towns have identified potential vernal pools from aerial photographs, and conducted field surveys to determine Significance (see Figure 25).

Maps of potential vernal pools allow towns to engage in large scale planning and proactive conservation. These maps also benefit landowners. Knowledge of vernal pool locations and whether or not they will require permits may allow landowners and developers to avoid delays caused by the requirement for spring surveys. Also, if potential vernal pools are pre-identified, developers are better able to plan projects to minimize impacts to pools.

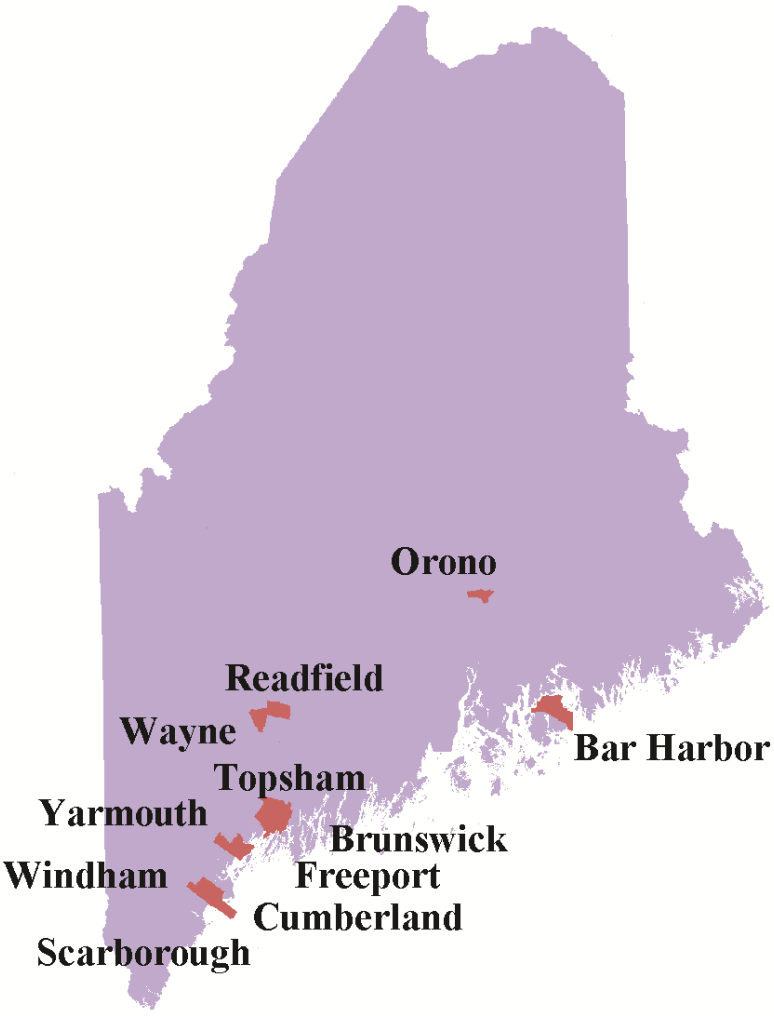


Figure 25: *Maine towns involved in the voluntary municipal mapping program.*

This section provides an explanation of federal and state vernal pool regulation, provides answers to frequently asked questions about regulation, and describes strategies for conservation that will complement federal and state regulation. We include strategies to conserve individual pools as well as "pool landscapes" at a municipal scale. Each of the following suggestions is intended to stand alone, but in some situations it may be feasible to pursue multiple strategies on the same parcel.

Part I: Vernal Pool Regulation in Maine

Government oversight provides a powerful tool for conserving vernal pools--when it is triggered. Federal, state, and local governments all regulate vernal pools, but not all vernal pools are regulated. It is very difficult to figure out all the levels of regulation and many landowners are frustrated and confused. Which jurisdiction a vernal pool falls under determines what measures have to be taken to limit impacts to the resource. Some vernal pools are not regulated at all.

Topics covered

- The roles of federal and state agencies, municipalities, and private consultants in regulation of Maine vernal pools
- State and federal regulatory oversight and when it is triggered
- What kind of management practices are required when a vernal pool has federal protection
- Maine's "Significant Vernal Pool" criteria and standards for compliance
- Frequently Asked Questions

Key concepts

- Federal oversight of a vernal pool is triggered when a landowner applies to fill in a wetland or waterway on the property
- Significant Vernal Pools are determined by egg mass abundance of any one amphibian indicator species, presence of fairy shrimp or essential use by state-listed rare, endangered or threatened species
- Maine's officially mapped Significant Vernal Pools currently represent less than 25% of all vernal pools assessed to date
- Regulations **do not** prohibit development when triggered, but manage it to minimize impacts on vernal pools and surrounding habitat

Who is involved in vernal pool regulation?

Army Corps of Engineers (ACOE)

The ACOE is a federal agency responsible for overseeing impacts to wetlands and waterways ("waters of the United States") that result from fill activities and secondary impacts (e.g., areas drained, flooded, fragmented, mechanically cleared or excavated). These waters may include vernal pools of any size and productivity, even if they are not state-recognized SVPs.

U.S. Fish and Wildlife Service (FWS) and U.S. Environmental Protection Agency (EPA)

The FWS and EPA are federal agencies that provide input to the ACOE on proposals for development that have potential impacts to wildlife habitat values, including species using vernal pools.

Maine Department of Environmental Protection (MDEP)

MDEP is the state agency responsible for permitting and enforcement associated with wetland alteration activities in Maine. It also oversees protection of other sensitive natural resources including regulation of SVPs.

Maine Department of Inland Fisheries and Wildlife (MDIFW)

MDIFW is the state agency responsible for mapping high value wildlife habitats and providing technical expertise on vernal pools and other Significant Wildlife Habitats. MDIFW maintains a mapped database of SVPs and forwards pool status recommendations to MDEP. MDEP notifies landowners and field observers of the final regulatory status of all pools submitted for state review.

Town Code Enforcement Officers and Planning Boards

Code Enforcement Officers administer and enforce municipal zoning, building, and similar ordinances, and, especially when local standards overlap with state and federal regulations, they encourage adherence to state and federal regulations such as protection of natural resources (including vernal pools). Planning boards are likely to encounter vernal pools as they review site plans and subdivision applications for conformance with local ordinances, and pertinent state and federal regulations.

Environmental Consulting Firms

Professional environmental consultants may be hired to delineate wetlands, identify SVPs and federally-regulated non-SVPs, and help landowners apply for permits and adhere to regulation at all levels.

Federal Regulation

The US Army Corps of Engineers (ACOE) oversees the temporary or permanent discharge of dredge or fill material into waters and wetlands. This regulation is under Section 404 of the Clean Water Act. ACOE has seven divisions throughout the country, each with districts of jurisdiction. The New England District oversees activities in New England.

Prior to altering a wetland, landowners are responsible for applying for and obtaining all required permits, which may consist of federal, state, and/or local approvals before work may begin. Authorization from ACOE does not mean that the landowner is not required to obtain other federal, state, or local authorizations required by law, and *vice versa*.

The **ACOE Maine General Permit (ME GP)** provides rules and guidance for regulating activities in and around wetlands and vernal pools.

Note: ACOE jurisdiction is triggered by wetland or waterway fill on a property.

Only in cases where ACOE jurisdiction is triggered can they consider the full scope of a project's environmental impact, both to aquatic and upland resources. It is through this jurisdictional trigger that secondary impacts to the aquatic resources (i.e., work in the upland VP Management Areas) are evaluated by ACOE (see Figure 26).

There are two permit review categories within the ME GP: **Category 1** (notification form required) and **Category 2** (application form required). Proposed activity and size of impact determines the category for permitting that is required. The ME GP may be found at: www.nae.usace.army.mil/reg/Permits/ME_GP.pdf.

The ACOE vernal pool definition states that presence of any of the following species in any life stage at any abundance level will designate a water body as a vernal pool: fairy shrimp, blue spotted salamanders, spotted salamanders or wood frogs (see the ME GP, Appendix A, Page 10). ACOE vernal pool permitting requirements are described in the ME GP, General Condition 28, page 16.

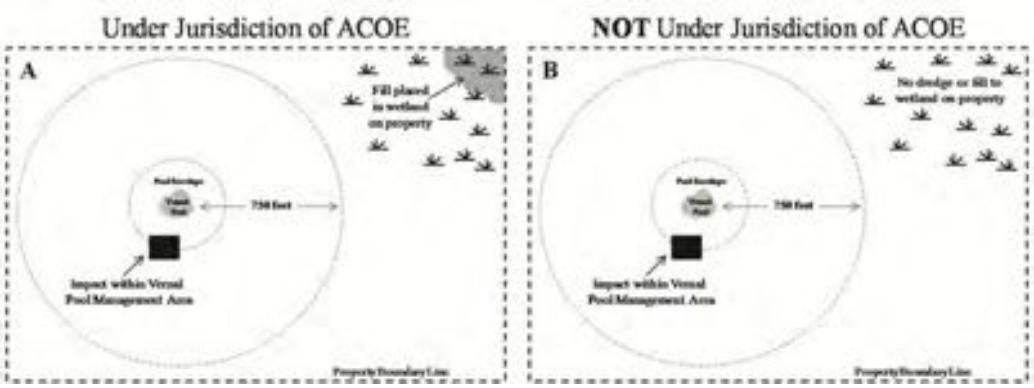


Figure 26: *ACOE Jurisdiction of vernal pools. A) Fill of a wetland or waterway anywhere on property requires the ACOE to consider secondary impacts caused by work in VP Management Areas. B) Without wetland fill on the property the same activities are not considered by the ACOE.*

Certain management practices must be followed for all work within the VP Management Area (see Figure 27) of all VPs in order to meet Category 1 (no application required to ACOE - only a Category 1 Notification Form) when there is fill placed in a wetland or waterway.

For example, assuming ACOE jurisdiction is triggered on a project (e.g., 20 square feet of wetland fill on the property but not within the Vernal Pool Management Area), Category 1 of the GP requires the following:

- No disturbance of the VP depression;
- No disturbance of the VP Envelope; and
- Maintaining a minimum of 75% of the Critical Terrestrial habitat as unfragmented areas (see Figure 28A). Calculating the percent cover loss must include existing unforested areas (roads, fields, power lines, development, etc.) as well as proposed clearing.

Figure 27: *ACOE Vernal Pool Management Area is made up of the depression itself, the vernal pool envelope (area within 100 feet of the pool margin), and the critical terrestrial habitat (area between 100 and 750 feet from the pool margin).*

Failure to meet these standards (see Figure 28B) requires at least a Category 2 review and submission of an application to ACOE which must include information on directional buffers in accordance with the VP Directional Buffer Guidance document at: www.nae.usace.army.mil/reg/PermitsVPDirectionalBufferGuidance.pdf. If there is no fill proposed in waters of the U.S. on the property then there is **no** ACOE jurisdiction.

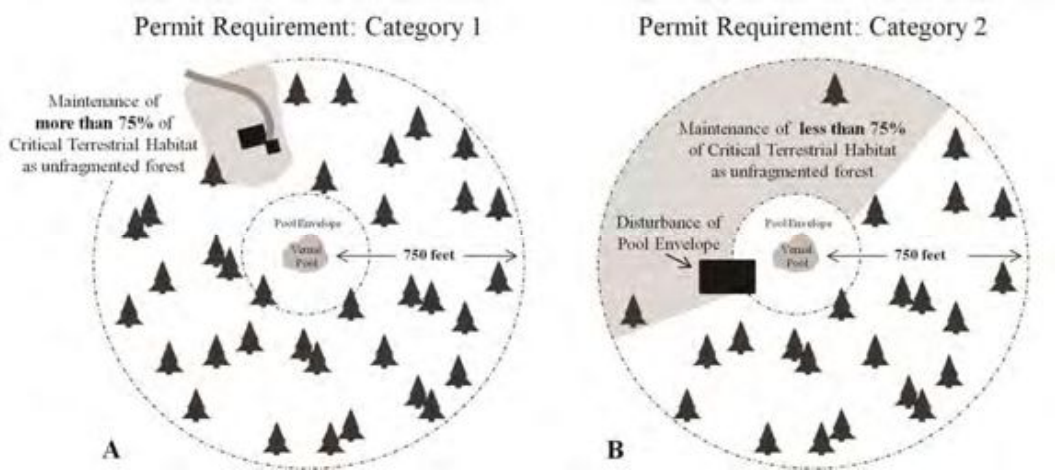


Figure 28: *ACOE permitting requirements A) Category 1--Permit required if there is not disturbance to the Vernal Pool Depression or Vernal Pool Envelope and a minimum of 75% of the Critical Terrestrial Habitat is maintained as unfragmented forest. B) Category 2--Permit required if disturbance is made to the Vernal Pool Depression or Vernal Pool Envelope, or less than 75% of Critical Terrestrial Habitat is converted from unfragmented forest.*

State regulation

Maine wetlands are regulated under the Natural Resources Protection Act (NRPA, Chapter 335) along with other sensitive natural resources, including fragile mountain areas, rivers and streams, great ponds, coastal dunes, and Significant Wildlife Habitats (SWHs). Permit and review procedures for habitat alteration of freshwater wetlands are based upon the size of the impact. Review and reporting requirements are only initiated for proposed impacts equal or greater than 4,300 square feet (roughly 1/10 acre).

Significant Vernal Pools

In September 2006, Maine passed legislation under NRPA to regulate Significant Vernal Pools as Significant Wildlife Habitat. Significant Wildlife Habitats host high concentrations of important wildlife populations and receive careful environmental review that may lead to restrictions on certain intensive land-use activities within and adjacent to the SWH, even if the adjacent land is not wetland. SWHs include seabird nesting islands, deer wintering areas, shorebird concentration areas, coastal and inland waterfowl and wading bird areas, and Significant Vernal Pools. MDIFW recognizes the importance of vernal pools to pool-breeding amphibians, invertebrates, and other game and nongame wildlife, including several rare and endangered species. To date, SVPs represent only a high value subset of the total statewide vernal pool resource (between 20 and 25%).

The NRPA provides guidance on optimal dates based on geographic location to survey pools to determine significance. Generally, at least two visits are needed to make an accurate determination, one during *peak wood frog breeding* and one during *peak salamander breeding* periods.

Regulated area associated with a SVP

The pool depression and a 250 foot circular "zone of consultation" is regulated (see Figure 29). Any activity in, on, or over the SVP or the 250 foot critical terrestrial habitat zone must avoid unreasonable impacts to the Significant Vernal Pool habitat and obtain approval from the MDEP, either through Permit by Rule (a streamlined permitting process) or a full individual NRPA permit.

Figure 29: *Regulated Zone of consultation within 250 feet of a Significant Vernal Pool.*

Significant Vernal Pool (as defined by the Natural Resource Protection Act)

Vernal Pool: A vernal pool, also referred to as a seasonal forest pool, is a natural, temporary to semi-permanent body of water occurring in a shallow depression that typically fills during the spring or fall and may dry during the summer. Vernal pools have no permanent inlet or outlet and no viable populations of predatory fish. A vernal pool may provide the primary breeding habitat for wood frogs (*Rana sylvatica*), spotted salamanders (*Ambystoma maculatum*), blue-spotted salamanders (*Ambystoma laterale*), and fairy shrimp as well as valuable habitat for other plants and wildlife, including several rare, threatened, and endangered species. A vernal pool intentionally created for the purposes of compensatory mitigation is included in this definition.

"Whether a vernal pool is a significant vernal pool is determined by the number and type of pool-breeding amphibian egg masses in a pool, or the presence of fairy shrimp (*Eubranchipus* spp.) or use by threatened or endangered species as specified in Section 9(B). Significant Vernal Pool habitat consists of a vernal pool depression and a portion of the critical terrestrial habitat within a 250-foot radius of the spring or fall high water mark of the depression. An activity that takes place in, on, over, or adjacent to a Significant Vernal Pool habitat must meet the standards of this chapter."

Significant Vernal Pool identification criteria: Vernal pool significance must be determined and documented by an individual who has experience and training in either wetland ecology or wildlife ecology and therefore has qualifications sufficient to identify and document a significant vernal pool.

1. **Abundance**. Any one of or combination of the following species abundance levels, documented in any given year, determine the significance of a vernal pool.

Species	Abundance Criteria
Fairy Shrimp	Presence in any life stage
Blue-spotted Salamanders	Presence of 10 or more egg masses
Spotted Salamanders	Presence of 20 or more egg masses
Wood Frogs	Presence of 40 or more egg masses

2. **Rarity**. A pool that has documented use in any given year by state-listed rare, endangered, or threatened species that commonly require a vernal pool to complete a critical portion of their life-history is a significant vernal pool. Examples of vernal pool dependent state-listed endangered or threatened species include, but are not limited to, Blanding's turtles, spotted turtles, and ringed boghaunter dragonflies.

Standards for compliance with the SVP regulation

- No disturbance within the vernal pool depression
- Maintain minimum of 75% of critical terrestrial habitat as unfragmented forest with at least a partly-closed canopy of overstory trees to provide shade, deep leaf litter and woody debris
- Maintain or restore forest corridors connecting wetlands and significant vernal pools
- Minimize forest floor disturbance
- Maintain native understory vegetation and downed woody debris

Local regulation

Some Maine towns have implemented local ordinances pertinent to wetlands, and more specifically, to vernal pools (e.g., Falmouth, Cape Elizabeth, South Portland, Bar Harbor, and North Yarmouth) that are more restrictive than state or federal rules. A town interested in maintaining the ecological integrity of its natural resources might be concerned by the loss at the local level despite protection at the state and federal level. Municipal ordinances enable a more tailored approach to protection that is specific to known resources at the municipal scale. For this reason, it is important to check with town officials before the area around a potential vernal pool is altered.

Frequently Asked Questions

1. ***How does a landowner know if he/she needs a permit to impact a vernal pool from either the ACOE or MDEP?***

   Town officials or consultants can provide you with guidance, you can contact state officials directly, or you can contact the ACOE for information on the Maine General Permit. A natural resource professional can determine whether or not you have a vernal pool on your property. ACOE and MDEP staff are available to meet with landowners in the field as well (see contact information below).

2. ***Are all vernal pools regulated by ACOE?***

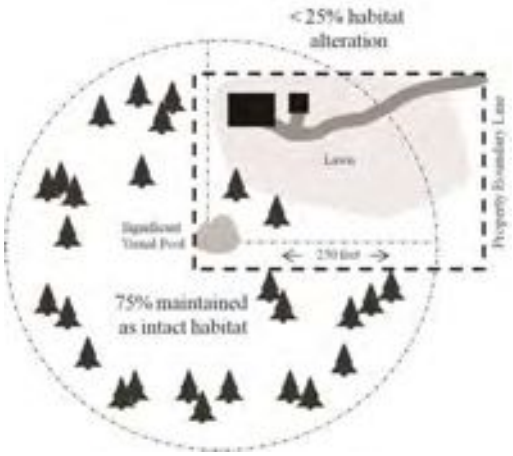
   ACOE does not regulate all vernal pools. For ACOE to regulate a vernal pool, it must be a wetland or waterway of the United States, be contained within a wetland or waterway of the United States, or (as noted above) occur on a property in which jurisdiction over impacts to upland is triggered based on review of impacts to a wetland or water body on the property.

3. ***Are all vernal pools regulated by the State?***

   No. Only a subset of pools defined as Significant Vernal Pools are regulated. Of the approximately 1200 vernal pools formally surveyed to date statewide, only 20-25% qualify as SVPs.

4. ***Do Significant Vernal Pools have to be mapped to be regulated?***

   No. Significant Vernal Pools are subject to specific land use protection standards whether or not they are documented on town or state maps. Landowners are responsible for acquiring relevant permits whether or not vernal pools on their land are mapped.



5. Is the 250 foot zone around a SVP a no-build zone?

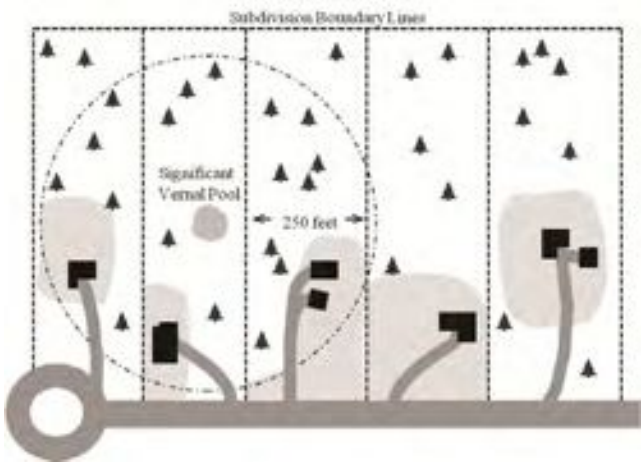
No. Think of this zone as a "zone of consultation" where the goal is to minimize adverse impacts to the habitat. When developing within 250 feet of a SVP, the goal is to retain a minimum of 75% of the habitat intact and follow guidelines outlined in the MDEP rules, Chapter 335. Landowners may need to get a permit from the MDEP for development within this zone (see additional resources below).

6. Why does regulation limit intensive development in the area adjacent to a vernal pool?

Pool-breeding amphibians often travel hundreds of feet into the terrestrial habitat surrounding their breeding pools where, as adults, they spend only a few weeks in the spring. The rest of the year most adults and juveniles are located within 750 feet of the pool where they feed in the summer and hibernate in the winter. The 250 foot zone around the pool only protects a portion of their non -breeding habitat needs (and only a portion of the population) and provides protection for newly emerged juveniles overwintering near the pool. Adequate forest canopy cover is necessary for providing a cool, moist environment for the amphibians as well as for providing organic material to the pool and forest floor. It is because of the wide dispersion of adults and juveniles that ACOE considers development impacts within 750 feet of the VP depression. This is a clear difference between the state and federal programs.

7. Will a Significant Vernal Pool in the middle of a proposed subdivision make the land unbuildable?

No. Each landowner is permitted to impact a portion of the area within 250 feet of the pool. The example below shows a subdivision where lots were laid out to enable construction of three 2-acre house lots where **within a 4 acre regulated zone** the developer was able to include a 20x100 foot driveway and a 12,000 square foot building envelope for each of the three house lots.

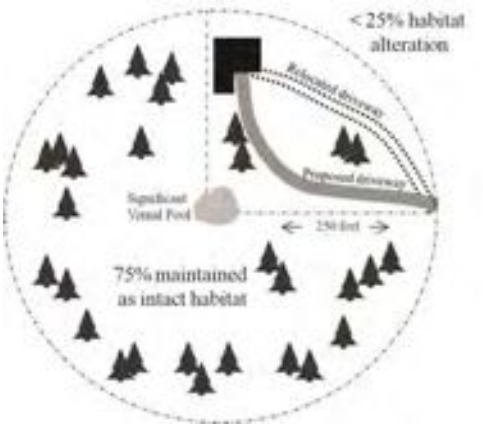


Within the 4 acre regulated area around Significant Vernal Pool:

- 3 lots x 20 x 100 foot driveway = 6,000 feet
- 3 lots x 12,000 square foot building envelope = 36,000 square feet
- Total 42,000 square feet <1 acre (43,560 square feet), which is <25% of (4 acre) regulated area

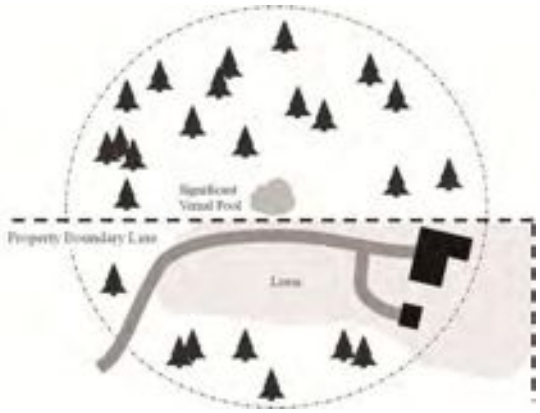
8. If a landowner has a SVP and wants to build a structure or driveway, how might he/she need to modify the project?

In this example, the landowner has adjusted the location of the driveway to provide more forested habitat in the immediate vicinity of the pool. The MDEP and ACOE work directly with the landowner to come up with flexible solutions.



9. If a landowner doesn't own the SVP, but the 250 foot regulated zone extends onto his/her property, is a permit from MDEP needed?

Sometimes. When a pool is located on a property abutting a proposed project and the 250 foot critical habitat extends into it, the project is not affected by the vernal pool regulation unless the pool has been formally surveyed, found to be significant and is on the State's vernal pool GIS data layer. Only then will an abutter be subject to the land use performance standards detailed for SVP's under the NRPA. Locations of currently mapped vernal pools may be viewed using Google Earth software. For more information see: www.maine.gov/dep/gis/datamaps/.



10. How will a landowner be regulated if he/she owns a SVP but not the majority of the 250 foot zone around the pool?

Each landowner is only required to maintain a minimum of 75% forest cover on that portion of the SVP habitat that he/she owns or holds title to. Stated differently, if an abutting neighbor has already converted 25% of his/her portion of the SVP habitat, the current landowner is still permitted to convert up to 25% of the SVP habitat on his/her property.

11. How will a landowner who owns a SVP be regulated if the 250 foot zone is already less than 75% forested?

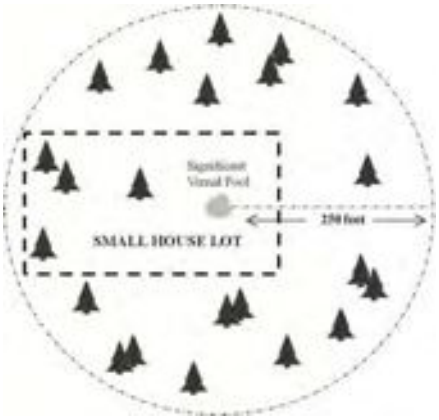
Land clearing within a SVP habitat that occurred prior to 2006 is exempted from regulation; but if existing clearing within the SVP habitat is already more than 75%, no further clearing can be conducted by the landowner without consultation and permitting with MDEP. As previously noted, ACOE considers the cumulative impact of cover loss to a VP, existing cover loss and proposed. Generally the greater the loss, the greater the potential impact, and the more difficult the application process will be with both ACOE and MDEP.

12. Does a landowner have to wait until the spring vernal pool season before breaking ground for development?

Permit by Rule (PBR) is an option extended to landowners to allow them to develop within the 250 foot zone of **any** vernal pool before it has been assessed, by assuming it is a SVP and meeting development standards of surrounding forested habitat. Permit by Rule allows for speedy development without a formal assessment of pool status during the spring breeding season. PBR can generally be obtained in two weeks and costs roughly ¼ of the fee required for a full permit (to date 60 PBRs have been issued). Permit application fees for 2010 were $65 for permit by rule and $271 for a full permit.

13. What if a small landowner wants to build a house on a lot that contains a Significant Vernal Pool and the entire lot falls within the 250 foot regulated zone?

No matter the size of the property, MDEP works with each individual landowner to first assess whether the proposed development meets the requirements of Permit by Rule (see question 12). If not, then a full permit is required and options for impact minimization are encouraged, with mitigation fees as a last resort. To date, no full permits have been denied, meaning that no development projects have been stopped due to a Significant Vernal Pool.



Additional Resources

Maine Department of Environmental Protection

Vernal Pool Factsheet
www.maine.gov/dep/blwq/docstand/nrpa/vernalpools/fs-vernal_pools_intro.htm

Google Earth file showing regulatory status of mapped vernal pools
www.maine.gov/dep/gis/datamaps/

SVP rules, application forms, and related materials
www.maine.gov/dep/blwq/docstand/nrpapage.htm

ACOE

State General Permit
www.nae.usace.army.mil/reg/Permits/ME_GP.pdf

Directional Buffers
www.nae.usace.army.mil/reg/Permits/VPDirectionalBufferGuidance.pdf

Maine Forest Service

Vernal Pool Best Management Practice Fact Sheet
www.maine.gov/doc/mfs/pubs/pdf/fpminfo/14vernalpool.pdf

University of Maine

Informational Website on Vernal Pools
www.maine.edu/vernalpools

Maine Audubon

Significant Vernal Pool Factsheet
www.maineaudubon.org/resource/documents/VP.8.5x11.pdf

Contact Information

MDEP Central ME Regional Office
17 State House Station
Augusta, ME 04333-0017

MDEP Eastern ME Regional Office
106 Hogan Road
Bangor, ME 04401

MDEP Northern ME Regional Office
1235 Central Drive, Skyway Park
Presque Isle, ME 04769
Phone: 207-764-0477 or 1-888-769-1053

MDEP Southern ME Regional Office
312 Canco Road
Portland, ME 04103

ACOE ME Project Office
675 Western Avenue #3
Manchester, ME 04351

Part 2: Conserving Vernal Pools at the Local Level

Mapping vernal pools is a critical first step towards conservation.

Your map becomes a living document which offers a powerful tool for education, conservation planning, and protecting valuable resources that have limited legal safeguards.

Learn how to use this map to its full potential.

Topics covered

- Using maps to educate and engage the community
- Using maps for proactive town planning
- How to prioritize "non-significant" vernal pools with high conservation value
- Town-wide conservation strategies
- Using mitigation fees for conservation

Key concepts

- Attracting attention to outstanding pools on public land can help drum up interest for pools on private land
- Sometimes relatively productive pools don't meet criteria for regulation but may still be important to conserve at the local level
- Protecting vernal pools that dry at different times during the summer helps to ensure a variety of pool indicator species
- Conserving vernal pools isn't enough--the quality of the adjacent forest is equally as important

What can a municipality do to conserve pools on a landscape level?

Map pools and educate your community

Using the protocol outlined earlier in this manual, vernal pools may be mapped and assessed at a variety of levels (land trust properties, public lands, municipal-wide, or regional). Knowledge of pool locations is the first step towards their conservation. Encourage local land trusts, conservation commissions or environmental groups to play an active role in this process. Not only do these organizations often have a volunteer base willing to help with mapping and monitoring projects, but they may also be able to help identify high priority areas for conservation.

Attracting community attention to productive pools on public land may serve to increase awareness and appreciation for pools located on private land. Vernal pool "best management strategies" can be demonstrated on public lands and documented with signage for educational purposes. Trails or boardwalks that improve access may also serve to engage the public and encourage appreciation of vernal pool functions.

Use vernal pool maps for proactive planning

It is a good idea to make vernal pool and other natural resource data available to the public and easily accessible for use by your Code Enforcement Officer, Tax Assessor, Planning Board, and other town officials.

If your town has an interactive web-based map for displaying town data layers, consider adding the vernal pool layer to be viewed at the same time as other natural resource layers, including maps from Beginning with Habitat (a collaborative program including federal, state, and local agencies, and non-governmental organizations that provides high value habitat maps and conservation planning tools to Maine towns). If you do not have interactive map layers available on a website, you might make your vernal pool map available for citizens to download. If your town is in the process of updating its comprehensive plan, or is developing an open space plan, these data can be informative in designating protective zones or conservation focus areas. Land trusts can also use vernal pool data in determining strategic conservation planning goals.

Include non-significant and potential pools in your data layer. "Non-significant" pools should not be regarded as without value as significance is based on a regulatory, not a purely biological measure. Potential vernal pools that were identified on aerial photographs but were not field assessed should also remain on

the maps as they alert landowners and town officials that a pool may be present and should be surveyed prior to development.

Consider local protection of high functioning non-significant vernal pools

Many vernal pools may not reach the regulatory criteria to be protected as Significant Vernal Pools, but may still be very important to conserve nonetheless. If you have completed a mapping project and have a data layer showing Significant Vernal Pools AND other non-significant pools, data collected by volunteers may be used to determine which non-significant vernal pools may be a conservation priority at the local level.

Since the determination of Significance for pools may be based on only one field season and is based on strict egg-mass number thresholds, some high value pools may be overlooked. Breeding effort is not consistent from year to year and pools may sometimes be Significant one year and "non-significant" the next.

In addition, the state regulatory definition of a Significant Vernal Pool only includes naturally occurring vernal pools. In locations where natural pools have been eliminated from the landscape, non-natural depressions with the appropriate hydroperiod may be used as alternative breeding habitats. In heavily developed areas, non-natural pools that are very productive may be the only option for protecting vernal pool breeding habitat.

Current federal and state regulations also do not recognize clusters of pools (i.e., occurring within hundreds of feet of one another) that individually may have egg mass numbers below the thresholds for Significance but collectively function to support healthy populations of salamanders, frogs, and other pool-breeding fauna.

To enhance the viability of pool animals in your town, consider conserving "non-significant" pools with the following characteristics

- Those surrounded by relatively undeveloped land up to 750 feet from the pool, or within unfragmented forest blocks as mapped by Beginning with Habitat
- Those adjacent to other protected conservation properties
- Those supporting egg mass numbers close to the threshold of SVPs
- Those supporting two or more of the amphibian indicator species (but none at threshold egg mass numbers)
- Those that are part of a cluster of pools (each within hundreds of feet of each other)
- Those overlapping with other state-recognized Significant Wildlife Habitats (deer wintering areas, waterfowl and wading bird habitat), Shoreland Zones, rare animal species habitats, or rare or exemplary natural communities mapped by the Maine Natural Areas Program as depicted on Beginning with Habitat maps of your town
- Those that are highly productive naturalized pools of human origin such as gravel pits, farm ponds, and borrow pits and that retain natural forested upland life zones

Protect a range of vernal pool types

Try to conserve pools of varying sizes, that have a range of hydroperiods (amount of time they hold water) and that represent different wetland types (e.g., open water, marshes, shrub swamps, forested wetlands). For example, pools with a very short hydroperiod (6-10 weeks) support the rapid growth and reproduction of fairy shrimp, but are less likely to support breeding amphibians. Wood frogs are able to use pools that dry down by mid-summer, while salamanders generally require the pool to persist until late-summer/early fall. Conserving a diversity of pools is the best strategy for maintaining the full range of vernal pool-dependent animals.

Maintain connections among breeding pools and non-breeding habitat

Look at the numbers and distribution of "non-significant" pools in your town. Do they out-number Significant pools regulated by the State? Consider including some protection at the town level for pools that are not recognized by the State, especially if inclusion of some of these pools increases overall habitat connectivity (see the Calhoun and Klemens [2002] tier system).

Areas where pools are numerous (including both individual pools and clusters of pools) and occur without impediment to wildlife movement (i.e., major roads, buildings, parking lots) are of high wildlife value. Pools in close proximity provide stepping-stones across the landscape for many animals including state-listed turtles that have been documented to spend their summers traveling from pool to pool to feed, rest, and overwinter (see Beaudry et. al, 2009 and Mitchell et. al, 2008). Conserving pools within distances that amphibians are capable of traveling (see Figure 30) allows for populations to stay genetically healthy and for repopulation of pools that experience declines due to disease or other mortality events.

On a town-wide scale, pools in close proximity that occur on a single parcel, or that are split between a privately- owned parcel and one that is already conserved, should be target areas for conservation.

The Beginning with Habitat *Undeveloped Habitat Block* data layer (referred to by

Figure 30: *Average (mean) and maximum travel distances reported in literature for adult wood frog and spotted salamanders in northeastern North America.*

BwH as Map 3) includes habitat connection information for both aquatic and terrestrial species. Incorporating this information into local vernal pool conservation planning efforts will help in identifying opportunities for landscape scale habitat connectivity that will increase long-term viability of local amphibian populations.

View pool locations with other natural resource data

Using GIS technology or Beginning with Habitat maps to view wildlife and natural resource data layers, you may identify areas where protection of vernal pools would also protect other valuable resources (see Figure 31), and *vice versa*. Such areas are likely targets for conservation. Maps, planning tools and additional information about the Beginning with Habitat program may be found at: www.beginning withhabitat.org.

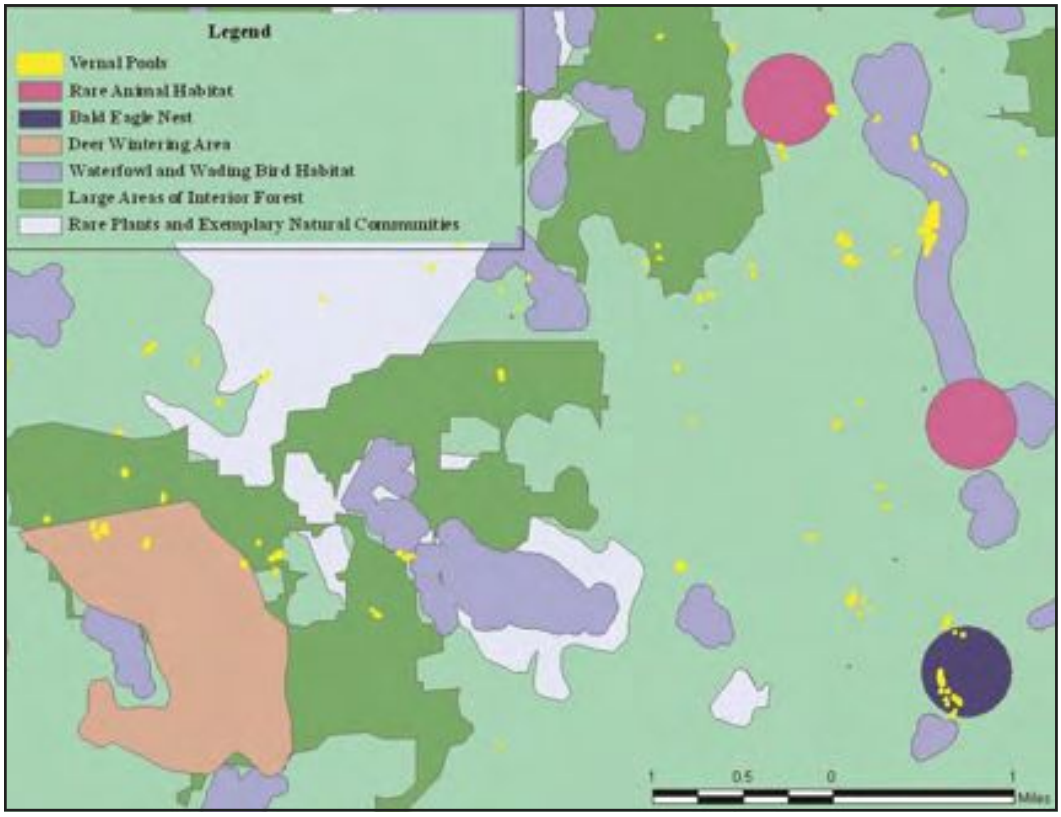


Figure 31: *Spatial overlap of natural resource data layers for purpose of identifying target areas for conservation. Target areas on this map might include: cluster of pools in lower right corner that are within and adjacent to buffer around bald eagle nest, pools located within and surrounding waterfowl and wading bird habitat in upper right region, and pools in lower left of map that correspond with a deer wintering area and region mapped as large area of interior forest.*

Use advanced planning tools

Consider using advanced GIS analysis to prioritize high-value natural resources, level of pressure from development, and land costs (see Baldwin and deMaynadier 2009; Calhoun et al. in press). These techniques can help a town to combine data on predicted development pressure, habitat significance, and current level of land protection to inform a threat analysis for each vernal pool. Although time consuming, this type of analysis may be especially advantageous for towns in predicted high growth areas that still have large remaining tracks of undeveloped forest land and intact pool resources. Consider seeking assistance from a local college or university for this type of analysis. Graduate and undergraduate students are often eager for applied projects to fulfill course requirements.

Part 3: Conserving Individual Pools

Conservation of vernal pools does not mean an end to development in a town. There are many strategies to support growth while protecting important natural resources, such as vernal pools.

Topics covered

- Directional management zones--an alternative to circular buffers
- Municipal-wide strategies for conserving vernal pools
- Best management practices for landowners
- Vernal pool mitigation

Key concepts

- Circular management zones often fall short of an amphibians' travel distance and contain land without suitable habitat--directional zones may be designed to incorporate more suitable habitat
- Having conserved land in a subdivision is a great selling point for homeowners
- There's a lot landowners can do for vernal pools even if they don't have the resources to fully implement best management practices
- It's very difficult to create new pools with the appropriate hydrology for the animals that depend on them; the best mitigation strategies are preserving or enhancing current pools

What can a municipality do to conserve individual pools?

Increase protection with ordinances

Maine's municipalities can adopt ordinances that build on and go beyond minimum State standards. Consider conservation-minded options for local regulation and incentive programs that might be appropriate in your town. Maine's current Significant Vernal Pool regulation only recognizes a small subset of vernal pools (20 -25%) that are naturally occurring and meet specified biological criteria.

One option for increased protection at the local level would be to regulate activities within 100 feet of all naturally occurring vernal pools. Another approach might consider expanding the regulated area around pools deemed to be of exceptional value to go beyond 250 feet.

You might also include language in a wetland ordinance that limits vernal pool mitigation to the strategies known to be most effective. These include enhancement, restoration, and preservation of pools on site, or off site, but within known travel distances of native vernal pool species, eliminating the less-than-optimal pool creation method.

Or, if creation must be used, require that the landowner also preserve a pool surrounded by intact habitat. This approach will serve to discourage the creation of pools for mitigation, and in cases where creation is used, still result in protection of critical breeding and non-breeding habitat. Our regional ACOE uses the best available science to inform site-specific vernal pool mitigation. Their work may be used as a model for towns to emulate.

Consider directional management zones when reviewing development permits

Pool-breeding amphibians spend greater than 95% of their life in the uplands or forested wetlands near the breeding pool. Regulating the area within 250 feet of select vernal pools recognizes the value of the pool as a breeding site, but only captures a portion of the habitat used during the non-breeding season.

While circular zones may be the most practical approach for regulation on a statewide scale, they do not necessarily guarantee adequate protection of pool breeding amphibian populations. Aside from falling short of the average annual travel distance of vernal pool breeding amphibians (see Figure 30), circular zones of protection often include land that is not suitable amphibian habitat (e.g., agricultural fields, lawns, paved areas). Consider using directional management zones as an ecologically informed modification to the current regulation (see the ACOE website regarding directional buffers at: www.nae.usace.army.mil/reg/Permits/VPDirectionalBufferGuidance.pdf).

For example, scientists know the post-breeding habitat needs of wood frogs in central and southern Maine often include forested wetlands (summer) and well-drained uplands (winter hibernation). It makes more sense to try to connect the breeding pool to these habitats (including other pools) than to draw circles around pools that may include non-habitat (see Figure 32). The zones can be of equal size or not depending on the mitigation opportunities. In some cases, the landowner may not own the property with the target habitat, but just as often, creative mitigation strategies can be developed through conversations with the landowner, MDEP, and ACOE. It may be worth exploring options with adjacent landowners for protection via a conservation easement where private ownership is retained but the type and amount of development is limited. This flexible approach can benefit both the landowner and pool breeding amphibian populations and should be encouraged by towns when reviewing development proposals.

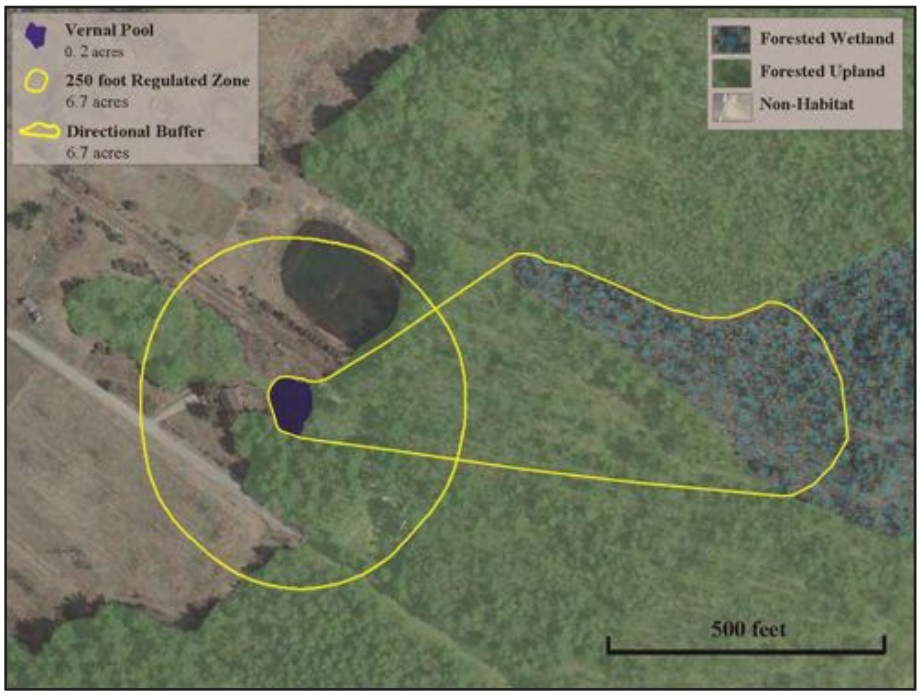


Figure 32: *Direction Buffer: an ecologically informed strategy for protecting critical habitat. A 6.7 acre circle results from a 250 foot radius drawn around this 0.2 acre pool. Use of a directional buffer of equivalent size (6.7 acres), may allow for the protection of critical year round habitat for vernal pool breeding amphibians while permitting development and other land uses within 250 feet of a pool.*

Vernal pool protective overlay districts

If volunteer mapping efforts have identified rural areas rich with vernal pool occurrences (both Significant and non-significant) consider adopting a resource overlay district sized appropriately to incorporate not only the pools themselves, but adequate life zones that tie the pools together and provide for non-breeding amphibian habitat. Additional development performance standards can then be applied to projects that fall within the overlay district, including enhanced buffering, lot size flexibility, requirements for turtle friendly curbing, and stricter mitigation requirements.

Consider Maine's in lieu fee program

In some situations when it is not possible to avoid or minimize adverse impacts to regulated natural resources, federal or state regulatory agencies may require compensation from the landowner for permitted impacts. For wetland mitigation, landowners have historically been required to restore, enhance, preserve, or create wetland in compensation for the lost or impacted resource.

The Maine Natural Resource Conservation Program (MNRCP) provides a new alternative to traditional options for mitigation. Using a formula that takes into account the degree of degradation, land valuation and a set resource multiplier, permittees may pay a fee ***in lieu*** of traditional methods of compensation. Monies collected by this program are reallocated by means of a competitive application and proposal review. Public agencies, non-profit conservation organizations, municipalities, and private entities are encouraged to apply for funds for restoration, enhancement, preservation, and/or creation of habitat within the same region where the resource loss has occurred.

If they have been pre-identified, lands hosting high value vernal pools, or clusters of pools and adjacent habitat, may be eligible for funds from the In Lieu Fee program as one option for long-term protection. For additional information please see *In Lieu Fee Compensation Program and Maine Natural Resource Conservation Program* at: www.maine.gov/dep/blwq/docstand/nrpa/ILF_and_NRCP/index.htm.

Establish a local in lieu fee program

If volunteer mapping efforts have identified rural areas rich with vernal pool occurrences (both Significant and non-significant) that are surrounded by intact habitat, you might consider adopting an area for conservation investment to offset losses to less valuable vernal pool habitat in designated growth areas.

In some situations, when it is not possible to avoid or minimize adverse impacts to regulated natural resources, state or federal regulatory agencies may require compensation from the landowner for permitted impacts.

Maine recently adopted a new alternative to traditional options for mitigation allowing permittees to pay a fee ***in lieu*** of traditional methods of compensation. A localized model can be implemented in your town. If a developer needs to encroach into a vernal pool buffer or fill a vernal pool depression in the growth area, the town can set up a fee-based program to fund habitat preservation in the rural area.

Conservation subdivisions

The existence of wildlife habitat, such as wetlands in general or vernal pools specifically, may be used as a selling point to attract clients to a subdivision. Developers with prior knowledge of pool locations may design a subdivision that is both lucrative and ecologically sensitive (see Figure 33). Highlighting the presence of vernal pools and open space as assets is appealing to many future homeowners.

FEBRUARY 8, 2007 REAL ESTATE THE COMMUNITY LEADER

House of the Week

Granite Falls Subdivision, No. Yarmouth
MLS#: 761667, 761636, 761556
Listed by: Jeff Daigle, Greater Portland Realty
Phone: 797-7777 ext. 16

Available Lot & Price List

LESTAGE Law Office, LLC

J. Gregory Lestage, Esq.

Real Estate Law • Divorce & Family Law
Business Formation & Representation • Personal Injury • Wills

"Granite Falls is entirely surrounded and further protected by conservation easements and deeded forever "wild space." A home investment in this neighborhood will forever reap the benefits of the existing setting."

Figure 33: *Real Estate advertisement in The Community Leader, February 8, 2007, that highlights wetlands and conservation land as an asset.*

Thoughtfully planned development that avoids impacts to valuable resources with reduced lot sizes and efficient layout will provide residents with shared open space, will reduce infrastructure costs, and decrease impervious surfaces such as driveways and roads, benefiting water quality, town residents, and local wildlife (see Figure 34). Marketing surveys demonstrate time and time again that, even though individual lots in a conservation subdivision may be smaller, real estate buyers are willing to pay more for property when they know that the view outside of their kitchen window is permanently protected. It is critical, however, that the open space requirements for conservation subdivisions prioritize vernal pool and life zone protection as targets for open-space designation.

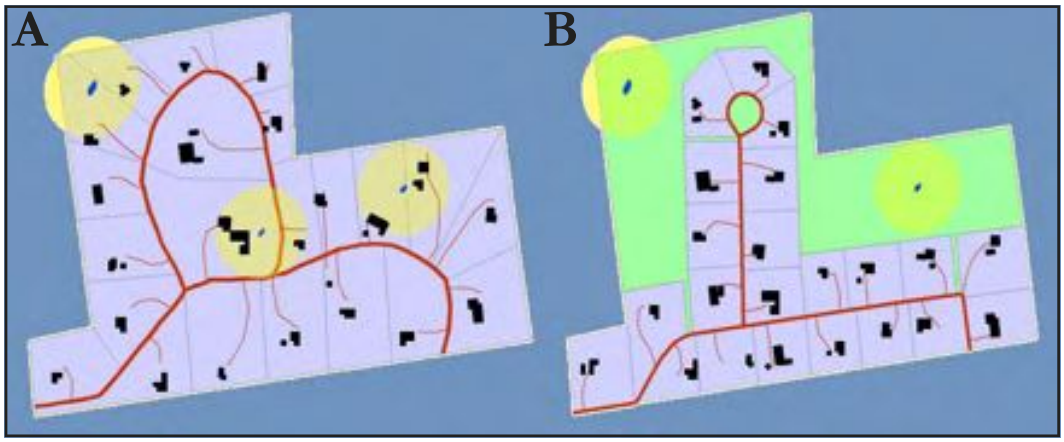


Figure 34: *Subdivision plan variations. A) Sample plan with Significant Vernal Pool locations depicted on map. B) Alternative plan with the same number of house lots, shorter road distance, shared open space, and conservation of two vernal pools.*

Current-use tax incentive for open space

Landowners who are interested in providing protection for their vernal pool resources, but would like compensation for their efforts, might consider enrolling in the Open Space current-use tax program. This category of the current-use program recognizes areas left in open space that provide a public benefit, including wildlife habitat, opportunity for recreation, game management, or scenic resources.

Although there is no minimum acreage to enroll, landowners must apply through their municipal office and meet certain criteria to qualify for a property tax reduction. At a minimum, in the category of Ordinary Open Space, landowners may see up to a 20% reduction in their property tax. If enrolled in additional categories of permanent protection through a conservation easement, providing access to the public, or establishment as "forever wild" may decrease taxes by up to 95%. The Open Space tax program does not require permanent protection so it's a great way to realize some tax benefits while protecting open space in the short term and leaving options open for future landowners. For additional information please see *Current Use Programs* at: www.maine.gov/revenue/propertytax/propertytaxbenefits/CurrentUseLandPrograms.htm.

What can an individual landowner do?

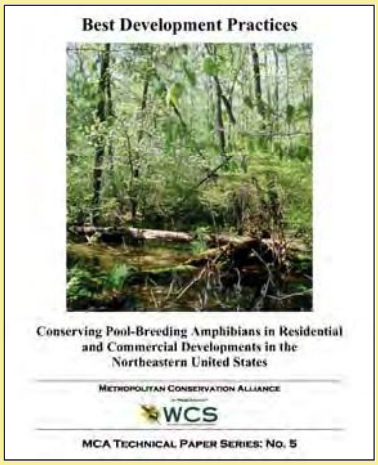
Implement best management practices

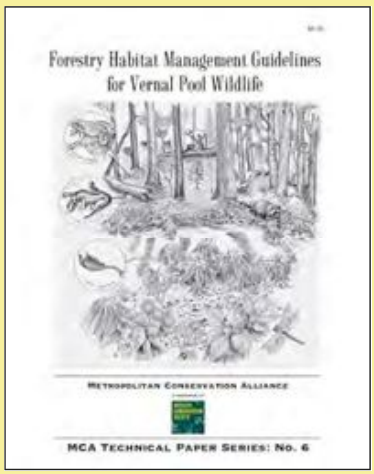
Individual landowners can implement best management practices to the best of their ability. Two documents were published to help citizens, resource managers, and planning officials conserve vernal pools.

Best development practices: conserving pool-breeding amphibians in residential and commercial developments in the northeastern United States (Calhoun and Klemens 2002) is the result of a regional effort to provide guidelines for developing land adjacent to vernal pools. This document provides guidance for towns and landowners wishing to implement vernal pool conservation plans and provides recommendations for development around individual pools.

Forestry habitat management guidelines for vernal pool wildlife (Calhoun and deMaynadier 2004) provides guidance for landowners managing forests for timber adjacent to vernal pools. The document contains science-based recommendations for forest management practices adjacent to vernal pools.

Landowners may not be able to comply with all of the recommendations, either because they don't have enough land, or because they cannot avoid impacts. However, if they are able to adopt any part of the guidelines in either the development or forestry documents, cumulative impacts to the vernal pool resource will be reduced.





Survey pools and submit data to the State

Landowners can advance vernal pool conservation by participating in a voluntary community-based mapping project, or by identifying SVPs on their own property and submitting data to the State. Making this information public may also be helpful for larger landscape or regional planning to occur (for example by informing voluntary land conservation efforts by land trusts). It also sets a good example for neighbors and other citizens that there is local support for creating a neighborhood where wildlife and humans can coexist.

Encourage friends and neighbors to map their pools

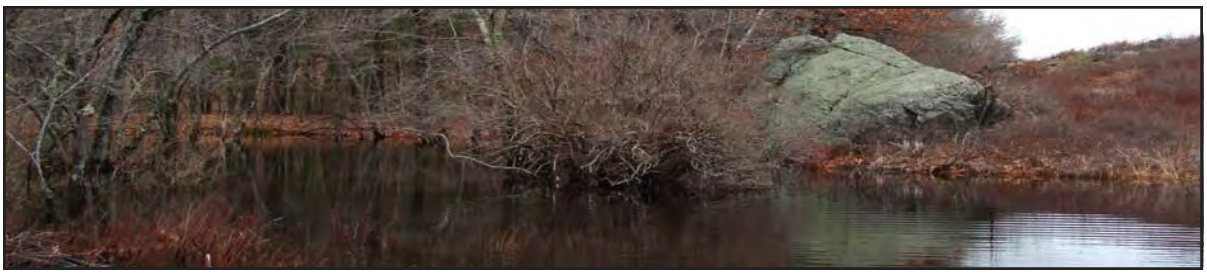
If you know of pools on other people's properties or have seen large spring-time amphibian migrations towards what is likely a productive breeding pool, talk to the landowners and encourage them to conserve their pool(s). A single visit to a pool during the breeding season is often enough to interest landowners in the resources on their property. Provide educational materials about pool ecology and the State's efforts to protect high value vernal pools; you could also direct interested landowners to DEP, or to the UMaine website for additional information.

Mitigation

Individual landowners can be responsible stewards by conforming to State regulations and by being aware of conservation issues associated with mitigating for vernal pool losses. In the project planning process it is always preferable that impacts to the pool and surrounding habitat be avoided. If impact is unavoidable, MDEP and ACOE will often work with landowners to permit their projects while minimizing impacts. Intensive development impacts to high value pools may require compensation. Projects needing a permit from the state are those within 250 feet of a SVP.

Mitigation may consist of restoring, enhancing, preserving, or creating vernal pools. Creation is a last resort. It is very difficult to re-create the seasonal hydrology, nutrient cycling, and natural communities of plants, animals, and micro-organisms characteristic of vernal pools (see Lichko and Calhoun 2003, Windmiller and Calhoun 2008; Gamble and Mitsch 2009). Restoration and enhancement projects are more likely to be met with success due to the fact that the mitigation sites once had the appropriate hydrology to function as naturally occurring vernal pools and the area may still host a resident population of breeding animals.

Preservation of existing high value vernal pools and adjacent habitat is the most effective mitigation strategy because it focuses on maintaining already intact systems. Independent of the method used, it is essential that mitigation acknowledge the multiple habitat needs of the animals that depend upon vernal pools. To be effective, restoration, enhancement, preservation, and creation must include a plan to maintain adjacent non-breeding habitat, in addition to conserving the pool depression. For information on regulatory requirements please see the DEP Fact Sheets, *Wetlands Compensation: Techniques for Restoring Lost Functions and Values* and *Natural Resource Compensation: Methods for Restoring Lost Functions and Values* available at: www.maine.gov/dep/blwq/docstand/ip-wlcomp.htm and www.maine.gov/dep/blwq/ docstand/nrpa/fs_methods.htm.



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