

# BEAVER MANAGEMENT PLAN

## Chesterfield, NJ



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Chesterfield Environmental Commission  
Spring, 2019

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## INTRODUCTION

This Beaver Manage Plan (BMP) for Chesterfield Township was written as a guide to assist in managing the beaver population in the Conservation Easement at Old York Village.

This Plan is modeled after a plan developed by Vickie Hennessy, M.S. who studied under Peter Busher, a Professor at Boston University, considered an expert in beaver, conservation and ecology. Ms. Hennessy was a professor of Biology at Sinclair College in Ohio.

Ms Hennessy developed the Beaver Management Plan for Yellow Springs, Ohio and granted permission for Chesterfield Township to use the information for its Beaver Management Plan. The Ohio Plan was sent to Chesterfield Township by Sharon Brown, a biologist and the Director at Beavers, Wetlands and Wildlife whose expertise was also provided for this BMP. Ms. Brown recognized that Yellow Springs, Ohio's beaver issues were remarkably similar to those of Chesterfield Township.

This document is divided into two parts. Part 1 provides a brief history of the Old York Village beavers and the behavioral characteristics of beavers that was written by Ms. Hennessy. Part 2 focuses directly on beaver management strategies that may be used for the natural areas of Old York Village.

The goal of this BMP is to deter beaver from the Conservation Easement (CE) at Old York Village. By utilizing the management techniques in Part 2 in this plan, it is anticipated that conflicts between beavers and residents will be minimized, if not eliminated by forcing the resident beavers downstream towards the Crosswicks Creek. Any beavers that disperse from the home lodge in the spring of each year and make their way up the tributary of the Crosswicks Creek to the Conservation Area will hopefully find the area unsuitable due to lack of a food source and inability to dam any culverts or manmade drainage systems.



planted by the developer. Further inspection revealed that there was a beaver bank den near one of the drainage pipes in a retention pond and that the beaver had dammed the intake in the pond.

Members of the Chesterfield Environmental Commission (EC) researched the methods of deterring beaver and used three foot high welded wire to wrap most of the trees on the southern portion of Recklesstown Way. The township did arrange for trapping the beaver, but was able to trap only one animal.

In the summer of 2018, there was no evidence of beaver activity in the area and by August of 2018, the bank den was clearly uninhabited as evidenced by lack of maintenance by beavers and general disrepair of the structure.

In the early fall of 2018, beaver activity was noticed on the northern side of Recklesstown Way near Glock Farm Way. EC members wrapped about 50 trees with welded wire in response to the renewed activity, then wrapped an additional 50 trees as damage became evident towards the western part of the CE. No further damage was noted until mid to late fall when the beaver began taking trees from an open area on Recklesstown near the playground across from 13 Recklesstown Way. That area is situated the closest to the tributary and intense activity in that area and no activity in other areas of the CE indicates that the beaver were forced out of the main basin areas and downstream towards the Crosswicks Creek.

Trees in that area were wrapped with wire and all beaver activity in that area ceased. In December, it was noted that beaver were taking smaller trees from the natural areas close to the tributary. EC members inspected the entire area along the tributary and could not find a lodge or den.

In December, 2018, the Township Committee elected to attempt to force the beaver from the CE rather than trap and kill. The Environmental Commission was tasked with writing this Management Plan.

EC members contacted several Beaver Conservation Organizations, including Wildlife Biologists, Veterinarians and the USDA. All entities provided information for inclusion in this plan. See Appendix A.

## **Natural History of Beavers**

(by Vickie Hennessy)

### **Beaver in Urban Habitats**

Beavers are very interesting creatures and they are now returning to this area after an absence of nearly 300 years. As beavers and people move into each others' backyards, many of us want to learn more about these wild animals -- either to enjoy watching them or to learn how to take preventive measures to protect property. The following information on the biology, life history, ecology, and behavior of *Castor Canadensis* is provided so we can get a better understanding of this remarkable mammal.

### **Basic Life History**

Beavers are the largest rodents in North America. Adults typically weigh from 35 to 50 pounds, but there are numerous records of them exceeding 100 pounds. They are between two and three feet in length, with an additional 12 to 18 inches for the tail. Beavers vary in color from light to dark brown. The fur contains long, shiny guard hairs covering dense, soft underfur that traps air and helps protect them from the cold. It is the underfur that is of value in the fur industry. Beavers are widely distributed, living in every Canadian province below tree line and in every state except Hawaii.

Beavers have numerous morphological, physiological, and behavioral adaptations that enable them to thrive in semi-aquatic environments. Their body is "torpedo" shaped and contributes to their agility in water, but on land it makes them a bit awkward and clumsy. They are muscular animals with large bones, and a massive skull that supports strong chewing muscles. Like all rodents, beaver teeth never stop growing, so they do not

become too worn despite years of chewing hardwoods. Their four front teeth (incisors) are self-sharpening due to hard orange enamel on the front of the tooth and a softer dentin on the back. Therefore as beavers chew wood the softer backside of the tooth wears faster, creating a chisel-like cutting surface.

Beavers have a broad, horizontally flattened tail that is scaly in appearance. The tail is used for stability while sitting or standing upright on land, as a rudder and propulsion in water, as a warning device, and for both fat storage and thermal regulation. Their hind feet are large and webbed for propulsion; the toenail on the second toe of each hind foot is split, forming a grooming claw that can be used to clean dirt and other debris out of their fur. The front legs are short and the front paws have heavy toenails for digging. Beavers' eyes are near the top of their head so they can see above the water while keeping most of their body underwater, and they have a translucent membrane that covers their eyes when underwater. Both ears and the nose have valves that close when the animal submerges. The throat can be blocked by the back of the tongue, and the lips close behind their incisors to permit gnawing and carrying sticks underwater without choking.

## **Feeding**

Beavers are vegetarians whose diet varies with changes in season. In spring and summer they feed on non-woody plants or plant parts such as water lilies, algae, grasses, sedges, herbs, ferns, and shrub leaves and shoots. In the fall and winter they favor twigs, roots, bark and inner bark (cambium layer) of woody plants. Aspen, birch, alder and willow are favored tree species, but beavers have been known to cut almost every kind of tree, including conifers. Bark and leaves may be eaten where they fall in the woods or dragged back to the water. Since they consume large amounts of cellulose, they have a specialized digestive tract with very long intestines. Also, beavers often are coprophagous and will ingest their feces to gain the undigested nutrients.

\*\*Beavers create a food cache each fall. The food cache is a stock of branches and twigs stored under the water near the lodge for a winter food supply. These are compiled from September to November. Beavers preferred tree species are notably aspens and willows, with other tree species eaten and used based on relative availability. In different studies beaver will cache many different species including aspens, willows, alders,

witch hazel, red maple, sugar maple, red oak, white birch, yellow birch, and white pine. Any branches that have been stripped during feeding will often be used in dam or lodge construction in the spring.

**Reproduction:** Beavers form permanent, monogamous breeding pairs that continue between breeding seasons. Copulation takes place in the water mainly from December to January. The gestation period on average lasts 107 days. In May to July kits are born typically in litters of 3 to 4. Reproduction normally takes place only in the adult pair of a colony and most females do not reproduce until age two. In populations with heavy trapping, females may breed at a younger age. At age seven, 90% of females will reproduce and will continue to do so until death.

Both sexes look identical externally. Beavers have no external sex organs, except teats on nursing females, and they have a common urogenital opening near the base of the tail (a "cloaca" similar to waterfowl).

Development of kits is relatively rapid. Beavers are born fully furred and teethed weighing about 0.7- 1.4 lbs. Within several hours they will have full use of their eyes and show defensive behaviors. They may also enter the water on their first day of life. Beaver young remain in the nest during their first year. Young are able to swim by 9 days old. By 3 weeks, young are able to groom themselves and are eating mainly vegetation and are normally fully weaned by week 10, even though lactation may continue. When weighing 7 – 8 lbs., kits begin to leave the lodge to explore and feed. Young normally remain in the lodge until their second year, at which time they will disperse to find a mate and build their own lodge. A yearling weighs 24 – 27 lbs.

If a member of a pair dies it will often be replaced with a 2-year old disperser. The average pairing lasts 2.5-3.1 years. The high replacement rate may be explained by the age discrepancies of repairing. On average a beaver lives to 10-12 years and up to 19 years in captivity.

## **Ecology and Behavior**

(by Vickie Hennessy)

### **Lodge and dam building**

Beavers live in lodges or bank burrows. Bank burrows can be used in faster moving water, but most beavers live in lodges. Lodges can extend several feet out of the water and are made of sticks, mud, leaf materials, and sod. There are normally two underwater entrances and a main room, which may be 6-8 ft. diameter and is completely above water. Often, beavers will have a main lodge or the nursing lodge and one to several alternative lodges. The second lodge site is used heavily after the kits are born, at varying water levels, and in the summer months. During the winter and cold seasons the lodges maintain a warmer temperature inside than outside (in one study the lowest temperature inside was 0° C while outside it reached -6° C). The lodges are well ventilated with no seasonal variation in CO<sub>2</sub> or O<sub>2</sub>.

The site selection for the lodge is influenced by many factors, which include population levels, territoriality, and habitat quality. Environmental factors that influence the site are percent canopy cover, slope of the riverbank, and water depth. Sites with greater slope and depth are normally chosen. The site of the lodge also tends to have more canopy cover than surrounding areas and is not harvested for building or food.

Beaver dams are initiated where water flows over obstructions in streams and at outlets to pools: audible stimuli are important in releasing and orienting construction behavior. Dams begin with beavers pushing pond or stream sediment and stones into a ridge. Ridge size depends upon stream velocity and when the ridge no longer holds back water, sticks and branches are added for support, followed by more mud. As a dam takes

form, building behavior is oriented where water flows over or around the structure. Building behavior generally ceases when water no longer flows over or around the dam or when ice forms.

Dams are maintained throughout the year, but most material is added during periods of excess water. Mud and sediment from the pond bottom are carried in the forepaws against the upper chest and are pushed along the upstream side of the dam to or near the crest. Sticks are towed to the dam and, using teeth and forepaws, slid over the crest to the downstream side. Maintenance behavior increases with age and all family members participate.

Beavers frequently perform slow, close inspection of dams. This inspection appears to be visual, but sound detection of escaping water also may be important. About one-third of all close inspections result in dam maintenance. All family members perform the behavior, and the frequency increases with age. Breaks in dams are rare, probably because of frequent inspections and maintenance. Materials selected for repairs follow a fixed sequence, similar to initial dam construction. Repaired crests often are higher than adjacent portions of a dam.

**Diving:** Beavers can regulate their blood chemistry, heart rate, and circulation pattern to enable them to remain underwater for 15 or more minutes, although a normal dive lasts for 5-6 minutes. When diving, blood is signaled to move to vital organs that could suffer from oxygen shortages. The heart rate and metabolism will also drop on a dive. The average resting heart rate of a beaver is 100 beats per minute and can drop to 50 beats per minute while diving.

**Mound Building:** Beavers hold territories of 10-75 acres. Scent mounds built from pond sediment and are marked with castoreum form these territories. Castoreum is a urine based excretion that is stored in castor sacs. The adult male primarily does the scent marking, but other family members will also take part in this activity. Beavers will periodically remark the mounds. They are also able to distinguish between family and non-family members as well as neighbors and non-neighbors. The main mound building time is in late spring, early summer, during the time a dispersal of young. Reasons for marking scent on a mound include elevation of the point of odor release, intensify odor with moist substrate, and protection from flooding.

**Social organization:** The beaver family social system is unique among rodents. Each family occupies a discrete, individual site. The adult pair bond is long-term and monogamous, although a lost adult may be replaced by a transient or an offspring. The family strategy is characterized by low birth rate, low young mortality, prolonged behavioral development, and high parental care. An age-class hierarchy exists and is maintained through close-range interactions where body orientations, vocalizations, postures, and gestures convey status; physical aggression is rare among family members. Adults dominate yearlings and yearlings dominate kits. Either adult may be dominant, or they may be co-dominant.

Offspring tend to stay with their parents until they are two and help with taking care of the young, building, food caching, and scent mound work. The male and female also allocate their time between many different roles or jobs. Both males and females spend about the same amount of time traveling to get food, but females spend more time on interactions, feeding and on food caching. Males on the other hand spend more time on lodge work and alarm displays. There is a shared responsibility in the care of young with both males and females.

**Activity Patterns:** The normal activity pattern is a crepuscular (dawn and dusk)-nocturnal active period and a diurnal resting period. This pattern becomes much more irregular in the winter. Beavers' activity during spring, summer, and fall is predominately dusk to dawn, with activity beginning later in spring and fall than in mid-summer. Active period length is 11-13 hours per night, but varies among individuals and families. One beaver usually emerges first from the lodge or burrow more frequently than any other family member. This individual may be male or female, but typically is an adult. The adult male often patrols the pond perimeter after emerging. In winter where ponds are frozen for several months, free-running circadian activity rhythms, with a period of 26-29 hours, probably are common. Activity above ice is correlated positively with air temperature. As temperature falls, above ice activity declines and at about 10-15 degrees F, it ceases.

## **Summary**

Beavers are extremely well adapted to their semi-aquatic life-style and their ability to dam streams, cut trees, and build lodges make their presence highly visible in the landscape. Beavers have played an active role in the Delaware Valley ecology for thousands of years. Intensive trapping and

deforestation that followed European colonization eliminated beavers from this region by the early 1800's. Today, the landscape that beavers are returning to is very different than the one they occupied over 200 years ago. While trees and waterways are similar, transportation corridors and human developments now break them. Beavers were not considered in human development patterns because they were absent, so areas with a low or gradual gradient, often next to streams and rivers, were selected for roads, railroads, housing developments, and parks. Because beavers have a dramatic impact on the landscape in very urban areas, their return to a human- dominated environment has not been without conflict.

### **Conflicts with Beavers and Landowners**

All of the conservationists and wildlife biologists agree that when problems arise, working with the beaver is the best solution. If beavers are removed from good habitat, many studies show that others tend to resettle the habitat. Survivors in the area often respond with larger litters, where if left alone, will not overpopulate an area. Removing beavers, whether by killing or live-trapping, rarely gives a lasting solution.

## **Primary Concerns Beaver in the Conservation Easement**

Beaver in the CE at Old York Village began taking trees that were planted by the developer. The majority of the trees taken were from township owned property, however, the beaver often crossed Recklesstown Road and removed or damaged trees on residents property. This behavior caused resident complaints to the township and the primary concerns of residents and township officials were tree damage and flooding.

### **Natural Population Control**

Beavers rarely overpopulate because they breed only once a year, defend stream side territories from non family members and the two-year-olds leave home each spring to find mates. They are limited to a small fraction of the landscape that is close to waterways. Kits have many predators including hawks and owls: dogs and coyotes will also take older beavers that are especially vulnerable when seeking new territories. Accidents are another frequent cause of mortality, including falls into abandoned wells, and traffic accidents. In general, trapping is the most common source of mortality.

Beavers are limited by the amount of available habitat and food. Like many wildlife species, beaver populations self-regulate by starting to decrease their rate of reproduction (fewer kits born per season and fewer reproductive pairs) when occupancy reaches a certain level. In areas where beavers are just returning to the ecosystem, populations may peak and then slowly drift down to a sustainable level.

Studies show that beaver populations follow a sigmoidal, or S-shaped pattern, meaning that populations rise and fall over time, with or without

trapping.

In New York's Allegheny Park, trapping beaver has been prohibited for 25 years and occupancy rate in this park varied from 40% to 60% during these years, never reaching 100% occupancy . Similar findings in California showed population expansion, decline and stabilization at 35% of maximum capacity. One of the longest term beaver studies in the US shows similar trends. Data gathered in 2006 shows a decrease from 2004 "continuing a downward trend that began in 2001".

Massachusetts beaver population estimates have leveled off since 2005.

## **PART 2**

### **BEAVER MANAGEMENT TASK FORCE**

The Management of the beavers at Old York Village will be under the direction of the Beaver Management Task Force (BMTF) with the policy set forth in this Beaver Management Plan.

**Structure:** The BMTF will be comprised of a Chairman, a representative from the Township Committee, a representative from the Environmental Commission, and township residents who will monitor the Conservation Easement for beaver activity under the supervision of the township Animal Control Officer, Committee member and EC member. The overall goal of the BMTF is to define the acceptable limits of beaver activity. The current acceptable limit is downstream of the Conservation Easement. Other goals include making plans to minimize beaver conflicts and recommend methods of management to the Township Committee. All management strategies and procedures must have approval from the Committee.

#### **Duties:**

The BMTF will survey and inspect the CE and construct a baseline report of beaver activity to include:

- Dams that may create stagnant or slow moving water
- Debris placed in or near storm drains, inlets or overflow devices
- Trees that were damaged or removed by beaver
- Flooding caused by beaver activity

The BMTF will conduct monthly inspections of the CE.

The BMTF will implement solutions to these situations by:

- Recommending solutions to the Township Committee
- Wrapping endangered trees with welded wire or applying a latex paint/sand mix
- Educating the public on methods to deter beaver damage
- Identifying areas where beaver should be extirpated
- Assuring that all beaver flow devices are working properly
- Develop a timeline of beavers behavior

### **Meetings:**

The BMTF will meet quarterly, at a minimum, to review the activities of members who conducted monthly inspections and to review remediation efforts.

A new management strategy may only be initiated if it has the approval of the Township Committee.

### **Maintenance:**

Any manmade device exposed to the elements requires some maintenance. Beaver Flow Devices and fencing should be inspected and cleared of debris as needed and/or after being reported by the BMTF.

## **Beaver Management Task Force 2019**

Township Committee member: Denise Koetas-Dale

Environmental Commission: Nancy Scarafile  
(Zone 1)

Animal Control Officer: Nicole Bencivengo

Girl Scout Troop Leader: Lorrie Their, Scoutleader  
(Zone 2) Troop 25013

Girl Scout Troop Leader: Beth D'Angelo  
(Zone 3) Troop 23948

Chesterfield Township Green Team: Ravi Arya  
(Zone 4)

SEWA International USA: Sandesh Kamal  
(Zone 5)  
(Zone 6)

Township residents:

## **BEAVER MANAGEMENT STRATEGIES**

### **Trees and Plantings**

#### **Protecting Trees from Beavers:**

When available, beavers prefer to eat seaweed, clover and other land and aquatic plants, instead of the cambium of trees, but in areas with harsh winters, they need to prepare an underwater food cache as described under “Feeding” on page five.

They will normally use the peeled stick leftovers to build their dams and lodges. Because one beaver family (colony) often makes several of these teepee-shaped dwellings, the number of lodges is not a reliable way to estimate the number of local beavers.

Beavers may fell a wide variety of trees, though they tend to cut fast-growing trees, such as poplar, willow, cottonwood and alder.

Those concerned about protecting trees from beavers must consider that most cutting occurs within 50 feet of the shore. Although beavers may travel 200 feet from water, the likelihood of tree damage decreases as the distance from shore increases. While beavers prefer certain tree species, they do not necessarily take them in order of preference, so it's a good idea to protect special ones. Leave the trees that are already down, so the beavers are not driven to cut more while you are protecting others.

#### **Recommendations for Preventing Tree Damage**

1. Homeowners who live along the edge of the CE are strongly encouraged to protect their trees with wire cylinder tree wraps or cages if beaver activity is noted.
2. Cylinder cages should be made of ½ inch-mesh hardware cloth or heavy wire 2" x 4" fencing. The cylinders should be 3 to 4 feet in height and well anchored to the ground to prevent beavers from crawling under. Encircle the trunk, leaving a space of about six inches between the tree and the fence. Cut every other horizontal wire to leave a long prong and bend these into hooks to attach with the other end. These cages can easily be removed to use on another tree. (Appendix B)
3. Making a cylinder with a diameter of 12 inches greater than the tree's diameter will keep the fence the required 6 inches from the tree on all sides to allow for growth. To make the cylinder, cut the wire fence that comes 4-feet high to the length that you need and roll it into a cylinder.
4. The Beaver Management Task Force will wrap selected trees on township property as described above and may assist property owners to protect their trees in the same manner.
5. Where wrapping of individual trees is impractical, low fences (3- or 4-foot high) are used to protect groups of trees or woody shrubs and normally need not surround the entire stand, since beavers dislike being separated from the water. Have the fence fit tightly to the ground and trail each end toward the water. Monitor often in the beginning for burrowing. If digging occurs, two concrete blocks tied together can be used to block the tunnel. (See Appendix B for alternate suggestions.)
6. Painting with a mix of latex paint and sand may prevent beaver gnawing. Eight ounces of sand to one quart of latex paint can be applied to the bottom three to four feet of the tree trunk. Avoid painting trees less than six feet tall as it may be harmful to a young tree.
7. Repellents may protect saplings and foliage plants for a few months, but these work best when there's other food available. Ro-pel is the

only deterrent currently registered as a beaver deterrent with U.S. EPA. Research indicates that repellents containing sulfur compounds, such as Deer Off and Big Game Repellent Powder, are effective as temporary deterrents, but they are not yet registered for this use with EPA. Growing Season Repellent from Nott Products is reported to protect plants for up to two months, will not clog sprayers and can be used around edibles.

Young, restoration trees can be protected with a combination of "4 the Birds," or "Birds Away," and sand. Apply the sticky substance with a dedicated brush that has also been dipped in sand, and painted a strip about four feet high on the trunks of saplings. Avoid using this method on older trees, which might be used by trunk climbing birds.

8. Beaver Conservationists advise that beavers can sometimes be lured from a problem area. Methods used range from leaving dog scat at the active site or placing favorite foods at a preferred site. Elimination of access to preferred foods will also force the beaver to leave an area,

Beavers, Wetlands and Wildlife. *Trees and Plantings: How to Protect Trees from Beaver.*  
<http://www.beaversww.org/solving-problems/trees-and-plantings/>

## **BEAVER MANAGEMENT STRATEGIES DAMS**

### **Water Level Flow Device**

If properly designed and built, a Pond Leveler will create a permanent leak through the beaver dam that the beavers cannot stop. In order for these pipe systems to work, they must be designed so that a beaver cannot detect the flow of water into the pipe. The Pond Leveler works by surrounding the submerged intake of the pipe with a large cylinder of fencing to prevent the beavers from getting close enough to the intake to detect water movement. As a result, the beavers do not try to clog the pipe, and maintenance is rarely needed. Usually a pond depth of at least three feet is required for the Pond Leveler to function properly. Generally, the height of the pipe in the dam determines the pond level. Water will flow through the pipe unless the pond level drops below the peak of the pipe. The pipe is set in the dam at the desired pond level, and can be adjusted up or down if desired. Pond Leveler pipes do not need to be sized like culverts to handle catastrophic storm events because heavy storm runoff will simply flow over the top of the dam. Following the storm, the pipe will return the pond to the normal level. Some mild pond fluctuations are possible following very wet periods, but since the pipe controls dam height, the pond size remains at a safe level. (Appendix B)

### **Recommendations for Beaver Dam Management**

1. In most cases, beaver lodges and dams should NOT BE DISTURBED, as this only encourages increased beaver activity. Lodges and dams should be disturbed only if a) they are causing a

safety hazard, b) are causing water backup, flooding or otherwise threaten private or village property (including bridges). (See Appendix B)

2. Beaver dams will not be removed, but “deceiver” or bypass devices will be installed where (a) water backup, flooding or other threats to private or village property can be mitigated by such a device, **and** (b) where the water depth and shoreline height are sufficient to accommodate the device.
3. Beaver dams will be removed only if (a) dams are causing water backup, flooding or otherwise threaten private or village property **and** (b) such threats cannot be mitigated by a beaver flow device, **or** (c) it is too shallow or water flow is too great for the use of these devices.

## **Trapping**

Chesterfield Township prefers to not trap and kill the beaver because it is inhumane, unsafe, and doesn't permanently solve the problem. Beavers are territorial and when a niche is opened, other beaver will fill that niche, usually within a year, often causing more damage by rebuilding dams and dens.

Surviving beavers respond to stress (such as trapping) with larger litters.

The traps that currently exist have proven to be unreliable in successfully causing a fast death in field conditions and drowning traps are inhumane for animals that can hold their breath for 10 minutes or more.

Because of this species' benefits in maintaining vital wetlands, and because removal is rarely a lasting solution, working with beavers provides both a financial and conservation solution.

The Chesterfield Environmental Commission and the Township Committee have agreed to give the proposed plan a chance to provide a remedy to destruction of street trees and engineered drainage systems. The BMP provides for the Environmental Commission along with community groups to monitor the state of trees and of the retention and detention basins. The

volunteer groups will give regular updates which will be presented to the Committee. If there is evidence of increasing damage to the street trees and the basins, the Committee will confer with the Environmental Commission on the possibility of trapping.

This Plan is designed to remain flexible with the best interest of the public and the engineered systems of the Conservation Easement as primary concerns.

## **Appendix A Consultants**

Ned Buyukmichci, VMD, President  
Unexpected Wildlife Refuge,  
Hammonton, NJ

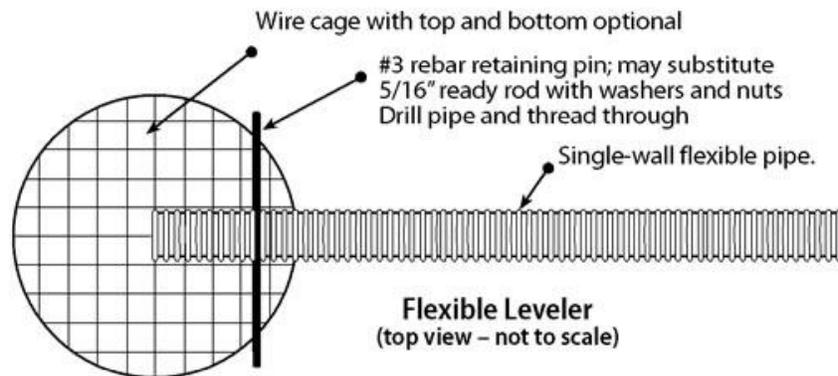
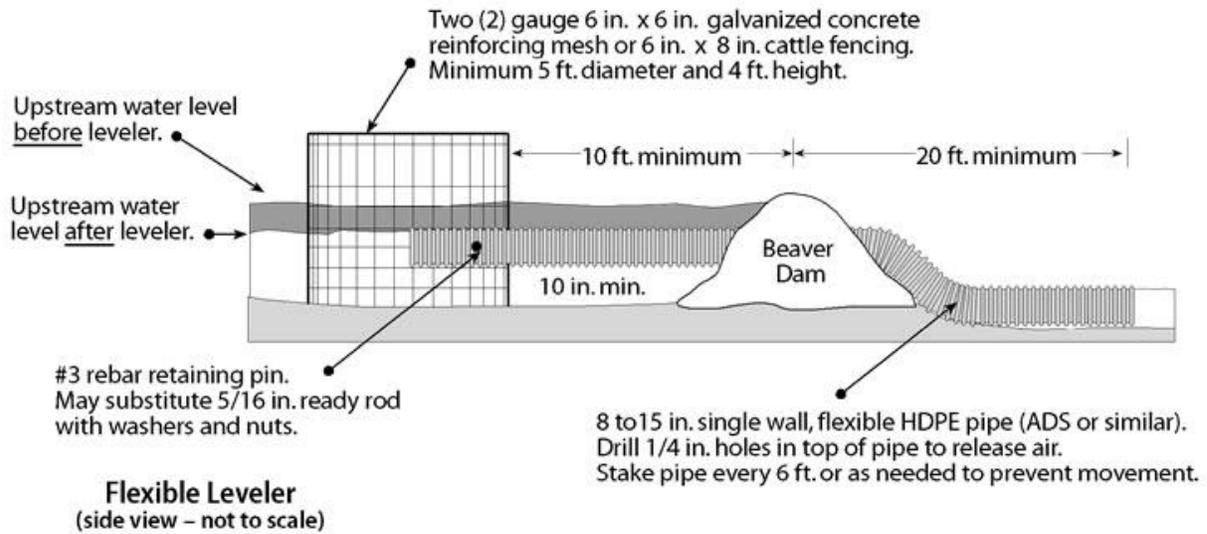
Sharon Brown, Wildlife Biologist  
Beavers, Wetlands and Wildlife Director  
Dolgeville, NY

Heidi Perryman, PhD  
Worth A Dam  
Martinez, CA

Mike Callahan, Founder  
Beaver Institute  
Beaver Solutions, LLC  
Southampton, MA

Vickie Hennessy, Biologist  
Green Environmental Coalition  
Yellow Springs, OH

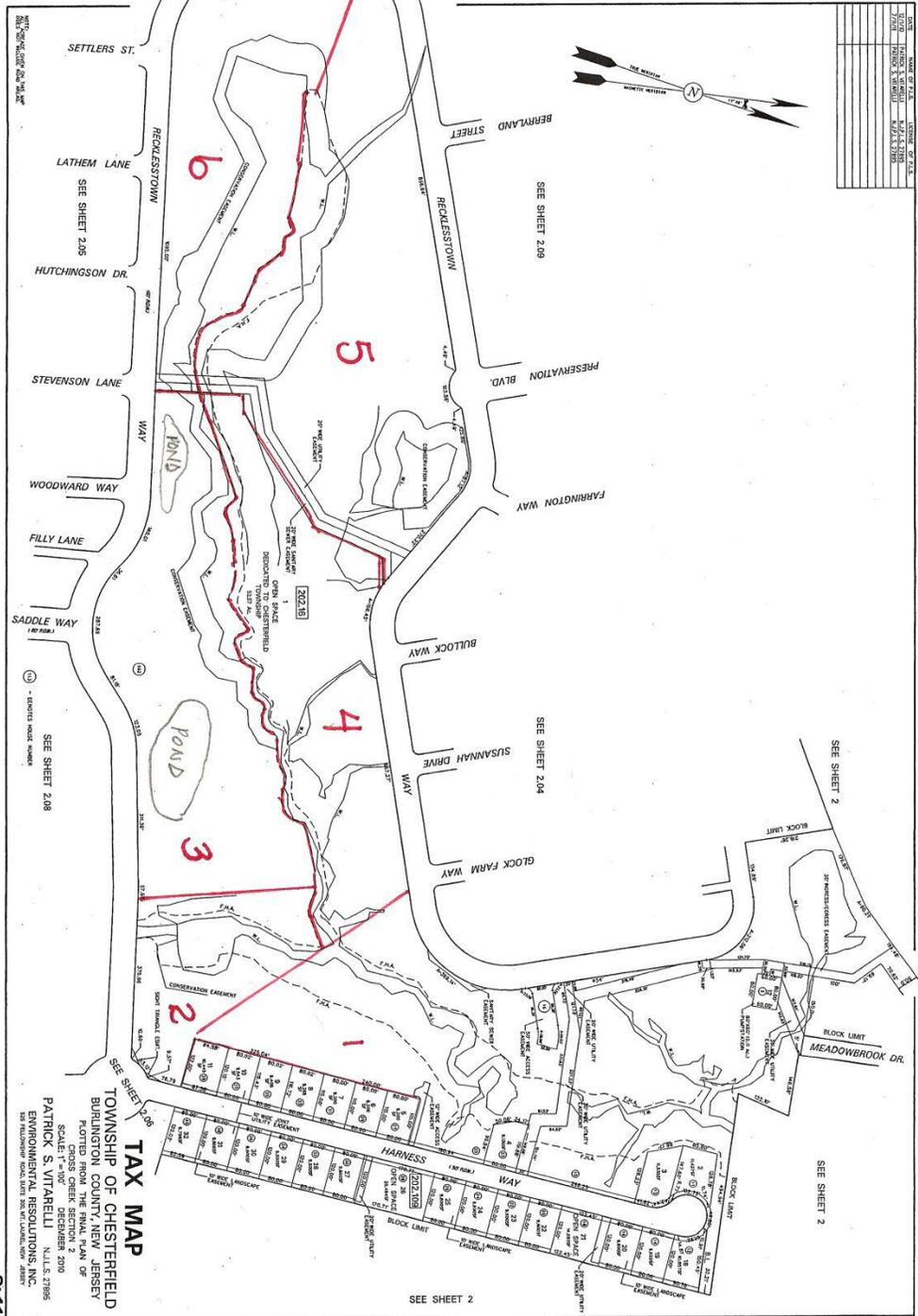
**Appendix B**  
**Pond Levelers and Flow Devices**



**Construction notes:**

1. Construct wire cage using hog rings or similar devices for fasteners. Overlap one section for cage wall.
2. Cut out hole for flexible pipe in cage wall.
3. Remove dam as needed to place flexible pipe. Replace dam after leveler is installed.
4. Stake single-wall HDPE pipe every 6 ft. To prevent it from floating or beavers from moving it, use two T-posts and wire between them and over the top of the pipe to secure the pipe.
5. Drill 3/8th in. hole in culvert for rebar to allow for friction fit. If ready rod is used, place washers next to pipe and secure with double nuts.
6. One (1) 16 foot section of fencing will construct a cage wall approximately 5 feet in diameter. An additional section is needed to construct the top and bottom of each cage.
7. Pipe diameter should be sized to pass the stream base flow.
8. Final layout of the pipe should allow for a shallow gradient to facilitate fish passage.

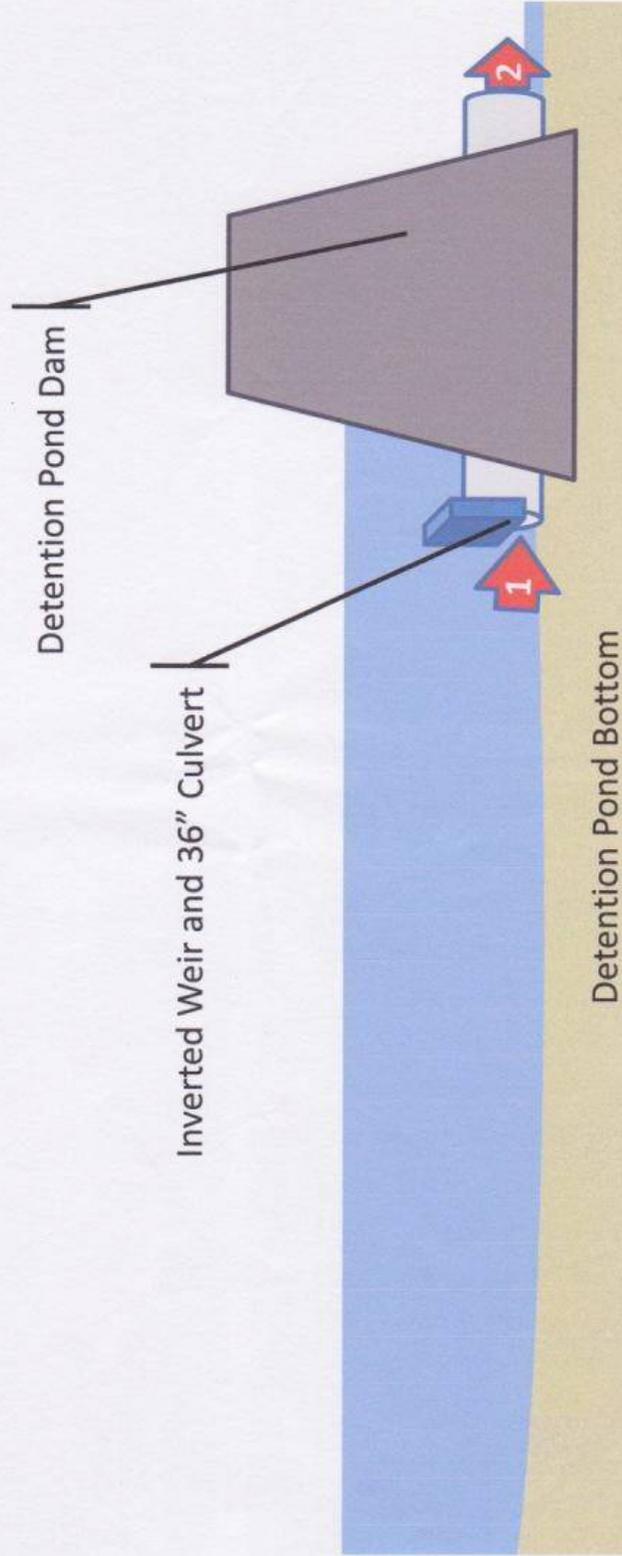
**APPENDIX C**  
**Inspection Zones**



2.11

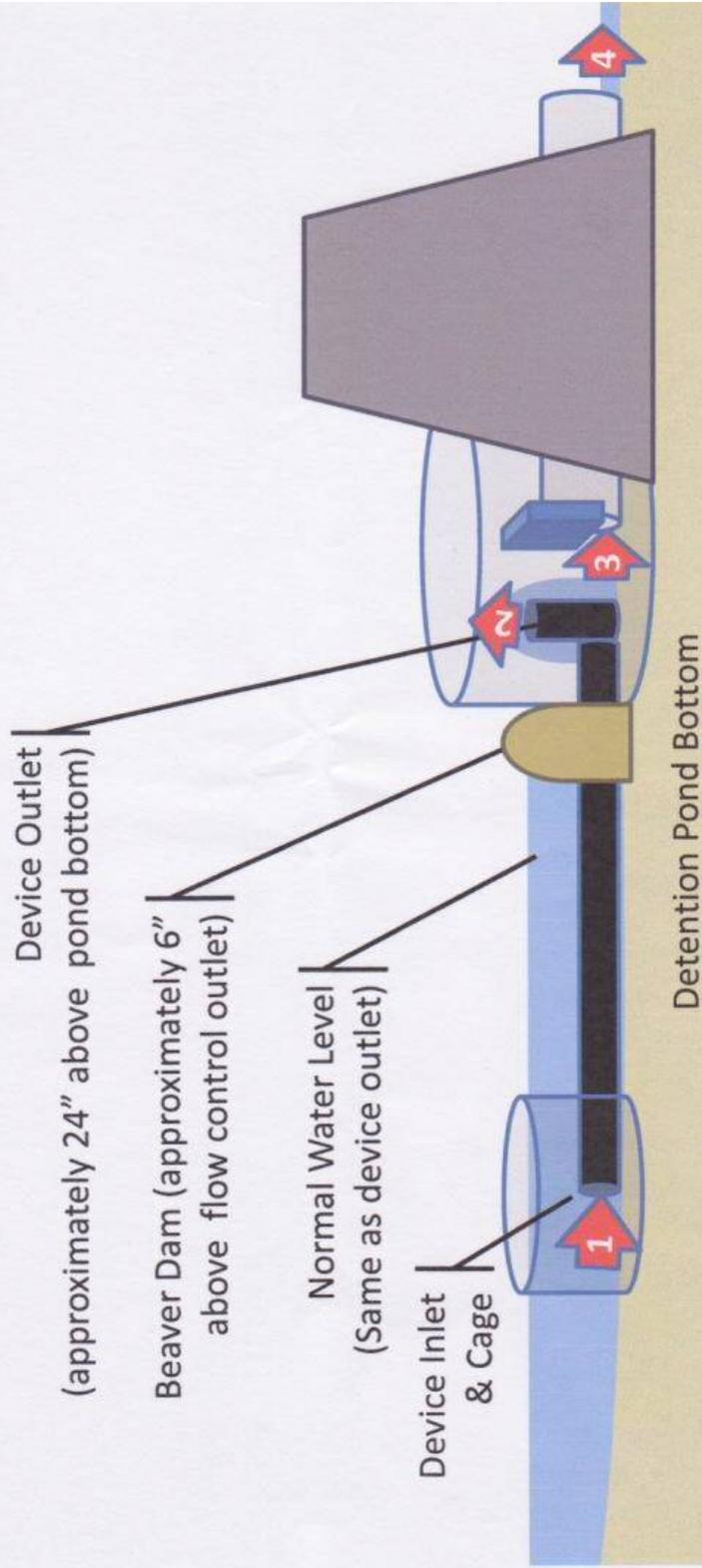
2.11

# Detention Pond at the Glass Farm Prior to Beaver and Flow Control Device



**Under High Water Flow Conditions** water is detained by the dam. The water level slowly lowers by controlled release of water through the inverted weir preventing flooding downstream. All water flows through the Inverted Weir (1) into the 36" culvert to be expelled (2) on the other side of the dam.

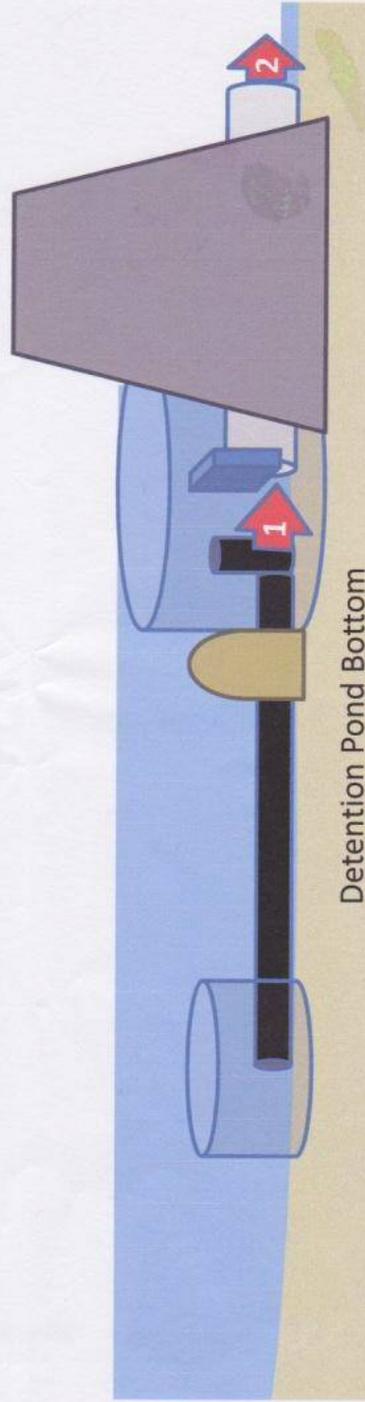
# Beaver Flow Control Device at the Glass Farm



**Under normal conditions** the flow control device keeps the water level at the height of outlet. All water flows in the flow control device inlet (1), out the outlet (2) and through the Inverted Weir (3) into the 36" culvert to be expelled (4) on the other side of the dam.

## Beaver Flow Control Device at the Glass Farm

During storm events the water flows through the same path as it would if the flow control device, beaver dam and beaver were not there.



**Under High Flow Conditions** the flow control device becomes irrelevant. The water level will exceed the height of the flow control device outlet and dam and all water will flow directly into the Inverted Weir (1) into the 36" culvert to be expelled (2) on the other side of the dam.