AgriLife Extension Solutions

Publication No. EWF-019

Managing Urban Stormwater Ponds

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What is a Stormwater Pond?

Stormwater or retention ponds are a typical sight in many urban areas, and are frequently found scattered about in subdivisions as a means to manage rainwater and prevent flooding. During a storm, these small ponds catch and hold runoff from highly altered urban and suburban areas such as parking lots, lawns, and roads. Stormwater ponds reduce the speed of water joining nearby waterways and protect surrounding areas from floods and erosion, by interrupting the surface flow and storing excessive rainwater. Slowing down the flow of water also allows chemicals and sediments that are suspended in the water to settle to the bottom, which improves water quality in downstream bodies of water. Stormwater and retention ponds typically are not as healthy or balanced as natural ponds because they essentially serve as traps for pollutants in the runoff. The reduced health of these aquatic ecosystems means desired aesthetics or recreational activities may be inhibited. It is important to remember that aesthetic properties and recreational activities are not the primary reasons for construction of stormwater ponds, and any alterations to enhance aesthetics or recreation should not impede the functioning of the stormwater pond for its intended purpose. However, when properly managed, a stormwater pond can be a tremendous asset to a neighborhood. A well-managed urban or suburban stormwater pond can be visually appealing, increase property values, provide opportunities for fishing or wildlife observation, and create a community gathering place for social activities—all while still serving its original purpose of stormwater management. Alternatively, altering or mismanaging a stormwater pond in a manner that alters its intended purpose can cause or increase flooding, raise neighborhood flood insurance rates, and lower property values.

A good stormwater pond holds rainwater from urban areas.

Because of their function as temporary storage and flood control, storm ponds often fluctuate in response to precipitation. Above: a retention pond shortly after a storm; below: the same pond days later.

Community Management

Most urban stormwater ponds fall under the responsibility of the Home Owner's Association (HOA), but some remain under ownership of the developer or are owned or managed by the city or county. Managing a stormwater pond is often more difficult than managing a private pond, simply because it is a community resource that requires cooperation and group decision-making to oversee. It is very unlikely that everyone in the community has the same interest, vision, or use focus for the pond. Some parties may want it to be aesthetically appealing, others may want swimming, while still others want fishing or wildlife viewing. The one aspect that is typically underrepresented or missing is the user group concerned with the intended purpose of the pond: stormwater management.

There are some simple methods that can be employed to make management of a stormwater pond or ponds within a community more effective, civil, and easy for all parties involved.

1) **Form a pond management committee.** Pond management committees typically consist of either three or five individuals who reside within the affected neighborhood, although they do sometimes include a knowledgeable individual from outside the neighborhood such as a professional pond and lake manager or a County Extension Agent. The committee can include individuals from the HOA board or committee, but should not consist entirely of these individuals. Good candidates for the committee are typically well-respected members with knowledge of natural resource management, ecology, biology, wildlife, fish, etc. Some of the best committee members are often those that have no vested interest in the pond, as these members are more likely to consider all user group interest, listen to management advice from professionals or outside experts, and to seek compromise. Above all, the committee's main objective must be to ensure proper functionality of the stormwater pond with a secondary objective of attempting to achieve management interests.

2) **Gather management interests and statistics**. Establish user or management interest and the percent of individuals involved that share in each management interest. This establishes a baseline as to what the potential management interests for the pond are and also establishes how interests overlap, which can be significant for justifying picking one area to manage over another. This task is accomplished easily through a blind vote or a paper survey where each residence in the neighborhood gets one vote, but they can list multiple management areas.

3) **Information gathering**. The committee should then gather as much science-based information on stormwater pond management, identified user interest, and pond ecology as possible. Consult with professionals or Extension specialists when necessary.

4) **Community comment forum**. Have an open community forum where all individuals or parties may have a brief comment or proposal period (2 to 5 minutes in length). Establish ground rules prior to the event so that individuals may not be unfairly interrupted, and yelling, name-calling, arguing, etc. will not be tolerated. Such behaviors should result in dismissal from the community forum.

5) **Proposal formulation**. After gathering information, statistics, and hearing community comments, the pond management committee should formulate a minimum of two

(three is typical) competing proposals including estimated costs to address the various management desires of the majority share of users while first and foremost maintaining the function of the stormwater pond. The proposals may focus on a single management interest, but more than likely should address portions of the top 2 to 3 management interest groups. These competing management proposals should be paired with an additional proposal to leave the pond as it currently exists and a proposal to improve the pond for stormwater mitigation practices only.

6) **Period of community review**. The proposals should be provided for review by the community during a period of no less than two weeks.

7) **Community comment**. There may be an optional period of comment during a public forum in which polite persuasion and cooperation should be used to propose any alterations to the proposals. Again, establish ground rules prior to the event that individuals may not be unfairly interrupted, and yelling, name-calling, arguing, etc. will not be tolerated and will result in dismissal from the community forum. After the forum, the pond management committee should determine based on community suggestions and science whether alterations to the proposals are necessary.

8) **Community voting**. Put the four (or more) proposals up for a blind vote to the community; each household again should receive one vote . If two competing proposals are within 10% of votes from one another, not necessarily a true tie, then a runoff vote may be held among just those two proposals. This practice allows users in the community that voted for eliminated proposals to still have a say in the management process and makes them less likely to become disgruntled, while at the same time ensuring that community majority is achieved by the winning proposal.

Algal overgrowth is a common sight in urban stormwater ponds due to their frequently high nutrient levels.

9) **Implementation**. The HOA, or pond management committee, if tasked to do so, should then make every possible effort to put the management practices of the winning proposal into effect, while maintaining the proposed budget and the functionality of the stormwater pond.

Why Is There Algae in the Pond?

Excessive algae growth is one of the most frequently encountered problems in stormwater ponds. Many factors contribute to excess algae, including nutrient pollution from sources such as pesticides, fertilizers, grass clippings, de-icing road salts, and oil from cars and asphalt. Excess of nutrients such as nitrogen or phosphorous can cause plants such as algae and submerged vegetation to become overabundant. Due to multiple sources of nutrient pollution affecting urban ponds, it is difficult to completely eliminate the issue, but communities can accomplish much if each homeowner does their part to cut back on their own nutrient pollution, such as frequent or excessive lawn fertilization. This is one issue that would benefit from participation of the entire community. As more people in the neighborhood become educated about the causes of excessive algae growth and how to prevent it, it's more likely the cause of the problem will be reduced.

What is Algae?

There are two types of algae typically found in urban ponds: planktonic and filamentous. Planktonic algae are generally what people think of when they hear "algae". Microscopic and free-floating, these algae exist in the top few feet of a pond where sunlight easily penetrates. Planktonic algae are naturally occurring, desirable, essential to the pond's food chain, and helpful for locking up excess nutrients that wind up in the water. Planktonic algae provide food for the microscopic animals, called zooplankton, that are the primary food source for fry, baitfish, juvenile sportfish, and other pond inhabitants. These organisms in turn support a larger sportfish population. Planktonic algae exhibit seasonal abundance, often blooming during spring and summer, coloring the pond shades of green, blue-green, or brown. Natural degradation of algae blooms can lead to oxygen depletion and fish kills in the pond.

Filamentous algae are made of algae cells that form long visible chains, threads, and filaments that intertwine to resemble wet cotton or wool. This type of algae grows along the bottom of the pond in shallow areas and then floats to the surface to form mats commonly referred to as "pond scum" or "pond moss". Filamentous algae are unsightly and may interfere with recreational activities. Additionally, they provide little usable habitat and they are utilized as a food source by very few fish or aquatic animals. Filamentous algae are the source of most complaints pertaining to aquatic vegetation in any type of pond.

How to Manage Algal Growth

This frog is resting on a mat of floating filamentous algae..

Filamentous algae may be temporarily managed through physical removal such as raking or seining the algae, but the effect is short-lived as the algae will recolonize soon after. Using dyes/colorants or pond mats to prevent algal growth by shading the bottom of the pond and reducing sunlight penetration may be a longer-lasting option, but it could also decrease the planktonic algae and inhibit the natural food chain of the pond. Dyes and colorants are not effective once the algae mats have reached the surface, so they should be applied in early spring prior to algae buildup.

Another form of control for both filamentous and planktonic algae is aquatic herbicides, such as aqueous copper sulfate, chelated copper complexes, diquat, or sodium carbonate peroxy-hydrate. To ensure that other aquatic organisms are not harmed, it is essential to consider several factors before using any chemical controls, including water alkalinity, water temperature, and pond size. See Texas A&M AgriLife Extension publication Managing & Controlling Algae in Ponds for further details. Aquatic herbicides are non-toxic to fish when applied correctly; be sure to follow all label instructions carefully.

Prevention is usually cheaper and more effective than treatment. Aerating the pond with a bottom diffuser (not a fountain) injects more oxygen into the water at the bottom of the pond, which in turn increases the number of aerobic bacteria. These bacteria feed on organic matter such as decomposing plants and reduce the amount of excess nutrients released into the water. Aeration also helps prevent fish kills, which occur when a buildup of deoxygenated water at the bottom of the pond mixes suddenly with the upper layers and suffocates the fish. However, pond aerators can be expensive to operate and may not always be the best option. The most effective way to prevent excessive algae growth is to decrease the sources of nutrient pollution reaching the pond.

Reducing Nutrient Pollution

Limit use of fertilizers. Fertilizers, especially those containing high levels of nitrogen and phosphorus, are common sources of nutrient pollution and can cause algae blooms or the overgrowth of pond weeds. Do not over fertilize. Be sure to check the

Cleaning up after pets is one easy way to reduce nutrient pollution.

weather to avoid applying fertilizer before rainstorms, which will prevent it from flowing directly into water systems.

Do not overuse herbicides or pesticides. Follow all label directions and ensure the product is applied correctly. When possible, use non-toxic weed-removal methods or pick weeds by hand.

Clean up after pets. Dispose of animal waste in the trash or toilet rather than leaving it in the yard.

Keep grass clippings and leaves out of the water. Plant material such as yard clippings and leaves wash or blow into ponds easily, adding nutrients and creating oxygen decreases due to bacterial decomposition, which can harm fish or other aquatic organisms.

Maintain native aquatic vegetation. Do not treat or remove native emergent aquatic vegetation; this is rooted vegetation that grows around the edge of the pond and in shallow areas in the water but rises above the water line. Emergent vegetation serves to reduce flow rate into the pond that stirs bottom sediment and it absorbs excess nutrients.

Reduce surface flow. Slowing down the flow of surface runoff allows chemicals to settle out and be reabsorbed into the ground rather than flowing directly into nearby bodies of water. Slow surface flow through the following methods:

1) ***Create no-mow buffer zones.*** Ideally, sustaining a 15 to 20 foot unmown buffer strip, or minimally several feet of grass mown to a height of no less than 8 inches at the pond's edge will reduce water flow rates while decreasing the amount of grass clippings that end up in the water.
2) ***Eliminate bare patches of soil by establishing plants or grass.*** Establishing terrestrial plants including grasses will anchor the soil and decrease the amount of sediment erosion and nutrients entering the water.
3) ***Plant rain gardens.*** Rain gardens are depressions, typically 9 to 12 inches deep and 3 to 4 feet wide, in the ground surrounding the pond and throughout the community, Rain gardens are filled with native plants, which attract native wildlife species and do not need fertilizer. Rain gardens catch runoff from impermeable surfaces like roads, sidewalks, parking lots, and roofs, giving runoff the chance to soak into the ground. Rain gardens are essential since mown lawns are not usually sufficient enough to stop surface flow, unless the grass is 8 inches or higher.
4) ***Use less impermeable surfaces when landscaping.*** Instead, consider utilizing permeable alternatives such as pervious concrete, pervious pavers, crushed shells/pebbles, or gravel for driveways, walkways, and patios.
5) ***Create a 3 to 1 bank slope (three feet of distance for every foot of depth).*** A shallower pond bank will give runoff more time to be absorbed, as well as decrease the likelihood of bank erosion.

Creating a no-mow buffer zone as well as a gentle 3-1 slope around the pond's edge can significantly slow down surface flow before it reaches the pond, giving chemicals and sediment time to settle out.

What are Siltation and Sedimentation?

Chemicals are not the on-

ly things that are washed into ponds by storm water runoff—it also catches soil from nearby land and carries it into ponds. Siltation refers to fine clay or silt particles suspended in the water, causing it to become muddy or turbid. Aquatic vegetation has a hard time growing in turbid water, and without roots to hold the bottom down, sediment is easily resuspended by wind, waves, or bottom-feeding fish.

When runoff reaches a pond and slows down, the sediment settles out of water and collects on the bottom of the pond. This is known as "sedimentation". Sedimentation often occurs because of nearby impermeable surfaces such as roads, parking lots, driveways, or sloped banks that are too steep to allow sediment to fall out of the water, but shoreline erosion is also a common cause. As a pond ages, its banks will collapse, dropping more sediment into the pond as well as steepening the shores and increasing the amount of sediment washed into the pond by runoff. Over time, the sediment builds up and causes the pond to lose depth. The loss of water volume and expansion of shallow areas can have several unfortunate side effects such as more shallow, fertile bottom sediment, which encourages the growth of aquatic vegetation and weeds. Increased aquatic vegetation raises the danger to fish of a low dissolved oxygen induced die-off, because a shallower pond means fish have a difficult time avoiding low dissolved oxygen zones (or excessive water temperatures). The pond's ability to manage storm water is also sharply reduced as it is unable to hold as much water. When a pond becomes too shallow, excess sediment may need to be dredged in order to deepen the pond and recover lost depth.

What Can Be Done to Reduce Sediment Deposition?

Like nutrient pollution, siltation and sediment deposition can be decreased by creating buffer zones to slow down runoff and prevent it from washing sediment directly into bodies of water.

Reduce erosion. Focus on patches of bare soil in the surrounding watershed and areas where the bank is eroded or collapsing into the water.

1) ***Eliminate bare patches of soil by establishing plants***. Establishing terrestrial plants including grasses will anchor the soil and decrease the amount of sediment erosion and silt or sediments entering the water.
2) ***Create a 3 to 1 bank slope (three feet of distance for every foot of depth)***. A shallower pond bank will give runoff more time to be absorbed, reduce flow rate, decrease the likelihood of bank erosion, and give sediment time to settle on land.
3) ***Divert waterspouts***. Angle waterspouts so they flow through areas that slow down water flow and allow sediment to absorb ground instead of becoming swift moving surface water that erodes the ground.

Create buffers to reduce surface flow.

1) ***Maintain no-mow buffer zones.*** Ideally, sustaining a 15 to 20 foot unmown buffer strip, or minimally several feet of grass mown to a height of no less than 8 inches at the pond's edge will reduce water flow from transporting silt and sediment directly into the water.
2) ***Plant rain gardens.*** Rain gardens are depressions, typically 9 to 12 inches deep and 3 to 4 feet wide, in the ground surrounding the pond and throughout the community, Rain gardens are filled with native plants, which attract native wildlife species and do not need fertilizer. Rain gardens catch runoff from impermeable surfaces like roads, sidewalks, parking lots, and roofs, giving runoff the chance to soak into the

Use permeable surface, such as gravel or pebbles, to allow surface water to absorb into the ground rather than washing straight into the pond.

ground. Rain gardens are essential since mown lawns are not usually sufficient enough to stop surface flow, unless the grass is 8 inches or higher.

3) ***Use less impermeable surfaces when landscaping.*** Instead, consider utilizing permeable alternatives such as pervious concrete, pervious pavers, crushed shells/ pebbles, or gravel for driveways, walkways, and patios.

Ponds and Aquatic Vegetation

A balanced amount of aquatic vegetation offers several advantages to a pond. Plant roots and leaves create safe habitats and offer protection from predators for key organisms like aquatic insects, frogs, and small fish. They also serve as sources of food and oxygen for many of the pond's inhabitants. Several aquatic plants have roots that help anchor the pond's bottom and banks to reduce erosion. In some cases, management instead of elimination of aquatic vegetation may be necessary to control nuisance insects such as mosquitos. There are many different types of aquatic vegetation, all of which play an important role in the pond's ecosystem.

- **Algae**: plants without true leaves or flowers. Most are free-floating like planktonic algae or grow in mats such as filamentous algae.
- **Floating**: plants that float on the surface of the water and are not anchored to the bottom, such as duckweed, watermeal, or mosquito fern.
- **Submerged**: plants that are rooted to the bottom of the pond, grow under water, and have flaccid stems, such as naiads and pondweeds.
- **Emergent**: plants whose roots are attached to the bottom with rigid stems that extend above the water surface, such as cattails and water lilies.

Like many elements of a healthy ecosystem, the amount of aquatic vegetation must be proportional to the size and depth of the pond. Ponds with large areas of shallow water tend to have more aquatic vegetation, as rooted plants will generally grow in areas with 3.5 feet of water or less. When aquatic vegetation becomes exceedingly abundant, aquatic plants may be deemed undesirable. A common complaint is that too much vegetation bordering the pond's edge can be unsightly and block the view of the water. However, plants play an essential role in the function of a stormwater pond by stabilizing sediment and locking up excess nutrients. One compromise is to maintain emergent aquatic vegetation on only half of the pond's shores. If the community is dead set against having aquatic plants (although not ideal as it limits the intended functionality of the stormwater pond), a stormwater pond can be managed without aquatic vegetation—but constant measures such as physical removal or herbicides must be taken to prevent plants from naturally establishing themselves in the pond. A pond without plants is also at higher risk for many of the problems discussed above, such as erosion, siltation, sediment deposition, and environmental toxins that may harm aquatic animals. Management of aquatic vegetation should be a community decision to ensure that everyone's expectations are addressed.

Shallow ponds are more susceptible to overabundant aquatic vegetation, which maybe become undesirable and require management or removal of plants.

Choosing the Right Aquatic Plants

Planting new aquatic plants in retention ponds is not generally recommended or needed, since the high levels of nutrients in the water often result in overgrowth of vegetation. Most retention ponds will already have aquatic plants that have found their way into the water system and naturally established themselves, so the introduction of more plants is not necessary.

However, if there is a desire to plant new aquatic plants, extra care must be taken when selecting species to ensure they will be beneficial to the pond. Some species of aquatic plants

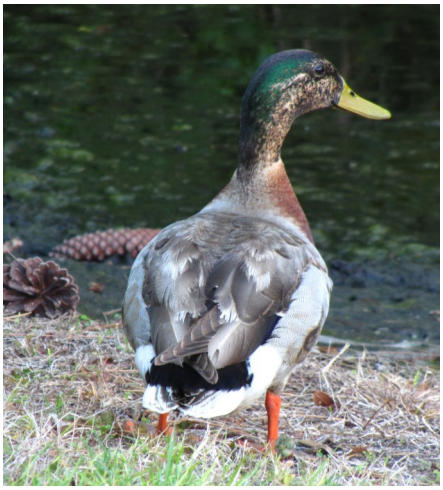
Native plants such as pickerelweed (left) are preferable to non-native plants like water hyacinth, which can be highly invasive and detrimental to the natural pond ecosystem.

are prone to dominating the habitat and might require more management, while other species can provide ecological function and maintain a relatively unobstructed view. Choose beneficial native species, such as American pondweed, arrowhead, pickerelweed, and rushes. Know what plant is being introduced, and never introduce a non-native species to a pond. Non-native species lack natural predators or controls and often become invasive and unmanageable. Invasive species such as giant salvinia, hydrilla, and water hyacinth rapidly outcompete and choke out native plants.

How to Manage Wildlife around the Pond

One of the best features of a pond is its ability to naturally attract wildlife. Many species that need water to make their home, such as birds, frogs, and turtles, will find their way to the pond without any effort by humans. Other species might need some prompting, but attracting wildlife is usually a chain reaction. If the small prey organisms such as fish, frogs, and insects are present, larger species that prey on them will settle nearby.

Stormwater ponds in urban areas are sometimes at a disadvantage when it comes to attracting wildlife because they often have conditions that can discourage wildlife. For example, frequent or continuous human activity by a pond, such as a busy road or walkway, will scare some animals away. Wildlife also tend avoid ponds with no aquatic plants or vegetation along the shores because they offer no shelter or protection from predators. Ponds with gently sloping banks and an irregular bottom and shoreline are ideal and result in more wildlife; they provide more unique and specialized areas called "microhabitats" where small organisms make their homes. One way to invite wildlife to take residence by the pond is to build nesting areas such as wood duck boxes or swallow houses in nearby trees. Creating flat sunning areas like large rocks or logs half submerged in the water or along the bank will also make the pond a more desirable habitat.



Ponds with a gentle slope and vegetation along the shore often naturally attract wildlife species.

One general misconception is that stormwater ponds contain fish. As fishing is not the intended purpose of these ponds, most developers never stock stormwater ponds with fish. Small minnows may be seen swimming around the edges of ponds as they are often swept in during flood events or "bait-bucket" introductions by people that fish in the pond (presuming it supports fish). However, most common angling species must typically be stocked into the pond by the community. Most stormwater ponds are smaller than an acre, so largemouth bass are not normally recommended. However, channel catfish, bluegill, and redear sunfish are ideal species to stock in stormwater ponds to allow fishing opportunities.

One common concern

The majority of snake species, such as this water snake, are nonvenomous and relatively harmless. As a vital part of the food chain, they control pest species like rodents.

about attracting wildlife to a pond is the possibility of snakes. Snakes are often feared or hated because of their potential for biting a person. However, the majority of snake species are nonvenomous and would much rather flee than come into contact with a human. The species of snakes most often encountered around ponds are garter snakes or water snakes, which are nonvenomous and relatively harmless as long as they are not harassed. Snakes are an important part of the ecosystem because they control species often regarded as pests, such as rodents, insects, and crayfish, as well as other organisms like fish and frogs.

Some people worry about ponds becoming breeding grounds for pests such as mosquitoes, but insect populations are easily controlled by natural species living in and around the pond. A substantial part of many fish's diets include invertebrates such as mosquito larvae. Mosquitoes are more likely to be a problem where water collects and

Places such as bird baths where stagnant water collects without natural predators to limit the larvae are a prime breeding spot for mosquitoes.

stagnates, such as in bird baths or wheelbarrows filled with rainwater, because the mosquito larvae can grow unchecked by predators like fish. Building bat or bird boxes near the pond will encourage the presence of animals that help reduce the numbers of nuisance insects.

Conclusion

Many neighborhoods contain ponds that are unutilized because residents do not realize their value or know how to manage them. Understanding the function and common problems associated with stormwater ponds will help homeowners manage issues like nutrient pollution and excessive algae growth. Although it may take periodic maintenance to keep aquatic plants at an appropriate level and prevent eroding banks, a healthy pond is worth the effort and is a valuable community resource. With proper management, a stormwater pond can serve its intended purpose, be aesthetically pleasing, attract and support fish and wildlife, while benefitting the entire community.

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