Breaching the Swine Lagoons

Lesson Overview

Hurricane Florence made landfall near Wrightsville Beach, North Carolina, on September 14, 2018. The slow-moving, category 1 storm produced more than 2 feet of rain that flooded many low-lying areas housing many of the state's hog farms. State officials estimated more than 5,000 hogs were killed. Further, rising floodwaters breached two dozen storage areas containing hog waste. The rising waters caused manure to overflow their lagoons and contaminate surrounding waterways. As a state-level GIS analyst, your task is to identify the lagoons located within 1 mile of a river, so officials can mitigate public risk.

Build Skills in These Areas

- Using geospatial tools
- Managing data

Software Requirements

- ArcGIS Online account (obtain a free ArcGIS Public Account or ArcGIS trial)

Estimated Time

- 30–60 minutes

Teacher Resources

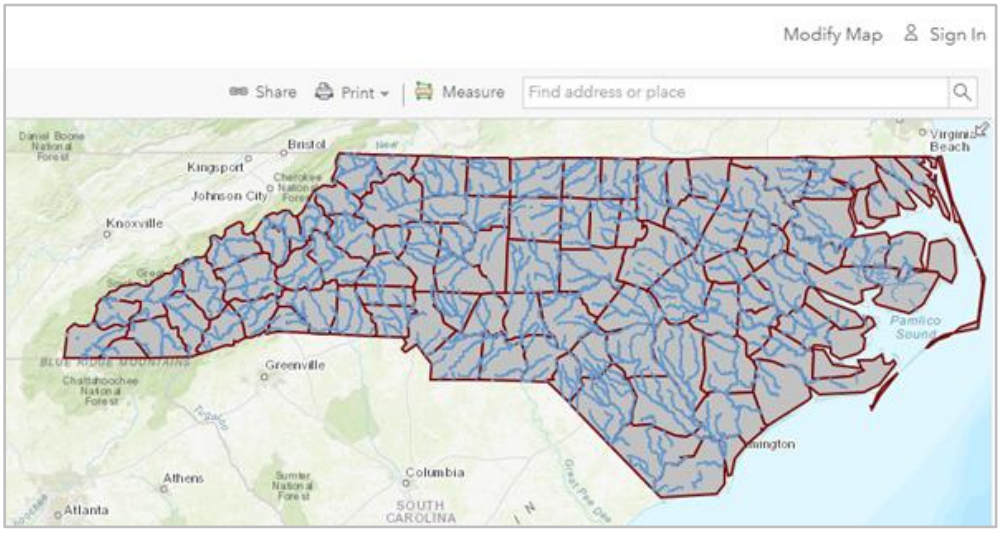
- North Carolina Pig Farms Video Essay

Exercise

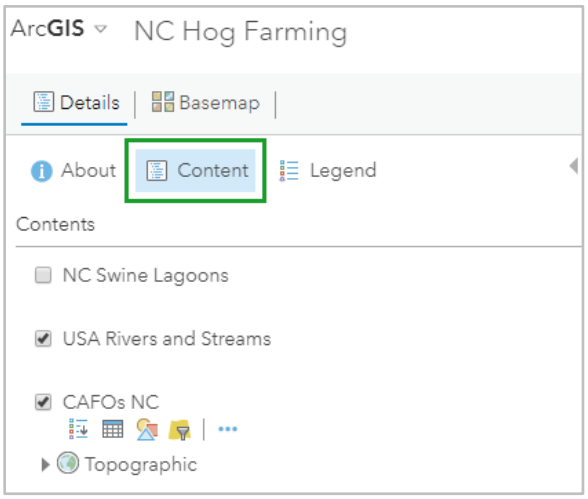
Step 1: Hog Farms in North Carolina

This lesson uses a Concentrated Animal Feeding Operation (CAFO) to map hog farms. The United States Department of Agriculture defines CAFO as an agricultural enterprise housing at least 1,000 animals for at least 45 days each year.

1. Click NC Hog Farming.



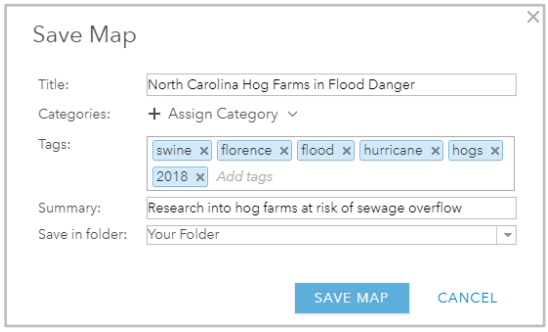
2. On the map, click **Sign In** to access your ArcGIS online account.
3. Click the **Content** tab, which shows the layers within the map.



4. On the ribbon, click **Save** and click **Save As**.

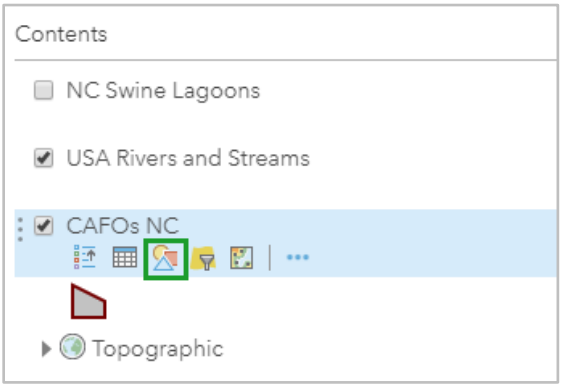
5. In the **Save Map** window, do the following:

- For **Title**, type North Carolina Hog Farms in Flood Danger.
- For **Tags**, delete the numbered tags and type hogs and 2018.
- For **Summary**, type Research into hog farms at risk of sewage overflow.
- Save in an appropriate folder.



- Click **Save Map**.

6. In **Contents**, point to the **CAFOs NC** layer and click **Change Style**.



7. For **Choose an attribute to show**, select **CAFOs**.

8. Click **Done**.

When you change the attribute, your map darkens the counties with higher concentrations of hog farms.

9. Save the map.

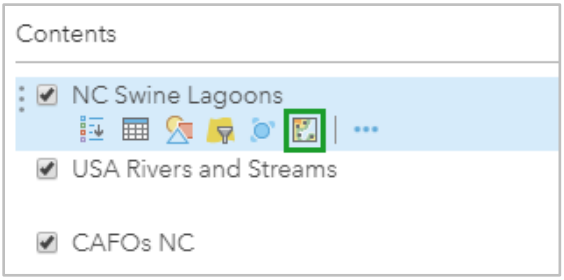
Q1. What region of North Carolina contains the highest concentrations of hog farms?

A1. _____

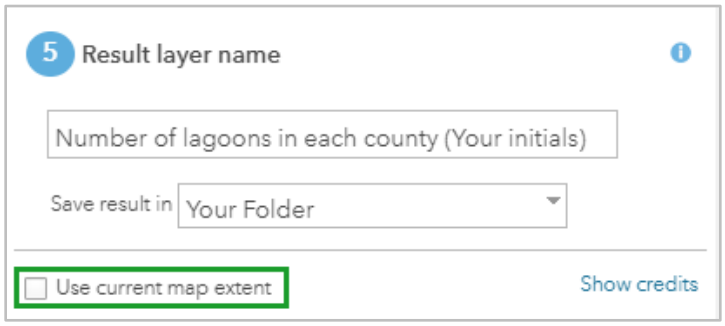
Step 2: Summarize Swine Lagoons by County

Industrial hog waste is stored in lagoons susceptible to overflow when floodwaters rise above the earthen embankments storing the manure. You need to create a map showing the number of lagoons in each county.

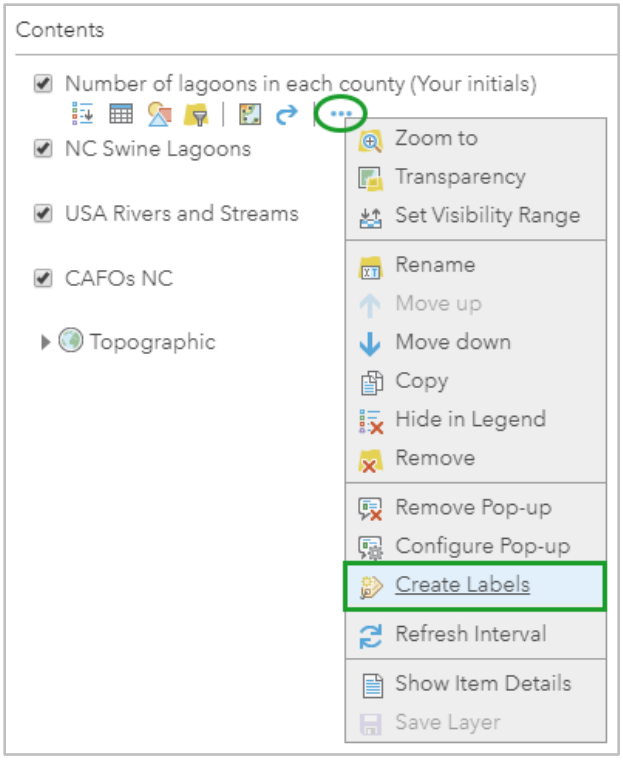
1. Check the layer for **NC Swine Lagoons**.
2. Point to the layer and click **Perform Analysis**.



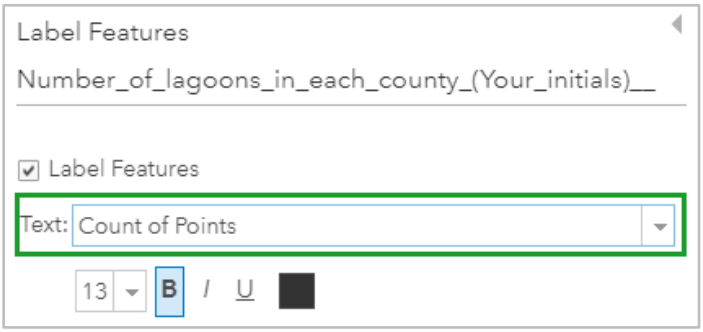
3. Click **Summarize Data** and click **Summarize Within**.
4. In the **Summarize Within** pane, do the following:
   - For **Choose the polygon layer**, confirm or select **CAFOs NC**.
   - For **Choose a layer to summarize**, confirm or select **NC Swine Lagoons**.
   - For **Result layer name**, type Number of lagoons in each county (Your initials).
   - Uncheck **Use current map extent**.



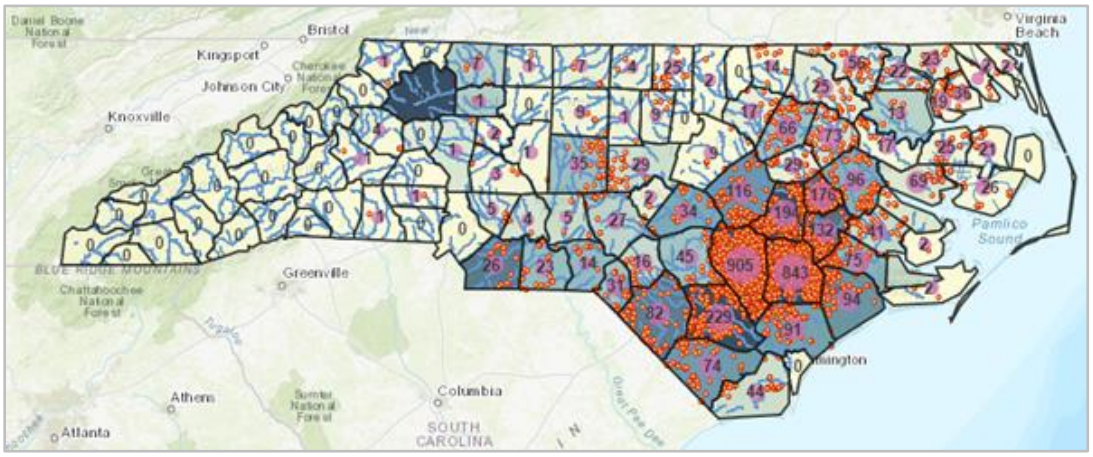
   - Click **Run Analysis**.
5. On the layer you just created, point to **More Options** and select **Create Labels**.



6. In the **Label Features** layer, for **Text**, click the drop-down arrow and select **Count of Points**.

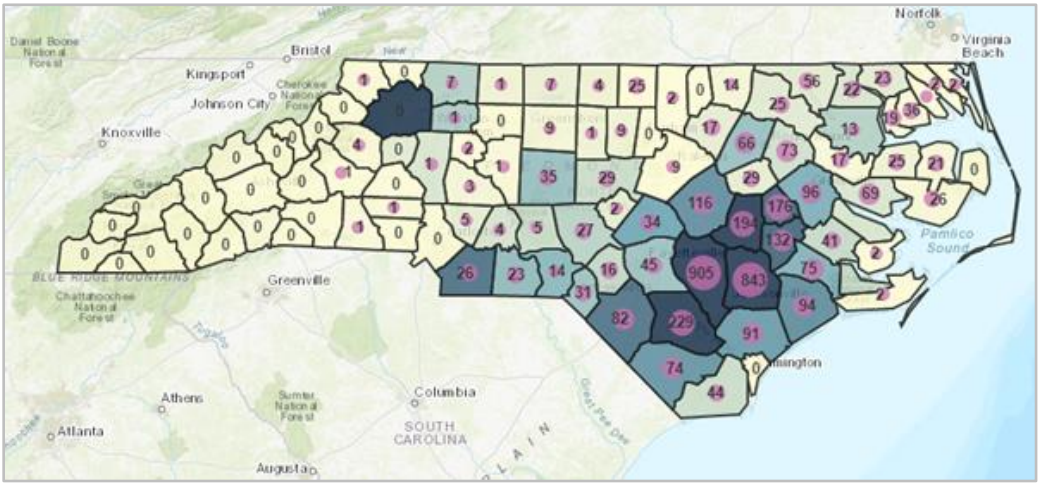


7. Click **OK**.



At this point, the map reflects the concentrations of hog farms, but there's so much data that the map's meaning is unclear. Turning off distracting layers clarifies your intent.

8. In **Contents**, uncheck the layers for **NC Swine Lagoons** and **USA Rivers and Streams**.



Now, you have a map that clearly communicates the concentrations of hog farms.

Step 3: Add a Buffer to Rivers and Streams

In this step, you'll add a 1-mile buffer to rivers and streams throughout North Carolina, so you can see which hog farms are vulnerable to rising floodwaters.

1. In **Contents**, check **NC Swine Lagoons** and **USA Rivers and Streams**.
2. Point to **USA Rivers and Streams** and click **Perform Analysis**.
3. Click **Use Proximity** and click **Create Buffers**.
4. In the **Create Buffers** pane, do the following:
    - For **Enter buffer size**, ensure the setting is **1 Miles**.
    - Expand **Options** and click **Dissolve**.
    - For **Result layer name**, type Buffer 1 mile (Your initials).
    - Uncheck **Use current map extent**.
    - Click **Run Analysis**.

Your map includes input from ArcGIS Living Atlas of the World.

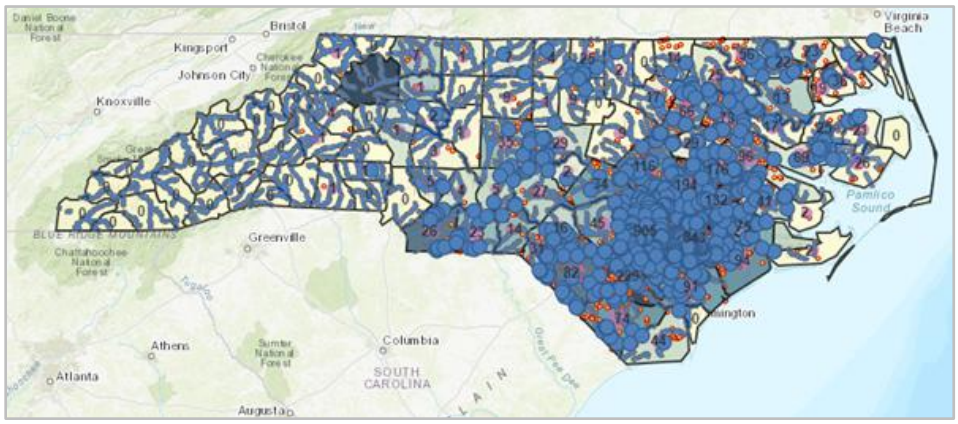
5. In the **Warning** window, click **OK**.
6. Zoom in and pan the map.

In the next step, you'll identify the swine lagoons located within a buffer zone you'll create.

Step 4: Intersect Swine Lagoons within the Buffer Area

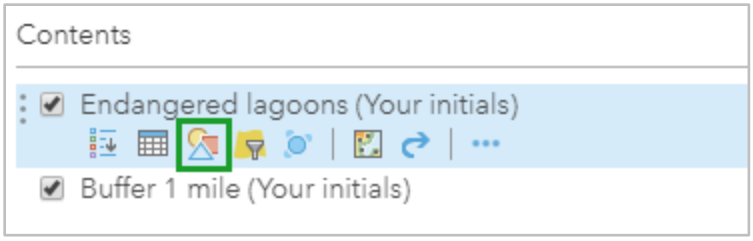
You're interested in the swine lagoons within the 1-mile buffer. To isolate those lagoons, you'll use the intersect tool.

1. Point to the **Buffer 1 mile (Your initials)** layer and click **Perform Analysis**.
2. Click **Manage Data** and click **Overlay Layers**.
3. In the **Overlay Layers** pane, do the following:
    - For **Choose input layer**, select **NC Swine Lagoons**.
    - For **Choose overlay layer**, select **Buffer 1 mile (Your initials)**.
    - For **Choose overlay method**, verify **Intersect**.
    - For **Output**, verify **Points**.
    - For **Result layer name**, type Endangered lagoons (Your initials).
    - Uncheck **Use current map extent**.
    - Click **Run Analysis**.

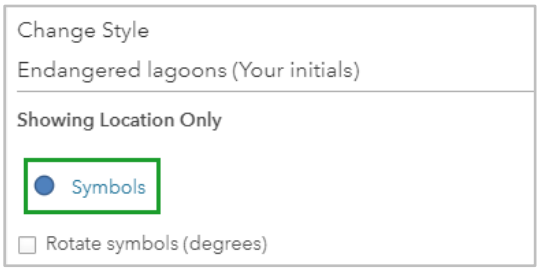


The map is confusing. By changing symbol colors and unchecking layers, you can clarify its message—namely, which lagoons are within the buffer.

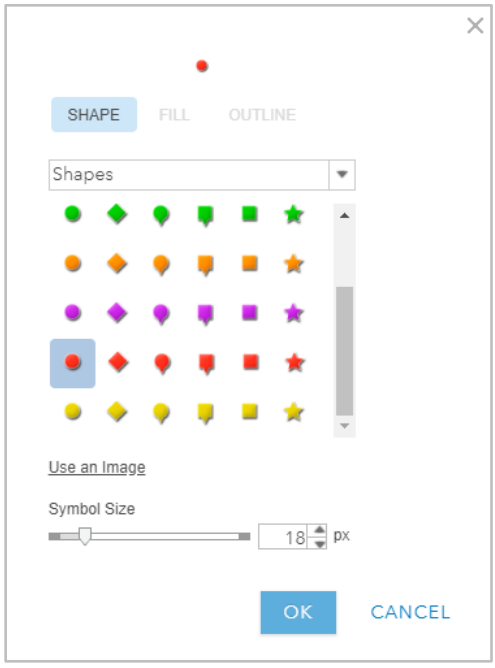
7. In **Contents**, uncheck the layers for **Number of lagoons in each county**, **NC Swine Lagoons**, **USA Rivers and Streams**, and **CAFOs NC**.
8. Point to the **Endangered Lagoons (Your initials)** layer and click **Change Style**.



9. Under **Select a drawing style**, click **Options**.
10. In the **Change Style** pane, click **Symbols**.



11. In the symbol window, scroll down and click the red circle.
12. Change the **Symbol Size** to 18 pixels.



- Click **OK** in the window and again in the **Change Style** pane.

13. Click **Done**.
14. Save your map.

Now, you have a map that clearly shows which hog farms could be threatened by floods.

Q2. Now that you have produced a map showing endangered hog farms, what does its information tell you? How could it help you mitigate the dangers of manure ponds in low-lying areas?

A2. _____

In 2018, Hurricane Florence dumped an estimated 30 inches of rain on North Carolina. Despite the deluge, and according to the North Carolina Pork Council, 20,000 pigs were moved to higher ground before the storm and 98 percent of the state's 3,300 lagoons did not experience significant issues with manure spillage. To combat the impact of future storms, the pork council said more measures are planned to mitigate the number of hog farms in flood-prone areas.

Exercise Answers

Q1. What region of North Carolina contains the highest concentrations of hog farms?

A1. The highest concentrations of hog farms in North Carolina are in the southeastern region of the state.

Q2. Now that you have produced a map showing endangered hog farms, what does its information tell you? How could it help you mitigate the dangers of manure ponds in low-lying areas?

A2. Answers could vary widely. The map shows concentrations of endangered hog farms, a fact that was unclear at the beginning of the lesson. By knowing these concentrations, you possess the knowledge that could help state and federal officials relocate the hog farms to areas outside the flood buffer zone. By moving these farms before the next major storm, officials could help reduce threats to public health as well as save pigs and reduce damage.

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About the Author

Kathryn Keranen is an award-winning teacher and author. She serves as an instructor in geographic science at James Madison University and is the cofounder of the award-winning Geospatial Semester. With Bob Kolvoord, she is the coauthor of the Making Spatial Decisions series from Esri Press.

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