GIS Storm Sewers Unit.
Instructional Sequence.
7th Grade Technology Class Curriculum
Broughal Middle School, Bethlehem Area School District

Day 1

Introduction to unit. Pretest.

1. Introduce the "driving scenario problem":
South Bethlehem has horrible flooding problems when it rains. The rain water flows like crazy down the North/South roads and water becomes many inches deep on the East/West street. This is a serious problem. On rainy days, kids are walking into the 48 Hour Video store with wet socks and shoes to get their video games. The water also piles up in front of "The Cup" and nobody wants to walk through big puddles to get ice cream. Business is bad on the South Side on rainy days. The city of Bethlehem has commissioned us to investigate this problem. We will learn special surveying skills with handheld Global Positioning devices – GPS, and GIS – Geographic Information Systems to investigate this issue and come up with a solution to help out this water problem on the South Side."

2. Instruct students to complete the **pretest**.

3. Instruct students to complete the "**Draw a map task**":

"Draw a map of a 2 block area around the school.
Label streets with names.
Label particular areas or objects on the map."

The following are *optional activities* to use when pretesting is complete:

1. Google Earth scavenger hunt to locate Broughal, Lehigh Valley Mall, Lehigh Valley airport, Dorney Park, Eagle's stadium.

2. Show ArcWeb Explorer - http://www.arcwebservices.com/awx/index.jsp
Use ArcWeb Explorer to show students some interactive mapping.
Click on "Find" and type in Broughal's address.
Navigation lets you zoom in and out.
Map types will let you display satellite and hybrid street images.

3. National Geographic Map Machine - http://plasma.nationalgeographic.com/mapmachine/
Show the interactive "Theme Maps" and highlight patterns in natural disasters, weather – annual temperature, land use, population density.

Materials needed:
GIS Storm Sewers Unit assessment [sewers_assess.pdf]

Assessment Information:
GIS Storm Sewers Unit assessment [sewers_assess_key.pdf]

Day 2

Introduction to mapping and AEJEE.
Students will learn basic tool features of AEJEE and will use handheld GPS devices to acquire geographic coordinates.

Guided Warm up: Students learn to open AEJEE, add data layers, and view and hide layers using earthquake and plate data sets.

1. Distribute the handout: **Explore the Earthquake Data** to each student.

2. Use an LCD projector to launch AEJEE and present an overview of the application.

3. Show how data gets added and maps are displayed.

4. Model each segment on the **Explore the Earthquake Data** handout. Have students repeat each task on their own computer.

5. Model step-by-step instructions for each segment on the handout, have students complete each task and answer the associated questions.

6. Review each response before moving on to the next task.

Main activity:

1. Ask students: *When you draw map, what features should it have?* Discuss responses

2. Model the construction of a sketch map on the board of a 2-block area around Broughal. Include features suggested by students. Be sure to note and include the following:

• North is oriented towards the top of the paper.
• Provide a compass rose.
• Explain the term “block”. Smallest area that is surrounded by streets. Includes the space for buildings, parking lots, parks, or other structures within the street pattern of a city.
• Include streets and label with names.
• Include all structures (for example, parking lots, buildings, grass areas). Label each structure with a name.

3. Present a 10 minute **Mapping** PowerPoint presentation that introduces GPS and how data is received by satellites. Emphasize how negative numbers translates into latitude/longitude positions.

4. Give students the geographic coordinates of the school.

5. Ask students to locate the school on a map using a projected image in the front of the room.

6. Reverse the latitude and longitude coordinates of the school and ask students to locate this position.

7. Next, change the latitude position of the school to a negative number.
Ask students to locate this position.
Emphasize the difference between the north and south positions when using positive and negative latitude numbers.
Repeat this sequence for the longitude position.

8. Clearly articulate behavior expectations for going outside.

9. Walk around the block or a nearby field with GPS units.
Focus on cardinal directions – N, S, E, W.
Instruct students how to view satellite acquisition screen and how to read latitude and longitude. Discuss the accuracy reading.
Have students note how the magnitudes of the latitude and longitude readings change when they walk in a specific direction.

Materials needed:

Handout: Explore the Earthquake Data [wu_explore_earthquake.doc]
GIS data sets: qts20012005gts, country, plates
Mapping presentation slides [Located in Teacher Resources]
GPS

Planning Note:
Extra people are needed to help with student groups outside. Groups of no more than 4 per adult are ideal.

Notes:

GIS layer descriptions:

1. **country** – this layer displays the world countries
2. **qks20012005gt4** - this layer displays earthquakes that have occurred between 2001-2005
3. **plates** – this layer displays the world's tectonic plates

Day 3

Geocaching activity day.
Students will use GPS devices to understand magnitude and direction of geographic coordinates.

Warm-up activity:

1. Launch AEJEE and load earthquake data (5 minutes).
Instruct students to launch AEJEE and add the following three files:
country.shp, qks20012005gt4.shp, and **plates.shp**

Write file names on an overhead to display on the board for students to see.

Prior to class:
Set up a set 10 sets of small orange flags (numbered 1-10) in the Lehigh campus grass area across the street from the school.
Provide student groups with a list of latitude and longitude coordinates of the flags.

Make the activity a treasure hunt contest. The group that locates the most flags during the class period is the winner.

Arrange two-three pairs of students (4-6 students) to go with one adult.

Main Activity - Outside:
1. Review cardinal directions and position orientations.

2. Show students the GPS screen that tracks satellites. Discuss triangulation.

3. Have students walk in a straight line heading north and note the magnitude change in the latitude or longitude.
Ask students:
As you move North, what changes? Lattitude or longitude? Does the latitude increase or decrease as you move North?
Repeat for each of the remaining three cardinal directions.
Ask students:
As you move South, what changes? Lattitude or longitude? Does the latitude increase or decrease as you move South?
As you move East, what changes? Lattitude or longitude? Does the longitude increase or decrease as you move East?
As you move West, what changes? Lattitude or longitude? Does the longitude increase or decrease as you move West?

4. Show students the latitude and longitude coordinates of a flag. Have them note their current position. Have them think about which directions they much travel to locate the flag.

5. Upon returning to class, ask students questions about the changes in latitude and longitude as they walk north, south, east and west.

Materials needed:
GPS units (at least one per student pair)
Orange flags with numbers 1-10 placed in areas across the street and other nearby areas.
Sheet of paper with flag coordinates.

Day 4

AEJEE features.
Students will use AEJEE to add data layers, locate latitude and longitude positions, use the identify tool to acquire information, and change layer names of shape files.

1. Distribute to each student the handout: **Exploring the Earthquake Data**.

2. Use an LCD projector to launch AEJEE and display GIS data with the three shape files as in the figure in Step 1 of the handout.

3. Model step-by-step instructions for locating position in AEJEE with latitude and longitude in Step 2. Have students repeat each task on their own computer and answer the questions.

4. Model step-by-step instructions for using the Identify Tool in Step 3. Have students repeat each task on their own computer and answer the questions.

5. Model step-by-step instructions for changing the earthquake layer name in Step 4. Have students repeat each task on their own computer and answer the questions.

6. Have students complete the summary section of the worksheet and review answers.
Have students close AEJEE when finished.

7. Present a brief overview of mapping with a PowerPoint presentation. The Presentation includes showing a diversity of a few maps, emphasis on cardinal directions, highlighting Bethlehem streets on the South side, and presenting an overview of different storm sewers and storm drain types.

8. To close the lesson, restate the "driving scenario problem" from Day 1:
South Bethlehem has horrible flooding problems when it rains. The rain water flows like crazy down the North/South roads and water becomes many inches deep on the East/West street. This is a serious problem. On rainy days, kids are walking into the 48 Hour Video store with wet socks and shoes to get their video games. The water also piles up in front of "The Cup" and nobody wants to walk through big puddles to get ice cream. Business is bad on the South Side on rainy days. The city of Bethlehem has commissioned us to investigate this problem. We will learn special surveying skills with handheld Global Positioning devices – GPS, and GIS – Geographic Information Systems to investigate this issue and come up with a solution to help out this water problem on the South Side."

Materials needed:
Mapping PowerPoint presentation slides [Located in Teacher Resources]
Handout: Exploring the Earthquake Data [Exploring_earthquake_data.doc]

Day 5

Practice data collection.
Students will use GPS devices to gather geographic coordinate data of storm sewers.

Warm-up activity:

1. Launch AEJEE and present an overview of the application. Show how data gets added and maps are displayed.

2. Instruct students to add the following GIS layers:
Northampton County streets layers, ***Lehigh County*** street layers, and ***Landmarks*** layer.

3. Instruct students to create labels to show the names of the landmarks.

4. Instruct students to create labels to display street names on the GIS.

5. Show students the display of the cursor's latitude and longitude position.

6. Instruct students to write the latitude and longitude of each landmark.

Main activity:

1. Restate the "driving scenario problem" from Day 1.

2. Show a GIS coverage of the South Bethlehem area streets around Broughal with a projected computer screen image. Add ***Rivers*** and ***Landmarks*** shape files. Show the sampling area around the school where the class will collect storm drain data.

3. Operationally define an **intersection**. The location where a North/South street meets an East/West street. Show examples of intersections and non-intersections. Show that an intersection can dead-end at a "T".

4. Introduce the concept of locating a storm sewer at an intersection. **Define a storm sewer located at an intersection as: The edge of a storm sewer is located at least 20 feet from the closest point where the two intersection streets meet.**

5. Handout **Data Collection Sheets** to students and provide explicit instruction on how to record data on the data collection sheet.

6. Emphasize accuracy and validation in data collection.

7. Clearly articulate behavior expectations for going outside.

8. Go to an intersection with paper maps and **Data Collection Sheets** of area.
Focus on cardinal directions – N, S, E, W and map orientation.
Identify different storm sewer types and determine if they are located at an intersection.
Provide explicit instruction on how to record data on the data collection sheet.

9. Ask students at intersections:
- *Are we on the north side or south side of the street?*
- *Are we on the east side or west side of the street?*

10. At intersections, have students point out on the paper map where they are currently standing.

11. Use a tape measure to measure the distance of the storm sewer to the curb to determine if the storm sewer meets the definition of being at an intersection.

Materials needed:
GPS units
Clipboards
Paper map of area
Tape measures
Handout: Data collection sheets [data_collection_sheet.doc]

Inclement Weather Day (between Day 4 and 7)

Locating information with AEJEE.
Students use AEJEE tools to explore and locate geo-referenced information near the school area.

Note: This lesson plan is designed to take place anytime between Day 4 and Day 7. It is recommended that this lesson be used on an inclement weather day, when students would not be able to go outside to collect data.

Warm up:

1. Launch AEJEE and present an overview of the application. Show how data gets added and maps are displayed.

2. Instruct students to add the ***Northampton County*** and ***Lehigh County*** street layers and ***Landmarks*** layer.

3. Instruct students to create labels to show the names of the landmarks on the GIS.

4. Instruct students to create labels to display street names on the GIS.

Main Activity:

1. Tell students they will make a sketch map of **one block** around Broughal.
Ask students: *When you draw map, what features should it have?*
List all student responses.

Be sure to note and include the following:
North is oriented towards the top of the paper.
Provide a compass rose.
Explain the term "block".
Include streets and label with names.
Include all structures (for example, parking lots, buildings, grass areas). Label each structure with a name.

2. Model the construction of a sketch map on the board of the **one block area** around Broughal. Have students tell you what to include. Include features suggested by students. After the sketch map is constructed, ask students what is located across the street on each block side and include this on the map.

3. Restate the "driving scenario problem" from Day 1.

4. Handout **Exploring the School Area with GIS** to each student.

5. Tell students they are going to explore storm sewers at the intersections near Broughal Middle School and the 48 Hours Video store to determine if there is enough storm sewers to prevent flooding and people from walking into buildings with wet socks and shoes.

6. Spend 5-7 minutes at the end of class bringing students back to the front of the room to look at the GIS display on a projected computer image. Review the questions pertaining to the intersections near Broughal Middle School and the 48 Hours Video store. Have students share answers and review and discuss student responses to the question: "**If it rains all day, do you think these storm sewers will stop the road from flooding"** at both intersections.

Materials needed:
Handout: Exploring the School Area with GIS [Exploring_area.doc]

GIS files: Sewers data layer, Northampton County and Lehigh County street layers and Landmarks layer.

Day 6

Data collection practice.
Students will use a GPS device to gather geo-referenced storm sewer data.

1. Instruct students they will be practicing data collection of storm sewers today.
Give each student a copy of the handout: **Data Collection Sheet Questions**.

2. Instruct students to complete the questions on the **Data Collection Sheet Questions** handout.

3. Review and discuss answers with students.

4. Hold a class discussion on group roles for data collection.
Emphasize accuracy and validation, writing neatly, and having partners validate the data written on the data collection sheet.

5. When walking to field site area, review cardinal directions with students.
Have students notice the magnitude in latitude and longitude coordinate position changes as they walk.

6. Locate storm sewers near the school and have students complete data collection sheets.
Emphasize accuracy and validation, and writing neatly.
At intersections, have students point out on the paper map where they are currently standing.

In the field:
• Verify students' data collection as soon as points are taken and provide immediate feedback.
• Review any inaccuracies in data collection on site points.
• Point out any questionable numbers written with low quality handwriting.
• Make sure accuracy is recorded.
• At intersections, ensure that the correct storm sewer location check box has been marked.
• Ask students at intersections:
1. Are we on the north side or south side of the street?
2. Are we on the east side or west side of the street?

Materials needed:
GPS units
Clipboards
Data collection sheets
Paper map of area
Tape measures
Handout: Data Collection Sheet Questions [Data_sheet_ques.doc]
Handout: Data collection sheets [data_collection_sheet.doc]

Day 7

GPS data collection – Day 1.
Students will use a GPS device to gather geo-referenced storm sewer data.

Warm-up activity:
Have students launch AEJEE, add three layers, maximize their AEJEE window, and make one layer active.

Main activity:

1. Go outside and collect storm drain data with students.

2. When walking to field site area, review cardinal directions with students.
Have students notice the magnitude changes in latitude and longitude coordinate positions as they walk.

3. Emphasize accuracy and validation, and writing neatly.

In the field:
• Verify the students' data collection sheet as soon as they take data.
• Review any inaccuracies in data collection on site points.
• Point out any questionable numbers written with low quality handwriting.
• Make sure accuracy is recorded.
• At intersections, ensure that the correct storm sewer location check box has been marked.
• Ask students at intersections:
1. Are we on the north side or south side of the street?
2. Are we on the east side or west side of the street?
• At intersections, have students point out on the paper map where they are currently standing.

Materials needed:
GPS
Clipboards
Data collection sheets
Paper map of area
Tape measures
Handout: Data collection sheets [data_collection_sheet.doc]

Day 8

GPS data collection – Day 2
Students will use a GPS device to gather geo-referenced storm sewer data.

Warm-up activity:
Have students launch AEJEE, add three layers, and maximize their AEJEE window, and make one layer active.

1. Go outside and collect storm drain data with students.

2. When walking to field site area, review cardinal directions with students.
Have students notice the magnitude changes in latitude and longitude coordinate positions as they walk.

3. Emphasize accuracy and validation, and writing neatly.

In the field:
• Verify the students' data collection sheet as soon as they take data.
• Review any inaccuracies in data collection on site points.
• Point out any questionable numbers written with low quality handwriting.
• Make sure accuracy is recorded.
• At intersections, ensure that the correct storm sewer location check box has been marked.
• Ask students at intersections:
1. Are we on the north side or south side of the street?
2. Are we on the east side or west side of the street?
• At intersections, have students point out on the paper map where they are currently standing.

Materials needed:
GPS
Clipboards
Data collection sheets
Paper map of area
Tape measures
Handout: Data collection sheets [data_collection_sheet.doc]

Day 9

Earthquake pattern analysis activity.

Students use the AEJEE Property Table and Attribute Table to customize map displays to observe relationships in the data layers and identify patterns.

1. Distribute the handout **Earthquake Analysis** to each student.

2. Tell students they will create maps that will show information about earthquakes and use AEJEE to analyze their maps to look for patterns in the data.

3. Have students complete the handout. Review and discuss student responses.

4. For lesson closure, ask students how AEJEE can be used to analyze earthquake data.

Materials needed:
Handout: Earthquake Analysis [Earthquake_Analysis.doc]
GIS shape files: **plates.shp, country.shp, qks20012005gts.shp**

Day 10

Storm sewer data entry.
Students will enter their collected storm sewer data into a database using a PHP coded database online form.

1. At the beginning of class, show students in Google Earth where Broughal Middle School is located. Highlight the geographic coordinates. Broughal is located at 40.60807N, -75.39071W.

2. Show students the location of these geographic coordinates with reversed positive and negative signs. -40.60807N, 75.39071W.

3. Begin data entry by having students enter two "**Test Run**" data collection sheets into the online database. Have students select "**Test Run**" in the **Group name** field. These are practice data entry for the students that you will later remove from the cumulative data set.

4. Explain that the date is from the data collection sheet and not the current date. Emphasize the proper format to enter data collection dates: (mm/dd/yyyy): (For example, 10/29/2007)

5. Explain the importance of the negative sign for entering longitude.
Emphasize that all digits recorded for latitude and longitude each data sheet must be entered into the database.

6. Review and explain the **intersection** choice selection by noting to students how the intersection data was recorded on the data collection sheet. Show the students how to select the appropriate field on the Web database form to enter this information.

7. Review and explain the **check box** on the data collection sheet that notes the street location of the storm sewer or drain. Show the students how to select the appropriate **Street direction** field on the Web database form to enter this information.

8. After the "**Test Run"** data has been entered, have students enter the collected storm sewer data into the online database.

9. After 15 minutes of data entry, display an output KML file in Google Earth. Note data errors to students. Show all points that are not in the sampling area. Discuss how these points may have been entered into the database.

10. Continue to have students enter the collected storm sewer data into the online database.

Materials needed:
Completed data collection sheets
Online database access

Day 11

Spatial pattern analysis.
Students will analyze their collected storm sewer data and investigate patterns in the location of double-grated storm sewers.

1. Tell students we are going to look at their collected storm sewer data and investigate patterns in the location of **double-grated storm sewers**.

2. Model how to launch AEJEE and load the following shape files:
Northampton and Lehigh County Roads, Rivers, Landmarks shape file, and student collected storm sewer data points.

3. Use a projected computer image to show students how to change the map displays to show the data in different ways.

4. Focus on map orientation and emphasize cardinal directions.

5. Define intersections.

6. Highlight how to change properties of each field attribute.

7. Show how to change attribute color.

8. Model how to identify patterns in the data. Scaffold this process.

9. Show students how to change the Properties to show only **DOUBLE SEWERS** on the GIS map. Show how to change colors of all other storm sewer types to white.

10. Ask students the following questions to highlight data patterns:
What type of storm drain occurs the most on our map?
What type of storm drain occurs the least on our map?
Where are most double storm drains located?
Is there a pattern for any type of storm drain on the map?

Students should observe that there are more double storm sewers in the northern part of the South Side.

11. Instruct students to launch AEJEE and load the following shape files:
Northampton and Lehigh County Roads, Rivers, Landmarks shape file, and student collected storm sewer data points.

12. Distribute **The Attribute Table** handout to each student.

13. Guide students through **The Attribute Table** handout.
• Emphasize that when a row is selected in the attribute table, it is displayed as a colored point in the GIS.
• Point out the different columns and note that these correspond to the fields that they entered into the database from their data collection sheets.
• Emphasize that we think some students did not enter their data correctly into the database. We are going to use the attribute table to find out.

14. After students explore the attribute table and complete the data table in the handout, review a few incorrectly labeled points on the GIS display.

Materials needed:
Handout: The Attribute Table [Attribute_Table_handout.doc]
GIS files: Northampton Roads, Lehigh County Roads, Rivers, Landmarks shape file, and student collected storm sewer data points.

Day 12

Changing GIS data displays to observe different data patterns.
Students will identify location patterns of double-grated and single-grated storm sewers, investigate patterns of storm sewer placements on East/West and North/South streets and examine the number of storm sewers at the intersections near the 48 Hours Video store, the Cup, and Broughal Middle School to determine if enough storm sewers exist at those locations to prevent customers from getting their shoes and socks wet as they walk into the stores or school.

1. Tell students we are going to display their collected storm sewer data in different ways to investigate if there will there be enough storm sewers near the 48 Video store, the Cup, and Broughal Middle School to prevent people from getting their shoes and socks wet as they walk into these buildings if it rains all day.

2. In a group setting:
Model how to launch AEJEE and load the following shape files:
Northampton and Lehigh County Roads, Rivers, Landmarks shape file, and student collected storm sewer data points.

3. Use a projected computer image to show students how to change the map displays to show the data in different ways.

4. Review how to add street label names.

5. Show students how to display names to the **landmarks** file.

6. Show students how to **change the color and symbol** of the landmarks attribute color.

7. Explicitly model the thought process for identifying patterns.

8. Review the “Double Sewer” data pattern from yesterday.

9. Show students different GIS map displays by changing the colors of the storm sewer data fields to unique symbols with different colors.

10. Review how to change properties of each field attribute.

11. Show new map displays by creating unique symbols for (1) storm sewer types and (2) storm sewers located at intersections.

12. Review how to change attribute color.

13. Show how to change properties to identify sewer patterns at intersections.

14. Ask students if there appear to be more sewers at intersections or not at intersections.

15. Next, have students look at storm sewer patterns located on East/West streets. Ask students if there are any East/West streets with more sewers within a block than in other block areas? Use scaffolding to note that more sewers within blocks appear on East/West streets around Lehigh University’s campus area.

16. Provide a brief overview of the AEJEE tools.

17. Highlight how to select the **SEWERS** layer and **Zoom to Full Extent**.

18. Instruct students to launch AEJEE and load the following shape files:

Northampton and Lehigh County Roads, Rivers, Landmarks shape file, and student collected storm sewer data points.

19. Distribute the handout **Changing GIS Map Displays** to each student and instruct students to complete the handout.

Students will identify location patterns of double-grated and single-grated storm sewers, investigate patterns of storm sewer placements on East/West and North/South streets and examine the number of storm sewers at the intersections near the 48 Hours Video store, the Cup, and Broughal Middle School to determine if enough storm sewers exist at those locations to prevent customers from getting their shoes and socks wet as they walk into the stores or school.

20. Spend 5-7 minutes at the end of class bringing students back to the front of the room to look at the GIS display on a projected computer image. Have students describe how they changed properties to look at data patterns. Have students share the patterns they observed in the data and review and discuss student responses to the key questions.

Materials needed:
Handout: Changing GIS Map Displays [GIS_Map_Displays.doc]
GIS files: Northampton Roads, Lehigh County Roads, Rivers, Landmarks shape file, and student collected storm sewer data points.

Day 13

Database querying.
Students will analyze their collected storm sewer data by querying the database.

Warm up:
1. Instruct students to launch AEJEE and load the following shape files:
Northampton and Lehigh County Roads, and student collected storm sewer data points.

2. Ask students to look at the placement of the storm sewers on their map and locate the best intersection to build a new indoor paint ball and laser tag building on the southside of Bethlehem.

3. Have select students come up to the board one at a time to mark the placements of where they think storm drains should be located. Have students articulate their reasons for their placement choices. Discuss patterns with storm sewers.

4. Model how to query data with the **Query Builder Tool** in AEJEE.

5. Query **SewerType = double** to show the results of double grated sewers.

6. Explicitly show how each **record** from the database will appear in the bottom window and that each location will be highlighted on the GIS map display.

7. Query **SewerType = single** to show the results of double grated sewers.

8. Query **streetName = Packer** to show the results of storm sewer locations on Packer Ave.

9. Distribute the **Querying the Map in AEJEE** handout to students.

10. Have students complete the worksheet.

11. Review and discuss student responses.

Materials needed:
Handout: Querying the Map in AEJEE [Query.doc]
GIS files: Northampton Roads, Lehigh County Roads, Rivers, and student collected storm sewer data points.

Day 14

Application task.

Students will complete an application task for storm sewer city planning in an unsurveyed part of Southside Bethlehem.

Warm up:

1. Instruct students to launch AEJEE and load the following shape files:
Northampton and Lehigh County Roads, Rivers, Landmarks shape file, and student collected storm sewer data points.

2. Instruct students to locate the storm sewers on their GIS map that they gathered during the outside field data collection days. Instruct students to use the **Identify tool** to identify the street names of their collected storm sewer data points.

Main activity:

1. Set the context for the application task:
South Bethlehem has horrible flooding problems when it rains. This is a serious problem. On rainy days, kids are walking into the 48 Hour Video store with wet socks and shoes to get their video games. The water also piles up in front of "The Cup" and nobody wants to walk through big puddles to get ice cream. Business is bad on the South Side on rainy days.

2. Tell students they will use GIS to explore storm sewer patterns to address this issue and then use their data analysis findings to help the city of Bethlehem to redevelop a nearby part of South Bethlehem to include **8 new businesses**. The new businesses include a new indoor paint ball and laser tag building, a bowling alley, a video gaming center, an all-ages dance hall, and 4 new restaurants.

3. Distribute the handout **Storm Sewer Planning Task** to each student. Instruct students to complete the task.

4. After all maps are collected, use an LCD projector to display the planning task map to the front of the room. Have students describe where they placed their sewers. Prompt students to articulate their reasoning for their planning decisions.

Materials needed:

Handout: Storm Sewer Planning Task [Sewer_planning_task.doc]
GIS shape files: Northampton Roads, Lehigh County Roads, Rivers, Landmarks shape file, and student collected storm sewer data points.

Assessment Information:

Storm Sewer Planning Task Rubric [Planning_task_rubric.pdf]

Day 15

Review.
Students will review main content and concepts for the GIS storm sewers unit.

Jeopardy or BINGO review.

Materials needed:
Jeopardy game PowerPoint [Mapping_jeopardy.ppt]
or
BINGO card sheets

Day 16

Posttest

1. Administer GIS Storm Sewers Unit posttest assessment to the students.

2. Instruct students to complete the "**Draw a map task**":

"Draw a map of a 2 block area around the school.
Label streets with names.
Label particular areas or objects on the map."

3. Instruct students to begin Google Earth scavenger hunt after their "Draw a map" task is completed.

Materials needed:

GIS Storm Sewers Unit assessment [sewers_assess.pdf]
Handout: Google Earth scavenger hunt [GE_scavenger.doc]
Handout: Google Earth scavenger hunt key [GE_scavenger_key.doc]

Assessment Information:
GIS Storm Sewers Unit assessment [sewers_assess_key.pdf]

Optional activities for inclement weather days:

Google Earth scavenger hunt to locate Broughal, Lehigh Valley Mall, Lehigh Valley airport, Dorney Park, Eagle's stadium.

Show ArcWeb Explorer - http://www.arcwebservices.com/awx/index.jsp
and
National Geographic Map Machine
http://plasma.nationalgeographic.com/mapmachine/

Show the interactive "Theme Maps" and highlight patterns in natural disasters, weather – annual temperature, land use, population density.

Use ArcWeb Explorer to show students some interactive mapping.
Click on "Find" and type in Broughal's address.
Navigation lets you zoom in and out.
Map types will let you display satellite and hybrid street images.

Latitude And Longitude Map Match Game
http://www.kidsgeo.com/geography-games/latitude-longitude-map-game.php
This game helps students practice the concepts of latitude and longitude on a grid map.