

# Options

**Grades:** 9 - 12

**Time Allotments:**

Teacher preparation: 5 minutes  
Lesson/activity: 2 45-minute sessions  
Closure/assessment: 20 – 30 minutes

**Content Objectives: After performing this activity students will be able to:**

- 1) Identify examples of nonpoint source pollution (NPS) and describe how this pollution can impact water quality within a watershed;
- 2) Identify solutions for these specific examples of NPS; and
- 3) List considerations needed when developing a plan designed to address a problem in a given area.

**Process Objectives: Students will:**

- 1) Analyze narrative information to determine what is scientifically relevant and distinguish between factual information and opinions and preferences;
- 2) Work with a small group on an assigned task;
- 3) Listen to and analyze the opinions, concerns and input from those impacted by a problem and how it may be resolved; and
- 4) Devise a plan to address a problem in a given area and include priorities, timeframes, estimated costs and relevant action steps.

**Curricular Areas and Corresponding Core Curriculum Content Standards:**

Consumer/Family/Life Skills **9.2** (G12) A1, C2  
Computer/Info. Literacy **8.1** (G12) B5, 8 & 11  
Social Studies: **6.6** (G12) B2 & 3, C2, D1 & 5, E3 & 6  
**6.1** (G12) A6  
Science: **5.10** (G12) A1  
Language Arts Literacy: **3.4** (G12) A1 & 2, B1, 3 & 4  
**3.3** (G12) A2 & D1  
**3.2** (G12) D1-2 (G7-8) D1  
**3.1** (G12) G1, 9 & 10

**Vocabulary:**

- Nonpoint Source Pollution
- Stormwater

**Materials Needed:**

- Copies of " The Situation with Beaver Brook" – one copy per student
- Copies of the "Description of Characters" – two to three sets depending on class size, cut up into individual slips of paper
- Pencils – one per student or per group of students
- Blank paper for notes
- Chalkboard and chalk

### **Anticipatory Set:**

- Ask students to brainstorm the types of pollution they are familiar with that occur in their own yards and neighborhoods. Write their examples on the chalkboard.
- Of these, ask them if they think these types of pollution are affected in any way by rain or snow and, if so, have them describe how.
- Use appropriate examples from their list to explain or review the definitions for nonpoint source pollution and stormwater.

### **Guided and Independent Practice:**

- Distribute copies of "The Situation with Beaver Brook" and allow time for students to read it. Explain that this situation could happen in their watershed and it reflects the concerns and difficulties of managing New Jersey's water resources.
- Explain to them that the Brookside Town Council will hold their public meeting on the topic of Beaver Brook's water-quality issues right there in the classroom. Select three students to act as members of the Brookside Town Council. Have the class locate the goal of the council in the narrative and write this goal on the board.
- The rest of the class will attend as concerned citizens. The descriptions from the "Description of Characters" handout should be cut into individual slips of paper (two to three sets) and assigned to various students. (Note on the handout that some of the roles require only one student while others can accommodate pairs or groups of students.) Allow students time to read the description and how it relates to the overall narrative.
- Explain that the purpose of the council's public meeting is to introduce to the citizens the problems and how the management plan will address these issues. Their feedback and concerns are important to the council and will determine how the plan is implemented.
- Divide the chalkboard into two sections. Assign a council member to write on one side of the board. He/she must write down the "well-received" NPS solutions and record who approved of it and why. A second council member should be assigned to write on the other side of the chalkboard. He/ she will record the "controversial" NPS solutions, along with who had concerns and why.
- Have a third council member read each solution in the plan aloud. After each one is read, ask any citizen who will be affected by this NPS solution to raise his/her hand. Encourage discussion. Facilitate debate whenever possible and make sure the council members record comments for each solution in the appropriate list on the board. Do this for the entire list of solutions.
- When finished, have the three council members rejoin the class. The public meeting is over and the students will work in small groups to handle the next task.
- Divide the class into small groups and give them time to review the comments and concerns from the citizens. Based upon this feedback, the groups must devise a final plan that should address the following points:
  - A. Prioritize all the solutions based on which are most important to do versus least important to do, and why (for each).
  - B. Of the five most important solutions, which will take one to three years to implement, four to five years, or five years or more?

- C. Of the five most important solutions, rate and estimate the expense of each (i.e., most expensive or second most expensive) and identify where the council may be able to secure the funds needed to implement the solution.
- D. For each of the five most important solutions, identify three actions that would be needed to ensure the successful and effective implementation of that solution.
- Remind students that their intention is to work cooperatively with the citizens, not against them. Many of the NPS solutions require voluntary action to be taken by the citizens. Before they begin, have students review the original goal of the council regarding the plan, which was written on the board.
- Have a representative from each group share their final plan with the class.

**Closure:**

- Discuss the following questions with the students:
  - Did your group have any additional questions while determining the final plan?
  - Did your group need more data or information about a specific topic?
  - Which solutions seemed easy to accomplish and were well-received by the citizens?
  - Which solutions created the most controversy among the citizens? Why?
  - Which solutions would require marketing or public education?
  - Which would require substantial funding?
  - Which would require the passage and enforcement of local regulations?
  - Which concerned citizen or group did you relate to the most? With whom did you disagree the most?
  - Did your final plan reflect any compromise between the board and the citizens?
  - Did your group's final plan ensure NPS will never be a problem again?

**Assessment:**

- Individual performance during the mock public meeting;
- Quality of the group's final plans, as determined by the four points to be addressed;
- Performance in a small group; and
- Responses to questions from teacher.

**Extensions:**

- Have students look for articles in newspapers and periodicals to identify how issues related to NPS are being addressed in your community as well as in other locations in New Jersey.
- Have students learn more about the watershed that your school or district is in. Visit "Surf Your Watershed," which is maintained by the Environmental Protection Agency ([www.epa.gov/surf/](http://www.epa.gov/surf/)).

**Source:**

- *Beneath the Shell...A Teacher's Guide to Nonpoint Source Pollution and Its Potential Impact on New Jersey Shellfish*. New Jersey Department of Environmental Protection. First Printing 1991; Revised 1993; Reprinted annually from 1997 – 2002 and 2004; adapted from "Options"(pgs. 104 - 108).

# The Situation with Beaver Brook

## **The Problem:**

Beaver Brook is experiencing a water-quality problem of high bacteria counts, which have caused several closures of the Tranquility Lake beaches. Tranquility Lake is at the downstream end of the Beaver Brook watershed. The Beaver Brook's 1,105-acre watershed is located in central coastal New Jersey in the town of Brookside.

## **The Current Situation:**

Residents and local business owners of Brookside are concerned about the continuing beach closures at Tranquility Lake. The closures have affected the residents' quality of life and have caused reduced revenues for local businesses. Members of the Brookside Town Council frequently hear complaints since the beach and adjoining picnic area are owned and operated by the town.

Brookside's Tranquility Park is on the southern shore of Tranquility Lake. It contains a public beach area and a large grassy picnic area. The picnic area is mowed down to the water's edge. It is a popular location for local residents and visitors to picnic, play ball and swim. Families also like to feed the geese their picnic leftovers. Brookside's downtown business area is next to Tranquility Park and the retail and restaurant businesses depend on the increased revenues, especially during the warmer months, generated by visitors to the lake.

The northern shore of the lake is privately owned. Houses there have large lawns that are mowed down to the water's edge. While this allows the homeowners easy access to the lake, it also is perfect habitat for the large goose population that frequents these large grassy lawns and the picnic area when they are not actually out on the lake.

In the Tranquility Acres section of town, 35 older homes within the Beaver Brook watershed are still on septic systems. The systems originally were installed 50 years ago when the homes were primarily used in the summer. The systems may not be adequate for their current year round use and may not be properly maintained. However, hooking this neighborhood to the municipal sewage system is a costly undertaking for both the town and the residents.

A new housing development has been considered for Hager Farms, one of the large horse farms in Brookside. Many residents worry that this will change the rural character of the town and cause additional traffic congestion and water pollution. The horse stables at Hager Farms are right alongside Beaver Brook and the farmer stores his manure in bins close to the river. The other farms have their manure storage facilities far from the brook and are not suspected as a source of bacteria.

A water-quality study has just been completed that indicates the primary sources of the high bacteria count are geese, horses and human waste.

The Beaver Brook Town Council is having a meeting tonight to discuss a plan prepared by the Planning Board and Environmental Commission that will address Beaver Brook's water quality issues. Based on findings from the study, they have recommended a number of management

measures that are outlined below. The council’s goal is to develop a plan that will improve the water quality of Beaver Brook and reduce the number of beach closings at Tranquility Lake.

The management plan includes the following recommendations:

- Adoption of a pet waste ordinance that requires all pet owners to pick up after their pets and dispose of the waste properly. The maximum fine for one offense is \$500.
- Posting of “Pick Up after Your Pet” signs and plastic bag dispensers in popular dog walking areas.
- Adoption of a wildlife feeding ordinance that prohibits the feeding of wildlife, including geese, on public property. The maximum fine for one offense is \$500.
- A contract for the connection of wastewater systems belonging to homes in Tranquility Acres to the local sewage treatment plant.
- Adoption of an ordinance that mandates a 25-foot wide buffer of vegetation along the shoreline of the lake, with the exception of Tranquility Park.
- An effort by the town to encourage Hager Farms to move its manure storage bins farther away from the brook’s shoreline. The local agricultural agent may be able to assist with funding for this project.
- A contract with a wildlife management company to harass the geese by chasing them with dogs and to remove goose nests and eggs. Trapping and physically removing geese also was suggested by the wildlife management company.
- Development of a storm drain monitoring program to check for illegal connections. The Public Works Department will implement this program but will need new equipment.
- An education campaign targeting residents that will stress the importance of picking up after pets and not feeding the geese.

**Additional Background Information:**

Land use in Beaver Brook’s watershed area is a mix of agriculture, forest, urban areas and wetlands. Break downs of these uses are provided below:

Land Use	Description	Percent of Watershed
Agriculture	Livestock, produce and landscape-plant operations	27.2 %
Forest	Natural areas	39.7 %
Urban	Residential development, shopping malls and office parks	27.0 %
Wetlands	Wetlands	6.1 %

Disease-causing microorganisms, such as certain bacteria, often are present in human or animal fecal matter. Diseases that can result from exposure to fecal matter include dysentery, hepatitis, gastroenteritis (food poisoning) and parasitic infections. In New Jersey, the presence of certain bacteria beyond levels deemed safe for humans results in the closure of bathing beaches, condemnation of waters for shellfish harvesting and restrictions on drinking water supplies.

Since no sewage treatment plants or industrial facilities discharge into Beaver Brook above Tranquility Lake, the high bacteria counts could come from any number of contributing sources. (Most of Brookside’s homes and businesses are connected to a sewage treatment facility that

discharges into Beaver Brook below Tranquility Lake.) Potential NPS could include animal waste from pets, livestock or wildlife; improper use of manure as a fertilizer on farms; malfunctioning septic systems; improper storage of manure at places where horses are boarded; or illegal connections of household sewer systems to the municipal stormwater system. Bacteria from these sources can reach water bodies directly through surface runoff or through sewage or stormwater sewer systems.

Each potential source of pollution has several management strategies. Options for control of these nonpoint sources of bacteria can include measures such as goose management strategies, pet waste ordinances, agricultural conservation management plans and septic system replacement and maintenance. Any illegal connections of household sewer systems to stormwater systems also would need to be corrected.

If the primary source is animal waste, the management strategy will depend on what type of animal – pets, livestock or wildlife. If pet waste needs to be controlled, the primary management strategies are adoption and enforcement of a pet waste ordinance that requires pet owners to pick up after their pets. An education program and appropriate signs can help ensure compliance.

If the source is livestock, farmers will need to take measures to reduce runoff of manure-contaminated stormwater into waterways. This usually involves moving manure storage facilities away from waterways or enclosing them so rain does not contact the manure. In addition, direct access to streams by livestock must be minimized. This usually involves fencing to keep livestock out of the stream. If manure is used as a soil amendment or fertilizer it also could be a source of bacteria. An examination of how, when and where the manure is applied is necessary. Changing the application rate, timing and location could reduce this as a source of bacteria.

If the source is wildlife, a wildlife management program is needed. One of the most common wildlife sources are resident Canada geese. Canada geese and other pest waterfowl have been identified as one of several primary sources of bacterial contamination in New Jersey. Geese may produce up to 1.5 pounds of fecal matter per day. Because geese are free to move about and commonly graze and rest on large grassy areas associated with homes, schools, parks, golf courses, corporate lawns and cemeteries, solutions are best developed at the community level. Goose management techniques include prohibiting feeding the geese, hazing or harassing the geese, altering the habitat to make it less appealing to the geese, relocating the geese, reproductive controls such as egg or nest removal, and harvesting the geese.

If human waste is suspected, the source could be malfunctioning septic systems or illicit connections of household sewage to the stormwater system. Septic systems that are improperly designed, located or maintained may result in bacterial contamination of local waterways. If a septic system is malfunctioning, a new system needs to be installed or the house should be connected to a municipal sewage treatment plant. An illegal connection is one that does not have a permit or incorrectly connects the household sewage pipe to the municipal stormwater pipes. Stormwater pipes are designed to carry stormwater runoff directly to local waterways to minimize flooding – this water is not treated, so the illegal connection must be corrected and the household sewage must flow into a municipal sewage system.

# The Situation with Beaver Brook

## Descriptions of Characters

### **Brookside Town Mayor (1):**

Responsible for managing the needs of the community and formulating policies that will affect it. He/she is an elected official who must heed the demands of the businesses associated with the community. He/she must balance the needs of a growing community and a clean environment. The mayor would like to help but the budget for extra staff and new programs is limited. Increased taxes could lead to his/her defeat in next year's election. Additionally, tourism related to the lake is the town's largest source of income.

### **Tranquility Acres Homeowners Association (1+):**

Concerned about the cost of connecting homes to the sewage treatment plant. Many of the residents are on fixed incomes and feel that they cannot afford this increased cost. They feel that the town should cover all of the costs since the connection will benefit the whole community. They also would like the town to investigate the illegal connections to the stormwater system before they are required to hook up their homes to the sewage treatment plant.

### **Local Housing Developer (1):**

Interested in building homes in the agricultural section of town. The development would change the rural character of that section of town but could reduce the potential for manure washing into Beaver Brook from the farms. Hager Farms is one of the locations they are considering for development.

### **Tranquility Lake Association (1+):**

Concerned with growth of the local community. The group is concerned that the proposed housing project will increase runoff into the lake. While it may reduce bacteria levels, it will introduce other pollutants and additional runoff into the lake's watershed. About half of the shoreline is privately owned and most of the membership of the lake association is lakeshore residents. They are concerned that new development will decrease their quality of life. They also are concerned that the lakeside buffer requirement will decrease their access to and view of the lake and it will not look attractive. If they are required to put in buffers, they would like some financial and technical assistance from the town and they would like the buffer to be required in Tranquility Park.

### **Hager Farms Horse Farmer (1):**

Breeds and boards horses for recreational purposes. The runoff of horse manure from manure piles contains bacteria. The farmer will be asked to move the manure storage facility because it is very close to Beaver Brook. This will be expensive and inconvenient for the farmer. He/she has told the mayor that this expense may drive him/her to sell the farm to the developers.

### **Concerned Dog Owner (1):**

Concerned that the pet waste ordinance is unduly harsh. He/she feels that since the main problem is not pet waste, dog owners should not have to pick up after their pets. After all, it is only natural and people don't want to have to pick up and carry around dog waste.

**Friends of Geese Group (1+):**

Concerned that the management strategy for geese will reduce the goose population in a cruel and inhumane manner. They enjoy watching and feeding the geese. They object to any decrease in the geese population, especially if it involves the death of any geese.

**Beaver Brook Watershed Association (1+):**

Generally supports the management plan but would like larger buffers around the whole lake and the rest of the Beaver Brook. This would help reduce bacteria levels and also other nonpoint source pollutants. The association also would like to maintain the rural character of the agricultural section of town and see Hager Farms manage its manure properly.

**Friends of Tranquility Park (1+):**

This is a volunteer organization that helps maintain Tranquility Park. They do litter clean-ups and provide free labor to build picnic benches and shelters in the park. They are strongly opposed to any buffer that would obstruct the view and reduce access to the lake. They feel the buffer would look unkempt and prefer a manicured lawn right up to the water's edge. They also worry that children might pick up ticks in a buffer. On the other hand, they are unhappy with the large number of goose droppings in the picnic area and are disturbed when the geese occasionally nip at small children.

**Brookside High School Environmental Club (1+):**

This group just finished a native landscaping project at their school. The large front lawn at school used to be another favorite goose habitat. During the last five years the environmental club has worked with the school's administration to reduce the size of the lawn and replace much of it with native trees and shrubs. The club provided volunteer labor and helped get supplies donated. Their goose research project has shown a reduced number of geese on the front lawn, although the geese still use the athletic fields in the back of the school. The club would be willing to work with the Tranquility Lake Association to plant the buffer.

**Brookside Environmental Commission (1+):**

Feels that the management plan they have developed is the best course of action for the town. It represents a compromise between the diverse interests in the town. While he/she would have liked to make it more comprehensive, funding was not available to do so. Taxes would need to be increased to fund more projects and that might have defeated the entire plan.

**Tranquility Lake Chamber of Commerce (1+):**

Supports the management plan. They would like to see the beach closings come to an end. Since the downtown is close to the beach, business owners depend on the increased business from lake users to maintain their profits. The lake users frequent restaurants, convenience stores, sporting goods stores, clothing stores and a host of other businesses during the warmer months.